Team Number :	84926

Problem Chosen :	B

2018 APMCM summary sheet

The talent market is like the economic market. The talent demand in profession is determined by the number of recruiters and the number of actual employed people through making differences or proportion, which referred as the difference ratio in the following. In order to solve the problem of A-city talent demand, we extract two factors that affect talent demand in the Annex and : the total difference ratio and the difference ratio of different educational degrees. Finally, we obtain the quantity and proportion of talent demands.

In Question 1, this paper uses the data in the Annex, calculates the degree of dependence on education and adjusts the types of attributes, and uses the method of Multi-attribute Decision to get the indicators of the talent demand.

In Question 2, we find that 50 professions in the Annex have obvious periodicity and non-periodicity on the scale of year. This paper predicts the data by Gray Prediction analysis of non-periodic professions and FFT cycle fitting analysis of periodic professions, and adjusts the algorithm of Question 1 with the data obtained from effective channels to get the characteristics of the number and proportion of talents in the next three years.

In Question 3, in order to obtain the development prospects of A-city in different fields, this paper divides 50 professions into 10 different fields. Through the prediction of different fields similar to the algorithm of Question 2, the development prospects of A-city in different fields are finally obtained, and we infer that A-city may be an undeveloped city in the northeast of China which has a developed commerce and undeveloped hi-tech industry.

In Question 4, this paper collects the special directions of college students' entrepreneurship, enlistment, civil servants and other topics in the past years. Combining with the development tendency of A-city in Question 3, this paper gives reasonable suggestions on the urban development and talent introduction.

In Question 5, combined with the author's research and experience in computer science, this paper puts forward personal ideas and reasonable development suggestions for the strengths and weaknesses of the city.

In this paper, periodic and non-periodic professions are evaluated respectively from two aspects of quantity and proportion. Although the relationship between decision data and Multi-attribute Decision is relatively complex, the model has higher accuracy due to the Multiple-attribute Decision.

Keywords: *Gray Prediction Model*, *Fast Fourier Transform (FFT)*,*Multi-attribute Decision Model*, *Residual Analysis*, *Confidence analysis*,

Contents

1 Introduction

1.1 Problem Background

As is known to all, inviting wits and attracting talents is one of the highlights for many cities over the past couple of years. Beijing, Shanghai, Wuhan, Chengdu, X-i'an, and Shenzhen are actually competing for talents with various attractive policies. Talents represent the motive power for the innovative development of cities because of their ability to learn better skills, make better products, and master better management methods within a shorter time. Talents are the major driver for urban innovation diffusion, since innovation diffusion is achieved by promoting new processes and technologies through high-quality talents are the media. In cities today, talents are recruited via the internet, on-campus job fairs, and open recruitment events in addition to local talent markets.

1.2 Our work

To solve the questions asked in the problem, we will establish the talent demand model and quantify the talent demand of A-city based on the data in the Annex. And we will establish the actual talent demand model and predict the potential talent demand of A-city in the next three years according to the talent demand of the "job market of A-City" and the data of the employment status of Chinese students. Thus, we can infer the administrative category, possible geographical area, economic position, and hi-tech industry development of A-City. Considering some new career preferences of college students, we establish a model to quantify this phenomenon and provide strategies for the urban development and talent introduction for A-City. At last, we will write a letter to the school authorities about our suggestions regarding to the talent training program of computer science.

2 Assumptions

1. Assuming that the talent demand is divided into quantitative talent demand and proportional talent demand.

   The talent market is the same as the economic market, it is unwise to measure the talent demand only by the number of recruiters or posts because the talent demand is the decided by the combination of the two. Any unilateral data does not reflect changes in market supply and demand. The size of the talents determined by the number of recruiters and posts must be based on comparison with other professions. Therefore, we need to find relative indicators to compare talent demand.

   Considering the actual situation, there are obviously two ways to quantify the talent gap or talent surplus. And we analyze the two separately:

   When the number of some professions occur a talent gap or surplus, it is easy for us to judge the development trend of the profession, but its limitations are also very obvious. When the number of posts is not high, if there is a small fluctuation

in the recruiters. Obviously, there should be a big fluctuation in the change of talent demand, but it is not well reflected when the change is covered by a large number of profession. Therefore, it is necessary to judge the talent demand by proportion.

However, the method of proportion also has obvious limitations. If the profession has a large base but has a large talent gap or surplus, the performance is poor when the proportion is large due to the large base.

