评委一评分，签名及备注	队号：10564	评委三评分，签名及备注
评委二评分，签名及备注	选题：C 题	评委四评分，签名及备注

题目：家庭暑假旅游套餐的设计

Abstract

Family summer travel packages, first of all, the design should consider the needs of different families, such as number, cost, time and other factors, and make the trip to scenic spots as much as possible, as far as possible to the scenic spot quality is high, the problem can be abstract as a multi-objective programming problem. Therefore, we can make use of multi-objective optimization model, filtered to scenic spots.

Secondly, on the basis of primary sites choose the optimal path. This is a classical traveling salesman problem, can make use of genetic algorithm and other algorithms to solve a specific line of travel.

However, in view of a tourist city, Shanghai, for example, spots number, complete variety, so calculated considering the attractions of the district in Shanghai, a large amount of calculation, and operability and practicability. Degree of dense, therefore, can according to the Shanghai attractions to partition scenic spots in Shanghai, and then filtered to each partition attractions, using genetic algorithm to find the optimal route. This greatly reduces the amount of calculation, and solutions are given more comprehensive, more can meet the needs of various customers.

Discuss various families in order to more clearly, the different levels of demand, we were divided into three scenarios to discuss the problem, respectively is: there is no cost constraints, time limitation; A cost limit, a time limit; Cost limit, no cost restriction conditions. Is one and three are two special circumstances, the second is a common condition. And in each case, respectively for the different types of different partitions the optimal route.

Finally, summarized a variety of situations, different category - natural folk, entertainment and leisure, cultural sports class, comprehensive district plan, given daily different schemes in various categories, consider a limit on the number, time limit and cost, and the quality of the scenic spots to get the optimal route. Any family according to your requirements, any combination collocation to get the required travel packages.

Keyword：Package Design   Multi-objective Programming Model   Traveling Salesman Problem   Genetic Algorithm

A Family Summer Vacation Navigation Designing

1. Problem Restatement

With the coming of summer vacation, many parents will choose this time to take children to travel to a certain city, but different family has different requirements (population, cost constraints, time constraints, etc.). Please choose a tourist city any one (such as your city), considering travel routes, cost, time, and other factors and other more important elements for families with different demand to design a best navigation.

2. Problem Analysis

Family summer package design should consider the needs of different families, such as number, cost, time and other issues, such as the conditions of the package design, so that to scenic spots as much as possible, as far as possible to the scenic spot quality is high, this can be considered as the objective function of the package design. Thus, the problem is a multi-objective programming model. But, in view of a tourist city, Shanghai, for example, spots number, complete variety, so consider Shanghai calculated, the attractions of the computational complexity is very big, is not practical and operational. Degree of dense, therefore, can according to the Shanghai attractions to partition scenic spots in Shanghai, and then filtered to each partition attractions, finally, using genetic algorithm to find the optimal route.

Discuss various families in order to more clearly, the different levels of demand, can be divided into three scenarios to discuss the problem, respectively is:

1. cost constraints, time limitation;
2. cost constraints, time limitation;
3. cost constraints, cost constraints.

The first and the third are two special circumstances, the second is a common condition.
And in each case, looking for different type of different partition line respectively.

3. Basic Assumptions of The Model

1. There aren't accident in travel such as traffic jam, delayed trains ,extreme weather and so on;
2. Tourists have 10hs every day in playing;
3. Tourists can order tickets and scenery spot tickets;
4. Adopting the bus transportation way;

60 ~ 70 - year - old population are defined as the old man, and the designing without regard to

the people more than 70 years old;

5. The old man and children enjoy half price;
6. If the play starting is nearby the first visit scenic spots, the distance can be neglected ;
7. This paper involves travel fees are charged according to each standard people every day.

n: the count of cities.

D_{ij}: the distance between i and j, $1 < i+1 < j < n$;

$$x_{ij} = \begin{cases} 1, \text{the route from i to j} \\ 0, \text{not chosing the route} \end{cases}$$

C: The initial circle

Cij: Improved ring of C, $1 < i+1 < j < n$

$$\sum_{i=1}^{n} xij = 1 : \text{each point is only one side outline, } j = 1,2,\cdots n;$$

$$\sum_{j=1}^{n} xij = 1 : \text{each point is only one side outline, } i = 1,2,\cdots n;$$

4. Symbol Description And Ranking definition

symbol	symbol description
d_{tj}	The distance from i to j
n	Number of sites
α	The policy makers to the first target recognition degree
t_{ij}	By the time needed for the first attraction to the first j a scenic spot
t_j	In the first j a stay
p_j	The first j a corresponding grade
T_0	On the way to the total time
T_l	Daily average visit time
f_j	The first j a scenic spot of admission
C	Each travel expenses, accommodation cost combined
M	Everyone all daily travel consumption sum

5. Modeling Preparation

As China's largest economic center city, Shanghai is also the most can reflect the modern development course of China after national famous historical and cultural city. There are more and more people choose vacations to travel Shanghai.

However, numerous tourist attractions in Shanghai for the consumer, how to quickly choose to suit oneself in many scenic spots of tourist route is the most concern of the consumers. Through the study of

the classification of tourist attractions, can be more targeted to develop new tourist route, greatly shorten the time of the development of tourist routes, and meet the travel demand of different families.

This chapter first collected above 3 a grade scenic spot of Shanghai information, according to these attractions intensive tourism division in Shanghai; After partition in each area, collect no rating but typical tourist attractions in the area, the main tourist attractions; Collect the division's main tourist attractions in latitude and longitude, tickets, suggested to play time, public comments on the net of scenic spots, such as the evaluation information and district of basic accommodation and so on. In order to later is used for the screening of multi-objective planning tourist attractions and the optimal solution of the route.

a) Classification of scenic spots

  i.   Classification according to the scenic spot star

Shanghai numerous tourist attractions, the scenic spots are different, in order to facilitate research, first choose 3A and the above attractions were analyzed, and the basic information of the gathering spots, all attractions can be divided into the humanities education, theme parks and natural leisure three categories, table 5.1 for 3A and above attractions in Shanghai.

