Research on Summer Job Selection Based on Ahp

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Abstract: High school students can choose a variety of summer jobs, but they don't know which one is the best. Although they can gain a lot of experience from summer work, many factors limit their work decisions, which are very helpful for their careers. We should establish an evaluation system to help our high school students find suitable jobs. Every job has different roles, so we need to understand them. First, we searched for a lot of information about summer jobs to determine the factors high school students would consider when choosing summer jobs. Then, we used Analytic Hierarchy Process (AHP) to establish a model that considers these factors to get the relationship between the job evaluation score and each factor. In order to promote the application of the model in life, we designed the layout of the application according to the model and described how to use the APP. It is understandable and easy to use.

1. Introduction

It is in November, but we need to start to think about how to find summer jobs next year. Nowadays we have so many kinds of jobs like cashier, wait staff to choose. It is a problem that how to choose our favorite summer jobs from these choses. Different jobs have different characters. Some are virtually and we can work in front of our computers, but others are needed to be worked in a special place. We have to take some transportation like a bus or train to get to the workplace. Some jobs are so skillful that only professional people who have analytical and organizational skills can handle the jobs. Some jobs are physically and do not need any mental work. Some people like a little bit overpressure and working for a long time each workday but others would not like. Some people deserve to get more salary from the hourly rates due to their abilities even talents. As for high school students, we do not have much work experience and we do not know how to take any consideration when we choose jobs. It is important for us to have a reasonable and reliable application or webpage to know what our suitable job is.

In order to solve the problem, we firstly decided to choose factors that affect job-hunting behavior. Then we conducted a survey to know what extent of each factor affects. After getting the survey data, we processed the data and built a comparison matrix to find out the relative influence level. We used the Analytic Hierarchy Process (AHP) to get each normalized weight of influencing factors and corresponding jobs. To test our model, we designed an APP that contains several questions to what the tester considers. He will get the commendation job style. To improve our model in the future, we will continue to take a survey about the match and interest degree for feedback. Finally, we proposed our design idea including the algorithm, results, and app.

2. Assumptions and Justifications

Assumption 1: Regardless of the impact of COVID-19 on seeking jobs. That is to say, the situation in 2021 is normal.

Justification: we are confident that the COVID-19 will be disappeared, and each person is not affected that the COVID virus.

Assumption 2: High school students have the same amount of time, but they will not work more than 9 hours a day.

Justification: In the summer holiday, high school students may have their private things like study, meal and sleep. So, they do not work in the whole day, they only start to work at 9 am and end work at 6 pm. Considering their health and safety, they would not work at night and their guardian would not agree with the night work.

Assumption 3: The influencing factors we consider are the main ones, other factors have little influence.

Justification: There are many factors that affect job evaluation but only several factors we choose is main factors. Other factors do not change the result at all.

Assumption 4: The student's estimate of their own ability is accurate. They should know what they could do and know how to do in their knowledgeable jobs.

Justification: They learn a lot of knowledge in their high school and know what they learned in their campus.

3. Nomenclatures

Table 1 Index Needed

Index	Meaning of the indexes
E	Enthusiasm for offline work (job types)
H	Degree of hard work (worktime length)
S	Degree of Salary pursuit (hourly rate)
A	Active level (if sedentary)
D	Durability during work (rest time)

4. Factor Determination

Through literature review and group discussion, we determined five independent factors that affect job-hunters between high school students (Fig. 1).

i. Job type: There are many classification ways to differentiate jobs. To make it simple, we only classify jobs like online jobs and offline jobs. Online jobs including online teaching, programmer and data processor, the employees need to work in front of their laptops or computers, not limiting with distance. While offline work like the cashier at a store and wait staff at a restaurant, the workers need to go to the workplace and work constantly. If the distance from their living to the workplace is far, they need to take transportation like bus or train to get to the workplace. This factor is qualitative, probabilistic and dimensionless.

ii. Time length of work: Different work requires different working time. Some work like online teaching is last for at most 2 hours in a class. But some other jobs need to be required for more time to finish. For example, cashiers at a store always take a long time to finish their one-day work. This factor has its units (h), and it is qualitative, variable and relatively deterministic.

