Dedicated Pipeline for Trip Arrangement

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***Abstract* — In the problem of camping, we should set reasonable schedule which can not only increase the utilization of campsites but also meet people's needs. Meanwhile, the carrying capacity of the river should be considered. To solve the problem, we will use maximum campsite's utilization and river trips as our target function and set up optimization model in the paper. An optimal travel plan which draws lessons from Bus Rapid Transit is presented by using cluster analysis and Pipeline System. According to the paper, the carrying capacity of Dedicated Pipeline, namely C_line, is less than that of the river, namely C_river, within 180 days. the park managers need to grasp passenger flow(P) of the river in the following period(T) and calculate P/(C_line/T)The best distribution program: the best utirlization of campsites is P/(C_line/T) in one period. According to the best utilization of campsites, The best distribution program can be got.**

Keywords - Cluster Analysis; Bus Rapid; Transit Pipeline System; Curve Fitting; Computer Emulation Simulation

I. INTRODUCTION

A. Restatement Of The Problem

The only way to enjoy the Big Long River (225 miles) is to take a river trip that requires several days of camping. River trips all start at First Launch and exit the river at Final Exit, 225 miles downstream. Passengers take either oar- powered rubber rafts, which travel on average 4 mph or motorized boats, which travel on average 8 mph. The trips range from 6 to 18 nights of camping on the river, start to finish. Given the rise in popularity of river rafting, it's necessary to allow more trips to travel down the river. The questions are how to develop the best schedule and how to determine the carrying capacity of the river .No two sets of campers can occupy the same site at the same time.

B. Theory Knowledge Introduction

Modle1: Bus Rapid Transit (BRT for short)

By setting up the full-time and the full-enclosed bus lane with various kinds, BRT is aimed for increasing the speed of the rapid bus (and increasing the speed of the normal bus by 1.5 time), the punctuality rate as well as security. The core of success is that through setting up different lanes and different speed, BRT is to get largest traffic in the same period.

Modle2: Pipeline System

Not only with huge transportation capacity, long distance, but also complete a number of process operations in the transportation process the Pipeline system used widely. Similar to the BRT model, we can make a Dedicated Pipeline for different trips Scheme. Once campsites are used by the line, it won't be used by other lines. according to the principle of "different line, different duration", we can make many pipeline to get our goals. Just like a lane, with the line we make, we can get the maximum utilization of the camps easily. The line adapted to the Big long river, the hikers can also do a variety of activities during the trip. All The above characteristics make campsites of each dedicated pipeline to get maximum use.

II. DEFINITIONS AND KEY TERMS

A. The Conditions Given

1)The overall length of the river is 225miles and all the campsites are fairly distributed on both sides of the river.
2)Six to eighteen nights of the journey should be spent in the campsites.
3)A campsite couldn't hold two caravans at one time.
4)The times for the two tour groups to meet each other are at the least number.
5)The boat goes forward at the speed of 4mph or 8mph.
6)Trips can travel down the Big Long River each year during a six month period (the rest of the year it is too cold for river trips.

B. Symbol Definition

TABLE I. SYMBOL DEFINITION

Noun	Interpretation
Camp_no	Camp site number
Camp_num	The number of camps
Camp_sim_num	The number of simulated camps
Duration	Trips range from 6 to 18 nights of camping
Ideal	Ideal camping scheme
Line_12	One pipeline with 12 camp sites
Line_no	pipeline number
QCL	Clustering results
Night_12	Trip camping on the river 12 nights
Scheme	simulated scheme

III. GENERAL ASSUMPTIONS

Assumption conditions
1) During the journey, the factors affecting the travel caused by travelers aren't be taken into account.
2)All the boats sailed down the river and to and fro isn't allowed. There are no accidents or dangerous situation.
3)The traveler can only make one overnight stop in the campsite, and he must continue his way on the second day.
4)The traveler can change his boat in the campsite on the condition that he must use the same one in one day.
5)The Scenic spots are evenly distributed along both the sides of the river, and the situation that a group of tourists crowd in one spot does not exist.
6)All the camping schemes have been fixed by the campsites and the travelers couldn't choose the camping place on their own way.

. IV. MODEL DESIGN

A. Model Establishment

There are Y campsites in all along the river, which are marked with Camp_no. Choose spots as the campsites a program will experience.
We want to determine how they might schedule an optimal mix of trips, of varying duration (measured in nights on the river) and propulsion (motor or oar) that will utilize the campsites in the best way possible.
Through related analysis of Goal Programming, objective function can be defined as follows:

$$Maxu = \sum_{i=1}^{n} \frac{x_i}{Y} \times \frac{[180-(x_i-1)]}{180} \quad (1)$$

Assume that is the Maximum utilization of campsites.

$$Maxtotal = \sum_{i=1}^{n} [180-(x_i-1)] \quad (2)$$

(total: total number of travelling down the river trips)
Constraints are as follows：

x_i must be an integer.