By Google map to find corresponding latitude and longitude of the scenic spots in table 5.1, the spatial distribution of the scenic spot is obtained by Baidu map, as shown in figure 5.1 for 3 A and above attractions of Shanghai space distribution

Figure 5.1 Shanghai 3A or more attractions space distribution

Table 5.1 above 3 a grade scenic spot of Shanghai

NO	names of scenic spots	Level of attraction	Attractions types
1	Oriental Pearl Tower	5A	Humanistic education
2	Shanghai Science and Technology Museum	5A	Humanistic education
3	Shanghai Wildlife Park	5A	Theme park
4	Shanghai Century Park	4A	Natural leisure

5	Shanghai GongQing forest park	4A	Natural leisure
6	Shanghai Urban Planning Exhibition Center	4A	Humanistic education
7	The Shanghai Zoo	4A	Humanistic education
8	Shanghai Museum	4A	Humanistic education
9	88 - storied jinmao tower	4A	Humanistic education
10	Yu Garden Chinese Restaurant	4A	Humanistic education
11	Shanghai Oriental green boat	4A	Natural leisure
12	Shanghai Sheshan National Forest Park	4A	Natural leisure
13	Shanghai zhujiajiao ancient town tourism	4A	Natural leisure
14	Shanghai Sun Island Holiday Resort	4A	Natural leisure
15	Qingpu revolutionary history memorial hall	4A	Humanistic education
16	Grand View Garden Shanghai	4A	Humanistic education
17	Case study of Shanghai	4A	Humanistic education
18	Case study of Shanghai	4A	Humanistic education
19	Dongping National Forest Park	4A	Humanistic education
20	Shanghai Film Park	3A	Ttheme park
21	Shanghai binhai forest park	3A	Natural leisure
22	Shanghai shooting club	3A	Humanistic education
23	Jiangnan village three people	3A	Humanistic education

According to the spatial distribution of the 3A and above attractions in Shanghai, Shanghai attractions distribution has obvious regional, therefore, in order to deal with accuracy and convenience, according to the intensity of scenic spots in Shanghai for tourism partitions, based on the partition of travel route development, finally get the whole comprehensive tourism routes.

Shanghai tourism partition consists of ABCDE five areas, namely with Shanghai science and

technology museum as the center of area A, Shanghai sheshan national forest park as the center of area B, such as Shanghai GuYi park as the center of the area C, shooting clubs in Shanghai as the center of the region D, dongping national forest park as the center of E area. A total of nine area A attractions, 8 B area attractions, 3 C area attractions, 1 D area attractions, 2 E area attractions. Further adds the corresponding latitude and longitude and partition information get above 3 a grade scenic spot of Shanghai information table, as shown in table 5.2.

Table 5.2 above 3 a-class scenic spot in Shanghai

No	Names of scenic spots	Longitude	Latitude	Level of attrac-tion	Attractions types	Partition type
1	Oriental Pearl Tower	31.24055	121.49986	5A	Humanistic education	A district
2	Oriental Pearl Tower	31.2225	121.5379	5A	Humanistic education	A district
3	Shanghai Wildlife Park	31.05525	121.72437	5A	theme park	C district
4	Shanghai Century Park	31.2145	121.5535	4A	Natural leisure	A district
5	Shanghai GongQing forest park	31.31823	121.54859	4A	Natural leisure	A district
6	Shanghai Urban Planning Exhibition Center	31.23181	121.47533	4A	Humanistic education	A district
7	The Shanghai Zoo	31.19338	121.36255	4A	Humanistic education	A district
8	Shanghai Museum	31.22864	121.47550	4A	Humanistic education	A district
9	88 - storied jinmao tower	31.23603	121.50569	4A	Humanistic education	A district
10	Yu Garden Chinese Restaurant	31.22770	121.49213	4A	Humanistic education	A district
11	Shanghai Oriental green boat	31.09934	121.01912	4A	Natural leisure	B district
12	Shanghai Sheshan National Forest Park	31.0946	121.2003	4A	Natural leisure	B district
13	Shanghai zhujiajiao ancient town tourism	31.11479	121.05397	4A	Natural leisure	B district
14	Shanghai Sun Island Holiday Resort	31.040	121.0911	4A	Natural leisure	B district
15	Qingpu revolutionary	31.00818	121.04470	4A	Humanistic	B

					education	district
16	Grand View Garden Shanghai	31.07323	120.91130	4A	Humanistic education	B district
17	Case study of Shang hai	31.00434	121.24835	4A	Humanistic education	B district
18	Shanghai guyi garden	31.29218	121.31590	4A	Humanistic education	D district
19	Dongping National Forest Park	31.67718	121.48138	4A	Humanistic education	E district
20	Shanghai Film Park	31.0178	121.310	3A	theme park	B district
21	Shanghai binhai forest park	30.9907	121.9087	3A	Natural leisure	C district
22	Shanghai shooting club	31.026	121.897	3A	Humanistic education	C district
23	Jiangnan village three people	31.7215	121.4983	3A	Humanistic education	E district

5.1.2 Partition information

Distinguish area situation according to the Shanghai star attractions, can be in different areas are usually visit star attractions have higher value, but not necessarily all visitors will choose to go to the star attractions, in order to increase the diversity of choice, to make the data more close to the actual situation, no rating but still need to add some more famous scenic spots, and through the hornet's nest travel guides, tourism, public comments on web sites such as baidu resources to find the best tourist attractions time and ticket information, at the same time, Google maps are used to get the scenic spots in latitude and longitude, supplement information after ABCDE five partitions the main attractions are shown in table 5.3 ~ 5.7

Table 5.3 the main attraction area A

NO	names of scenic spots	longitude	latitude	景点类型	Time	Ticket
1	Oriental Pearl Tower	31.24055	121.49986	Humanistic education	2h	80
2	Shanghai Science and Technology Museum	31.2225	121.5379	Humanistic education	4h	60
3	Shanghai Century Park	31.2145	121.5535	Natural leisure	3h	10
4	Shanghai GongQing forest park	31.31823	121.54859	Natural leisure	4h	15
5	Shanghai Urban Planning Exhibition Center	31.23181	121.47533	Humanistic education	3h	30
6	The Shanghai Zoo	31.19338	121.36255	Humanistic education	2h	40

