Tourism Management and Technology Economy (2021) 4: 9-13
Clausius Scientific Press, Canada

DOI: 10.23977/tmte.2021.040202
ISSN 2616-2199

Research on the best strategy for crossing the desert

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Keywords: multi-parameter optimization, game theory, qualitative decision-making

Abstract: Crossing the desert is a self-adjusting journey, and studying how to cross the desert rationally and scientifically has important practical significance. From the perspective of players, this paper establishes a model based on the principles of multi-parameter goal optimization, risk-taking and loss-making game theory, and qualitative decision-making, which can provide players with reasonable choices and decisions under different game rules[1]. Mainly by establishing a corresponding strategy model to reach the end within the specified time of the game, and reserve as much funds as possible. For different problems, the optimal criterion for judging is to reach the end of the remaining funds on the premise of the completion of the game.

1. Model preparation

Observing the benchmark price and quality of water and food at each checkpoint, combined with the upper limit of load and the initial capital, the basic inequality of the problem can be obtained[2], as follows:

$$\begin{cases} 2f + 3w \leq 1200 \\ 10f + 5w \leq 10000 \end{cases} \tag{1}$$

When the player stays in the mine, he can gain income through mining. If mining, the amount of resources consumed is 3 times the basic consumption, but a certain amount of labor remuneration can be obtained accordingly. Therefore, in most cases, as long as mining is carried out, there must be a profit.

2. Model establishment and solution

2.1 Problem one model establishment

Regardless of mining and replenishment, replenishment can only be purchased at the starting point, and the shortest route is directly selected to reach the end point. Different weather conditions consume different amounts of resources[3], so the required funds and remaining funds are:

$$M_{\text{out}} = 24D_1 + 28D_2 + 20D_3 \tag{2}$$

$$M = M_s - M_{out} \tag{3}$$

Set the parameters J_1 and J_2 for whether to pass through the village on the way.

2.2 Problem one model solving

2.2.1 First pass solving

According to the model, there are two paths. When the player goes directly to the end point, the best path is obtained according to the map. For the first pass, it only takes three days to reach the start point to the end point. Through model 1, the cost of the route is calculated, and the remaining funds are 9,410 RMB.

When passing through the mine, analyze the optimal route, the path belongs to J_1 =1, J_2 =1, the analysis shows that the shortest distance from the starting point to the mine is Nmin = 8, and the shortest distance from the mine to the end point is Nmin = 5. The specific path is shown in Figure 2.

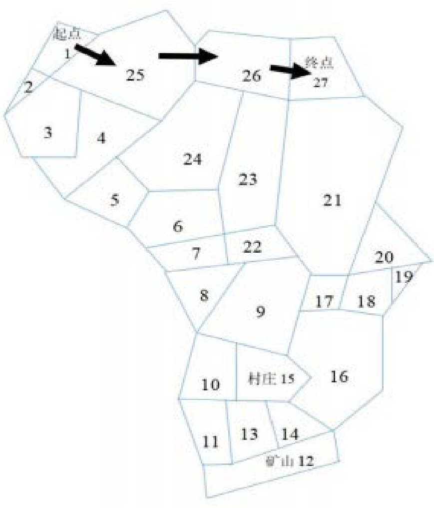

Figure 1: Route not to the mine

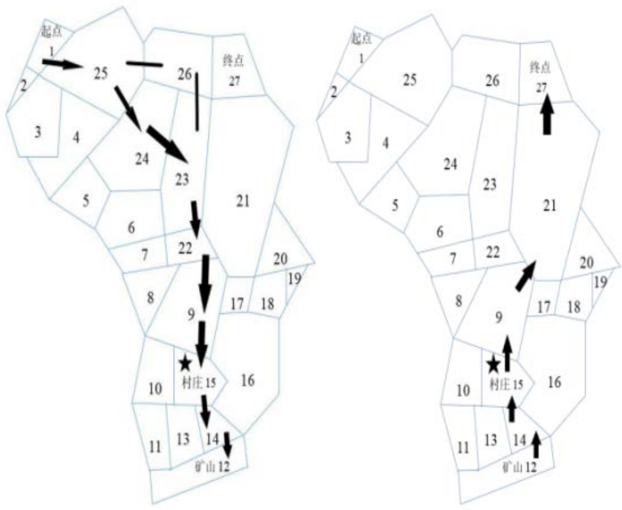

Figure 2: Route to the mine

Through model analysis, it is recommended that players choose to go directly to the end point in the first level, without passing through the mine, and reach the end point at the specified time. The remaining funds are up to 9,410 RMB.

2.2.2 Second pass solving

First, study whether the shortest distance from the start point to the end point passes through the mine. From the map analysis, it can be seen that as long as you don't go to the left, you can find countless shortest paths with equal distances. The minimum path value is Nmin =11.

It takes two days for the factory to reach the end of the shortest path. In order to maximize the benefits, the plan only needs to reach the end in the last two days. It is recommended that players choose to go to two different mining areas in level three and reach the end within the specified time. The remaining funds are up to 13,665 RMB.

2.3 Problem two model establishment

According to the probability distribution of the weather, a kind of weather is randomly selected through Matlab, and the probability of the corresponding weather will decrease when it is selected again next time. The decreasing probability is as follows:

$$P_{dn} = \frac{N_i - n}{N - n} \tag{4}$$

P_{un} means that the probability of a certain weather rising n times is similar to the next time the probability of other weather appearing will increase accordingly:

$$P_{un} = \frac{N_i}{N-n} \tag{5}$$

The criterion of the optimal strategy is to reach the end within the specified time and retain as much funds as possible. For the model of the funds used in the second question:

$$M_{\text{out}} = 14D_1 + 36D_2 + 20D_3 \tag{6}$$

2.4 Problem two model solving

2.4.1 Third pass solving

According to the map, two optimal routes can be obtained, one is to go directly to the destination, and the other is to go to the mine.