According to the total campsites, $\left[\frac{Y}{18}\right] \le x_i \le \left[\frac{Y}{6}\right] a$ can be drawn.

$8 \le x_i \le 16$ is known, and Y is unknown.

From the above conditions, we obtain

$$Max(\left[\frac{Y}{18}\right], 6) \le x_i \le Min(\left[\frac{Y}{6}\right], 18)$$

Another constraint should also be included:

$$\sum_{i=n}^{n} x_i \le Y$$

B. Model Solution

1) To Determine Y
(1) Assumptions
①The travelers move at an equalized speed.
②The travelers can only rest at the nearest campsite.
(2) Different speeds for solving
Based on the given conditions, we can have that the tourist group needs to spend 6 to 18 days in the trip. Considering the actual situation, the camps will be set neither at the departure nor the destination. The group will start on the first daytime, and arrive at the destination on the last day of the trip. According to that, different travelling routes will cost 7 to 19 days. So we can divide the whole length of river by their respective speed.
Speed=length/days. The results are as Table II:

TABLE II. THE RELATIONSHIP BETWEEN THE LENGTH OF THE SPEED AND TIME

Days	7	8	9	10	11	12	13
Speed(mps/day)	32.1429	28.13	25	22.5	20.45	18.75	17.31
Days	14	15	16	17	18	19	
Speed(mps/day)	16.0714	15	14.06	13.24	12.5	11.84	

(3) The computer programming emulation simulation:

Based on the given information in the questions, it can be inferred that the numerical value of Y must be larger than or equal to 18, because some of the tourist groups will spend 18 nights on the river. Therefore, the numerical value of Y will be simulated from 18. After that, the programming data are to be ordered. The results are as Fig.1.:

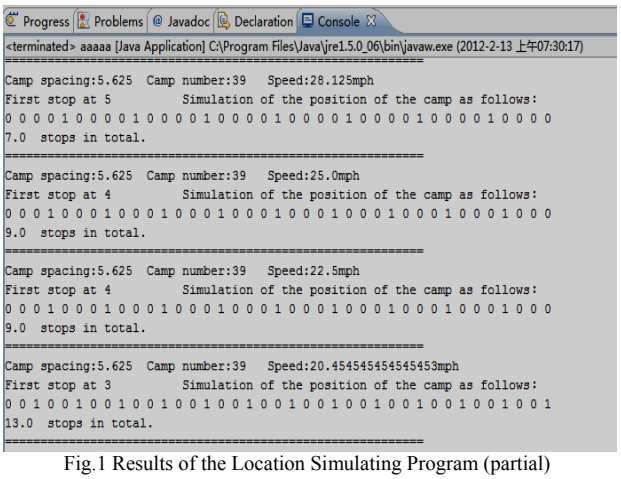

Fig.1 Results of the Location Simulating Program (partial)

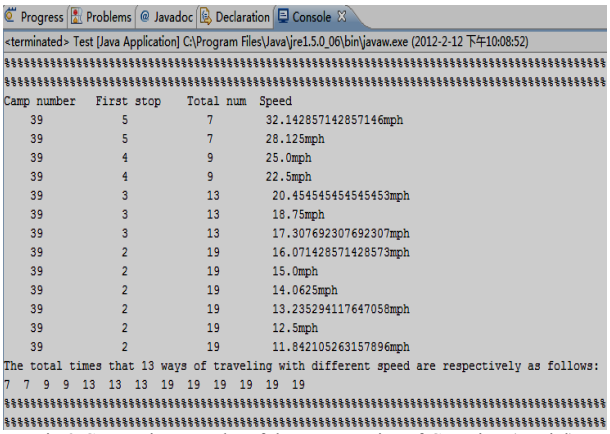

Fig.2 Computing Results of the Frequencies of Camping (partial)

