

The Best Summer Job Selection Based on Ahp

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Abstract: Our high school students have a long summer vacation every year. In order to make the most of the summer vacation, many students engage in summer work. There are many kinds of summer jobs, and how to choose the most suitable job is a challenge for everyone. In this article, we treat this problem as a multi-attribute decision-making problem, and find a solution to this problem. In order to solve this problem, an evaluation model based on analytic hierarchy process was established. The model can help each student analyze and evaluate summer work, and then make the best choice. The model we build in this article is accurate and reliable. Each high school student only needs to fill out the score sheet to know which summer job is best for them. Of course, our model is not perfect, and there are problems such as low scalability. But for the “best summer job” problem, our model is effective enough.

1. Introduction

After a long and tiring school year, the summer vacation is a time all students have longed for. During summer vacation, students are free from school and can participate in anything they are interested in. Nowadays, summer jobs have become a popular choice for people to gain real life experiences in working and to fill up their long summer vacations. Summer jobs provides people with not only monetary support, but also important memories and experience. Summer jobs provides people with not only work experience, but also they help us with developing necessary skills in the future. As summer approaches, people would look for ideal summer jobs that fits their requirements.

2. Modeling Based on Analytic Hierarchy Process

2.1 Analytic Hierarchy Process (Ahp)

The Analytic Hierarchy Process (AHP) [1-4] is a model for picking out the best choice out of several choices based on different factors. There are three parts in an Analytic Hierarchy Process. The first part is the ultimate goal that we need to achieve. The second part is the alternatives that are “candidates” for the final goal. The third part is the criteria that are used to evaluate the alternatives and choose the best alternative for our final goal. [5] When we put all the alternative summer jobs into the Analytic Hierarchy Process, it will select the best summer job (the goal) by evaluating the alternatives using the three criteria [6].

Despite being put together in the model above, the four criteria have different importance. The wage of the summer job might factor more than the location of the summer job. In the Analytic Hierarchy, this importance of each factor is called “weight” of each factors. The more important the factor is, the bigger the magnitude of the “weight” is [7-13]. Different weight creates a way to customize the Analytic Hierarchy Process to fit different requirement since different people have different thoughts on the importance of the four factors. The presence of weight in the Analytic Hierarchy Process makes it objective and flexible [14].

2.2 Building an Evaluation Model Based on Ahp

2.2.1 Defining the Hierarchies of Ahp

We are now going to build a model for evaluating summer job options based on the determined information and previous analysis. According to the AHP method, we should first determine our goals^[21]. Naturally, our goal is to choose the best summer job among the many summer job options. Combined with the analysis in the previous section, we define the hierarchies of AHP as shown in the figure below:

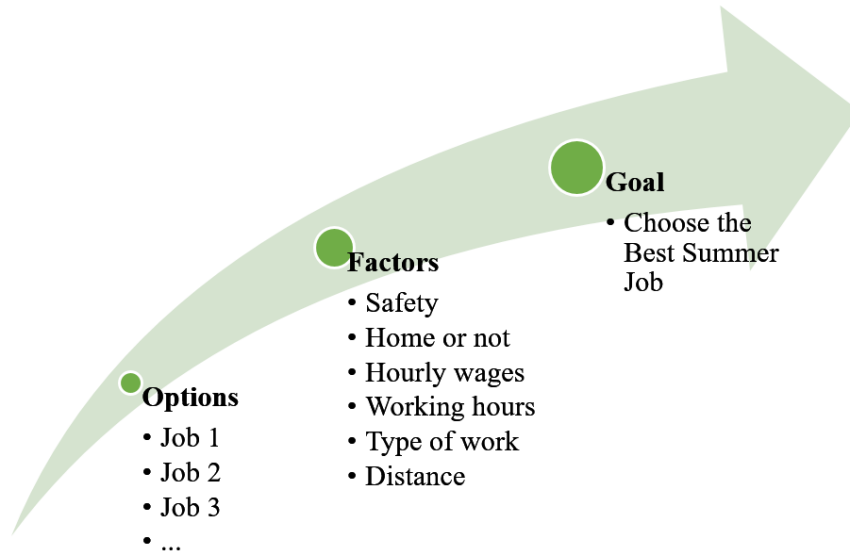


Fig.1 The Hierarchies of Ahp

2.2.2 Building a Comparison Scoring Sheet

According to the analysis in the previous section, there are six factors that determine the quality of our summer work. Now the question is, which of these six factors are important and which are not? The answer to this question may be different for everyone. In order to quantitatively determine the importance of different factors, we designed the following scoring sheet. In the scoring sheet, each item can be scored on a scale of 1/9 to 9, 9 indicates that the factor is extremely important in comparison, while 1 indicates that the two factors are equally important, and the reciprocal indicates that the other factor is more important.

