Task-4

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1 Problem Statement

Estimate parameters for a simple model using the EM algorithm: What are the chances of heads and tails from two unlabeled coins?

2 Algorithm

2.1 Initialization

The biases of the two coins are initialized to values
biasA=0.6 biasB=0.3

We also initialize a value 'epsilon' which specify the EM Algorithm to stop when the difference between value of parameters(biasA and biasB) in two successive iteration is less than or equal to its value.This value is initialized to 0.0005.

maxIteration specifies the maximum number of iteration the EM Algorithm should run if not converged.Its value is set to 20.

2.2 Fetching draws data from API

Function getDrawsfromAPI call the Head/Tail API and returns the response.

Function constuctdrawHeadsArray calls the getDrawsfromAPI function for 30 iteration.It counts the number of head in each draw and create an array which stores the head count for each draw.

2.3 E-Step

With the assumed initial values of the biases of the two coins and the values of the draws data that was fetched from the API, we calculate the probability of both of the coins using Bayes theorem.

$$P(A|E) = \frac{P(E|A) * P(A)}{P(E|A) * P(A) + P(E|B) * P(B)} \tag{1}$$

where
E is the event of a particular draw of coin flip sequence
$P(A|E)$ is the probability that chosen coin was A conditioned on the draw event E
$P(B|E)$ is the probability that chosen coin was B conditioned on the draw event E
$P(A)$ and $P(B)$ are probability of choosing coin A and B respectively.

After calculating the likelihood and probability,we calculate the number of heads and tails that occurred for each of the two coins

$$headsA = P(A|E) * numberOfHeadsInEventE \tag{2}$$

$$tailsA = P(A|E) * numberOfTailsInEventE \tag{3}$$

Similarly we calculate for coin B.

2.4 M-Step

Once we have the number of head and tails for each coin we calculate the bias for each coin according to the equation

$$biasA = \frac{headsA}{headsA + tailsA} \tag{4}$$

$$biasB = \frac{headsB}{headsB + tailsB} \tag{5}$$

3 Conclusion

The EM Algorithm is a combination of 2 steps. The E-Step makes an assumption of the parameter of model and calculates the value of hidden variables. The M-step uses the values of hidden variables calculated in E- Step to update the parameters of the model. This combination of E-Step and M-Step is continued until we reach convergence.Thus EM Algorithm is a more generalized version of the Maximum Likelihood Estimate.

4 Refernces

1.Chuong B Do and Serafim Batzoglou,What is the expectation maximization algorithm?