

COMS 4771: Machine Learning - Problem Set #4

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Problem 2

1. class y_i can take any value from classes $1, 2, 3, \dots, k$. These classes have a probability as $p_1, p_2, p_3, \dots, p_k$. Assuming each y_i is independent.

$$P(Y|p_1, \dots, p_k) = \prod_{i=1}^N P(y_i)$$

The likelihood function can be defined as

$$L = \prod_{i=1}^N p_{y_i}$$

The log likelihood is defined as

$$\log L = \sum_{i=1}^N \log p_{y_i}$$

For a particular y_i , its contribution to the log likelihood is $\log p_{y_i}$. The expected contribution of a y_i over all classes is given by

$$E = \sum_{j=1}^k p_j \log p_j$$

This bears resemblance to the entropy equation

2. Since the contribution to the log likelihood is already calculated, the revised expectation for the contribution of each y_i to the log-likelihood would now be:

$$E = \sum_{j=1}^k q_j \log p_j$$