(4) Results of the frequencies of camping

TABLE III. RESULTS OF THE FREQUENCIES OF CAMPING

Camp_sim_num	Ideal camping scheme												
	6	7	8	9	10	11	12	13	14	15	16	17	18
18	9	9	9	18	18	18	18	18	18	18	18	18	18
19	9	9		9	9	19	19	19	19	19	19	19	19
20	6	10	10	10	20	20	20	20	20	20	20	20	20
21	7	10	10	10	10	21	21	21	21	21	21	21	21
22	7	11	11	11	11	22	22	22	22	22	22	22	22
23	7	7	11	11	11	11	23	23	23	23	23	23	23
24	8	8	12	12	12	12	24	24	24	24	24	24	24
25	8	8	12	12	12	12	12	25	25	25	25	25	25
26	8	8	8	12	12	12	12	25	25	25	25	25	25
27	6	8	8	13	13	13	13	13	26	26	26	26	26
28	7	9	9	14	14	14	14	14	28	28	28	28	28
29	7	9	9	9	14	14	14	14	14	29	29	29	29
30	7	10	10	10	15	15	15	15	15	30	30	30	30
31	7	7	10	10	15	15	15	15	15	15	31	31	31
32	8	8	10	10	10	16	16	16	16	16	32	32	32
33	8	8	11	11	11	16	16	16	16	16	16	33	33
34	6	8	11	11	11	17	17	17	17	17	17	34	34
35	7	8	8	11	11	11	17	17	17	17	17	17	35
36	7	9	9	12	12	12	18	18	18	18	18	18	36
37	7	9	9	12	12	12	18	18	18	18	18	18	18
38	7	9	9	12	12	12	12	19	19	19	19	19	19
39	7	7	9	9	13	13	13	19	19	19	19	19	19
40	8	8	10	10	13	13	13	20	20	20	20	20	20
41	6	8	10	10	13	13	13	13	20	20	20	20	20
42	7	8	10	10	14	14	14	14	21	21	21	21	21
43	7	8	10	10	10	14	14	14	21	21	21	21	21
44	7	8	8	11	11	14	14	14	14	22	22	22	22
45	7	9	9	11	11	15	15	15	15	22	22	22	22

(5) Obtaining the result by using the SPSS software analysis: Using the SPSS analyzing software, we can obtain the result through liner fitting.

TABLE IV. THE RESULT BY USING THE SPSS SOFTWARE ANALYSIS

	sig	Unstandardized Coefficients	Adjusted R Square				
		k	constant	Std. Error			
ideal	0.000	0.000	1.000	5.000	0.000	0.000	1.000
18.000	0.004	0.000	0.742	10.731	0.208	1.653	0.494
19.000	0.001	0.000	0.989	9.000	0.222	1.764	0.610
20.000	0.001	0.001	1.121	8.769	0.243	1.930	0.628
21.000	0.001	0.001	1.187	9.077	0.257	2.044	0.628
22.000	0.000	0.001	1.341	8.077	0.239	1.895	0.718
23.000	0.000	0.015	1.626	5.462	0.239	1.896	0.791
24.000	0.000	0.006	1.626	6.462	0.239	1.896	0.791
25.000	0.000	0.020	1.742	5.192	0.242	1.918	0.809
26.000	0.000	0.048	1.830	4.269	0.242	1.924	0.823
27.000	0.000	0.093	1.907	3.346	0.229	1.819	0.850
28.000	0.000	0.069	2.016	3.962	0.248	1.966	0.845
29.000	0.000	0.258	2.044	2.615	0.267	2.197	0.818
30.000	0.000	0.154	2.077	3.308	0.272	2.163	0.826
31.000	0.000	0.282	1.995	2.731	0.304	2.411	0.778
32.000	0.000	0.347	2.099	2.385	0.306	2.427	0.794
33.000	0.000	0.162	1.758	3.923	0.330	2.617	0.696
34.000	0.000	0.241	1.934	3.153	0.321	2.546	0.747
35.000	0.000	0.138	1.566	3.885	0.306	2.428	0.677
36.000	0.000	0.084	1.599	4.577	0.377	2.413	0.690
37.000	0.000	0.000	1.005	7.346	0.136	1.080	0.817
38.000	0.000	0.000	1.121	6.538	0.131	1.041	0.857
39.000	0.000	0.000	1.209	5.769	0.131	1.040	0.875
40.000	0.000	0.000	1.225	6.423	0.136	1.076	0.871
41.000	0.000	0.000	1.253	5.538	0.121	0.958	0.899
42.000	0.000	0.000	1.319	5.846	0.123	0.979	0.904
43.000	0.000	0.000	1.363	5.231	0.127	1.009	0.905
44.000	0.000	0.001	1.401	4.731	0.130	1.034	0.905
45.000	0.000	0.000	1.363	5.462	0.114	0.906	0.922
46.000	0.000	0.000	1.462	5.077	0.130	1.034	0.912

① We can find from the value of Sig. in different coefficients that when the number of campsites is between 37 and 46, all values of Sig. are 0. At that time the fitting coefficient has the greatest significance. And from the adjusted R square we can find that when the number is between 37 and 46, the fitting effect is pretty good.