7	Shanghai Museum	31.22864	121.47550	Humanistic education	4h	0
8	Yu Garden Chinese Restaurant	31.23603	121.50569	Humanistic education	2h	120
9	Yu Garden Chinese Restaurant	31.22770	121.49213	Humanistic education	2h	40
10	Shanghai film museum	31.18629	121.437042	Humanistic education	4h	60
11	Shanghai Botanical Garden	31.15032	121.44978	Natural leisure	4h	40
12	Sightseeing Tunnel at the Bund	31.23942	121.49701	Natural leisure	0.5h	50
13	Huangpu River Cruise	31.22929	121.49705	Natural leisure	1h	80
14	Tianzifang	31.20826	121.46973	Natural leisure	2h	0
15	Madame Tussaud's	31.23513	121.47349	Humanistic education	2h	130
16	Nature wild insect house	31.24087	121.49782	Humanistic education	3h	60
17	Shanghai Italian center	31.186805	121.492234	Humanistic education	2h	60
18	Shanghai World Financial Center	31.23491	121.50748	Humanistic education	2h	150
19	Week 8 town	31.10890	121.38770	Humanistic education	3h	50
20	A site of the communist party of China	31.22063	121.47542	Humanistic education	1h	0
21	Shanghai chocolate happy paradise	31.18463	121.4861	Ttheme park	4h	185
22	Baylor win happy children sports pavilion	31.21782	121.42422	Ttheme park	4h	180

Table 5.4 B area main attraction

NO	names of scenic spots	longitude	latitude	Attractions types	Sightse-eing time	Ticket
1	Shanghai Oriental green boat	31.09934	121.01912	Nature and leisure	4h	50
2	Shanghai Sheshan National Forest Park	31.0946	121.2003	Nature and leisure	4h	0

3	Shanghai zhujiajiao ancient town tourism	31.11479	121.05397	Nature and leisure	3h	30
4	Shanghai Sun Island Holiday Resort	31.040	121.0911	Nature and leisure	2h	30
5	Dianshan Lake	31.1112	120.977	Nature and leisure	4h	0
6	Qingpu revolutionary history memorial hall	31.00818	121.04470	Humanistic education	1h	0
7	Grand View Garden Shanghai	31.07323	120.91130	Humanistic education	2h	60
8	Case study of Shanghai	31.00434	121.24835	Humanistic education	3h	12
9	Shanghai Film Park	31.0178	121.310	Ttheme park	2h	80
10	Chenshan Botanical Garden	31.07079	121.18123	Nature and leisure	3h	60
11	Shanghai Sculpture Park	31.1024	121.2061	Nature and leisure	3h	120
12	The Cement Garden	31.24989	121.4855	Nature and leisure	1h	80
13	The root of the xuelang lake hot spring	30.9257	121.0908	Nature and leisure	2h	198
14	The diversified ecological farm	31.62144	121.61376	Nature and leisure	3h	50
15	Drunken Bai Pond	31.00215	121.23027	Nature and leisure	2h	12
16	Songjiang museum	31.00659	121.24618	Humanistic education	2h	10
17	Songjiang gallery	31.03331	121.19806	Humanistic education	1h	0
18	The earthquake KePuGuan	31.09214	121.19576	Humanistic education	1h	5
19	Shanghai astronomical museum	31.09425	121.19367	Humanistic education	1h	14
20	Happy Valley Shanghai	31.09520	121.22001	Ttheme park	5h	200

Table 5.5 the main attraction area C

NO	names of scenic spots	longitude	latitude	Attractions types	Sights-eing time	Ticket
1	Shanghai Wildlife Park	31.05525	121.72437	Ttheme park	2h	130
2	Shanghai binhai forest park	30.9907	121.9087	Nature and leisure	2h	35
3	Shanghai shooting club	31.026	121.897	Humanistic education	1h	99
4	Luchao port	30.85683	121.84651	Nature and leisure	2h	0
5	China Maritime Museum	31.23806	121.48791	Humanistic education	1h	50
6	Nanhui academy family	30.94165	121.89221	Humanistic education	3h	0
7	Fu lei's former residence	31.04953	121.59324	Humanistic education	1h	0
8	ChuanSha ancient city wall	31.19525	121.70703	Humanistic education	2h	0
9	Former Residence of Zhang Wentian	31.13187	121.76299	Humanistic education	1h	0

Table 5.6 D area main attraction

NO	names of scenic spots	longitude	latitude	Attractions types	Sights-eeing time	Ticket
1	Shanghai guyi garden	31.29218	121.31590	Humanistic education	1h	12
2	Shanghai Museum of Glass	31.34383	121.47277	Humanistic education	2h	48
3	Jiading wisteria garden	31.37909	121.25820	Nature and leisure	1h	0
4	Baoshan rural eastern holiday	31.35481	121.35345	Nature and leisure	2h	30
5	Autumn XiaPu	31.38715	121.25318	Nature and leisure	3h	10
6	WeiSiJia scent	31.43778	121.35390	Nature and leisure	2h	80
7	Shanghai in the east of Buddha museum of art	31.36936	121.22642	Humanistic education	2h	45
8	Nanxiang 2-foot-tall tower	31.29137	121.30777	Humanistic education	1h	0
9	Dream small thatched cottage	31.46445	121.26391	Humanistic education	3h	129
10	Method of China tower	31.38438	121.25067	Humanistic education	1h	0

Table 5.7 E main attraction

no	names of scenic spots	longitude	latitude	Attractions types	Sights eeing time	admission ticket
1	Dongping National Forest Park	31.67718	121.48138	Humanistic educatio	2h	70

				n		
2	Jiangnan village three people	31.7215	121.4983	Humanistic education	3h	60
3	Dongtan wetland park	31.51983	121.91238	Nature and leisure	2h	0
4	Purple sea heron romantic manor	31.67270	121.49503	Nature and leisure	2h	0
5	Already the garden	31.6263	121.4032	Nature and leisure	2h	100
6	Gold AoShan	31.61534	121.42096	Nature and leisure	1h	0
7	ShouAn temple	31.61482	121.42150	Humanistic education	1h	0
8	Orange continent QiongLu	31.40165	121.68588	Ttheme park	2h	38
9	Wildlife wetland park	31.62151	121.61367	Nature and leisure	2h	0

5.2 Main scenic spots of Shanghai scores

Considering the tourist satisfaction will also be different in different scenic spot, this article will be tourists to the scenic spot of satisfaction into the scenic spot, is put forward based on attraction level ratings of the specification, the corresponding criteria are shown in table 5.8

Table 5.8 scoring criteria

	5A	4A	3A	No rating
grade	5	4	3	2

For 3 a, 4 a and 5 a grade scenic spot rate for 3, 4, 5, respectively, with no rating of attractions, its a 2 points, combined with the public comments on the net of the masses and Baidu tourism online scoring is reduced, so the conversion formula is as follows:

$$P'_j = \frac{2 \times P_j}{P}$$

The Pj 'for the final score, Pj online score for the populace, p for full marks, public comments on the net and baidu travel generally take 5.

