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# The Third Methode to Explore the Boat Schedule of big long River

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**Abstract**

In this paper we assumpt three groups of boats are supposed to launch each day, including, group 1 comprised of motorized boats of different durations, group 2 comprised of oar-powered rubber crafts of different durations and group 3 motorized boats of different durations. By following this schedule, no contact will take place. In this case, the carrying capacity of the river is 238, which means at least 238 campsites should be provided. Besides, the total visits in 6 months are 3163. In contrast, no one is more superior to the other. The former schedule will provide even spread of boat types in terms of propulsions; while the latter ensures the maximal visits to the river.



*Keyword:* Active matrix, Dynamic balance, Interval of time

## 1. Introduction

Crafting is developing with the development of human society. Like many other entertainments and sports, it evolved from people's life, survival, transportation and war to a kind of tourist recreational activity, which is challenging and competitive.

Crafting dated back to Eskimo's kayak, Indians' bark, Chinese bamboo raft, which were utilized with the purposes of meet people's needs, such as living, surviving, transporting and battling. While crafting has become a sport ever since World War 2.


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In 1970s and 1980s, commercial crafting was well developed and other industries related to it also developed, such as professional boats, equipment, devices, clothing. And the government also issued administrative rules for commercial crafting, such as rules targeting business owners, licenses for rivers, security issues, and environment protections, safety of boating equipment and rankings of crafting rivers in terms of difficulty.

## 2. The Model

### *2.1. Analysis*

The final purpose is to work out a schedule to ensure the minimal contact between boats, the maximal visits and utilization of the campsites. By increasing the number of boats launched into the river or cutting down on the time of interval between two groups of boats, X becomes larger and the utilization of campsites becomes better. However, this will increase contact between boats; Likewise, by cutting on the number of boats launched into the river or lengthening the interval time, the contact can reach its minimum. That is to say, these two are interacted. And our final purpose is to work out a schedule which can minimize the negative influences between them two. To make the problem simple, we will give our considerations from two perspectives respectively and then optimize the schedule in consideration to the contact problem.The time for crafting starts at 6:40 am.

We do the following assumption:

- The minimal time of interval for boats launched next to each other is 10 minutes in consideration to the time for preparation.
- Each boat must craft for the same distance and cannot camp at the same site longer than 24 hours.
- The latest camping time must before 18 pm which is to ensure the safety of tourists.
- Once the boat has reached the campsites, it cannot launch until the next day.
- To change the original plan because of the increasing tourists , we suppose tourists are enough.
- We assume that 6-8-night oar-powered rubber rafts are unavailable in consideration to visitors.

Boats of the type of 6,8,10,12,14,16,18 nights are available, and there are three campsites at the place of $\frac{l}{7},\frac{l}{9},\frac{l}{11},\frac{l}{13},\frac{l}{15},\frac{l}{17},\frac{l}{19}$ on the river. Suppose three groups of boats launched simultaneously, they can find campsites respectively on time.

To minimize the contact of different boats, we launch all the motorized boats within the same period of time; meanwhile, all the oar-powered rubber crafts stay at the campsites and haven’t been launched. When all motorized boats finish their trip, launch all oar-powered rubber crafts at the same time. In this case, there will be on encounter between crafts and boats and there will be no encounter inside of crafts or boats due to the different speed they’re with.

### *2.2. The solution*

The schedule is like this:

On the first day morning, launch 7, 9, 11 ,13, 15, 17 ,19-night motorized boats at an interval of 10 min.

Table 1. The schedule for the first group of boats (motorized boats) on everyday morning

| $M_6$ | $M_8$ | $M_{10}$ | $M_{12}$ | $M_{14}$ | $M_{16}$ | $M_{18}$ |
|---|---|---|---|---|---|---|
| 6:40 | 6:50 | 7:00 | 7:10 | 7:20 | 7:30 | 7:40 |

Notes：$M_i$ 为 refers to i-night motorized boats

The longest time for the first group launched everyday morning is:

$$\frac{225}{7\times 8}=4.01h\approx 4h$$

In other words, the working time for the first group( motorized boats) is 6:40-10:40. Let the second group (oar-powered rubber crafts) launched on the first day set off at 10:50 on the second day. In order to avoid the situation that the first group (motorized boats) on the second day catch up with the second group (oar-powered crafts) on the first day, fix the departure time for all the second groups of boats at 10:50. Thus the departure time for the two different types of boats is set apart, resulting in no contact between them. The following table shows the schedule of the second group of boats (oar-powered rubber crafts) every morning.