iii. Hourly rate: The hourly rate depends on the properties of the jobs. Some skillful jobs need professionals to handle. The employers need to afford more money to hire the skills man. In contrast, some other jobs do not need any special skill, so the salary is not very high. This factor has its units ($), and it is qualitative, variable and relatively deterministic.

iv. Sedentary or non-sedentary work: As we know, sedentary is not good for our health. Some people are afraid that sitting for a long time may cause hemorrhoids and they are active and like go for activities. Others like sedentary work because they would concentrate on the work by sitting for a long constant time and do not take any activities. This factor is qualitative, probabilistic and dimensionless.

v. Rest time during work: Some people cannot concentration on the work for a long-time during work, they would like to take rests to recover energy and make more efficient. While others may be more energetic that they need not take much time to have rest and accept the constant work. This factor has its units ($), and it is qualitative, variable and relatively deterministic.

These five factors we assume are independent. We would consider these factors when we choose summer jobs. However, we do not know the extent of each factor influence the job-hunting evaluation. We start to collect the data via a survey around our classmates and ask them to fill the survey carefully to make sure the objection. The more survey we did, the more accurate results we will get. Limiting time and surroundings, we can only get several survey data.
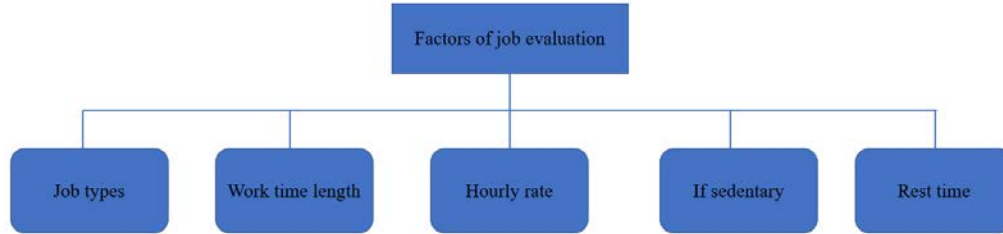

Fig.1 Five Factors Considered When High School Students Search the Summer Jobs

5. Evaluation Based on Analytic Hierarchy Process

We took a survey from our classmates and friends who are high school students and got 60 questionnaires effectively. The original results are attached in the appendix. We count the possibility of each option and score each factor. Then we create the comparison matrix via factor pairwise comparison. The comparison equation is below.

$$a_{i,j} = C_i / C_j \tag{1}$$

where $a_{i,j}$ is the importance of ith factor C_i relative to jth factor C_j. If $a_{i,j} > 1$, ith factor is more important than jth factor. On contrary, less important than the latter factor.

During data process, we make sure that all processed data is with the same size, so we use data normalization and then build the comparison matrix. The score for each factor is in Table 2. The comparison matrix should be a symmetrical and squared matrix, the diagonal element is 1. The final comparison matrix A is

$$A = \begin{bmatrix} 1 & 1.3636 & 1.1538 & 1.6667 & 1.3251 \\ 0.88 & 1 & 1.0154 & 1.4667 & 1.1661 \\ 0.8667 & 0.9848 & 1 & 1.4444 & 1.1484 \\ 0.6 & 0.6818 & 0.6923 & 1 & 0.7951 \\ 0.7547 & 0.8576 & 0.8703 & 1.2578 & 1 \end{bmatrix} \tag{2}$$

Table 2 Score for Each Factor

Factors	Jobs types	Work time length	Hourly rate	If sedentary	Rest time
Scores	7.5	6.6	6.5	4.5	5.66

Note: The full score is 10. The bigger the score is, the more important factor we consider when we seek summer jobs.

Then we need to check the consistency. Theoretically, if factor C_i is much important than factor C_j, i.e., $C_i >> C_j$. Meanwhile, factor C_j is no less important than C_k, i.e., $C_j \square C_k$. Then factor C_i should be important than factor C_k, $C_i > C_k$.

To test the consistency, we need to prepare Consistency Indicator (CI), Consistency Ratio (CR) and average Random coincidence Indicator (RI). The formula of CI is as follows:

$$CI = \frac{\lambda - n}{n - 1} \tag{3}$$

where n is the number of considering factors, λ is the maximum eigenvalue of the judgment matrix. We know $n = 5$, can get the value of RI from Table 3.

