

# Election Result Prediction System using Hidden Markov Model [HMM]

Mohd. Manjur Alam

Asst. Professor

Dept. of CSE

BGC Trust University Bangladesh

Md. MezbahUddin

Student

Dept. of CSE

BGC Trust University Bangladesh

Shamsun Nahar Shoma

Lecturer

Dept. of CSE

BGC Trust University Bangladesh

## ABSTRACT

Election is an important part of political and social science. It can be defined in the field of Game as the winning chance of a team and TV reality show where candidates are the participants and decide if the participants will stay or not based on public votes. The election result can be predicted before the actual outcome using a prediction method. There are many methods, theory, and research to predict election result. Election prediction is very significant for the candidates and the society. It is normally based on some factors such as numbers of years in active politics, Popularity, Vote Bank, Development performance, Currently in Govt., View of voters towards party, Major Issue, Party/Independent and Internal War. In this paper a most famous model named Hidden Markov Model has been used to predict the results using these parameters.

## Keywords

Hidden Markov Model (HMM), Election Commission of Bangladesh [ECB].

## 1. INTRODUCTION

In the Earth, Election is very much liking word. It is a method to select a qualified one from a crowd of candidates. But in different sector election process may be different. There are different types of election such as parliamentary election, legislative election, local election, presidential election and election in small group. It can be divided into two categories. The election in a small organization or group or within an institution can be classified into a group, and Country election such as Parliamentary election, Presidential election, election for mayor and councilor in municipal area, Union Perished election etc. can be classified into another group. In Bangladesh there are 8 divisions, 65 districts and each district has an individual number of sub-district and Thana. Every sector has election system to select a leader such as Mayor, Chairman, and Councilor etc. Different organizations use different electoral methods to compute the election. ECB evaluates the election in those field related to the government, District, Thana. Election prediction is also very important as like as election. But it is not so easy to predict election result and has a lot of challenges to predict election result. Hidden Markov Model [HMM] is used to evaluate the prediction. Above nine parameters will be used to predict the chances of winning and losing chances of a candidate.

## 2. FACTOR DESCRIPTION

There are some factors which may influence the mode of an election system. These are shown in table 1 with descriptions.

Table 1: Factor Description

Factor Name	Factor Description
No of years in active politics	Political experience under any registered party.
Popularity	Popularity in his/her area
Vote Bank	Directly related with religious or community factor
Development performance	Development in candidate's area by that candidate / party.
View of voters towards party	Image of the party that is very good or vice versa.
Currently in Govt.	Candidate belongs to opposition party or ruling party
Major Issue	There are Religious or non-religious issues which actually effect on the election directly or indirectly.
Party/Independent	Candidate belongs to any party or not. If not considered as Independent
Internal War	Means that some of the members of the party do not like that candidate which is force ably imposed in their constituency by the party.

## 3. HIDDEN MARKOV MODEL FOR PREDICTION IN ELECTION SYSTEM

A Hidden Markov Model (HMM) is an automated system with output where both the state transition and the output are defined in a probabilistic manner. The state Transition arises according to a simple Markov model but it is assumed that we don't know on which state we are standing now and that we can observe an output symbol at each state. We could estimate the transition sequences through observing output sequence. In this thesis, The most flexible and successful approach, the Hidden Markov Model (HMM) method as the training/recognition algorithm [1] for prediction in an election system has been used. The objectives of HMM parameter estimation is to maximize the likelihood of the data under the

given parameter setting. The three basic parameters in HMM are given below:

1.  $\pi$  - The initial state distribution.
2.  $a$  - The state-transition probability matrix.
3.  $B$  - Observation probability distribution.

### 3.1 Estimating The Parameters, $\lambda = (A, B, \pi)$

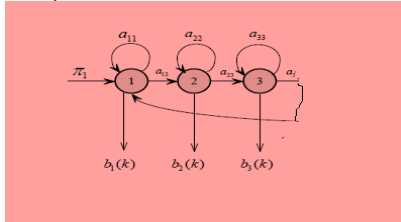


Fig.1 : HMM for each Candidate.

