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# Application of Travelling Salesman Model for Ashta-Vinayak of Vidarbha Region

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***Abstract:***
The religious tourism sector of Vidarbha region includes visit to one of the famous chain of eight temples called "Vidarbhache Ashta-Vinayak". The location of these eight temples is situated in Nagpur and its peripheral districts. This research work is an attempt to provide an optimum route (by road) for visiting these eight temples using Travelling Salesman Model. The application serves for planning, that can cover maximum of these temples in one day or an alternative of two days. It also provides the trade-off between the utilization of cost in terms of distance and time that can be afford by an individual, family or by a large group.

***Keywords:****Tourism sector, Travelling Salesman Model, Planning.*

## I. INTRODUCTION

Maharashtra seeks the famous religious tourism called Ashtavinayakyatra covering the hills of Sahyadry range in western Maharashtra. Special weekend packages from Mumbai as well as Pune are offered by various travel agencies. The religious devout follows a proper sequence for visiting these famous temples.

Vidarbha does have its own Ashtavinayak, but surprisingly it is very less talked about. Mythologically speaking these are self originated idols of Lord Ganesha known as the "Vidarbhache Ashta - Vinayak" i.e. Ashta - Vinayaks of Vidarbha and the devout can visit the eight temples in a proper sequence[1]. Following table provides the sequence of the temple and their respective locations situated in various part of Vidarbha region.

Table no. 1 Sequence of Ashta-Vinayaks of Vidarbha Region

| Sr.No. | City | Temple Name |
|---|---|---|
| 1. | Ramtek | Athra-BhujaGanpati |
| 2. | Nagpur (Tekdi) | Vardvinayak |
| 3. | Adasa | Shamivighnesh |
| 4. | Paoni | PanchananGanpati |
| 5. | Mendha (Bhandara) | Bhrushunda Ganesh |
| 6. | Kalamb | Chintamani Ganesh |
| 7. | Kelzar | Ekchakra Ganesh |
| 8. | Bhadravati | GauralaGanpati |

The following figure provides the road map of the above mention sequence.

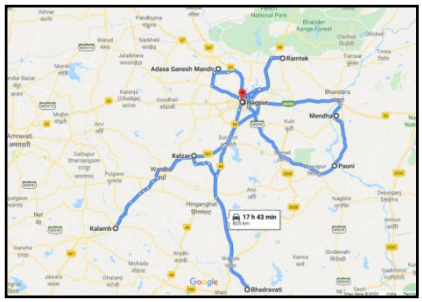


Fig. No. 1 Road Map for the Sequence of Ashta-Vinayaks of Vidarbha Region

The above figure indicates that the road connectivity following above sequence covers almost 805 kilometers and seems to be infeasible and time consuming. If the constraint of the mentioned sequence is wiped off then, the visitor needs to make decision on how to choose an optimum route to visit all the temples with minimum traveling time.The Travelling Salesman algorithm finds the shortest path for a salesman who must travel between N

January-February 2020
ISSN: 0193-4120 Page No. 16245 - 16249

cities. The order in which he does so is something he does not care about, as long as he visits each once during his trip, and finishes where he was at first.This research study provides an optimum solution by using the technique of travelling salesman model which can minimize the travelling in terms of kilometers and the number of hours. The focus of this research study also provides an alternative solution in which the tour can be completed in two days considering with and without the origin point of Nagpur city. The assumption of this study renders its origin as the centrally situated Nagpur city which is well connected to these mentioned temples of Ashta-Vinayaks of Vidarbha.

## II. Literature Survey

This section has been divided into two parts where the first part talks about the available data of the significance of the Ashta-Vinayak temples. The next section covers the technical aspects of travelling salesman model in the domain of Operations Research.Mahesh in his blog has given the proper sequence of the Ashta-Vinayak of Vidrabha and their significance in terms of the religious values [1]. Manish Pande in her blog confirms about the significance of BhrushundiAshtavinayak Ganesh Temple at Bhandara. The ancient history and the present trust related to this temple are also highlighted [2]. Dr. B. K Deshpande and Mrs. Reetuja Deshpande had studies the prominent tourist places in every district of Maharashtra region. They have put their opinions that Maharashtra tourism can serve for economic growth of the state. Two of the ashtavinayak of Kalmab and Kelzer have been highlighted in their paper [3].SlavomirVukmirović and DragoPupavac worked on application of transport network based on travelling salesman problem. They have used the excel spreadsheet to solve their application [4]. N. Sathya and A. Muthukumaravel provide survey on various approaches to solve the travelling salesman problem. They have mentioned the pros and cons of each approach [5]. Amarbir Singh had worked on special case of multiple travelling salesmen problem. This gave us idea to think about various cases as the alternative solution keeping the first cities as the starting and ending constraint [6]. NaixueXionget. al. performed a comparative study using various approach to the travelling salesman model used on the application of social network. They have talked about the connectivity and interaction between various people using the graph concept [7]. ThiThiHtun in his paper has described the mathematical aspect of travelling salesman problem and its various way to achieve the minimum cost by using various optimization tools. It is a NP hard problem and can be converge in polynomial time [8]. Tu-San Pham et al. has given a new concept of the intermittent travelling salesman problem using the branch and bound approach for the travelling salesman problem [9]. MarlinaSetiaSinagaet. al., had work on various aspect of minimum spanning tree using TORA software. They have mentioned the utility of TORA software for solving the travelling salesman problem [10].