Table 2 Factors and Importance

Comparisons	Scores
Safety vs. Home or not	
Safety vs. Hourly wages	
Safety vs. Working hours	
Safety vs. Type of work	
Safety vs. Distance	
Home or not vs. Hourly wages	
Home or not vs. Working hours	
Home or not vs. Type of work	
Home or not vs. Distance	
Hourly wages vs. Working hours	
Hourly wages vs. Type of work	
Hourly wages vs. Distance	
Working hours vs. Type of work	
Working hours vs. Distance	
Type of work vs. Distance	
(1/9 to 9, 1 means equally important, 9 means much more important and 1/9 means much more unimportant)	

2.2.3 Determining the Weight of Each Factor

Through the scoring sheet, we can get the judgment matrix, and then we will illustrate it with an example. Here's a chart filled out by a fictional high school student named Basil Ford:

Table 3 Fictional Basil Ford'S Chart of Importance

Comparisons	Scores
Safety vs. Home or not	1
Safety vs. Hourly wages	1/3
Safety vs. Working hours	3
Safety vs. Type of work	1/4
Safety vs. Distance	4
Home or not vs. Hourly wages	1
Home or not vs. Working hours	4
Home or not vs. Type of work	1/6
Home or not vs. Distance	2
Hourly wages vs. Working hours	4
Hourly wages vs. Type of work	1
Hourly wages vs. Distance	8
Working hours vs. Type of work	1/8
Working hours vs. Distance	1
Type of work vs. Distance	5
(1/9 to 9, 1 means equally important, 9 means much more important and 1/9 means much more unimportant)	

We define a 6×6 judgment matrix A . Each row and each column represent the ratio of the importance of other factors to this factor. We convert Basil Ford's scoring of factors into matrix form as shown below:

$$A = \begin{pmatrix} 1 & 1 & 3 & 1/3 & 4 & 1/4 \\ 1 & 1 & 1 & 1/4 & 6 & 1/2 \\ 1/3 & 1 & 1 & 1/4 & 1 & 1/8 \\ 3 & 4 & 4 & 1 & 8 & 1 \\ 1/4 & 1/6 & 1 & 1/8 & 1 & 1/5 \\ 4 & 2 & 8 & 1 & 5 & 1 \end{pmatrix}$$

Then according to the AHP method, we calculate the maximum eigenvalue of the judgment matrix and the corresponding eigenvector. By calling the “eig” function provided by MATLAB, the maximum eigenvalue λ_{max} can be calculated by A as follows:

$$\lambda_{max} = 6.39$$

The corresponding eigenvector W is:

$$W = (0.25, 0.25, 0.12, 0.65, 0.08, 0.65)$$

W is the corresponding weight of the six factors, that is, their importance. It should be noted that we need to check the consistency of the judgments at this time to ensure that W is reliable enough. According to the AHP method, n is the order of the judgment matrix, and we define the consistency index (CI) is:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

After calculation, we know that $CI = 0.078$. Now let's focus on the other important parameter, the random consistency index (RI). The standard value of RI is shown in the table below:

Table 4 the Standard Value of the Random Consistency Index (Ri)

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

The order of the judgment matrix n is 6, so $RI = 1.24$. Then we get the consistency ratio (CR):

$$CR = \frac{CI}{RI}$$

According to the AHP method, if $CR < 0.1$ then matrix the judgment matrix A passes the consistency test, which means that the W we just calculated can be used to measure the importance of each factor. Conversely, if matrix A fails the consistency test, it means that the chart is filled in incorrectly and the person who fills in it needs to re-evaluate the comparison of various

factors. For Basil Ford, $CR = 0.063 < 0.1$ means W is his assessment of the importance of various factors.