The model parameters can be estimated as follows:

$$\pi_i = \gamma_1(i) \quad (1)$$

=expected number of times in state i

$$a_{ij} = \frac{\sum_{t=1}^{T-1} \xi_t(i,j)}{\sum_{t=1}^{T-1} \gamma_t(i)} \quad (2)$$

$\frac{\text{expected number of transition from state } i \text{ to state } j}{\text{expected number of transition from state } i}$

### $b_i(k)$ Measurement

Probability from each state to observation is measured from winning probability of each factor in the election. It is actually evaluated from the influencing of the factor in the election system.

### 3.2 Scores

For each candidate, probability score is computed [first]. The candidate whose model produces the highest probability score is selected as the winner. The total probability is given by:

$$P(X|Q) = \prod_{i=1}^n a_{ij} b_i(k) \quad (3)$$

## 4. EXPERIMENTAL RESULT

Bangladesh is a democratic country. The people of this country strongly believe the democracy. So the election system of every sector in our country is very neutral and fair. Many organizations conduct many surveys for prediction in the election system. Here some data before the election are gathered from the observations of B. M. Char Union Council election, 2012. The union is situated at Cox'sBazar in Bangladesh. The survey has been accomplished by SSSD. The data about the Chairman candidates are collected for the prediction. There are five candidates for the post. The candidates are Mr. Shahedul karim, Mr. MuslehUddin, Mr. Nuhan Jakir, Mr. MesbahUddin and Mr. Nurul hossain. Factors are described in table 1 for the prediction. The organization estimated the influencing factors for the each chairman candidate. These are mentioned in table 2. Popularities and vote bank are evaluated among 100 people here.

### 4.1 $\Pi$ Estimation

$$\pi_1=.1, \pi_2=.1, \pi_3=.1, \pi_4=.1, \pi_5=.1,$$

Table 2: probabilities of factors

Factor Name	Shahedul karim	Musleh Uddin	Nuhan Jakir	MesbahU ddin	Nurul Hossain
No of years in active politics( with linguistic Values )	10 .9	5 .4	6 .5	7 .6	2 .1
Popularity	23%	25%	12%	15%	15%
Vote Bank	12% (most Hindus)	13% (Most Muslims)	10% (Hindu, Muslims )	30% (Most Hindus)	34% (Most Muslims)
Development performance (with linguistic Values )	Low, .1	Low .1	Medium .2	High .3	High .3
View of voters towards party (with linguistic Values)	Average .4	Average .4	Average .4	Average .4	Average .4
Currently in Govt. (with linguistic Values)	No .1	No .1	Yes .2	Yes .2	Yes .2
Major Issue (with linguistic Values)	Null .1	Null .1	Null .1	Null .1	Null .1
Party/Independent (with linguistic Values)	Yes .3	No .1	No .1	Yes .3	No .3
Internal War (with linguistic Values)	Yes .4	No .1	No .1	Average .3	No .3

### 4.2 $a_{ij}$ Estimation

Each HMM has nine states for nine factors and nine observations

$$\text{Hence, } a_{11}= a_{12}=a_{22}= a_{23}= a_{33}= a_{34}= a_{44}= a_{45}= a_{55}$$

$$= a_{56}= a_{66}= a_{67}= a_{77}= a_{78}= a_{88}= a_{89}= a_{99}= a_{91}=1/2=.5;$$

### 4.3 $b_i(k)$ Measurement

From the survey mentioned in section 4,  $b_i(k)$  can be easily evaluated. It is done by measuring influencing probability of each factor which is shown in table 2. For each candidate, these are evaluated below:

Mr. Shahedul karim:

$$b_1(k)=.9, b_2(k)=.23, b_3(k)=.12, \\ b_4(k)=.1, b_5(k)=.4, b_6(k)=.1, \\ b_7(k)=.1, b_8(k)=.3, b_9(k)=.4,$$

Mr. MuslehUddin:

$$b_1(k)=.4, b_2(k)=.25, b_3(k)=.13, \\ b_4(k)=.1, b_5(k)=.4, b_6(k)=.1, \\ b_7(k)=.1, b_8(k)=.1, b_9(k)=.1,$$

Mr. Nuhan Jakir:

$$b_1(k)=.5, b_2(k)=.12, b_3(k)=.1, \\ b_4(k)=.2, b_5(k)=.4, b_6(k)=.2, \\ b_7(k)=.1, b_8(k)=.1, b_9(k)=.1,$$