Table 2. The schedule of the second group of boats (oar-powered rubber crafts) every morning

| $O_{10}$ | $O_{12}$ | $O_{14}$ | $O_{16}$ | $O_{18}$ |
|---|---|---|---|---|
| 10:50 | 11:00 | 11:10 | 11:20 | 11:30 |

Notes：$O_i$ refers to i-night oar-powered rubber crafts

Thus, there's enough time for the third group of boats. Obviously, motorized boats are superior. However, time interval must be ensured between the third and the second.

Assume the time interval is $t$： within $t$, the contact between the third and the second groups of boats will never happen.

$$\begin{cases} t+\frac{\frac{L}{19}}{8}>\frac{\frac{L}{19}}{4} \\ t+\frac{\frac{L}{17}}{8}>\frac{\frac{L}{17}}{4} \\ t+\frac{\frac{L}{15}}{8}>\frac{\frac{L}{15}}{4} \\ t+\frac{\frac{L}{13}}{8}>\frac{\frac{L}{13}}{4} \\ t+\frac{\frac{L}{11}}{8}>\frac{\frac{L}{11}}{4} \end{cases} \quad => t>\frac{L}{88}\approx 2.55h=2:33$$

The departure time of the third group is $11:30+2:33=14:03$. Set aside 7 min in consideration to disturbance from the campsite.

The following boat shows the details:

Table 3. The schedule of the departure time of the third group (motorized boats) every morning

| $M_6$ | $M_8$ | $M_{10}$ | $M_{12}$ | $M_{14}$ | $M_{16}$ | $M_{18}$ |
|---|---|---|---|---|---|---|
| 14:10 | 14:20 | 14:30 | 14:40 | 14:50 | 15:00 | 15:10 |

Notes：$M_i$ 为 refers to i-night motorized boats

The longest traveling hour for motorized, we've got, is 4h. the latest time when all the boats finish is 14:10+4=18:10 which is around 18:00, so it is acceptable.

Next, we will work out the maximum carrying capacity of the river that is the maximal number of boats available under the precondition that all the boats have campsite respectively. Every day there're 19 boats launched. In the previous 18 days, the number of boats launched is more than that finished. On the 19th day these two numbers are equal, that is 19 boats launched off and 19 boats finished crafting. The number of boats camping has reached to its maximum on the 18th day. And 19 days later, the balance between the number of boats launched and that finished remain. By using the method provided by model 2, we work out the total of boats launched is

$$(12+10)*2+(8+6+4+2)*2=104$$

So the number of boats on campsites on 18th night is:

$$19*18-104=238$$

which means at least 238 campsites should be offered for visitors. Therefore, Y>=238.

Then we try to work out the total visits are:

Suppose there are 180 days in six months. In the previous 161 days, the number of boats launched each day is the same, i.e. 19 boats per day. When it comes to the 162nd day, either oar-powered rubber crafts or motorized boats of 19-night are unavailable so the number of boats launched will be on decrease. And this will last until 175th day when no boat is allowed to set off.

Table 4. The distribution of the number of boats launched in the last 18 days

| 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 16 | 13 | 13 | 10 | 10 | 7 | 7 | 4 | 4 | 2 | 2 |

The number of boats launched in the last 18 days is 16*2+13*2+10*2+7*2+4*2+2*2=104. Then we get the total: X=19*161+104=3163.

The examination on the above assumptions:

The distance between $\frac{l}{7} \sim \frac{l}{19}$ is about 20.3miles and 238 campsites are distributed evenly on the riverbank, therefore, we work out the distance between each campsite is 0.945 miles. The campsites between $\frac{l}{7} \sim \frac{l}{19}$ are $20.3/0.945=21.5>19$ (19 is the number of boats camping between $\frac{l}{7} \sim \frac{l}{19}$ when the third group starts off).

## 3. Summary

To develop the best schedule, we propose three models in different considerations which can meet the requirements of visitors and park managers. However, despite the differences in travel times and river carrying capacity resulted from the three models, and their disadvantages and advantages, they can offer many choices for the park managers. These models proposed by us need improving in order to strike a balance between contact times and campsites' utilization.

In consideration to the cost, if the cost for campsite is very high, then the second model will be the best for it has reduced the number of campsites by 84; if the cost is not very high, then the third model is the best.

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