Through model analysis, it is recommended that players choose to go directly to the end point in level three, without passing through the mine in the middle, and reach the end point at the specified time. The remaining funds are up to 9350 RMB.

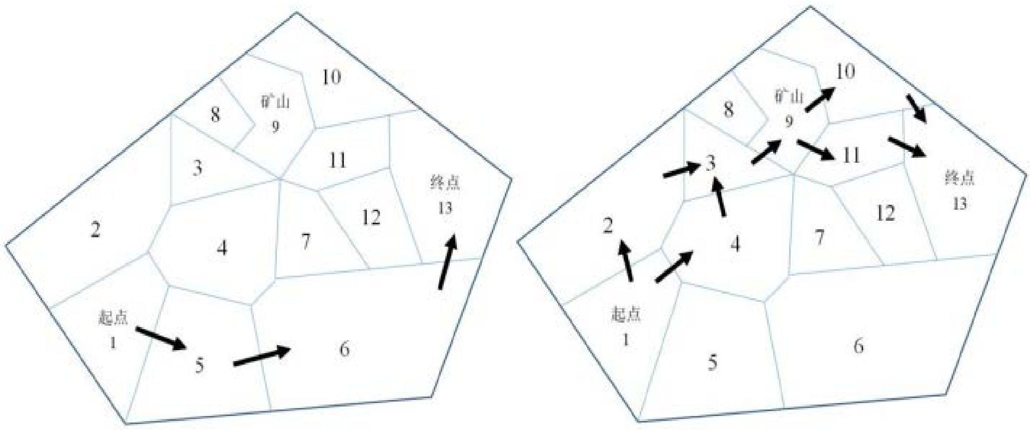

Figure 3: The optimal route without passing through the mine and passing through the mine

2.4.2 Fourth pass solving

For the fourth level, from the analysis on the map, it can be concluded that when the route is guaranteed to walk to the right or down, the end point can be reached, and it is the optimal value.

Option 1: Work once, if you only go through the mine and don't go to the village to supply supplies, the remaining funds will be 13,415RMB.

Option 2: Work twice. If you go to the village to supply supplies and then return to work in the mine, the model can be analyzed and the mine work requires a total of 16 days to work.

Compared with the first option, the second option works 9 more days, and the total cost is 15 more days, and the funds are 725 more. If the final goal is to use the remaining funds as the final goal, the second option is recommended.

2.5 Multivariate model establishment

2.5.1 Model establishment and solution of the first question

There are multiple players in the game. When a player meets other players, the corresponding basic consumption will increase and the income will decrease. Therefore, in order to maximize the remaining funds at the end of the game, it should be based on the optimal route, and try to avoid problems with other players as much as possible.

First, suppose there is only one player. The player has two choices. One is to start from the starting point and use the shortest path to reach the starting point. When the route is known, if the weather is known, the last remaining funds M_i under each route can be calculated correspondingly:

$$M = 10000 - M_s + M_{bri} \tag{7}$$

Add a player, the player also has the same choice as the first player. However, due to the relationship with existing players, additional expenditures and reductions in income may arise from encounters with other players during the journey, which are called lost funds:

$$Sr_i = \sum p_j \times \left(mr_{fj} + mr_{wj} + mc_j\right) \tag{8}$$

If you encounter other k players and choose to go further together, it will cost 2k times the cost of the basic consumption, but if you stay, you can reduce the probability of going together; if you effectively avoid going forward together, you can save 2k-1 times the basis the cost of consumption. If the shortest journey takes m days, the cost of (2k -2)m-n times the basic consumption can be saved at most.

After analysis, for average players, if you choose route 1→5→6→13 and stay for one day (preferably stay in hot weather, because you can save more money), there is a high possibility that there will be more left at the end of the game funds.

2.5.2 Model establishment and solution of the second question

For considering two extreme values, that is, when there is only one person, calculate the maximum and minimum remaining funds, and define the upper and lower limits of the route.

$$\begin{cases} l_{max} = M_{max} \\ l_{min} = M_{min} \end{cases} \tag{9}$$

In most cases, players have different levels, so 0.33 is generally taken as the reference fund difference, where the fund difference comparison is the ranking of the fund difference between the final players. The final decision is based on the recommended value of l_{max} corresponding to M_{max}, and the final asset is also determined by three parameters.

$$S = 0.5 \times (c_1 + 1) \times (c_2 + 1) \times (c_3 + 1) \tag{10}$$

From the fourth level, the remaining funds for the optimal path for a single person on the map are 14,140 yuan, and the recommended remaining funds for the travel plan are expected to be 4666 yuan, that is, the planning loss is 10,800 yuan, which ensures that the destination can be reached with the least loss.

3. Model evaluation

3.1 Advantage

(1) Model 1 uses regression to inversely derive the optimal value of load capacity, which reduces the difficulty of the algorithm to a certain extent;

(2) It is innovative and reasonable to use random functions to predict the weather through continuous iteration;

3.2 Disadvantage

(1) For model 1, when the number of mines is large, the solution speed is slow, and the global optimal solution cannot be found;

(2) Regarding the prediction model in Model 2, the general situation is adopted in terms of weather probability, without considering the existence of other probabilities, which may have a certain impact on the results.

References

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