Mr. Mesbah Uddin:

$$b_1(k)=.6, b_2(k)=.15, b_3(k)=.30, \\ b_4(k)=.3, b_5(k)=.4, b_6(k)=.2, \\ b_7(k)=.1, b_8(k)=.3, b_9(k)=.3,$$

Mr. Nurul hossain:

$$b_1(k)=.1, b_2(k)=.15, b_3(k)=.34, \\ b_4(k)=.3, b_5(k)=.4, b_6(k)=.2, \\ b_7(k)=.1, b_8(k)=.3, b_9(k)=.3,$$

### 4.4 Scores Estimation

The individual candidate scores are shown on the following tables. The scores are computed by using the formula given in Eq.(3)

#### 4.4.1 Mr. Shahedul karim

Table 3: Mr. Shahedul karim

State sequence (Q)	Observation sequence(x)	State transition probability, $a_{ij}$	Observation probabilities, $b_i(k)$
Q1	1	.5	.9
Q2	2	.5	.23
Q3	3	.5	.12
Q4	4	.5	.1
Q5	5	.5	.4
Q6	6	.5	.1
Q7	7	.5	.1
Q8	8	.5	.3
Q9	9	.5	.4

Total probability for Mr. Shahedul karim,  $P(X1Q) = 0.0000000023$

#### 4.4.2 Mr. Musleh Uddin

Table 4:Mr. Musleh Uddin

State sequence (Q)	Observation sequence(x)	State transition probability, $a_{ij}$	Observation probabilities, $b_i(k)$
Q1	1	.5	.4
Q2	2	.5	.25
Q3	3	.5	.13
Q4	4	.5	.1
Q5	5	.5	.4
Q6	6	.5	.1
Q7	7	.5	.1
Q8	8	.5	.1
Q9	9	.5	.1

Total probability for Mr. Musleh Uddin,  $P(X1Q) = 0.0000000008$

#### 4.4.3 Mr. Nuhan Jakir

Table 5:Mr. Nuhan Jakir

State sequence (Q)	Observation sequence(x)	State transition probability, $a_{ij}$	Observation probabilities, $b_i(k)$
Q1	1	.5	.5
Q2	2	.5	.12
Q3	3	.5	.1
Q4	4	.5	.2
Q5	5	.5	.4
Q6	6	.5	.2
Q7	7	.5	.1
Q8	8	.5	.1
Q9	9	.5	.1

Total probability for Mr. Nuhan Jakir,  $P(X1Q) = 0.0000000002$

#### 4.4.4 Mr. Mesbah Uddin

Table 6:Mr. Mesbah Uddin

State sequence (Q)	Observation sequence(x)	State transition probability, $a_{ij}$	Observation probabilities, $b_i(k)$
Q1	1	.5	.6
Q2	2	.5	.15

Q3	3	.5	.3
Q4	4	.5	.3
Q5	5	.5	.4
Q6	6	.5	.2
Q7	7	.5	.1
Q8	8	.5	.3
Q9	9	.5	.3

Total probability for Mr. Mesbah Uddin,  $P(X1Q) = 0.0000000114$

#### 4.4.5 Mr. Nurul Hossain

Table 7:Mr. Nurul Hossain

State sequence (Q)	Observation sequence(x)	State transition probability, $a_{ij}$	Observation probabilities, $b_i(k)$
Q1	1	.5	.1
Q2	2	.5	.15
Q3	3	.5	.34
Q4	4	.5	.3
Q5	5	.5	.4
Q6	6	.5	.2
Q7	7	.5	.1
Q8	8	.5	.3
Q9	9	.5	.3

Total probability for Mr. Nurul Hossain,  $P(X1Q) = 0.0000000022$

## 5. RESULT

The highest score is obtained from Mesbah Uddin, hence the winner will be Mesbah Uddin in this election.

## 6. CONCLUSION AND FUTURE WORK

This research work computes the winning probability of a candidate. Some factors / parameters are used for this proposed work. These factors are taken and discussed from experts in the area of political science. The purpose behind this research is to do prediction for a candidate without using only public opinion. For this purpose, concept of Hidden Markov Model [HMM] has used. Some factors related to

election have been chosen because these factors effects election. The future work of this research is that more number of parameters can be used to predict the result. Moreover these parameters can be changed as per the geographical area of constituency. Even the effect to time is also a responsible factor in election. New input parameters can be added or edited according to the time. Increment in sample size will also lead to give more accurate result.

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