Combination level of each area attractions, scenic spots and the masses online score calculation, get the final score of 70 sites in Shanghai, the main attraction of Shanghai grading are shown in table 5.9.

Table 5.9 major scenic spots in Shanghai.

序号	names of scenic spots	景点级别及网上评分	最终评分	分 district
1	Oriental Pearl Tower	5A	5	A district
2	Shanghai Science and Technology Museum	5A	5	A district
3	Shanghai Century Park	4A	4	A district
4	Shanghai GongQing forest park	4A	4	A district
5	Shanghai Urban Planning Exhibition Center	4A	4	A district
6	The Shanghai Zoo	4A	4	A district
7	Shanghai Museum	4A	4	A district
8	88 - storied jinmao tower	4A	4	A district
9	Yu Garden Chinese Restaurant	4A	4	A district
10	Shanghai film museum	4A	4	A district
11	Shanghai Botanical Garden	4	1.6	A district
12	Sightseeing Tunnel at the	4	1.6	A

	Bund			district
13	Huangpu River Cruise	4	1.6	A district
14	WHERE	4.5	1.8	A district
15	Madame Tussaud's	4.5	1.8	A district
16	Nature wild insect house	4	1.6	A district
17	Nature wild insect house	3.5	1.4	A district
18	Nature wild insect house	4.5	1.8	A district
19	Week 8 town	4	1.6	A district
20	A site of the communist party of China	4.5	1.8	A district
21	Shanghai chocolate happy paradise	4	1.6	A district
22	Baylor win happy children sports pavilion	4	1.6	A district
23	Shanghai Oriental green boat	4A	4	B district
24	Shanghai Sheshan National Forest Park	4A	4	B district
25	Shanghai zhujiajiao ancient town tourism	4A	4	B district
26	Shanghai Sun Island Holiday Resort	4A	4	B district

27	Dianshan Lake	4A	4	B district
28	Qingpu revolutionary history memorial hall	4A	4	B district
29	Grand View Garden Shanghai	4A	4	B district
30	Case study of Shanghai	4A	4	B district
31	Shanghai Film Park	3A	3	B district
32	Chenshan Botanical Garden	4.5	1.8	B district
33	Shanghai Sculpture Park	5	2	B district
34	The Cement Garden	3.5	1.4	B district
35	The root of the xuelang lake hot spring	3	1.2	B district
36	The diversified ecological farm	4	1.6	B district
37	Drunken Bai Pond	4.5	1.8	B district
38	Songjiang museum	3.5	1.4	B district
39	Songjiang gallery	3.5	1.4	B district
40	The earthquake KePuGuan	4.5	1.8	B district
41	Shanghai astronomical museum	4	1.6	B distric

				t
42	Happy Valley Shanghai	5	2	B district
43	Shanghai Wildlife Park	5A	5	Cdistrict
44	Shanghai binhai forest park	3A	3	Cdistrict
45	Shanghai shooting club	3A	3	C district
46	Luchao port	4.5	1.8	C district
47	China Maritime Museum	4	1.6	C district
48	Nanhui academy family	4.5	1.8	C district
49	Fu lei's former residence	3.5	1.4	C district
50	ChuanSha ancient city wall	4.5	1.8	C district
51	ChuanSha ancient city wall	3	1.2	C district
52	Shanghai guyi garden	4A	4	D district
53	Shanghai Museum of Glass	4	1.6	D district
54	Jiading wisteria garden	4	1.6	D district
55	Baoshan rural eastern holiday	4.5	1.8	D district
56	Autumn XiaPu	5	2	D district

57	WeiSiJia scent	2.5	1	D district
58	Shanghai in the east of Buddha museum of art	4.5	1.8	D district
59	Nanxiang 2-foot-tall tower	4	1.6	D district
60	Dream small thatched cottage	3	1.2	D district
61	Method of China tower	3.5	1.4	D district
62	Dongping National Forest Park	4A	4	E district
63	Jiangnan village three people	3A	3	E district
64	Dongtan wetland park	4	1.6	E district
65	Purple sea heron romantic manor	4	1.6	E district
66	Already the garden	3.5	1.4	E district
67	Gold AoShan	4	1.6	E district
68	Dongping National Forest Park	3.5	1.4	E district
69	Orange continent QiongLu	4	1.6	E district
70	Wildlife wetland park	3.5	1.4	E district

5.3 Partition of accommodation and the cost of the bus Tours in Shanghai

Consider cost limit and time limit of the model, the influence of the need to provide all the cost of accommodation and tourism travel by car, so to Shanghai each partition data statistics, get all accommodation and the cost of the car, and the details shown in table 5.10 ~

Table 5.10 Shanghai jinlong bus basic fee (data source) http://www.deqinzuche.com/

	Basic fee (RMB/day)	Average cost (RMB/person)	The total average (yuan/person)
King Long 53 seat bus	1200	22.64	23
King Long 33 seat bus	800	24.24	
King Long 49 seat bus	1100	22.44	
King Long 45 seat bus	1000	22.22	