## III. Problem Statement

The research gap identified was that there was not much about the optimal solution regarding the road transport for visiting the Ashta-Vinayak temples of the Vidarbha region. So from a research point of view we decided to find feasible routes for devotees, tours and travel agencies to travel Ashta-Vinayak in Vidarbha, found in different places taking in consideration various situations.

Following are the assumptions considered for this research work.

1. The mythological sequence if any has been wiped off.
2. The starting point in each case is the Nagpur city which is well connected to every other place under consideration.
3. The solution is the application based on road transport only.
4. The solution is based on two classical methods
   (i) Hungerain Method
   (ii) Branch and Bound Approach

January-February 2020
ISSN: 0193-4120 Page No. 16245 - 16249

## IV. Formation and Analysis of Travelling Salesman Model

Based on the major state highways and national highways connected to the second state capital of Maharashtra state i.e. Nagpur city, following is the cost matrix in terms of the road-way distance between all the major temples.

Table no. 2 Travelling Salesman Cost matrix in terms of distance in kilometers

| From\To | Nagpur | Ramtek | Adasa | Pauni | Bhandara | Kalamb | Kelzar | Bhadravati |
|---|---|---|---|---|---|---|---|---|
| Nagpur | x | 44 | 37 | 83 | 63 | 127 | 62 | 128 |
| Ramtek | 44 | x | 60 | 96 | 49 | 177 | 113 | 179 |
| Adasa | 37 | 60 | x | 124 | 106 | 147 | 84 | 164 |
| Pauni | 83 | 96 | 124 | x | 50 | 169 | 111 | 125 |
| Bhandara | 63 | 49 | 106 | 50 | x | 164 | 119 | 164 |
| Kalamb | 127 | 177 | 147 | 169 | 164 | x | 76 | 109 |
| Kelzar | 62 | 113 | 84 | 111 | 119 | 76 | x | 103 |
| Bhadravati | 128 | 179 | 164 | 125 | 164 | 109 | 103 | x |

The distance values are verified as the shortest distance between the locations using the Google map. Maximum of the path are toll free and are interconnected by state highway and national highways.

a)Using Hungerian method our final path isPauni→Bhandara→Ramtek→Kalamb→Bhadravati→Kelzar→Nagpur→Adasa→Pauniand total distance is 50+49+177+109+103+62+37+124=711

Using Nagpur as the starting point, our modified path isNagpur→Adasa→Pauni→Bhandara→Ramtek→Kalamb→Bhadravati→Kelzar→Nagpur and total distance remain the same i.e. 37+124+50+49+177+109+103+62=711The above result sounds practically non-supportive as Adasa → Ramtek→ Bhandara→Pauni is a feasible path.

b) Using Branch and Bound Technique our final path is Pauni→Bhandara→Ramtek→ Adasa→Nagpur→Kelzar→Kalamb→Bhadravati→Pauniandtotal distance is 50+49+60+37+62+76+109+125=568Using Nagpur as the starting point, our modifiedpathisNagpur→Kelzar→Kalamb→Bhadravati→Pauni→Bhandara→Ramtek→Adasa→Nagpur and total distance remain the same i.e. 76+109+125+50+49+60+37+62=568

Case II: An alternative for two days tour

If driving 568 Km in a day seems to be impractical, an alternative for covering these eight temples in two days can be a second thought. There are two ways for this, e.g. taking halt at Bhadravati covering 300 km in day 1. Next day starting from Bhadravati come back to Nagpur covering remaining distance of 268 Km.Another solution can be starting from Nagpur, covering four temples on first day, and coming back to Nagpur. Same can be repeated for the next day covering the remaining four temples. In that case the travelling salesman can be put in the following two phases.

Phase 1:

As mentioned, Day 1 covers first four temples where the starting and ending point remains at Nagpur. Following table provides the cost matrix in terms of distance between the locations in kilometers.