②TableIV. Summary and the Relationship between Four Factors

cam	37	38	39	40	41	42	43	44	45	46
Squ	111	111	107	163	110	172	156	147	167	215
k	1.005	1.121	1.209	1.225	1.253	1.319	1.363	1.401	1.363	1.462
cons	7.346	6.538	5.769	6.425	5.538	5.846	5.231	4.731	5.462	5.077
			0.119	0.15	0.121					
Std.			0.943	0.909	0.958					

Cam: the number of campsites
Squ: Squared Euclidean distance
Cons: constant
Std: Std. Error of k and constant

Observe the above table, first we can compare the Squ, the smaller it is, the better the result will be. So the situations of 40, 42, 43, 44, 45, and 46 shall be excluded, in the table are shown in red. After that the situations of 37 and 38 can be excluded through the comparison between the actual and ideal efficiency (namely 1.000 and 5.000; the nearer, the better), and in the table they are shown in blue.

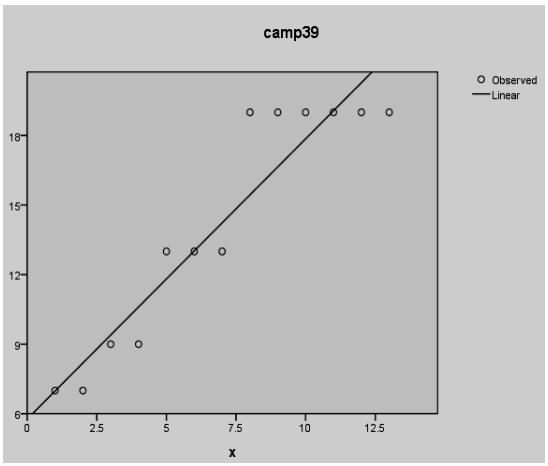

Fig.3 Computing Results of Camping (partial)

At last, we can compare Std. (the smaller, the better), and the situation of 41 can be excluded, in the table are shown in green. Consequently, when the number of the campsites is 39, we can obtain the optimized result.

③ Using spss to analyse , when the number of campsites is 39 ,the result is as follows:

According to the analysis above, we can know that in the river of 255 miles, if we arrange 6 to 18 nights of camping, 39 campsites is the best option.

2) To Determine The Camping Program

Prerequisite: starting point and end point of the river is not suppose to camp, and the distance of each camp is equal in between which is 5.6 miles. Number those campsites from the starting point of the river, which are 1-39

(1) The first step, work out the best camping place.

Make use of the 39 campsites, and arrange the best camping place.

Steps:

① we camp for X nights, which means that we relax in X campsites. The total days staying on the river is X+1. As time goes on, the position of camp in the Nth day accordingly is as follows (the distance between the starting point)

TABLE V. LINEAR MODEL SUMMARY

R	R Square	Adjusted R Square	Std. Error of the Estimate
.941	.886	.875	1.768

TABLE VI. ANOVA MODEL SUMMARY

	Sum of Squares	df	Mean Square	F	Sig.
Regression	265.934	1	265.934	85.102	.000
Residual	34.374	11	3.125		
Total	300.308	12			

TABLE VII. COEFFICIENTS MODEL SUMMARY

	Unstandard-ized Coefficients		Standard-ized Coefficients	t	Sig.
	B	Std. Error	Beta		
x	1.209	.131	.941	9.225	.000
(Constant)	5.769	1.040		5.547	.000

Duration	Speed	Distance away from the starting point																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
6	32.14	32	64	96	129	161	193	225												
7	28.13	28	56	84	113	141	169	197	225											
8	25	25	50	75	100	125	150	175	200	225										
9	22.5	23	45	68	90	113	135	158	180	203	225									
10	20.45	20	41	61	82	102	123	143	164	184	205	225								
11	18.75	19	38	56	75	94	113	131	150	169	188	206	225							
12	17.31	17	35	52	69	87	104	121	138	156	173	190	208	225						
13	16.07	16	32	48	64	80	96	113	129	145	161	177	193	209	225					
14	15	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225				
15	14.06	14	28	42	56	70	84	98	113	127	141	155	169	183	197	211	225			
16	13.24	13	26	40	53	66	79	93	106	119	132	146	159	172	185	199	212	225		
17	12.5	13	25	38	50	63	75	88	100	113	125	138	150	163	175	188	200	213	225	
18	11.84	12	24	36	47	59	71	83	95	107	118	130	142	154	166	178	189	201	213	225

Fig.4 The Position of Camp in the Nth Day Accordingly

② According to the distance that one can walk, we distribute the best camping place, choosing the nearest campsite to relax. The number of campsites that we work out is as follows.