Table 5.11 the tourist partitions per capita consumption

district	Restaurant	(RMB/per person)	Total cost (RMB/meal) per capita
A district	In the "Xia Li restaurant in xinjiang	79	77
	State sand pot of porridge	99	
	Hot is addiction	49	
	The old factory of chongqing hot pot	91	
	57Degree of hunan	95	
	secret recipe	26	
	Uncle tea restaurant at sea	106	
	PANKOOPankoo	86	
	Xiang yue hui (appropriate hill shop)	62	
	The righteous side house (xujiahui)	74	
B district	Hutchison dishes (songjiang)	93	64
	Chen Yang crab roe soup package (pine hui road shop)	19	
	Small fat private kitchens	37	
	Hole 2 baba sichuan hot pot ji	92	

district	restaurant	(RMB/per person)	
	uting shop		
	ShaLong restaurant	66	
	Qiao Thai restaurant	79	
	Lesvila themed restaurant	47	
	Olive manor (kaiyuan Mediterranean restaurant)	79	
	At hunan garden (kaiyuan Mediterranean shop)	74	
	Weston (pine hui road shop)	54	
C district	Jinjiang chef (lingang town shop)	70	84
	Thousand island lake chun fresh mud city shop	70	
	Mr Cameron fire barbecue (pudong theme shop)	62	
	Store seafood restaurant (jinqiao store)	130	
	Up and modest, so incense pot (pudong new stores)	98	
	The righteous side house (thumb plaza)	78	
	My grandma's era (CRC)	58	
	Kwai garden organic	86	
	Shenyang garden (nanhui shop)	122	
	Su Wu sheep (nanhui shop)	64	
district	restaurant	(RMB/per person)	Kwai garden organic
D district	The show sushi (jiangqiao wanda store)	86	74
	Flourishing sichuan garden	42	
	Diffuse camel western restaurant (jiangqiao wanda store)	68	
	JiWang dim sum tea restaurant (anting store)	74	
	Shanghai holdings (anting store)	168	
	Small Yang is Fried (jiangqiao wanda store)	16	
	Holland's restaurant	83	
	Two new concepts sichuan (jiading store)	68	
	Ding ding Macao bean bails (shop) in the city	73	
	Papa John's pizza (Shanghai anting store)	57	
district	restaurant;	(RMB/per person)	Total per capita cost

			(RMB/meal）
E district	Aulacese restaurant farm soil	50	62
	West to the farm	66	
	Group of elegant restaurant	75	
	Pankoo	63	
	Song, coffee (chongming shop)	20	
	Jiang goat scorpion hotpot	61	
	MaiChengLi (south store	115	
	Will bing restaurant	73	
	The new recruit fresh hot pot	44	
	Good steak to experts	55	

Table 5.12 partition Tours in per capita consumption for dinner

Area	Per capita consumption/meal for dinner	The total per capita/meal
A	77	72
B	64	
C	84	
D	74	
E	62	

data sources: http://www.dianping.com/

Table 5.13 traveling each partition per capita consumption

Hotel	The standard cost (yuan/day)	The standard cost (yuan/day)
seven days	180	186
Home Inn	170	
Quince pudding	179	
Hanting	199	
99Chain	124	
Green Hotel	249	
Jinjiang Inn	215	
Mottez	169	

The hotel chain's official website data sources:

Table 5.14 the partition board and lodging and per capita by car

Area	Per capita food and accommodation and car/person/day	The average daily consumption/person/day
A	402	
B	369	
C	419	390
D	394	
E	364	

6. Modeling and solving

It should be considered when designing family summer Vacation Navigation to meet the requirements of different families (population, cost, time, etc.), making a trip to scenic spots as much as possible, as high.ar as possible of the quality .This question is a multi-objective programming problem on the basis of meeting the constraint condition. It can meet the requirements of routes selection. Then, we can use the method of the shortest path to find out the suitable route for travel. And the optimal path problem can be disposed as a traveling salesman problem. Thus, the plan can satisfy different needs of family travel.

To discuss various families' needs more clearly, the different levels of demand can be divided into three scenarios to the problem: there are not cost constraints, under time limitation; there are cost constraints, and time limitation; there are cost limitations, and no cost restriction conditions. The first and third are two special cases, and the second case is a general situation. In the statement of model, the paper embodies the process from special to general and special mathematical thinking. The following is the total flow chart of solve the problem.

The third case is a special case of the case 2, so there can be route in the second case basis up to the discussion of the case third. By the case second, according to a day of travel consumption standards have various line consumption level report table..

The third case is to discuss if the fee is limited at various time package's design, namely for M yuan one-day, two-days, three-days, four-days, five-days, six-days tour, and so on.

6.1 modeling

6.1.1No cost constraints, under time limitation, the mathematical model of case

(1) Screening scenic spots with multi-objective optimization model

$$\text{Max} \ \sum_{i=1}^{n}\sum_{j=1}^{n} x_{ij}$$

$$\text{Max} \ \sum_{i=1}^{n}\sum_{j=1}^{n} p_j x_{ij}$$

$$\text{s.t.} \ \sum_{i=1}^{n}\sum_{j=1}^{n} t_j x_{ij} + T_0 \le T_l$$

$$\sum_{i=1}^{n} x_{ij} \le 1 \qquad j = 1,2,\cdots,n$$

$$\sum_{j=1}^{n} x_{ij} \le 1 \qquad i = 1,2,\cdots,n$$

$$x_{ij} = 0\text{或}1 \qquad i,j = 1,2,\cdots,n$$

There are many method can be used to solve e the multi-objective programming. We usual use the help of linear programming, nonlinear programming, stochastic programming and numerical calculation methods and skills. Here I use "linear weighting method" to double goal programming model into single objective programming problem, namely take decision goal is

$$\text{Max} \quad \alpha\sum_{i=1}^{n}\sum_{j=1}^{n} x_{ij} + (1-\alpha)\sum_{i=1}^{n}\sum_{j=1}^{n} p_j x_{ij}$$

The α is any numerical in [0,1],and it reflects the decision makers the degree to which each objective value, here $\alpha = \dfrac{1}{2}$, at the same time considering the number as much as possible to attractions, scenic spot quality is high, as far as possible the proportion of the two as the same.

$$\text{Max} \ \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} x_{ij} + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} p_j x_{ij}$$

$$\text{s.t.} \ \sum_{i=1}^{n}\sum_{j=1}^{n} t_j x_{ij} + T_0 \le T_l$$

$$\sum_{i=1}^{n} x_{ij} \le 1 \quad j = 1,2,\cdots,n$$

$$\sum_{j=1}^{n} x_{ij} \le 1 \quad i = 1,2,\cdots,n$$

$$x_{ij} = 0\text{或}1 \qquad i,j = 1,2,\cdots,n$$

(2) Traveling route model of the traveling salesman problem

Tourists in a scenic spot would along the way after various spots a starting spot, to determine a walking route, shortest route. This problem is a traveling salesman problem (TSP). Analysis from the perspective of graph theory, it is in a complete graph of empowerment, find out a Hamilton loop has the smallest weight C, namely the optimal circle.

