CS-584 ASSIGNMENT 2

GENERATIVE LEARNING

CWID : A20344798

Q: 5) Naive Baye Binomial Feature

a) log likelyhood function

$$l(\theta) = \left[\sum_{i=1}^{m} \sum_{i=1}^{n} \log \left(\frac{p^{(i)}}{x^{(i)}} \right) \alpha_{j/y=y^{(i)}}^{x_j^{(i)}} \left(p^{(i)} - \alpha_{j/y=y^{(i)}} \right)^{p^{(i)} - x^{(i)}} \right]$$

derivative respect to $\alpha_{j/y=y^{(i)}}$ & equate to zero : $\frac{\partial l(\theta)}{\partial x_{j/y=y^{(i)}}} = 0.$

$$\therefore \frac{\partial}{\partial x_{j/y=y^{(i)}}} \left[\sum_{i=1}^{m} \sum_{i=1}^{n} \log \left(\frac{p^{(i)}}{x^{(i)}} \right) + x_j^{(i)} \log \alpha_{j/y=y^{(i)}} + (p^{(i)} - x^{(i)}) \log (1 - \alpha_{j/y=y^{(i)}}) \right] = 0.$$

$$\therefore \sum_{i=1}^{m} \frac{x_p^{(i)}}{\alpha_{j/y=j}} = \sum_{i=1}^{m} \frac{(p^{(i)} - x_j^{(i)})}{(1 - \alpha_{j/y=j})}$$

$$\therefore \frac{1}{\alpha_{j/y=j}} \sum_{i=1}^{m} x_p^{(i)} = \frac{1}{1 - \alpha_{j/y=j}} \left[\sum_{i=1}^{m} p^{(i)} - x_p^{(i)} \right]$$

$$\therefore \quad \alpha_{j|y=j} = \frac{\sum_{i=1}^{m} (y=j)\, x_p^{(i)}}{\sum_{i=1}^{m} 1(y=j)\, p^{(i)}}$$

$$\therefore \quad \frac{\partial l(\theta)}{\partial \alpha_k} = \frac{\partial}{\partial \alpha_k} \sum_{i=1}^{m} \log\left(p^{(i)}(y=k)\right)$$

$$0 = \sum_{i=1}^{m} \frac{1(y=k)\, x}{\sum_{i=1}^{m} p^{(i)}(y=k)}$$

$$\therefore \quad p^{(i)}(y=k) = \sum_{i=1}^{m} \frac{1(y=k)}{m}$$