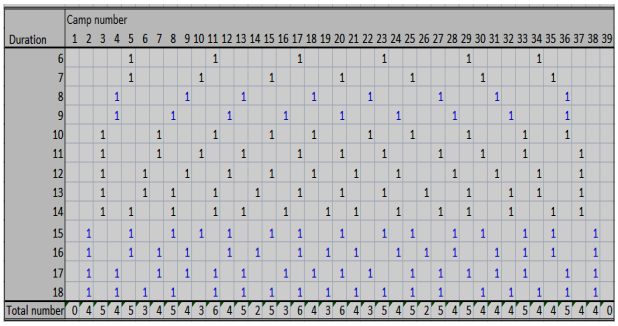

Fig.5 The Number of Campsites

(2) Cluster Analysis

From the graph we could know that, as time goes on, the best camping option in one day that is next to the other day is closer to each other. In order to let the tourists enjoy the no one trip to the fullest, and reduce the contact with other tourists, we must choose the nearest campsites to do the cluster analysis. Meanwhile, we can simplify the approaches of the use of campsites so as to maximum the utilization of campsites.

The clustering steps:

Make use of SPSS software to do the cluster analysis.

We do the clustering steps based on the 13 data, and classify them into 4 groups. We get the following result:

TABLE VIII. CLASSIFY THE CLUSTERING STEPS

Camp_no	Duation												
	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	2	2	2	2
3	0	0	0	0	3	3	3	3	3	0	0	0	0
4	0	0	4	4	0	0	0	0	0	0	0	4	4
5	5	5	0	0	0	0	0	0	5	5	5	0	0
6	0	0	0	0	0	0	6	6	0	0	0	0	6
7	0	0	0	0	7	7	0	0	0	0	7	7	0
8	0	0	0	8	0	0	0	8	8	8	0	0	8
9	0	0	9	0	0	0	9	0	0	0	9	9	0
10	0	10	0	0	0	10	0	0	0	10	0	0	0
11	11	0	0	0	11	0	0	11	11	0	0	11	11
12	0	0	0	12	0	0	12	0	0	12	12	0	0
13	0	0	13	0	0	13	0	0	13	0	0	13	13
14	0	0	0	0	0	0	0	14	0	0	14	0	0
15	0	15	0	0	15	0	15	0	0	15	0	0	15
16	0	0	0	16	0	0	0	0	16	0	0	16	0
17	17	0	0	0	0	17	0	17	0	17	17	0	17
18	0	0	18	0	18	0	18	0	0	0	0	18	0
19	0	0	0	0	0	0	0	0	19	0	19	0	19
20	0	20	0	20	0	20	0	20	0	20	0	20	0
21	0	0	0	0	0	0	21	0	21	0	21	0	21
22	0	0	22	0	22	0	0	0	0	0	0	22	0
23	23	0	0	0	0	23	0	23	0	23	0	0	23
24	0	0	0	24	0	0	24	0	24	0	24	0	0
25	0	25	0	0	25	0	0	0	0	25	0	25	25
26	0	0	0	0	0	0	0	26	0	0	26	0	0
27	0	0	27	0	0	27	0	0	27	0	0	27	27
28	0	0	0	28	0	0	28	0	0	28	28	0	0
29	29	0	0	0	29	0	0	29	29	0	0	29	0
30	0	30	0	0	0	30	0	0	0	30	0	0	30
31	0	0	31	0	0	0	31	0	0	0	31	31	0
32	0	0	0	32	0	0	0	32	32	0	0	0	32
33	0	0	0	0	33	33	0	0	0	33	33	33	0
34	34	0	0	0	0	0	34	34	0	0	0	0	34
35	0	35	0	0	0	0	0	0	35	35	35	0	0
36	0	0	36	36	36	0	0	0	0	0	0	36	36
37	0	0	0	0	0	37	37	37	37	0	0	0	0
38	0	0	0	0	0	0	0	0	0	38	38	38	38
39	0	0	0	0	0	0	0	0	0	0	0	0	0
QCL_1	1	2	3	1	3	2	1	1	1	2	2	3	4

QCL-1 represents the clustering result, and1,2 3, 4 represent 4 groups of data.

From the table results above, we can get the following clustering result:

Classify	Duration					
1	6	11	13	14	18	
2	7	15	16			
3	8	10	17			
4	9	12				

Fig.6 Clustering Result

(3) The 3rd step, selecting the most typical camping program.

Our purpose is to maximize the number of the trips within the minimized number of encounters between different groups. Accordingly we can try to cluster the camping program, select the most typical and find out the optimized program.