2.2.4 Final Evaluation of Summer Job Options

We introduced how to evaluate each factor in Section 3.2. Through Table 1 we can get each person's tendency for each factor. Still taking Basil Ford as an example, the scoring chart he filled out is as follows:

Table 5 Fictional Basil Ford'S Chart of Measures

Factors	Measures (0-9, 9 means strong interest and 0 means reject)				
Safety	safe	a little dangerous			dangerous
scores	7	5			4
Home or not	working from home			working outside	
scores	7			4	
Hourly wages	low	relatively low	medium	relatively high	high
scores	0	3	5	6	7
Working hours	short	relatively short	medium	relatively long	long
scores	9	7	5	1	0
Type of work	mental work	physical work			both mental and physical
scores	5	4			3
Distance	at home or very close	within walking distance	need to ride a bike	need to take the subway or bus	need to drive or take a train
scores	6	7	6	0	0

There are three summer jobs for Basil Ford to choose from:

Job 1: Swimming pool lifeguard. This summer job is a little dangerous and requires working outdoors. The hourly salary is high but the working hours are relatively short. This is a physical job, and the work location is a bit far away and requires taking the subway or bus to go to work.

Job 2: Website maintenance worker. This summer job is safe and requires working from home. The hourly wage is medium but the working hours are relatively long. This is a mental job, and the work location is at home.

Job 3: Porter. This summer job is a little dangerous and requires working outdoors. The hourly salary is relatively low and the working hours are medium. This is a physical job, and the work location is within walking distance.

We can calculate which of these three jobs is the best summer job through the two forms that Basil Ford has filled out. For the first job, Basil Ford could not accept a work location that was too far away, so it was excluded first. For the second job, the scores of these 6 factors are: 7, 7, 5, 1, 5, 6. Combined with the importance of these factors calculated before:

$$W = (0.25, 0.25, 0.12, 0.65, 0.08, 0.65)$$

We can calculate the score for job 2 as:

$$S_2 = (7, 7, 5, 1, 5, 6) \cdot (0.25, 0.25, 0.12, 0.65, 0.08, 0.65) = 9.05$$

In the same way, we can calculate the score of job 3:

$$S_3 = (5, 4, 3, 5, 4, 7) \cdot (0.25, 0.25, 0.12, 0.65, 0.08, 0.65) = 10.73$$

$S_3 > S_2$, job 3 scores higher than job 2, so job 3 is the best summer job for Basil Ford.

To sum up, each high school student only needs to complete Table 1 and Table 2 to calculate the scores of different jobs through our model. The best summer jobs can be chosen by comparing scores, which is easy and reliable.

3. Helping Them Choose the Best Summer Job

We fictitious information about 10 personal reasons and input it into the AHP model, we got the corresponding scores for 5 summer jobs, as shown in the following table:

Table 6 the Scores Of Tests

Name	Scores				
	Job 1	Job 2	Job 3	Job 4	Job 5
Frances Virginia	7.86	10.41	7.15	9.21	0.00
Jeff Wood	0.00	9.68	9.31	12.43	10.45
Joyce Tommy	5.26	5.51	6.28	4.06	5.56
Sampson Field	0.00	11.04	10.05	0.00	10.90
Erica Ben	0.00	12.22	13.49	11.07	12.87
Ben Kit	10.96	13.00	12.49	10.54	10.36
Joy Brooke	9.77	5.53	10.17	8.38	11.28
Gilbert Cook	10.12	9.34	7.63	8.07	8.31
Kimberley Sander	0.00	11.58	8.37	10.04	10.36
Hayden Beck	5.66	0.00	9.23	8.51	0.00

Compare the scores of individual jobs, and get the best summer job options that meet their requirements:

Table 7 the Results Of Tests

Name	Frances Virginia	Jeff Wood	Joyce Tommy	Sampson Field	Erica Ben
Best Job	Job 2	Job 4	Job 3	Job 2	Job 3
Name	Ben Kit	Joy Brooke	Gilbert Cook	Kimberley Sander	Hayden Beck
Best Job	Job 2	Job 5	Job 1	Job 2	Job 3

After analyzing the results, we can see that job 2, pool lifeguard is the most popular job, which may be related to the higher salary of this job. The next most popular job was job 3, website maintenance worker, because it is the only work-at-home job.