It can be seen that the subtract method is suitable for those with a larger base, and the proportional method is suitable for those with a smaller base number, and the two have the equal importance in our modeling and judgement. There are two ways to do this in practice:

1. Divide all professions into two categories according to the base size, corresponding to different talent demand algorithms and normalizing, and finally compare the talent demand of different profession.

2.Analyze each profession by using two algorithms, and finally through the normalization and then summed and then compare the talent demand of each profession.

The analysis result shows that the first method does not produce good results when we analyze the jobs whose total demand near the basis line, while the second does not have such a problem, so the second one can be selected.

2. Assuming that the profession is divided into periodic profession and non-periodic profession and can be fitted with different method.

   Through the analysis of the number of posts and recruiters, some professions have a significant change in the number of years, while some professions show a cycle-free nature.

   For the non-periodic profession, we can easily obtain the fitting function using the Gray Prediction Model or Linear Regression Analysis. However, for the periodic profession, the fitting function does not have a corresponding method. Inspired by the FFT algorithm for processing periodic electrical signals, we use the FFT algorithm to filter the features of the periodic variation, that is, subtract the three-fold periodic variation function, and then obtain the filtered prediction function by the Gray Prediction Model. The final fitting curve is the sum of the 3 octave period change function and the Gray Prediction function.

3. Assuming that the degree of the educational requirements is higher, the talent demand is bigger, and vice versa. The educational requirements of professions and the number of eligible recruiters determine the educational degree factors that influence the talent demand.

   However, we can only find the number of different education requirements required by the recruiters in the Annex, and there is no qualified number of eligible recruiters, so that we cannot find the second influencing factor. Therefore, only one standard can be defined as the standard for judging the second factor, which could represent the distribution of different educational requirements. For the education degree of recruiter, we can infer that the higher the educational degree is, the fewer recruiters are, that is, the higher the educational degree that the recruiters need, the greater the talent demand, and vice versa.

4. Assuming that the dependence of the degree of profession is obtained from the residual analysis relative to the value of Gray Prediction. When the dependence is low, it has little influence on the talent demand, which is equivalent to the requirement of Bachelor degree.

   In the same profession, if the demand of different degree fluctuates greatly in different months, it can be regarded as less dependent, and vice versa. And the results obtained from the residual analysis relative to the value of Gray Prediction are more reasonable.

$$s = 1 - \left(\frac{Ed - Ed\_pre}{Ed\_pre} \right)^2$$

   According to the analysis of the current talent market, the employment of Bachelor degree still occupies a large share of the market, and classification of the data of earlier years in the Annex are also based on the data of the Bachelor degree, which both indicate that the Bachelor degree is intermediate and average, and when the profession does not require high educational requirements, it should be closest to the average.

3 Symbols and Definitions

Symbol	Meaning of the sympol
A	the pairwise comparison matrix
$Q=[q_1, q_2, q_3, q_4]^T$	the weighted matrix
$D(i,4)$	the decision matrix
s	the dependence of degree
c	the forecast confidence
$G=[g_1, g_2, g_3, g_4]^T$	the scored matrix
Ed	the number of the educational requirements
Td	the total demand
Er	the total posts
Im	the fixed characteristic
k	the regression coefficient

4 Models

4.1 The model of Question 1

4.1.1 Analysis of Question 1

From the Annex, we know that total demand has great influence on talent demand, posts and the educational requirements. The analysis of talent demand requires a comprehensive analysis of the number of posts and recruiters of various attributes. Considering the actual situation, there are obviously two ways to quantify the talent

gap or talent surplus by subtracting or proportional. And we analyze the two situations separately.

After making a preliminary analysis of the data, we find that there is no obvious regularity of the data given in the Annex. Hence, we make an analogy between the discrete data and the periodic electrical signals to process the data using Fast Fourier Transform. Thus, we divide professions into two categories: periodic and non-periodic.

For a profession, we choose two factors to measure the talent demand. The first factor affecting talent demand can be derived from the number of posts and recruiters, and the second factor can be concluded from the number of educational requirements of employers and recruiters. Based on the assumption 3, the second element can be obtained by the analysis of educational requirements. Considering different elements have different attributes, we turn to multi-attribute decision model.

4.1.2 The establishment and resolution of the model

From the analysis of the quantitative talent demand above, the first element corresponds to a cost type attribute: the difference between Total demand and Educational requirement, the second element corresponds to three attributes: cost type attribute Below Bachelor degree, benefit type attribute Bachelor degree, benefit type attribute Above Bachelor degree.