Measures of selecting:

Step1: Compare two adjacent scales of camping programs (classified by the number of days spent)

For example, compare the programs of 6 and 7 nights, taking 6 nights as a base. The first night of both camping programs are numbered as 5, therefore the difference is 0.

We shall calculate the minimum differences between the numbers of the best campsites on each night in the 7

nights program and those in the 6 nights program in proper order. After that the number of total transfer can be obtained by summing all the data together.

Duration	Number of transfers	Average number of each transfer	Compare	Number of total ransfer	Repetition rate	Number of each transfer
6	6	1.666666667	6 to 7	10	0	0 1 2 3 2 1 1
7	6	1.666666667	7 to 6	10	0.142857	0 1 2 3 2 1 1
8	8	1.5	8 to 7	12	0	1 1 2 2 2 2 1 1
9	7	1.428571429	9 to 8	10	0.222222	0 1 1 2 2 2 1 1 0
10	9	1.222222222	10 to 9	11	0.1	1 1 1 1 2 2 1 1 1 0
11	8	1.375	11 to 10	11	0.272727	0 0 1 2 1 2 1 2 1 0 1
12	10	1.1	12 to 11	11	0.166667	0 1 1 1 2 1 1 1 1 1 1 0
13	9	1.111111111	13 to 12	10	0.307692	0 0 1 1 1 1 1 1 2 1 1 0 0
14	9	1	14 to 13	9	0.357143	0 1 0 0 1 1 1 1 1 1 1 0 1 0
15	12	1	15 to 14	12	0.2	1 0 0 1 1 1 1 1 1 1 1 1 1 0 1
16	9	1	16 to 15	9	0.4375	0 0 1 1 0 1 0 1 1 1 1 1 1 1 0 0 0
17	11	1	17 to 16	11	0.352941	0 1 0 0 1 1 1 1 1 1 1 1 1 0 0 1 0
18	10	1	18 to 17	10	0.444444	0 0 1 1 0 0 1 1 1 1 1 1 0 0 1 1 1 0 0
11	8	1	19 to 18	8	0.272727	0 1 1 1 1 0 0 0 1 1 1 1 0
11	6	1	11 to 13	6	0.454545	0 1 1 1 0 0 0 1 1 1 0
14	9	1	14 to 16	9	0.357143	1 0 1 1 1 1 0 0 0 1 1 1 0 1

Fig.7 Compare Two Adjacent Scales of Camping Programs

Step2: Calculating the repetition rate
In the last calculation, 0 represents that the best campsites of two programs are completely coincided. And a smaller Repetition rate indicates a more minimized distance between the two best campsites. We can calculate the repetition rate of the best campsites of two programs in order to screen the different sorts of clustered data.
Step3: Calculating the average number of transfer campsites
Merge the different programs by calculating the average number of transfer campsites. The smaller the number is, the programs are more suitable to be merged and vice versa
Step4: Screening the right camping programs
Principles for screening:
Try to select the camping programs from the different sorts obtained by the cluster analysis. In a same sort, the program of a smaller repetition rate is priority.
If the repetition rates have little difference, the program of the minimum number of average transfer campsites is to be chosen.
Under the above circumstance of screening, we can get 4 numbers, 6, 16, 8 and 12. And at the same time, we can find that in the first clustered sort, 6 is the base which requires the least campsites and in that sort existing 5 camping programs. In order to have a more coordinated entire data, we need to pick a program other than 6 in accordance of the principles aforementioned, namely 11.
Through the cluster analysis and optimal screening, we can now obtain 5 camping programs, as 6, 8, 11, 12, and 16 from the problem of 6 to 18 nights camping.

3) To Find Capacity Of The River

Prerequisite: starting point and end point of the river is not suppose to camp, and the distance of each camp is equal in between which is 5.6 miles. Number those campsites from the starting point of the river, which are 1-39
Work out the carrying capacity of the river
From the problem itself, we can deduce a reasonable range of Y, and 39 campsites are the fittest. Therefore Y=39 is used in our model.

$$Max(\left[\frac{Y}{18}\right],6) \le x_i \le Min(\left[\frac{Y}{6}\right],18) \ ,$$

then

$$6 \le x_i \le 6$$

$$\text{So } x_i = 6.$$

That is to say, we can choose 6 different spots as the accessible campsites of a camping program. The program is Night_6 trip .Then 39 campsites can be divided to 6 groups .