The test results prove the accuracy and reliability of our AHP model. Through the model, different people can choose the best summer job for them according to their own preferences. This model can help high school students who are faced with choices.

4. Designing an App to Show Our Model

4.1 Explanation and Interface of the “Best Summer Job” App

To show and use our model, we design an APP to help high school students choose their best summer job. The APP is mainly divided into the following three parts:

Introduction Part. This part is used to introduce our APP and tell users how to use it.

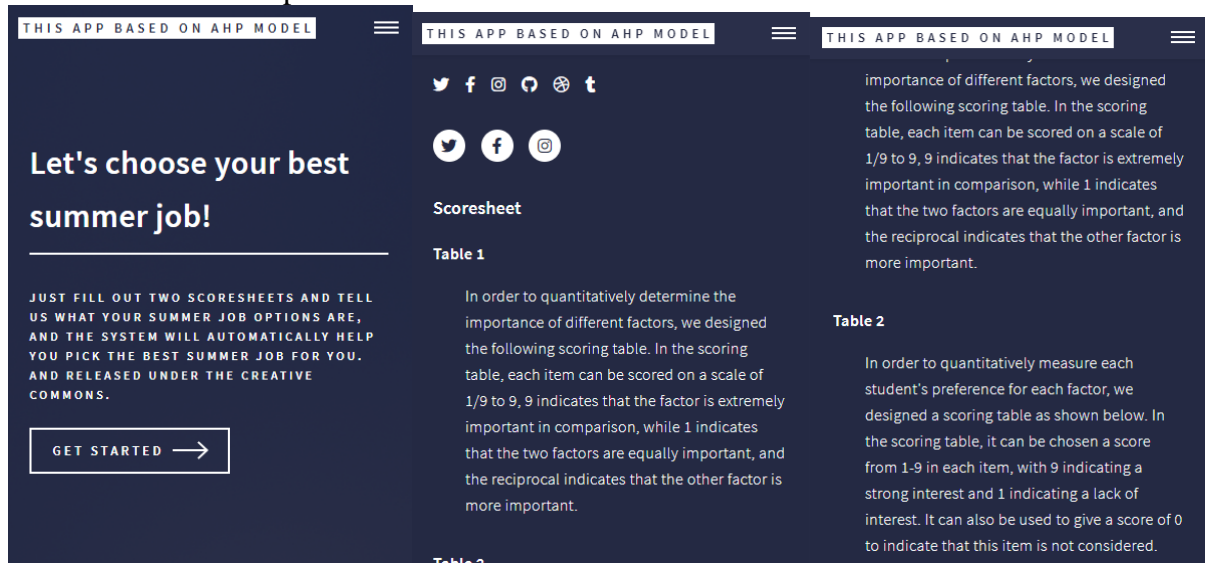


Fig.2 Introduction Part.

Table Part. This Part is Used to Allow Users to Fill in the Scoring Sheet, in Order to Know the User's Preferences for Different Summer Jobs.

THIS APP BASED ON AHP MODEL

Table

Table 1

Comparisons	Scores
safety vs. work from home or not	
safety vs. hourly wages	
safety vs. working hours	
safety vs. type of work	
safety vs. distance	
home or not vs. hourly wages	

Table 2

Factors	Measures
Safety	safe a little dangerous
Home or not	working from home working outside
Hourly wages	low relatively low med
Working hours	short relatively short med

Fig.3 Table Part..

Result Part. This section is used to return calculated results and let users know the scores and best jobs for different summer job options.

THIS APP BASED ON AHP MODEL

Result

Jobs	Scores
Job 1: Cleaner	5.66
Job 2: Swimming pool lifeguard	0.00
Job 3: Website maintenance worker	9.23
Job 4: Porter	8.51
Job 5: Golf caddy	0.00

Best Summer Job

Job 3 is the best summer job for you!

Fig.4 Result Part.

5. Advantages and Disadvantages of Our Model

5.1 Advantages

Our model can accurately calculate the corresponding scores of summer job options according to different people's different tendencies, which can help people make choices clearly and clearly;

Our model can adapt to many kinds of work and has a wide range of application;

Our model, which requires only two charts to be filled out by the user, is simple but reliable.

5.2 Disadvantages

Our model is not robust enough to deal with contradictory information input by users.

Our model is not scalable enough. If additional considerations are added, the model needs to be rebuilt.

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