Traveling salesman problem of the mathematical model of expression as follows：

$$\min \sum_{i \neq j} d_{ij} x_{ij}$$

$$\text{s.t.} \quad \sum_{j=1}^{n} x_{ij} = 1, i = 1, 2 \cdots n$$

$$\sum_{i=1}^{n} x_{ij} = 1, j = 1, 2 \cdots n$$

$$\sum_{i,j \in s} x_{ij} \leq |s| - 1, 2 \leq |s| \leq n - 1, s \subset \{1, 2, \cdots, n\}$$

Three constraints respectively: each point out there is only one edge; each point out there is only one edge; each starting point and end point, and does not constitute a circle.

6.1.2 A mathematical model under time limitation and cost limitation

(1) screening attraction multi-objective optimization model

$$\text{Max} \sum_{i=1}^{n} \sum_{j=1}^{n} x_{ij}$$

$$\text{Max} \sum_{i=1}^{n} \sum_{j=1}^{n} p_j x_{ij}$$

$$\text{s.t.} \quad \sum_{i=1}^{n} \sum_{j=1}^{n} t_j x_{ij} + T_0 \leq T_l$$

$$\sum_{i=1}^{n} \sum_{j=}^{n} f_j x_{ij} + C \leq M$$

$$\sum_{i=1}^{n} x_{ij} \leq 1 \qquad j = 1, 2, \cdots, n$$

$$\sum_{j=1}^{n} x_{ij} \leq 1 \qquad i = 1, 2, \cdots, n$$

$$x_{ij} = 0 \text{或} 1 \qquad i, j = 1, 2, \cdots, n$$

So the "linear weighting method" will be used to change double goal programming model into single objective programming model:

$$\text{Max} \ \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}x_{ij} + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}p_{j}x_{ij}$$

$$\text{s.t.} \ \sum_{i=1}^{n}\sum_{j=1}^{n}t_{j}x_{ij} + T_{0} \leq T_{l}$$

$$\sum_{i=1}^{n}x_{ij} \leq 1 \quad j = 1,2,\cdots,n$$

$$\sum_{j=1}^{n}x_{ij} \leq 1 \quad i = 1,2,\cdots,n$$

$$x_{ij} = 0或1 \quad i,j = 1,2,\cdots,n$$

6.2 solution method for model

Carried out in accordance with the attractions of discrete degree of Shanghai tourism partitions, on each partition according to different attractions category considered separately, respectively with the help of attractions screening, multi-objective programming model by genetic algorithm (ga) for screening of the attractions of the optimal solution of the path, get the best travel route plan. To find the optimal path belongs to the classical traveling salesman problem, we will use genetic algorithm to solve the optimal path searching.

6.2.1 genetic algorithm is introduced

Traveling salesman problem is a classic combinatorial optimization problem, is also a NP problem. But the method in this holiday travel planning, Shanghai has the actual programming help. So, one of the goals of our research is to find a kind of both the high quality of the solution, but also has fast convergence properties of approximate algorithm.

Traveling salesman problem of research in recent years has made many achievements, so far, from the international point of view mainly Dijkstra (Dijkstra algorithm, the binary tree method, Floyd algorithm, neural network and genetic algorithm method. Each algorithm has its own characteristics, among which the genetic algorithm in comparison is more suitable for solving traveling salesman problem.

Genetic algorithm is a kind of reference for biological natural selection and natural genetic mechanism of the random search algorithm, and it is simulated genetic selection and natural selection of Darwin's biological evolution process calculation model. Approach is to put the problem of parameters of the code for chromosome, reusing iterative manner such as selection, crossover and mutation operation information to the exchange of chromosomes in a population, the resulting chromosomes to conform to the goal of optimization. Practice has proved that the genetic algorithm for solving combinatorial optimization problems such as the TSP problem has better optimization performance.

Genetic algorithm Shanghai tourist route On the genetic algorithm to do work mainly focused on:

(1) adopting appropriate expression method for encoding circuit;

(2) the design of the available genetic operators to keep their characteristics, and avoid feasibility;

(3) to prevent due to premature convergence, a local optimum.

7. Evaluation and improvement direction of the model

7.1 Summary of the model

Through multi-objective programming and genetic algorithm to get the optimal travel path in the tourism area of Shanghai, the popularity of multi-objective programming to attractions into scores of attractions, both fares, scenic spots in different areas of the best time to visit and accommodation consumption level and other factors, and put forward several kinds of different style, different consumption level of the best travel attractions, considering the different family travel demand, to some extent to meet the need of family travel; Genetic algorithm based on multi-objective programming, according to the scenic spots in latitude and longitude data to get the best travel scenic spot the optimal travel path, the path can reduce the time was lost on the way, is conducive to better tourism.

Table 7.1 area A best tourist route information

Line type	Time played	The Best Route	Admission /yuan	Admission /yuan
Natural folk class	8h	Shanghai GongQing forest park, the bund sightseeing tunnel, the huangpu river tour hetian child fang	145	547
		Shanghai century park, Shanghai GongQing forest park and the bund sightseeing tunnel	75	477
		Shanghai GongQing forest park, the bund sightseeing tunnel, the huangpu river tour hetian child fang	140	542
	10h	Shanghai century park, Shanghai GongQing forest park, the bund sightseeing tunnel hetian child fang	155	557
		Inside tianzifang, Shanghai century park, Shanghai GongQing forest park and the bund sightseeing tunnel	75	477
Entertainment and leisure class	8h	The Oriental pearl radio and television tower and jinmao tower in Shanghai Zoo and 88 - storied	240	642
		Shanghai yuyuan garden and Shanghai Zoo	80	482
		The Oriental pearl TV tower, Shanghai yuyuan garden and Shanghai Zoo	160	562
	10h	The Oriental pearl TV tower, Shanghai Zoo, 88 - storied jinmao building and Shanghai yuyuan garden	280	682
		Shanghai yuyuan garden and Shanghai Zoo	80	482
		The Oriental pearl TV tower, Shanghai yuyuan garden and Shanghai Zoo	160	562
Humanities education class	8h	Shanghai science and technology museum, madame tussaud's, and a site of the communist party of China	190	592
		Shanghai science and technology museum and Shanghai urban planning exhibition hall	90	492