From the analysis of proportional talent demand above, we can easily find that the first element corresponds to a cost type attribute: the proportional between Total demand and Educational requirement, the second element corresponds to three attributes: cost type attribute Below Bachelor degree, benefit type attribute Bachelor degree, benefit type attribute Above Bachelor degree. Though Above Bachelor degree and Bachelor degree both are benefit type attribute, we still differentiate the relative importance of them: Above Bachelor degree is more important than Bachelor degree. And we evaluate the relative importance of different degrees of education just representing the degree of education the profession need, the relative importance will not affect the final sorted profession.

$$e_j{}^T D\_num(i,4) = [Td - Er, Ed\_ab \cdot s\_ab, Ed\_b \cdot s\_b, Ed\_bb \cdot s\_bb]$$

To eliminate the influence of those profession whose requirement of the degree of education has a sudden change or has little influence, we choose the product of the number or the proportion of the degree of education and the dependence of the degree of education to make the multi-attribute decision model. Hence, the sorted profession which do not have a high demand for education will relatively lower than others, while the sorted profession which have a high demand for education will rise.

First, we construct a pairwise comparison matrix:

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 2 & 3 \\ 1 & \frac{1}{2} & 1 & \frac{3}{2} \\ 1 & \frac{1}{3} & \frac{2}{3} & 1 \end{bmatrix}$$

And next we find the weights of the four are$Q$=$[0.2428, 0.3755, 0.2172, 0.1645]^T$.

Due to CI = 0.0393 and CR = 0.0442, the consistency of this matrix is acceptable. Next we normalize the matrix:

$$r_{ij} = \frac{a_{ij}}{\max\limits_{i} a_{ij}}$$

$$r_{ij} = \frac{\min\limits_{i} a_{ij}}{a_{ij}}$$

$$r_{ij} = 1 - \frac{a_{ij} - \alpha_j}{\max\limits_{i} |a_{ij} - \alpha_j|}$$

For the non-periodic profession, we utilize the weight to work out the quantitative indicators for 36 months and make an average of the non-periodic quantitative indicators for each profession.

$$D\_num\_m(i,4) \cdot Q = G\_num\_m(i,1)$$

And next we use the average of non-periodic quantitative indicator for each profession divided by the maximum value to normalize the non-periodic quantitative indicator.

$$gi\_num\_m = \frac{gi\_num\_m}{gi\_num\_m\_MAX}$$

For the non-periodic profession, we utilize the weight to work out the proportional indicators for 36 months and make an average of the non-periodic proportional indicators for each profession. And next we use the average of non-periodic proportional indicator for each profession divided by the maximum value to normalize the non-periodic proportional indicator.

For the periodic profession, we utilize the weight to work out the quantitative indicators for 36 months and make an average of the periodic quantitative indicators for each profession. And next we use the average of periodic quantitative indicator for each profession divided by the maximum value to normalize the periodic quantitative indicator.

For the non-periodic profession, we utilize the weight to work out the proportional indicators for 36 months and make an average of the periodic proportional indicators for each profession. And next we use the average of periodic proportional indicator for each profession divided by the maximum value to normalize the periodic proportional indicator.

Based on the data processing above, we get the quantitative indicators and proportional indicators of each profession and make an average of the sum of the quantitative indicators and proportional indicators as the final indicator to sort the profession.

4.1.3 The results of the model

For each occupation we have the corresponding quantitative and proportional requirements, and the mean of the two.

1. Quantitative talent demand indicators

   This index shows obvious gradient difference, and the index size of each occupation represents whether there is a shortage of talents in this occupation. Obviously, Education, Senior management, Translation, Fashion/textile/furs, Legal profession/law, Science Technology, Movies, TV and recreation, Computer hardware, Banking, Communications technology, Security/housekeeping/other, Transportation service, Property management, Electronics/appliances/semiconductor/instrumentation, Engineering/machinery/energy professional talent quantity demand is higher, can accept more employment. There is a low demand for talents in Restaurants recreation, Technical work, and a relatively small number of talents. The rest are at the mass level.