January-February 2020
ISSN: 0193-4120 Page No. 16245 - 16249

Table no 3: Day 1 tour plan

| From\To | Nagpur | Kelzar | Kalamb | Bhadravati |
|---|---|---|---|---|
| Nagpur | x | 62 | 127 | 128 |
| Kelzar | 62 | x | 76 | 109 |
| Kalamb | 127 | 76 | x | 103 |
| Bharavati | 128 | 109 | 103 | x |

a) Using Hungerian method our final path is Nagpur→Kelzar→Kalamb→Bhadaravati→Nagpur and total distance is 62+76+103+128=369.

b) Using Branch and Bound technique our final path is Nagpur→Kelzar→Kalamb→Bhadaravati→Nagpur and total distance is 62+76+103+128=369.

So in both case the value remains the same and is the optimum solution for phase 1.

Phase 2:

Day 2 covers remaining four temples where the starting and ending point remains the same at Nagpur. Following table provides the cost matrix in terms of distance between the locations in kilometers.

Table no. 4: Day 2 tour plan

| From\To | Nagpur | Ramtek | Adasa | Pauni | Bhandara |
|---|---|---|---|---|---|
| Nagpur | x | 44 | 37 | 83 | 63 |
| Ramtek | 44 | x | 60 | 96 | 49 |
| Adasa | 37 | 60 | x | 124 | 106 |
| Pauni | 83 | 96 | 124 | x | 50 |
| Bhandara | 63 | 49 | 106 | 50 | x |

a) Using Hungerian method our final path is Nagpur→Bhandara→Pauni→Ramtek →Adasa→Nagpur and total distance is 63+50+96+60+37=306.The above results sounds practicallynonsupportiveasBhandara→Pauni→Ramtek→Adasa patch is not an optimum path.

b) Using Branch and Bound Technique our final path is Bhandara→Pauni→Nagpur→ Adasa→Ramtek→Bhandaraandtotal distance is 50+ 83+37+60+49=279.Using Nagpur as the starting point, our modified path is Nagpur→Adasa→Ramtek→Bhandara→Pauni→Nagpur and total distance remain the same i.e. 37+60+49+50+83=279So the total distance covered in both days is 585 kilometers. The total journey time can be estimated from the following Google maps for all the mention cases.

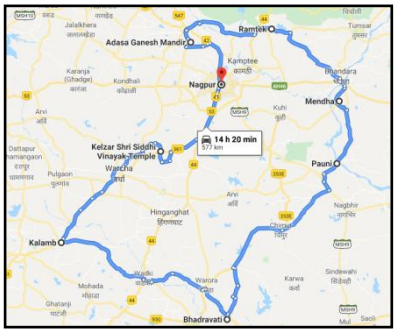


Fig. No. 2a One Day Tour

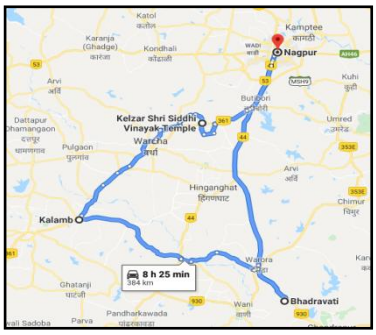


Fig. No. 2b Day 1 Tour Plan

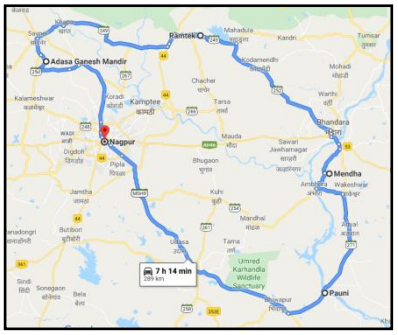


Fig. No. 2b Day 2 Tour Plan

As per the above figures the travel time required for one day tour is 14 hr.20 min covering 577 kilometer in one day. In Two days tour , Day 1 cover 384 kilometers taking travel time of 8Hr. 25 min. Lastly Day 2 covers distance of 289 kilometers taking traveling of 7 hr. 14 min. Maximum of these path are toll free and well built state highway and national highways and are well connected.

## Conclusion

The results obtained by Solving travelling sales man

*January-February 2020*
*ISSN: 0193-4120 Page No. 16245 - 16249*

problem using Branch and Bound technique provides the feasible and optimum solution to the research problem under consideration. The theoretical values are mostly in line with values obtained by Google map figures.It can be suggested for small family using their private or hired small four wheelers to go for option of one day tour. For larger groups Two days tour either taking halt or coming back to Nagpur can be a better option.

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