	10h	Shanghai science and technology museum, Shanghai museum and a site of the communist party of China	340	742
		Shanghai science and technology museum, Shanghai museum and a site of the communist party of China	90	492
		Shanghai science and technology museum, Shanghai urban planning exhibition hall and a site of the communist party of China	90	492

Table 7.2 B area best tourist route information

Line type	Time played	The Best Route	Admission /yuan	The total cost /yuan
Natural folk class	8h	Shanghai sheshan national forest park and drunken Bai Chi	12	381
	10h	Shanghai sheshan national forest park and dianshan lake	0	369
Entertainme-nt and leisure class	8h	Dream garden, Shanghai sun island resort and film and television paradise	190	559
		Shanghai Oriental green boat and Shanghai sun island resort	80	449
	10h	Shanghai Oriental land, Shanghai sun island resort and film and television paradise	160	529
		Shanghai Oriental green boat and Shanghai sun island resort	80	449
Humanities education class	8h	Qingpu revolutionary history memorial hall, the grand view garden in Shanghai, songjiang museum, songjiang KePuGuan galleries and earthquake	75	444
		Qingpu revolutionary history memorial hall, case study of Shanghai, songjiang KePuGuan galleries and earthquake	17	386
		Qingpu revolutionary history memorial museum, Shanghai grand view garden, songjiang and KePuGuan earthquake	75	444
	10h	Shanghai zhujiajiao ancient town tourism, qingpu revolutionary history memorial hall, the grand view garden in Shanghai, songjiang KePuGuan galleries and earthquake	95	464
		Qingpu revolutionary history memorial hall, case study of Shanghai, songjiang KePuGuan astronomical museum and art gallery, Shanghai earthquake	31	400
		Qingpu revolutionary history museum, museum of Shanghai grand view garden, songjiang, Shanghai and seismic KePuGuan astronomical museum	89	458

7.2 shortcoming of the model

(1) to deal with multi-objective programming problem, the multiple objectives into single object ive problems, using the linear weighted method, the weight of each target are 0.5, lack of fu rther theory basis.

(2) in the cost of computation, adopt the average data, may have some deviation with the act ual real data.

Table 7.3 CDE area best tourist route information

Line type	Time played	The Best Route	Total admission /yuan	The total cost /yuan
CHumanities education route	8h	China's maritime museum, fu lei's former residence, ChuanSha ancient city wall and zhang wentian's former residence	50	469
	10h	China's maritime museum, nanhui academy family, fu lei's former residence, ChuanSha ancient city wall and zhang wentian's former residence	50	469
C-Small area natural entertainment comprehensive route	8h	Shanghai wildlife park, binhai forest park and Shanghai shooting club	264	683
	10h	Shanghai wildlife park, binhai forest park, luchao port and Shanghai shooting club	264	683
D-Area natural folk	8h	Jiading wisteria garden, pastoral and autumn XiaPu baoshan Oriental holiday	40	434
	10h	Jiading wisteria garden, baoshan Oriental holiday pastoral, autumn XiaPu and garden that WeiSiJia smell	120	514
D-Area of humanities education	8h	Shanghai guyi garden, Shanghai museum, Shanghai museum of art, the method of figure of Buddha tower and east nanxiang 2-foot-tall tower	105	499
	10h	Shanghai guyi garden, Shanghai museum, Shanghai museum of art, the method of figure of Buddha tower and east nanxiang 2-foot-tall tower	105	499
E-Area natural folk	8h	Dongping national forest park, jiangnan three people of the village, and gold AoShan	130	494
	10h	Dongping national forest park, jiangnan three people of the village, orange continent AoShan QiongLu and gold	168	532
E-Natural small area humanities	8h	Dongping national forest park, gold AoShan, ShouAn QiongLu temple and orange state	108	472
	10h	Dongping national forest park, wildlife wetland park, g old AoShan, ShouAn QiongLu temple and orange state	108	472

References

Attachment

Main scenic spots in area A

Number	Name of scenic spots	Longitude	Latitude	Level of scenic spots	Type of scenic spots	Sightseeing time	Admission
1	The Oriental Pearl Television Tower	31.24055	121.49986	5A	Recreation and entertainment	2h	80
2	Shanghai Science & Technology Museum	31.2225	121.5379	5A	Humanistic education	4h	60
3	Shanghai Century Park	31.2145	121.5535	4A	Natural folk	3h	10
4	Shanghai Gongqing Forest Park	31.31823	121.54859	4A	Natural folk	4h	15
5	Shanghai Urban Planning Exhibition Center	31.23181	121.47533	4A	Humanistic education	3h	30
6	Shanghai Zoo	31.19338	121.36255	4A	Recreation and entertainment	2h	40
7	Shanghai Museum	31.22864	121.47550	4A	Humanistic education	4h	0
8	Jinmao Building 88-story Sightseeing Hall	31.23603	121.50569	4A	Recreation and entertainment	2h	120
9	Shanghai Yuyuan Garden	31.22770	121.49213	4A	Recreation and entertainment	2h	40
10	Shanghai Film Museum	31.18629	121.437042	4A	Humanistic education	4h	60
11	Shanghai Botanical Garden	31.15032	121.44978	4	Natural folk	4h	40
12	The Bund Tourist Tunnel	31.23942	121.49701	4	Natural folk	0.5h	50
13	Huangpu River Cruise	31.22929	121.49705	4	Natural folk	1h	80
14	Tian zi fang	31.20826	121.46973	4.5	Natural folk	2h	0
15	Madame Tussaud's Wax Museum	31.23513	121.47349	4.5	Humanistic education	2h	130
16	Natural Wild Insect House	31.24087	121.49782	4	Recreation and entertainment	3h	60