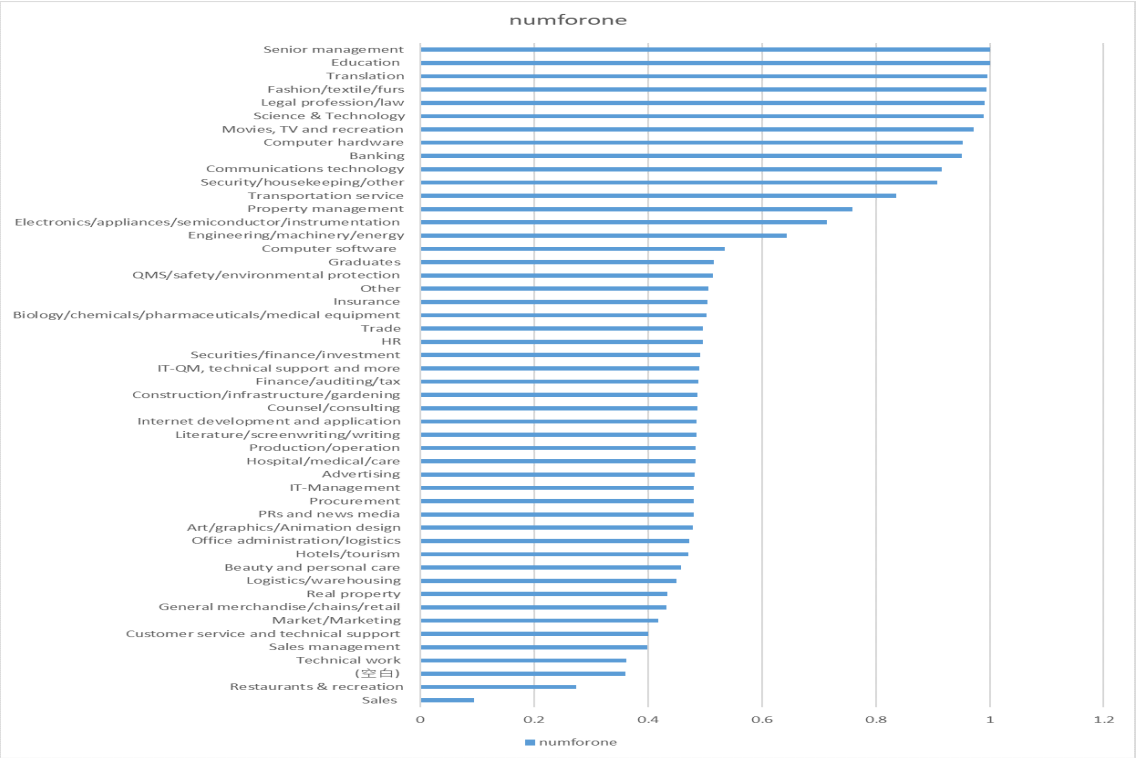


Figure 1: The quantitative demand

2. Similar to quantitative talent demand, proportional talent demand index analysis is as follows.

   This index also shows obvious gradient difference. The index size of each occupation represents whether there is a shortage of talent supply and demand proportion in this occupation. Education, Senior management, Translation, Fashion/-textile/furs, Legal profession/law, Science Technology, Movies, TV and recreation, and Security/housekeeping/other, Banking, Engineering/machinery/energy, and Computer hardware professional talent demand higher proportion. Real property, Securities/finance/investment, Insurance, Customer service and technical support, General merchandise/chains, retail, Sales professional talent demand low proportion. The rest are at the mass level.