Table 3 the Relationship Between Ri and n

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

According to Table 3, we know RI (5) =1.12. We can calculate the CR via the formula

$$CR = \frac{CI}{RI(n)} \qquad (4)$$

If CR<0.1, it means the consistency of the judgment matrix is good. Otherwise, we need to check the problem and rebuild the matrix.

We made the programming via MATLAB to calculate the maximum eigenvalue of the judgment matrix λ then CI and CR come out. We collected 60 sets of data and calculate the result of CI and CR. After programming, we get $CI = 0.0099$ and $CR = 0.0088 < 0.1$. It indicates the consistency is good and we can accept the weight of each factor. Actually, the weight of each factor is the eigenvector corresponding to the largest eigenvalue. Considering the sum of weights is 1, we need to conduct a normalization operation after getting the eigenvector. The weights of each factor are in Table 4.

Table 4 Weights of Each Factor

Factors	Jobs types	Work time length	Hourly rate	If sedentary	Rest time
Weights	0.2511	0.2125	0.2093	0.1449	0.1822

According to the AHP, we know the evaluation model for summer jobs as below.

$$T = 0.2511E + 0.2125H + 0.2093S + 0.1449A + 0.1822D \qquad (5)$$

Excepted the question related to the factors, we also put one extra question about the expected jobs so that we could get the character of the jobs. We divided the jobs into seven classes: catering, education, transportation, service industry, internet, laboratory and medical industry. Through we count the scores for each class, we know the range of score in Table 5.

Table 5 Score of Each Type of Summer Jobs

Job classes	Catering	Education	Transportation	Service	Internet	Laboratory	Medical	Others
Score range	4.31-6.82	6.3-7.73	6.88-7	4.31-7.73	6.82-8.27	4.31-8.27	8.27-10	0-4.31

The more survey we take, the accurate the score is. Now we can use the criterions to evaluate the summer job options and test our model.

6. Model Test between Fictional Persons

In order to test our model, we conceived ten virtual characters reflecting different types of persons: Home-work type, Social type, Hard-working type, Network type, Technical type, Efficient learning type, Introverted type, Stable working type, Active working type, and Entertainment type. The ten sets of reasonable data are attached in the appendix. Combining with the evaluated factors, we anticipated these types of biases with five factors.

Table 6 the Judged Characters of Ten Persons

Types	Home-work	Social	Hard-working	Network	Technical
Judgement	E'HS'AD	EH'SA'D	EHSAD'	E'HSAD'	EHSA'D'
Types	Efficient learning	Introverted	Stable working	Active working	Entertainment
Judgement	E'HS'AD'	E'H'S'AD'	EHS'A'D'	EH'S'A'D	E'H'S'A'D'

●Notes: E stands for offline work; H stands for lone work time; S means high hourly rate; A is sitting work; D is the long rest time between working intervals.

●Home-work type: The employee would prefer working at home, and he does not like working for a long time. He may not pursuit a high salary and he wants to work with sitting even rest at home.

●Social type: The worker likes communicating about work and would like to go to the workplace and meet his/her colleagues face to face. This type of person does not want to work for a long time because they cannot concentrate all the time. The hourly rate is high as he has more recruit opportunity, and he does not like sitting while likes to relax.

●Hard-working Type: The person he likes working for a long time, so he does not mind taking the time to go to the workplace to do high hourly rate jobs. He likes working by sitting on the chair. He does not need to have much rest when he is working.

●Network Type: This worker has a talent for Internet surfing, and he would like to choose online work for his convenience. He can sit in front of his computer for a long time and he can concentrate on the Internet work without any rest.

●Technical Type: The employee is much more professional than other types of people. He can work in the office and does some experiments to verify his ideas. He can get abundant money if he proposes some creative ideas. He does not want to take rests when he is working.

●Efficient learning Type: The worker has a strong ability for study. He is curious about learning from online for his work. He does take a long time on his job and does not mind how much hourly rate he gets. He likes sitting and does not want to have a rest.

●Introverted: He is not an outgoing person so he would like work online with a short time. Thus, he does not want to contact others. The hourly rate is a little slow and he also does not want to have rests when he is working because he only wants to finish the daily work as soon as possible.