17	Shanghai Italian Center	31.186805	121.492234	3.5	Humanistic education	2h	60
18	Shanghai World Financial Center	31.23491	121.50748	4.5	Humanistic education	2h	150
19	Week 8 Town	31.10890	121.38770	4	Recreation and entertainment	3h	50
20	Site of the First National Congress of the CPC	31.22063	121.47542	4.5	Humanistic education	1h	0
21	Shanghai Chocolate Happiness Paradise	31.18463	121.4861	4	Recreation and entertainment	4h	185
22	Baylor Win Children Happiness Sports Center	31.21782	121.42422	4	Recreation and entertainment	4h	180

Main scenic spots in area B

Number	Name of scenic spots	Longitude	Latitude	Level of scenic spots	Type of scenic spots	Sightseeing time	Admission
1	Shanghai Oriental Land	31.09934	121.01912	4A	Recreation and entertainment	4h	50
2	Shanghai Sheshan National Forest Park	31.0946	121.2003	4A	Recreation and entertainment	4h	0
3	Shanghai zhujiajiao Ancient Town Tourist Area	31.11479	121.05397	4A	Humanistic education	3h	30
4	Shanghai Sun Island Holiday Resort	31.040	121.0911	4A	Recreation and entertainment	2h	30
5	Lake Dianshan	31.1112	120.977	4A	Natural folk	4h	0
6	Qingpu Revolutionary Historical Memorial Hall	31.00818	121.04470	4A	Humanistic education	1h	0
7	Shanghai Grand View Garden	31.07323	120.91130	4A	Humanistic education	2h	60
8	Shanghai Fangta Garden	31.00434	121.24835	4A	Humanistic education	3h	12
9	Shanghai Film Park	31.0178	121.310	3A	Recreation and entertainment	2h	80
10	Chenshan Zoo	31.07079	121.18123	4.5	Natural folk	3h	60

11	Moon Lake Sculpture Park	31.1024	121.2061	5	Natural folk	3h	120
12	The Cement Garden	31.24989	121.4855	3.5	Recreation and entertainment	1h	80
13	Zhigen Xuelang Lake Hot Spring	30.9257	121.0908	3	Recreation and entertainment	2h	198
14	The Diversified Eco-farm	31.62144	121.61376	4	Natural folk	3h	50
15	Zui bai chi	31.00215	121.23027	4.5	Natural folk	2h	12
16	Songjiang Museum	31.00659	121.24618	3.5	Humanistic education	2h	10
17	Songjiang Art Gallery	31.03331	121.19806	3.5	Humanistic education	1h	0
18	Shanghai Earthquake Museum	31.09214	121.19576	4.5	Humanistic education	1h	5
19	Shanghai Astronomical Museum	31.09425	121.19367	4	Humanistic education	1h	14
20	Shanghai Happy Valley	31.09520	121.22001	5	Recreation and entertainment	5h	200

Main scenic spots in area C

Number	Name of scenic spots	Longitude	Latitude	Level of scenic spots	Type of scenic spots	Sightseeing time	Admission
1	Shanghai Wild Animal Park	31.05525	121.72437	5A	Recreation and entertainment	2h	130
2	Shanghai Binhai Forest Park	30.9907	121.9087	3A	Recreation and entertainment	2h	35
3	Shanghai Shooting Club	31.026	121.897	3A	Recreation and entertainment	1h	99
4	Luchao Port	30.85683	121.84651	4.5	Natural folk	2h	0
5	China Navigation Museum	31.23806	121.48791	4	Humanistic education	1h	50
6	Nanhui Academy	30.94165	121.89221	4.5	Humanistic education	3h	0

7	Fu Lei's Former Residence	31.04953	121.59324	3.5	Humanistic education	1h	0
8	Chuan Sha Ancient City Wall	31.19525	121.70703	4.5	Humanistic education	2h	0
9	Zhang Wentian's Former Residence	31.13187	121.76299	3	Humanistic education	1h	0

Main scenic spots in area D

Number	Name of scenic spots	Longitude	Latitude	Level of scenic spots	Type of scenic spots	Sightseeing time	Admission
1	Shanghai Guyi Garden	31.29218	121.31590	4A	Humanistic education	2h	12
2	Shanghai Glass Museum	31.34383	121.47277	4	Humanistic education	2h	48
3	Jiading Wisteria Garden	31.37909	121.25820	4	Natural folk	1h	0
4	Baoshan Oriental Holiday Garden	31.35481	121.35345	4.5	Natural folk	2h	30
5	Qiuxia Garden	31.38715	121.25318	5	Natural folk	3h	10
6	Wei Sijia Learning Garden	31.43778	121.35390	2.5	Natural folk	2h	80
7	Shanghai Xiangdong Buddha Museum of Art	31.36936	121.22642	4.5	Humanistic education	2h	45
8	Nanxiang Pagoda	31.29137	121.30777	4	Humanistic education	1h	0
9	Mengwei Humble Cottage	31.46445	121.26391	3	Humanistic education	3h	129
10	Fahua Temple	31.38438	121.25067	3.5	Humanistic education	1h	0

Main scenic spots in area E

Number	Name of scenic spots	Longitude	Latitude	Level of scenic spots	Type of scenic spots	Sightseeing time	Admission
1	Dongping National Forest Park	31.67718	121.48138	4A	Humanistic education	2h	70
2	JIangnan Sanmin Cultural	31.7215	121.4983	3A	Humanistic	3h	60

	Village				education		
3	Dongtan Wetland Park	31.51983	121.91238	4	Natural folk	2h	0
4	Zi Hai Lu Yuan Romantic Garden	31.67270	121.49503	4	Natural folk	2h	0
5	Zhanyuan Garden	31.6263	121.4032	3.5	Natural folk	2h	100
6	Jin Ao Shan	31.61534	121.42096	4	Natural folk	1h	0
7	Shou'an Temple	31.61482	121.42150	3.5	Humanistic education	1h	0
8	Ju Zhou Qiong Lu Garden	31.40165	121.68588	4	Natural folk	2h	38
9	Wildlife Wetland Park	31.62151	121.61367	3.5	Natural folk	2h	0