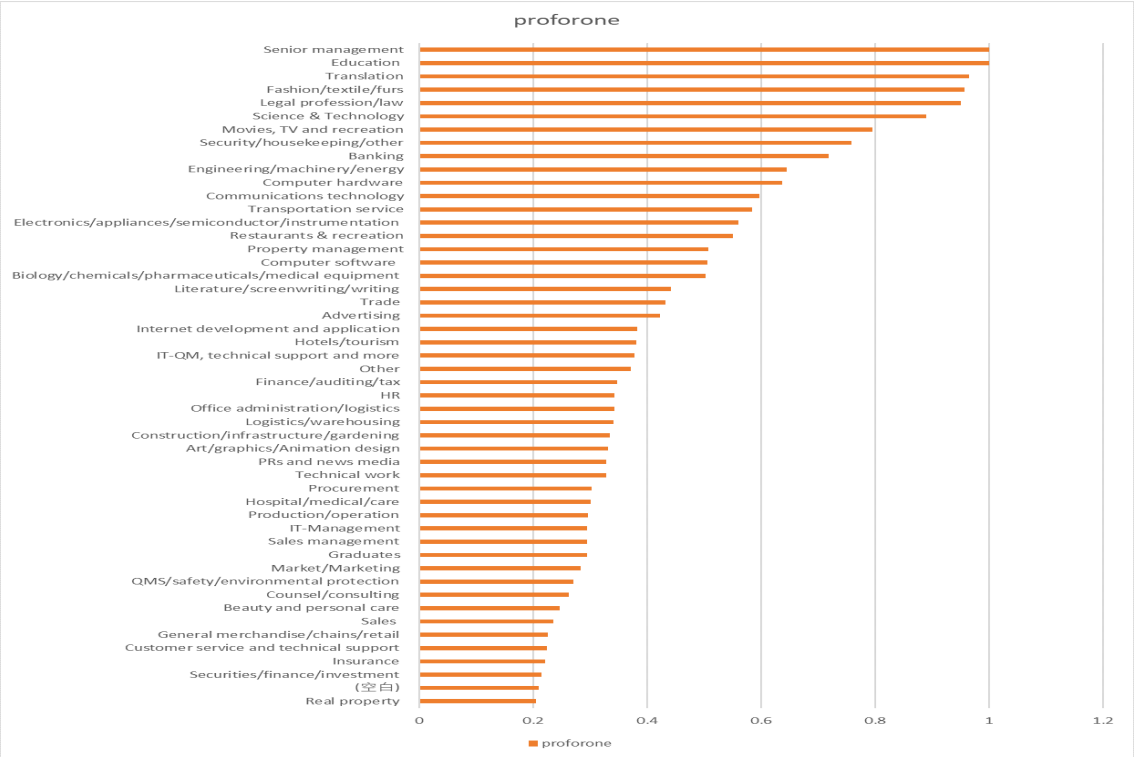


Figure 2: The proportional demand

3. Considering the ranking of the two, the following results can be obtained according to hypothesis 1.

   Comprehensive analysis of various professional, can be concluded that Education, Senior management, Translation, Fashion/textile/furs, Legal profession/law, Science Technology, Movies, TV and recreation, Banking, Security/housekeeping/other talent demand is bigger. Sales, Customer service and technical support, Real property, General merchandise/chains/retail and technical work, Sales management, Market/Marketing, Beauty and personal care, Securities/finance/investment demand is smaller. The rest are centered.

4.2 The model of Question 2

4.2.1 Analysis of Question 2

We can predict the potential talent demand of A-City in the next three years through the data in the Annex and bring the predicted values into the algorithm similar to Question 1 which considering three elements influencing talent demand to find the corresponding indicators. However, according to the data of the employment status of college students in China in the same period, we find that the proportion of the total demand to the posts as a cost type attribute does not reflect the characteristics of talent demand perfectly. Considering the employment rate of college students usually have regular changes every year, we adjust the attribute characteristics to a fixed type attribute. Similarly, according to the proportion of graduates from different degrees in China, we find that the proportion of graduates with different degrees has a certain

