Assume(设)

1. The search area of the ocean is S.
2. There are M ships and N aircraft in search and rescue task
3. The initial distance for the each ship and aircraft is D(公式符号)
4. The maximum speed of each ship and aircraft is V(公式符号)
5. The functionality of each ship and aircraft is A (公式符号)
6. The maximum flying time for each aircraft is
7. Each aircraft's operation in this search and rescue task is (公式符号)
8. The search area can contain at most Q ships and P aircraft
9. This task will cost T(h) hours

The:(则)

1. In full speed, i-th ship take T=D/V to reach the search area
2. It cost (公式符号) for i-th ship to works in the search area
3. In full speed, i-th aircraft will cost (公式符号) in a round trip to the search area
4. Each time, the i-th aircraft will work (公式符号) in the search area
5. The total operations of j-th aircraft are L.

The goal of the model is finding the best ship and aircraft, which can work together and the total searching time (T) in the search area is minimum. There are a few variable in this decision.

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In order to cover the whole search area with minimum cost, you need to analysis the proportion of the ships' cost and aircrafts' cost.

As figure 3.2 shows, assume that the search and rescue task start at Ts and finish at Te. Then the total cost of this task is $T = te-ts$.

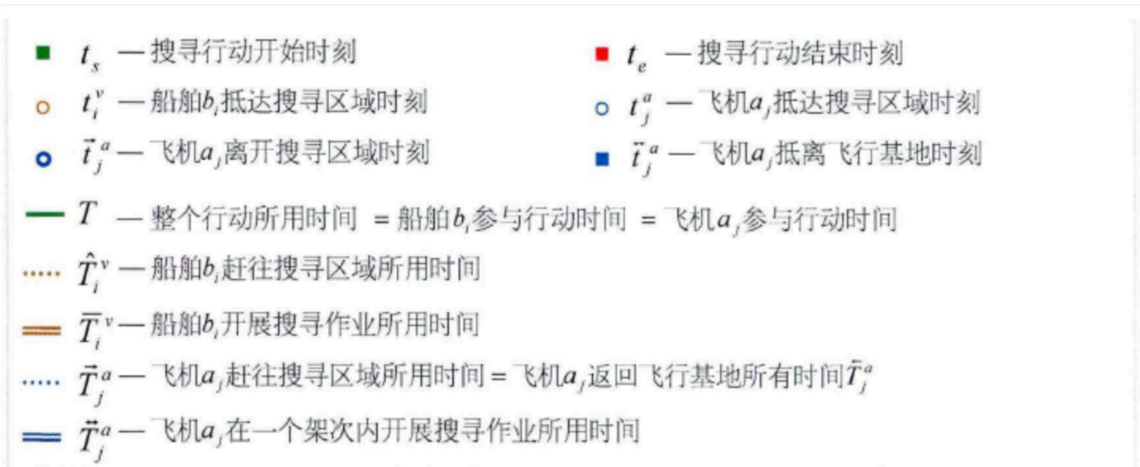
Firstly, let's analyze the ships' cost in this task: Since the maximum speed, the distance to the search area and the initial distance are different for each ship, they will arrive in the search area at different time T. In the figure, ship b1, b2 can reach the search area before the search and rescue task finish, but the ship b4 will arrive in the search area after the task. Therefore, not all the ships can join this task. For each ship bi, who will participate the search and rescue task, the time it spends in this task is equal to this task's time cost. Ti has two parts. The first part is time, which ship takes for arriving the search area. The second part is the time that the ship works in the search area. It $T = Ti+Ti$(公式符号). In addition, for those ships at the search area at the beginning of the search and rescue task, the time they work in the search area is equal to the time cost of the search and rescue task.

Then, let's analyze the aircrafts' time cost in this task: it's very similar to the ships' time cost. Not all aircraft will join the search and rescue task, only those aircraft which will arrive the search area before the task is finished.

In the figure, aircraft a1 can join this task but the aircraft a2 can't join this task. For each aircraft, which will participate the task, the flying time is limited so they need to take off couple times. For each take off, the aircraft will work Tj, which is the its maximum flying time. The Ti has three parts.

1. It take Tj for aircraft a1 to reach search area
2. Aircraft a1 will work Tj in search area
3. It takes Ti for aircraft a1 come back to air base

For convenience, we assume that the time cost reach search area equal to the time cost comes back to air base and we don't consider the time cost of filling gas. So the aircrafts aj's work time equal to sum of work time for each takes off. (公式符号). Since the work time for each take off equal to the maximum flying time minus the time of round trip from air base to the search area. So,,…... (公式符号).



The goal of the mode is finding the minimum search time of the search and rescue task. We have two constrain here: the number of ships and the number of the aircrafts. The search and rescue ability is limited by two factors: the objective factor, which includes the area of search ocean, type of the ship, the size of the ship, the tonnage of the ship, the type of the aircraft (helicopter, Fixed- wind airplane), and the maneuverability; The subjective factor is the constrain of the total cost of the search and rescue task. The instructor need to consider the cost of different search tool and make a efficiency action plan which cost minimum time and minimum number of input