The carrying capacity of the river, namely the Maximum trips, is also 1050
And then 36 campsites are used among the total 39, so the utilization is

$$Maxu = \sum_{i=1}^{n} \frac{x_i}{Y} \times \frac{[180-(x_i-1)]}{180} = \frac{[180-(6-1)]}{180} \times \frac{36}{39} = 94.95\%$$

Note of the carrying capacity of the river:
The carrying capacity of the river is gained under the situation of maximizing the transport capacity. Now only Night_6 trip is open, which is not suitable for the requirement of varying duration in the title.

4) Determine Dedicated Pipeline

(1)Adjust the camping place .
Adjustment principle: Let the campsite be used the smallest possible. Calculation results show that all the campsites are used fewer than twice.
Make sure that the campsites of Night_6 trip are belong to that of Night_12 trip, so the same as that of Night_8 trip being belong to that of Night_16 trips.

Duration	Camp_no 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
6	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
8	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
11	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
12	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
16	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Total number	1 2 2 1 1 1 1 2 2 1 1 1 2 1 2 1 1 2 1 1 1 2 1 2 1 1 2 2 1 1 1 2 1 2 1 1 2 1

Fig.8 Adjust the Camping Place

Note: The campsites of Night_12 trip are totally different from Night_16 trip.

(2) Set up pipeline

According to above analysis, the campsites of Night_6 trip are belong to that of Night_12 trip, so the same as that of Night_8 trip being belong to that of Night_16 trip.
Then the camping program for the trips which Night_6 trips and Night_12 trips can be achieved in the same pipeline; similarly, the camping program for the trips which Night_8 trips and Night_16 trips can also be achieved in an pipeline while Night_11 trip should adopt another pipeline.
Clustering results:
Those 39 campsites are divided into three kinds of lines:
Line_12: The line is available only for Night_6 trips or Night_12 trips.
Line_16: The line is available only for Night_8 trips or Night_16 trips.
Line_11: A free line is available for the trips that camp within 11 nights trips. While there are lots of trips which camp within 11 nights, they can use Line_11 if Line_12 and Line_16 aren't available.
Schedule an optimal mix of trips
Inference: Different pipelines, different camp no.
Description: Renumbered Camp site according to the original order of each pipeline as Line_no. As the following picture shows.

Duration \ line_no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
6	3	9	15	24	28	34										
8	2	8	13	18	22	27	32	38								
11	1	5	10	14	17	23	26	29	33	36	39					
12	3	7	9	12	15	19	21	24	28	31	34	37				
16	2	4	6	8	11	13	16	18	20	22	25	27	30	32	35	38

Fig.9 Renumbered Camp Site

Line_12: Only available for the trips which camp 6nights or 12nights.
Scheme1: Only two group of Night_6s are set up in the same days. All the Line_no of the earlier one are even number while the other Night_6 are odd number.
Scheme2: Only one group of Night_12 are set up in the same days. Rest by Line_no.
Important: Too keep the pipeline normal and get a higher utilization, only 7days after, a night_12 can be followed by night_6s and enter the river.
Assumption: enough trips of any kinds
Utilization of Line_12:
When all the trips are night_6s, we can get the highest utilization. According to the equation mentioned above , what we can get :

$$Maxu = \sum_{i=1}^{n} \frac{x_i}{Y} \times \frac{[180-(x_i-1)]}{180} = \frac{[180-(6-1)]}{180} = 97.22\%$$

When the night_6s and night_12 interlaced as 1: 1, with the period of 8 days we can get a lowest utilization. (2*12)/(12*8)=25%

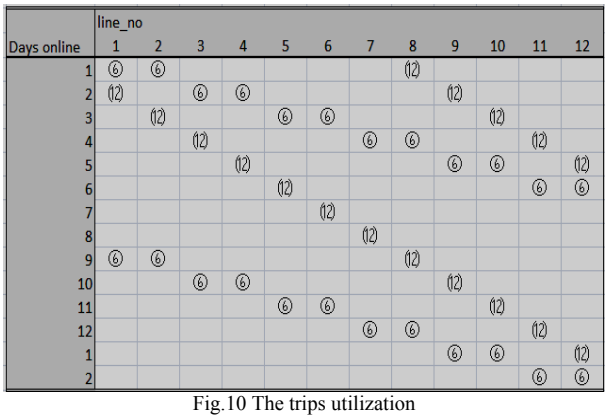

Fig.10 The trips utilization

Line_16: the Arrangement of Line_16 and Line_12 is very similar.
Utilization of Line_16:

$$Maxu = \sum_{i=1}^{n} \frac{x_i}{Y} \times \frac{[180-(x_i-1)]}{180} = \frac{[180-(8-1)]}{180} = 96.1\%$$

When all the trips are night_8s, we can get the highest utilization. According to the equation mentioned above , what we can get

When the night_8s and night_16 interlaced as 1: 1, with the period of 10days we can get a lowest utilization.