●Stable working Type: He may have a big family, so he does not want to leave them. He prefers taking offline jobs and the workplace should be near of his living. Although the salary may be low, but he can work more time daily. Compared with sitting, he would like to have a business for his jobs and does not rest during his work.

●Active working Type: He is an outgoing person and like communicating with others. He tends to choose the jobs with a special place. He likes sitting work, but he does not want to take a rest when he works. He cannot work for a long time and he is not eager to get a high hourly rate.

●Entertainment Type: The character is that the work likes to relax, thus he would have enough rests when he works. Except for the rest, he does not have any other requirements when he chooses jobs.

According to the characters for ten fictional persons, we can calculate the range of score via the model.

Table 7 Score Range Of Each Virtual Person

Types	Home-work	Social	Hard-working	Network	Technical
Score range	4.98-8.55	5.55-8.34	7.55-10	5.03-7.82	6.1-8.88
Types	Efficient learning	Introverted	Stable working	Active working	Entertainment
Score range	4.25-7.04	0-5.76	5.31-8.1	4.76-7.55	0-5.04

We can compare with Table 5 and Table 7; the results are verified with our model. It indicates our model is good. We can use this application for summer jobs choice of high school students. We will design the application in the next section.

7. Design for the App

In Section 7, our evaluation algorithm fully considers summer jobs hunting for different high school student requirements because of their different preferences. Now we design an APP to let students understand our model.

The APP is looks like a questionnaire when people download and install the APP. There will be five questions providing to get the client preference. It can be embodied in the following questions.

Question 1: Do you prefer to work online or offline? There are two options – online and offline.

If the person chooses online, then we will know he would prefer Internet Type work and some online Education Type jobs. If the person chooses offline, then we will recommend more other jobs which has special workplace.

Question 2: How long do you tend to work every day? There are three options – less than 3 hours per day, 3-6 hours per day and 6-9 hours per day.

If people choose 6-9 hours per day, at least we know he is hard worker. We will recommend the jobs that fit for Hard working Type. If people choose less than 3 hours per day, we know he would

like the entertainment, so we will choose the jobs for entertainment Type. If not, we will recommend other types of jobs in next question.

Question 3: How much is your expected hourly rates based on your own assessment? There are three options -- $5-$10 per hour, $10-$15 per hour and above $15 per hour.

If people choose more than $15, we will regard him as the technical or professional one. We will recommend the related jobs for him. If he chooses $5-$10, we know he may be a freshman or effective faster learner, we will also recommend the jobs from our job library. If not, we will recommend the jobs in next question.

Question 4: Are you willing to sit for a long time while working? There are two options – Yes and No.

If the hunter chooses Yes, he may be ingoing, or he would like to do the office jobs. If he chooses no, he may be the active type and we will recommend the Active Type jobs.

Question 5: How much entertainment time can be accepted during the workday? There are three options – Below 1 hour, 1-2 hours and more than 2 hours.

If the employee takes first one, he may be diligent, and we can recommend the stable working type. If choosing more than 2 hours, he is a little bit pleasure-loving, we could recommend some relaxing jobs. If not, we will evaluate the five answers using our model to get the score. Then we can recommend the jobs according to the counting score.

After answering these five questions, we will recommend the type of jobs for the answer person. In order to improve our model, we set two questions after he get the results.

Question 6: How well the recommended position matches your current expectations? Give us a score from 1-10.

If we get the feedback of 10, we think the model is very predictable and perfect. If we get a score of 1, we need to check and improve the model via more survey and data.

Question 7: The level of interest in the recommended position for you. Give us a score from 1 to 10.

If he is very interested in the recommended jobs and give us a high score, we think the model also is good and we can apply it to the high school market. If not, we still need to improve the model.

8. Model Evaluation

8.1 Advantages:

●The AHP analysis is understandable and we can easily to evaluate the level of each factor
●We made a survey considering the five relatively independent factors and have effective data to analyze
●We characterize each type of jobs via the survey and formed the corresponding relations between score and jobs.
●The whole process is easy to operate and referable.

8.2 Disadvantages:

●The data sample is not very enough due to the limited survey time
●Not very specific breakdown of summer jobs

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