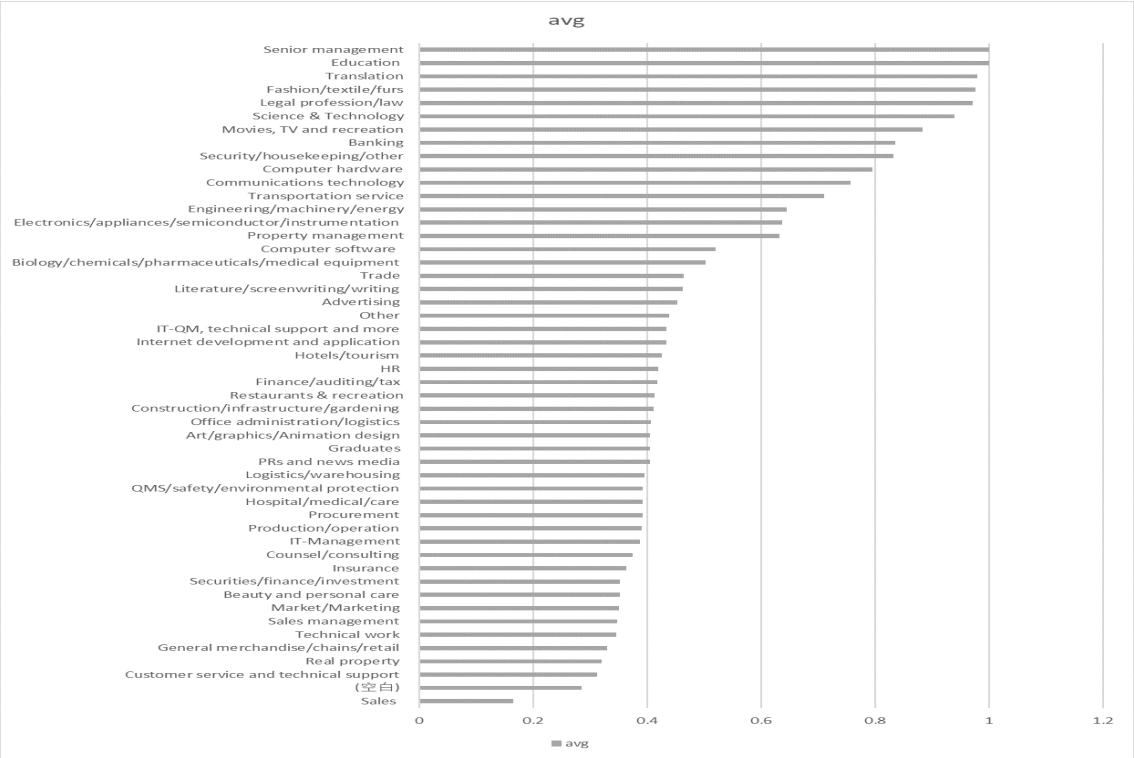


Figure 3: The average combination

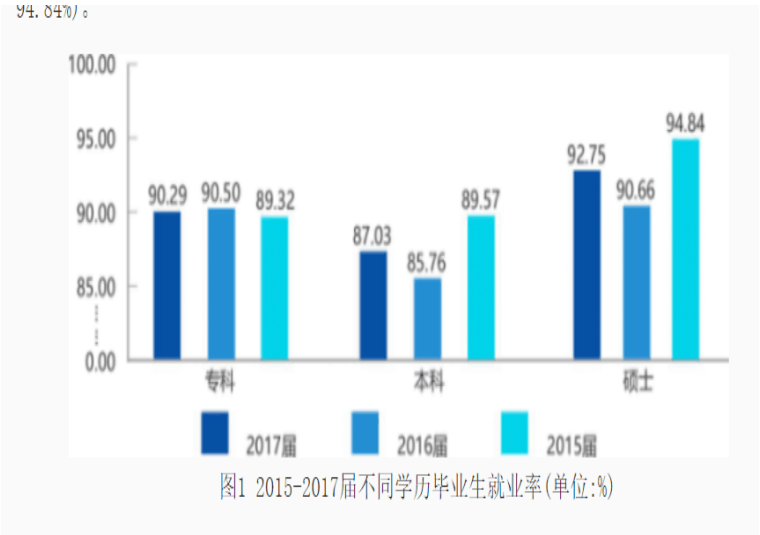


图1 2015-2017届不同学历毕业生就业率(单位:%)

change each year, and it cannot be reflected perfectly if we make it a cost or benefit type attribute. So we adjust the attribute characteristics to a fixed type attribute.

Considering that the total posts is the denominator when calculating proportional demand, and the total number of different months in each year is different, we can't simply add up the 12 months proportional indicators. We should get the weighted average of each year based on the corresponding number of posts, which is the proportional indicator of that years value. For the problem that there is no weighted value of quantitative indicators, the average of 12 months should be taken as the annual demand directly.

When analyzing the potential career in A-city, it is also necessary to combine the trend of the total number of jobs offered by each position, and to express the trend by the regression coefficient of the total number of jobs predicted in the future.

4.2.2 The establishment and resolution of the model

For each profession, the number of people with different degrees of education requirements has regular changes with time, we use Gray Prediction Model to predict the number of people with different degrees of education requirements for the next three years.

For non-periodic profession, Gray Prediction is used to predict the total number of posts and recruiters respectively, and the predicted value for the next 36 months is obtained. For periodic profession, FFT is used to fit the total number of posts and recruiters, and the periodic effect of periodic profession can be filtered out by subtracting three times of the frequency between the total number of posts and recruiters. We use Gray Prediction to the results after filtering, the final total number of posts and recruiters is the sum of three times the frequency we subtract in the beginning and Gray Prediction we get now.

The reciprocal of the total employment rate of graduates in the past years is predicted by Gray Prediction function and the predicted value in the next 36 months is taken as the fixed standard for the ratio of the total number of posts to the total number of recruiters. Avgedu is taken for the proportion of educational requirements required for all occupations in all months.