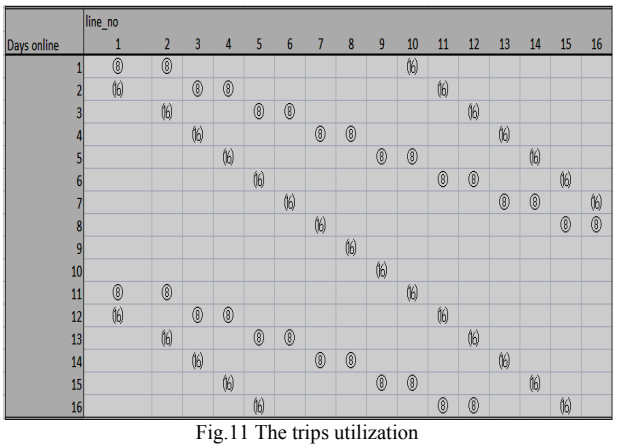

Fig.11 The trips utilization

Line_11 : This pipeline can be used by all the trips which within 11nights .
Scheme: all the trips which within 11nights can use this Line_11, such as Night_7, Night_10.
Only one group of Night_11 are set up in the same days. Rest by Line_no.
Utilization of Line_11:

When all the trips are night_11s, we can get the highest uitilization. According to the equation mentioned above, what we can get.

$$Maxu = \sum_{i=1}^{n} \frac{x_i}{Y} \times \frac{[180-(x_i-1)]}{180} = (180\text{-}10)/180 = 94.44\%$$

When the night_7 and night_11 interlaced as 1: 1, with the period of 5days. we can get a lowest Utilization. It is 20/(11*5)=36.36%.

Days online	line_no 1	2	3	4	5	6	7	8	9	10	11
1		⑦			⑪			⑦	⑪		
2	⑪			⑦		⑪			⑦	⑪	
3		⑪			⑦		⑪			⑦	⑪
4			⑪			⑦		⑪			
5				⑪				⑦	⑪		
6		⑦			⑪				⑦	⑪	
7	⑪			⑦		⑪				⑦	⑪
8		⑪			⑦		⑪				
9			⑪			⑦		⑪			
10				⑪				⑦	⑪		
11		⑦			⑪				⑦	⑪	

Fig.12 The trips utilization

C. Strength And Weakness

A) Strengths

(1) By using Computer Emulation Simulation, we can get the capacity of the river if the length of the river and the days of river trip. Then, we can make the Dedicated line . Using the Dedicated line, problems about Queuing Theory and cluster analysis will have an new idea.

(2) This model of Dedicated pipeline is very flexible, and can be easily managed .By using Goal programming, We can get the capacity of the river. Then, combine the capacity of the river with the real requirement of different camping program to schedule an optimal mix of trips and get the best profit .

(3) I n the model of dedicated pipeline, the campsites of every camping program are invariant. From this way, it will become easier to manage the campsites. The river managers can also by making different campsite has different characteristics and attract more people to make the journey more enjoyable.

B) Weaknesses

In this model of Dedicated Pipeline, a insufficient aspect is few camping programs how to schedule its campsites can't be given clearly. To schedule this kind of camping program, we can nest in other camping program or merging two different camping programs.

V. CONCLUSION AND ADVICES

A. Conclusion

According to the above analysis, the carrying capacity of Dedicated Pipeline, namely C_line, is less than that of the river, namely C_river, within 180 days. the park managers need to grasp passenger flow(P) of the river in the following period(T) and calculate P/(C_line/T)

The best distribution program: the best utirlization of campsites is P/(C_line/T) in one period.

According to the best utilization of campsites, The best distribution program can be got.

B. Problems

1) Some initial programs isn't easy to be carried out due to classifying all the campsites into 3 groups.

2)The speed of the trip varies by their transport. So the probability to meet with each other of trips on different lines will increase greatly when utilization of the campsites is very high.

(3) It's possible for the visitors to change their transport.

C. Advices

(1) The advantage of our Dedicated Pipeline model lies in its flexibility .Not only utilization of the campsites can be easily maximum, but also setting up other different programs on the specialized line.

(2) After a rigorous calculation, the choose of Transport will not affect the place of campsites, while the duration will. In order to reduce the impact caused by above question, we can persist a principle: trips with less days have priority to start up. When the day is the same, trips with motorized boats have priority to start up.

(3) In order to make the trip more comfortable, the transport can be changed at every campsite, while cannot be replaced on the river.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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