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The Application of Multi-objective TOTSP in Scenic Spot Tour Route Planning

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Abstract: In view of the tourists in the scenic spots in the process of realize the maximization of the benefit that the shortest walk, play time but visit the longest shortest problem, this paper USES the improved half Hamiltonian algorithm, to solve the problem is converted into fixed time sightseeing, walking, and the time distribution of waiting time. Then, the optimal tour route is obtained by analyzing and solving the tour time from the perspectives of waiting time and no-waiting time.

Keywords: Tourism path; 0-1 Variables; Hamiltonian algorithm; Matlab

1. Introduction

The problem of distribution route optimization in logistics distribution is one of the more concerned aspects. At the same time, with the development of economy and society, traffic congestion has become one of the bottlenecks restricting urban and regional development. Finding efficient and reasonable vehicle transportation routes has become an urgent problem for transportation network systems. This paper mainly explores the planning of scenic spots.

2. Data Source and Model Assumptions

The data used in the model is derived from the 2018 Mathematical Modeling 51 issue. In order to solve the problem conveniently, the following hypotheses are proposed: Assume that the sum of the waiting times of all the scenic spots due to uncertain factors is the same; It is assumed that the distance between the two scenic spots of the tour group can only be the value defined in the title; Assume that the tour group does not change direction when meeting on the road; Assume that the tour group only exists on the way, waiting outside the attraction and visiting the attraction.

3. Data Preprocessing

Data indexing

Based on the shortest walking distance data between the attractions, the matrix required for the model is derived:

$$D=\begin{bmatrix} 0 & 300 & 360 & 210 & 390 & 475 & 500 & 690 \\ 300 & 0 & 380 & 270 & 230 & 285 & 200 & 390 \\ 360 & 380 & 0 & 510 & 230 & 765 & 580 & 770 \\ 210 & 270 & 510 & 0 & 470 & 265 & 450 & 640 \\ 590 & 230 & 230 & 470 & 0 & 515 & 260 & 450 \\ 475 & 285 & 765 & 265 & 515 & 0 & 460 & 650 \\ 500 & 200 & 580 & 450 & 260 & 460 & 0 & 190 \\ 690 & 390 & 770 & 640 & 450 & 650 & 190 & 0 \end{bmatrix}$$

4. Improved Semi-hamilt on Model based on TOTSP Traveler's Perspective

4.1. Research ideas

In order to maximize the benefits of visitors in the process of visiting attractions, we use the improved Hamiltonian algorithm and consider that it is not a closed loop and ask for the longest tour time, from walking time, waiting time and tour Time analyzes and builds models in three aspects. Using C++ programming to get the optimal solution.

4.2. Model building

First, we introduce the weighting graph. The weighting graph means that there is a non-negative number corresponding to each edge in the graph, and we use the real number corresponding to each edge as the weight. This weight represents two. Tourist walking time between attractions.

Remember that $G=(V,E)$ is the weight map, $V=(1,2,3,\cdots,n)$ is the vertex set and E is the edge set. Knowing the distance $d_{ij}(d_{ij}>0;i,j\in V)$ between vertices, it is assumed that:

$$x_{ij}=\begin{cases}1, & \text{If (i,j) on the optimal loop}\\ 0, & \text{other}\end{cases}$$

First we construct an objective function, which is expected to be relatively short walking time:

$$\min Z = \sum_{i=1}^{n}\sum_{j=1}^{n} d_{ij}x_{ij}$$

According to the meaning of the question, the constraints are constructed. The first two formulas represent that for each vertex, there is only one edge and one edge. A Hamiltonian loop can be constructed as long as the condition of the thorn restraint is full.

$$s.t.\begin{cases} \sum_{j=1}^{n} x_{ij} = 1 & i \in V \\ \sum_{j=1}^{n} x_{ij} = 1 & j \in V \\ \sum_{i\in S}^{n}\sum_{j\in S} x_{ij} \le |S|-1 & \forall S \in V \\ x_{ij} \in \{0,1\} \end{cases}$$

