

Travelling Salesman Model for Election Campaigning of Lok Sabha Constituencies of Vidarbha Region

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Abstract:

Election Campaigns of various Lok Sabha as well as Vidhan Sabha Constituencies has been part of Indian democracy which repeats in every five years. The demographic of centrally situated Vidarbha region constitutes 11 districts in which most to the airports has been no more in commercial operations expect the Nagpur Airport. This research work is an attempt to provide an optimum route (by road) for the Lok Sabha election campaigning using Travelling Salesman Model. The application serves to any political party planning to cover maximum constituencies in minimum time and also provides the trade-off between the utilization of cost in terms of distance travel and time.

Keywords: Travelling Salesman Model, Optimum route, Trade-off.**I. Introduction**

The centrally situated Vidarbha region of India, includes 11 districts in which there are 10 Lok Sabha (lower house of people, elected for India's bicameral Parliament) Constituencies. Vidarbha

region comes under Maharashtra State of total 48 Lok Sabha Constituencies. The recent statistics of various constituencies of Vidarbha region and their electors is reflected in the following table.

Table no. 1 Vidarbha region Lok Sabha Constituencies and their electors

Sr. No.	Const. No.	Constituency	Male Electors	Female Electors	Total Electors
1	5	Buldhana	845,547	750,687	1,596,234
2	6	Akola	869,922	776,541	1,646,463
3	7	Amravati	848,050	763,315	1,611,365
4	8	Wardha	817,514	747,039	1,564,553
5	9	Ramtek	887,157	790,088	1,677,245
6	10	Nagpur	979,995	920,792	1,900,787
7	11	Bhandara - Gondia	841,442	814,842	1,656,284
8	12	Gadchiroli- Chimur	753,927	715,840	1,469,767
9	13	Chandrapur	921,099	832,591	1,753,690
10	14	Yavatmal- Washim	916,049	827,449	1,743,498
Total:			8,680,702	7,939,184	16,619,886

Source: Election commission of India[1]

In above table, Nagpur city shares the highest electors followed by Yawatmal-Washim constituency. Ramtek, a tahsil place under Nagpur districts has its separate identity. There are three constituencies which are joined either by adjacent districts e.g Bhandara-Gondia and Yawatmal-Washim or by adjacent area in case of Gadchiroli-Chimor.

In Vidarbha region, there are 8 airports out of which 7 are closed and only one commercial airport "Dr. Babasaheb Ambedkar International Airport" situated at Nagpur city, is working. The scope of our study renders for any star campaigner of a national party coming for the Election Campaigning will start from Nagpur and end at Nagpur considering the optimum route by road. The objective of this research study is to build a travelling salesman model and find the optimum route by the connected road to the major cities of the ten Lok Sabha constituencies.

II. Literature Survey

While reviewing the available literature for our study, there was a huge gap, as there was no as such previous study based on this local problem. We found blogs and articles first and then concentrated on the technical aspects and applications of travelling salesman problem (TSP).

Milan Vaishnav in his study has provided the statistical analysis of Lok Sabha election of 2014. He has highlighted the structural drivers and their influence before the Elections of 2019 [2]. Archana Chaudhary and Jeanette Rodrigues in their article of Economics times had talked about the growing expenses of political parties in election campaign [3]. Richa Bhatia in her article before 2019 election predicted about the influence of data analytics . She also gave the highlights of social network used by the various political parties [4]. Parimal Maya Sudhakar in her keynote of National conference had talked about the influence of party system in Indian politics. The story begins with very first party politics of Indian Congress, followed by influence of

regional parties and in the recent time, the strategies of Bhartiya Janta Party [5].

Ayman Srouf et. al. innovated a new algorithm of TSP and performed the analysis using various data sets. The improved results using the novel approach helps to solve the complex real life problems [6]. Muhao Chen et. al explore on mathematical model of TSP and had simulated their application of virtual instrument technology. They have used both the primary and advance concept of travelling salesman problem [7]. Nilofer and Dr. Mohd. Rizwanullah had performed the analytics using TSP-Branch and bound technique. They have worked on a case study of twelve randomly chosen pizza outlets situated in Jaipur city. They have solved their application reflecting step by step improvement towards the optimal solution[8]. S. Prabaharan et. al., surveyed on various approach of TSP . A comparative study reveals that advance approach of ant colony concept provides the optimal solution [9]. Jihene Kaabi and Youssef Harrath gave an idea for penalty method for solving the traveling salesman problem [10].

