**Problem 2**

**A crossing the Desert**

Consider the following small games: players use a map, and use the initial funds to buy a certain amount of water and food (including food and other daily necessities), start from the starting point and walk in the desert. In case of different weather on the way, you can also supplement funds or resources in mines and villages. The goal is to reach the destination within the specified time and retain as much funds as possible.

The basic rules of the game as follows:

(1) Take the day as the basic time unit, the start time of the game is day 0, and the player is at the starting point. The player must reach the end point on or before the deadline. After reaching the end point, the player's game ends.

(2) Water and food resources are needed to cross the desert, and their minimum unit of measurement is box. The sum of water and food quality owned by players every day cannot exceed the upper limit of weight bearing. If you don't reach the end point and the water or food is exhausted, the game will be regarded as a failure.

(3) The daily weather is one of the three conditions of "sunny", "high temperature" and "sandstorm", and the weather in all areas of the desert is the same.

(4) Every day, players can go from one area in the map to another area adjacent to it, or stay in place. You must stay where you are on Sandstorm day.

(5) The amount of resources consumed by players staying in place for one day is called the basic consumption, and the amount of resources consumed by walking for one day is times the basic consumption.

(6) On day 0, players can buy water and food at the base price with initial funds at the starting point. Players can stay at the starting point or return to the starting point, but they cannot buy resources at the starting point multiple times. Players can return the remaining water and food after reaching the destination. The return price of each box is half of the benchmark price.

(7) When players stay in the mine, they can obtain funds through mining. The amount of funds obtained in a mining day is called basic income. If mining, the amount of resources consumed is times of the basic consumption; If there is no mining, the amount of resources consumed is the base consumption. No mining is allowed on the day of arrival at the mine. Mining can also be carried out on sandstorm days.

(8) When players pass or stay in the village, they can use the remaining initial funds or the funds obtained from mining to buy water and food at any time. The price of each box is twice the benchmark price.

Please establish a mathematical model according to different settings of the game to solve the following problems.

1. Assuming that there is only one player and the weather conditions are known in advance during the whole game period, try to give the player's optimal strategy in general. Solve the "first pass" and "second pass" in the appendix, and fill the corresponding results in result.xlsx respectively.

2. Assuming that there is only one player and the player only knows the weather conditions of the day, he can decide the action plan of the day, try to give the player's best strategy in general, and discuss the "third level" and "fourth level" in the appendix.

3. There are players who have the same initial capital and start from the starting point at the same time. If any player walks from area a to area B () one day, the amount of resources consumed by any one of them is times of the basic consumption; If any player mines in the same mine on a certain day, the amount of resources consumed by any one of them is times of the basic consumption, and the fund that each player can obtain through mining in a day is the basic income; If any player buys resources in the same village one day, the price of each box is times the benchmark price. In other cases, the amount and price of resources consumed are the same as those of single player games.

(1) Assuming that all weather conditions are known in advance during the whole game period, the action plan of each player needs to be determined on the day and cannot be changed thereafter. Try to give the strategies that players should adopt in general, and discuss the "fifth level" in the appendix.

(2) Assuming that all players only know the weather conditions of the day, from the next day, after the action of the day, each player knows the action plan of the other players and the amount of remaining resource

s, and then determines their action plan for the next day. Try to give the strategies that players should adopt in general, and discuss the "sixth level" in the appendix.

Note 1: in the map given in the appendix, two areas with common boundary are called adjacent, and two areas with only common vertices but no common boundary are not considered adjacent.

Note 2: in result.xlsx, the amount of remaining funds (remaining water volume and remaining food volume) refers to the amount of funds (water volume and food volume) after all the required resources are consumed on that day. If there is a purchase on that day, it refers to the amount of funds (water and food) after the purchase is completed.