After that, through Gray Prediction of the proportion of graduates with different educational degrees in the country, we can get the predicted value in the next 36 months, and multiply the predicted value with avgedu to get the proportion of the applicants with different educational degrees, which is the fixed standard of corresponding different educational levels.

Finally, the quantitative demand index and proportional demand index in the next 36 months will be obtained. For the quantitative demand, the annual quantitative demand index can be obtained by calculating the average directly, and for the proportional demand, the weighted average of each year can be obtained by weighting the corresponding number of posts in different months of each year as the proportional index value of that year. The regression coefficients of the two methods are obtained by normalizing them, and the regression coefficients are averaged.

4.2.3 The results of the model

Based on the prediction of the existing data, the data of the change trend in the next three years are obtained. The size of the change trend represents the development potential of this profession.

- Quantitative requirements

  In the future, the Market/Marketing, Office administration/logistics, Sales management, professional talent quantity gap increased rapidly, there is great potential to accept employment. (blank), Construction/infrastructure/gardening, Education, Electronics/appliances/semiconductor/instrumentation, Banking, Security/housekeeping/other professional talent demand decline, development situation is not very good. The rest are still average.

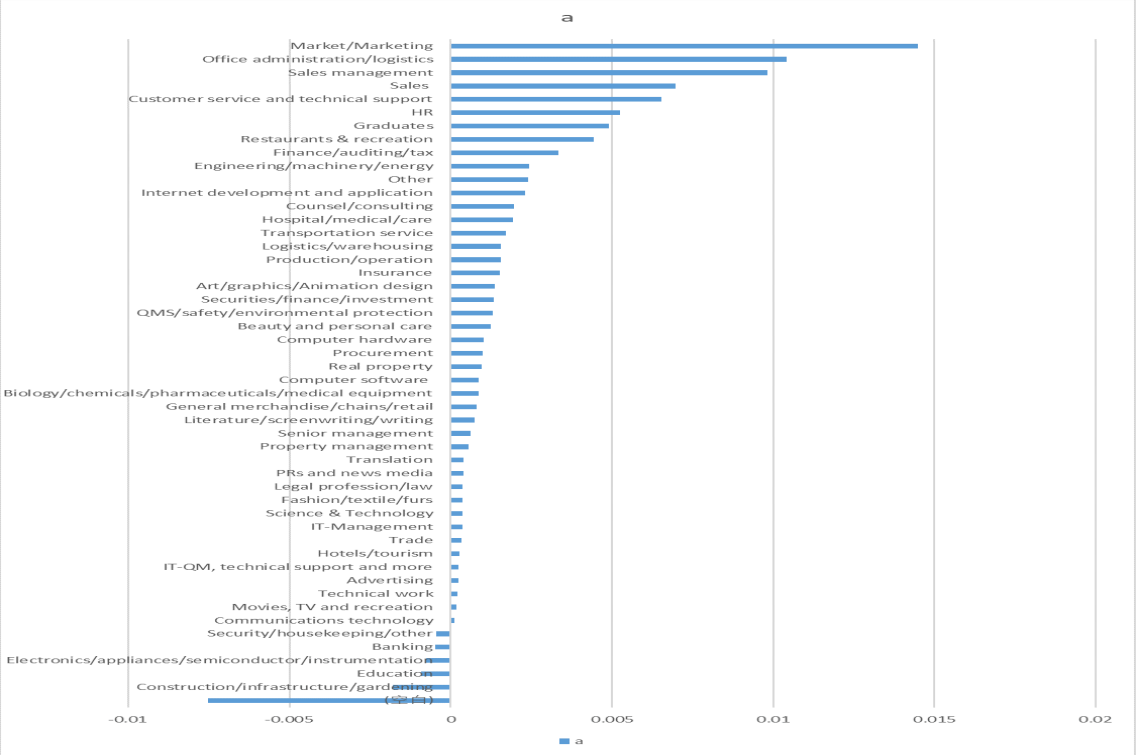


Figure 4: The quantitative combination in the future

- For proportional demand analysis Market/Marketing, Office administration/logistics, Sales management, Customer service and technical support professional talent gap increased rapidly. There will be a growing demand for talent in these occupations, possibly leading to a shortage of cutting-edge talent. Communications technology, (blank), Other, Banking, Education, Movies, TV and recreation, and Security/housekeeping/other, Electronics/appliances/semiconductor/instrumentation, Construction/infrastructure/gardening, IT-QM, Technical support and more, the General merchandise/chains/retail professional talent proportion reduced demand, less likely to apply for success. The rest are still average.