III. Formation and Analysis of Travelling Salesman Model

Travelling Salesman Problem (TSP) is used to find the shortest path based on minimization of Traveling cost. The constraint is, the salesman should visit each city once where the starting point and ending point remains the same. The classical techniques in domain of Operations Research are

- i. Hungarian Method
- ii. Branch & Bound Techniques
 - With penalties
 - Without penalties

Following table provides the base for formation of Travelling salesman model using the distances (in kilometers) between the various Lok Sabha constituencies within the Vidarbha region. In case of adjacent district/area we have considered the major associated city only.

Table no. 2 Travelling Salesman Model for Various Lok Sabha constituencies

To\From	Nagpur	Ramtek	Bhandara	Gadchiroli	Chandrapur	Akola	Amravati	Buldhana	Wardha	Yavatmal
Nagpur	-	56	63	171	155	252	153	351	80	168
Ramtek	56	-	48	183	204	297	199	397	130	217
Bhandara	63	48	-	136	213	312	217	413	136	226
Gadchiroli	171	183	136	-	81	418	396	519	211	241
Chandrapur	155	204	213	81	-	310	237	412	131	160
Akola	252	297	312	418	310	-	105	99	194	153
Amravati	153	199	217	396	237	105	-	344	108	91
Buldhana	351	397	413	519	412	99	344	-	296	255
Wardha	80	130	136	211	131	194	108	296	-	71
Yavatmal	168	217	226	241	160	153	91	255	71	-

It was observed that the classical methods using Hungarian method and Branch and bound technique without penalties, were infeasible to provide an optimum solution. So the method of penalties was used to obtain the optimal solution. It uses the penalties to locate the nearest source to destination

point. The chain is developed at various iterations which can be used to calculate the minimum travelling cost for the optimal route of travelling from one city to another city. The details of the analysis is provided in following table.

Table no.3 Penalty method to obtain the optimal solution

Itr. No.	Path	Cost	Chain	Total Cost	Remark
1	Akola→Buldhana	99	-	-	-
2	Chandrapur→Gadchiroli	81	-	-	-
3	Amravati→Akola	105	Amravati-Akola-Buldhana	204	3,1
4	Buldhana→Yavatmal	255	Amravati-Akola-Buldhana-Yavatmal	459	(Chain 1) 3,1,4
5	Wardha→Chandrapur	131	Wardha-Chandrapur-Gadchiroli	81+131=212	(Chain 2) 2,5
6	Yavatmal→Wardha	71	Chain1+Chain2	742	3,1,4,6,5,2
7	Nagpur→Amravati	153	Nagpur+Chain1+Chain2	895	7,3,1,4,6,5,2
8	Bhandara→Ramtek	48	-	-	(Chain 3)
9	Ramtek→Nagpur	56	Bhandara-Ramtek-Nagpur	104	8,9
10	Gadchiroli→Bhandara	136	Chain1+Chain2+Chain3	895+104+136	1135

From the above table, the optimum route using Travelling Salesman model based on penalty method, for Election Campaigning of Lok Sabha Constituencies of Vidarbha Region is:

“Nagpur → Amravati → Akola → Buldhana → (Yavatmal-Washim) → Wardha → Chandrapur → (Gadchiroli-Chimur) → (Bhandara – Gondia) → Ramtek → Nagpur”.

The minimum travelling cost in terms of distance is 1135 Kilometers by road ways. The estimate time duration can be approximately of three complete days.

IV. Conclusion

The research work began with the demographics, statistics and scope of the region under consideration. The local problem was surveyed for facts and figures but found a research gap and was an attempt to solve it by using the classical methods. The focus was on data modeling and analytics in terms of obtaining an optimum solution. Penalty method was found suitable to get the desired result.

In view of the trade off, the three chains provide a suggestion to region party workers to plan a three day tour for the election campaign. One can also notice that the optimal chain can be reversed, where the starting point and ending point as well as the minimum travelling distance remains the same.

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