Next, we analyze the walking time required by the three tour groups to each attraction. According to the Hamiltonian loop constructed above, the total route taken by each tour group can be obtained:

$$f_a = \sum_{j=1}^{7} d_{j,j+1} (a \in [1,3])$$

In the above formula, a is represented as the a-th tour group, and $C_{j,j+1}$ represents the distance between the j-th attraction and the j+1th attraction. f_a indicates the distance traveled by the a tour group at various attractions. We know that the average walking speed of visitors is $v = 2km/h$, we need to get the walking time between tourists in the attractions, ie the function expression is:

$$t_a = \frac{(\sum_{j=1}^{7} c_{j,j+1})}{v}$$

Therefore, the waiting time of tourists at j attractions is regarded as t_{wj}, and the time of tourists' visits at j attractions is t_{vj}.Due to the visit time of the tourists, the three tour groups must arrive at the wetland commercial street before 17:00, so we need to set the restrictions: $t_{vs} \ge 0.8$ (hours), while maximizing the total time of visitors, and waiting for tourists at the sights. The time between the time and the visitor's walking time between the attractions reaches a minimum. The total time spent on the three tour tours at this time is:

$$t_a = \sum_{j=1}^{8} t_{wj} + \sum_{j=1}^{8} t_{vj} + \frac{(\sum_{j=1}^{7} C_{j,j+1})}{v}$$

At this time, the total time t_a needs to satisfy the constraint condition $t_a \le 5.5$ (hour).

4.3. Model solving

The travel time t_a is obtained by using the distance matrix of each route through the tour group. In the solution process, we first consider the extreme conditions without waiting time, and then consider the longest tour time under the condition of waiting time, the two angles are combined and solved according to the software. Bring the above matrix into the program to obtain:

Table1. Travel routes and schedules of the three tour groups

	First tour group			Second tour group			Third tour group		
	Arrival time	**Tour time (residence time, in minutes)**	**Leave time**	**Arrival time**	**Tour time (residence time, in minutes)**	**Leave time**	**Arrival time**	**Tour time (residence time, in minutes)**	**Leave time**
Keystone	12:00	0	12:00	12:00	0	12:00	12:00	0	12:00
Tourist service center	14:49	15	15:04	13:54	28	14:22	12:09	30	12:39
Sun lawn	15:15	24	15:39	12:10	60	13:10	15:45	25	16:10
Forest small theater	13:00	30	13:30	14:30	30	15:00	15:00	30	15:30
Children's science experience area	15:46	30	16:16	13:17	30	13:47	16:17	30	16:47
Children's water play	12:14	38	12:52	15:08	60	16:08	13:59	53	14:52
Wetland museum	13:43	60	14:43	16:22	32	16:54	12:45	60	13:45
Wetland commercial street	16:30	60	17:30	17:00	30	17:30	17:00	30	17:30
Total walking time	73minutes			60 minutes			72 minutes		
Total tour time	257 minutes			270 minutes			258 minutes		

Total waiting time	0 minute	0 minute	0 minute

According to its solution, it can be known that the travel route of the first tour group is: ①→⑥→④→③→⑤→⑦→②→⑧; the tour route of the second tour group is: ①→③→⑤→②→④→⑦→⑥→⑧; the tour route of the third tour group is: ①→②→⑦→⑥→④→③→⑤→⑧. And the total waiting time for each tour group is zero.

5. Advantages of the Model

This paper effectively uses the improved semi-Hamilton model to solve the target problem efficiently, and develops the most efficient different paths for different tour groups to enter the scenic spot at the same time. This answer will bring great convenience to travel agencies. At the same time, the model established in this paper is easy to understand, which will greatly facilitate the latent exploration of the model.

6. Suggest

When a travel company develops its travel route, it is necessary to consider factors such as the distance between different play attractions and the walking time of tourists to find one or more tour routes that are most suitable for tourists to visit at the same time. The implementation of such measures will bring a mutually beneficial and win-win situation for both travel agencies and tourists.

On the other hand, travel agencies need to travel at different times during different time periods. This approach will solve the administrator configuration problem for different time periods in the scenic spot.

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