Name -> Nipun Sharma
Batch -> C020

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

$$L(x_1, x_2, \dots x_n) = \prod_{i=1}^{n} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x_i-\mu)^2}{2\sigma^2}}$$

$$= \left(\frac{1}{\sqrt{2\pi\sigma^2}}\right)^n e^{-\frac{(\Sigma x_i-\mu)^2}{2\sigma^2}}$$

Taking log on both sides

$$= n \ln\left(\frac{1}{\sqrt{2\pi\sigma^2}}\right) \cancel{+} -\frac{(\Sigma x_i - n\mu)^2}{2\sigma^2} \quad - (1)$$

Differential w r t ~~~~ μ

$$\cancel{\Rightarrow 0 - (x_1 + x_2 + \dots n_n}$$

$$0 \quad \frac{-\Sigma x_i^2 - \mu^2 + 2\Sigma x_i n\mu}{2\sigma^2} = 0$$

$$0 - 2n\mu + 2\Sigma x_i = 0$$

$$n\mu = \Sigma x_i$$

$$\mu = \frac{x_1 + x_2 + \dots x_n}{n} = \bar{X}$$

~~Diff~~ Diff (1) w r t σ

$$\cancel{= n \times \sqrt{2\pi\sigma^2} + \frac{4\sigma}{4\sigma^5}(\Sigma x_i - \mu)^0 = 0}$$

$$\frac{\partial L}{\partial x} = n \sqrt{2\pi x} \times \sqrt{2\pi} \; \frac{x}{2} \Big| x^{-1/2}$$

$$\Rightarrow n \; 2\pi \; \sigma \times \frac{1}{2\sigma} = 0$$

Q2 Diff (1) wrt σ^2

$$-\frac{n}{\sigma} + \frac{(\Sigma x_i - n\mu)^2}{\sigma^3} = 0$$

$$(\Sigma x_i - n\mu)^2 = n\sigma^2$$

$$\sigma = \sqrt{} \; \frac{\Sigma x_i - n\mu}{\sqrt{n}}$$

$$\sigma = \frac{\Sigma x_i - n\bar{x}}{\sqrt{n}}$$

Q2 $L(\theta) = \prod_{i=1}^{n} {}^{n}C_{x_i}\, \theta^{x_i} (1-\theta)^{m-x_i}$

Taking Log on both side

$\ln(L(\theta)) = \ln {}^{m}C_{x_i} + x_i \ln(\theta) + m - x_i (\ln(1-\theta))$

diff. w.r.t θ

$\ln = 0 + \frac{x_i}{\theta} + \frac{m - x_i}{1-\theta} \times -1 = 0$

$\frac{x_i}{\theta} = \frac{m - x_i}{1-\theta}$

$x_i - \theta \cancel{x_i} = m\theta - x_i \cancel{\theta}$

$m\theta \cancel{-x} = x_i$

$\theta = \frac{x_i}{m}$