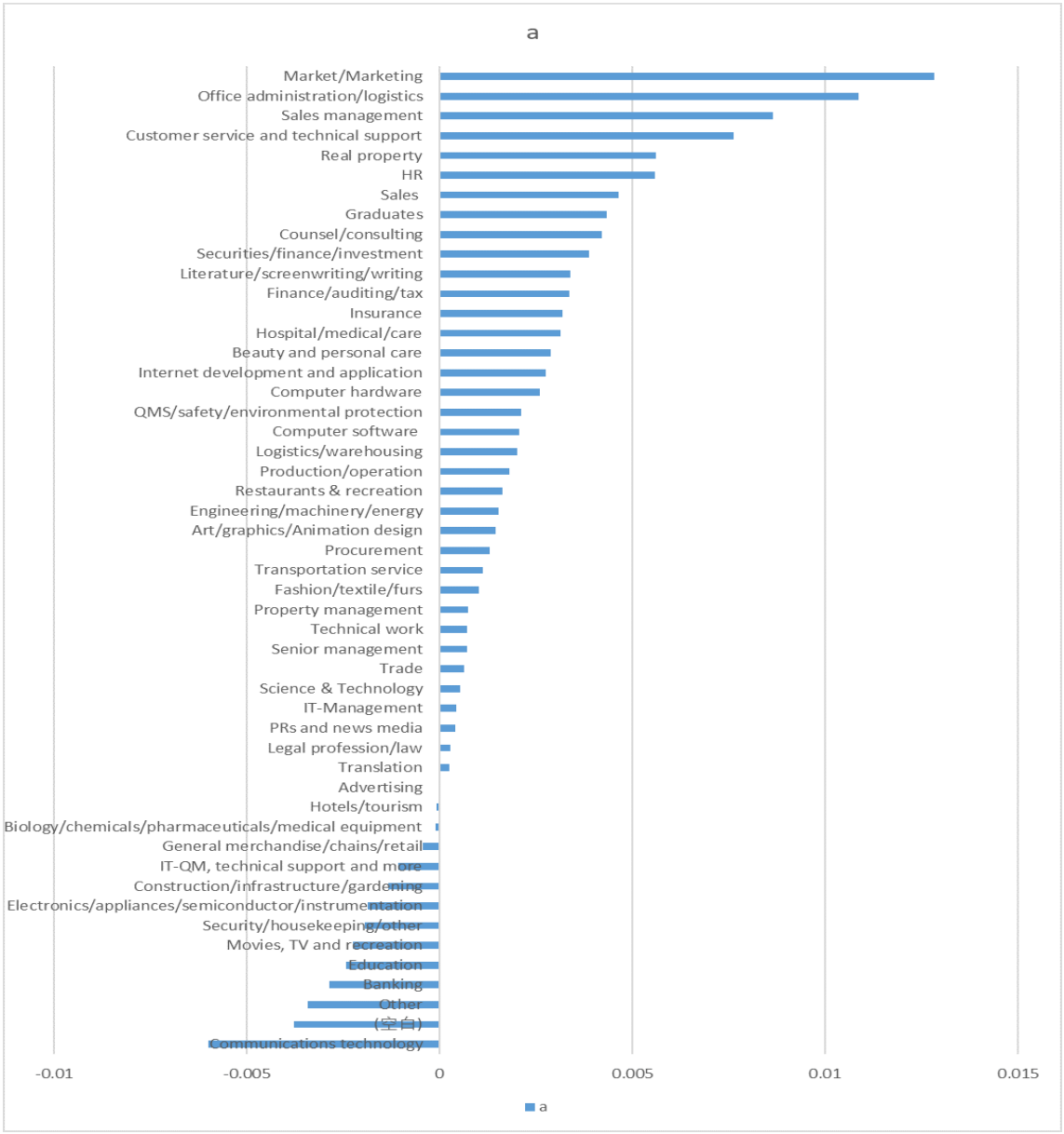


Figure 5: The proportional combination in the future

- Average combination analysis of the two Market/Marketing, Office administration/logistics, Sales management, Customer service and technical support, Sales, HR professional talent gap increases rapidly. (blank),Communications technology, Education, Banking, Construction/infrastructure/gardening, Electronics/appliances/semiconductor/instrumentation, Security/housekeeping/other, Movies, TV and recreation, Other, IT-QM, technical support and more professional talents need to reduce. The rest are still average.

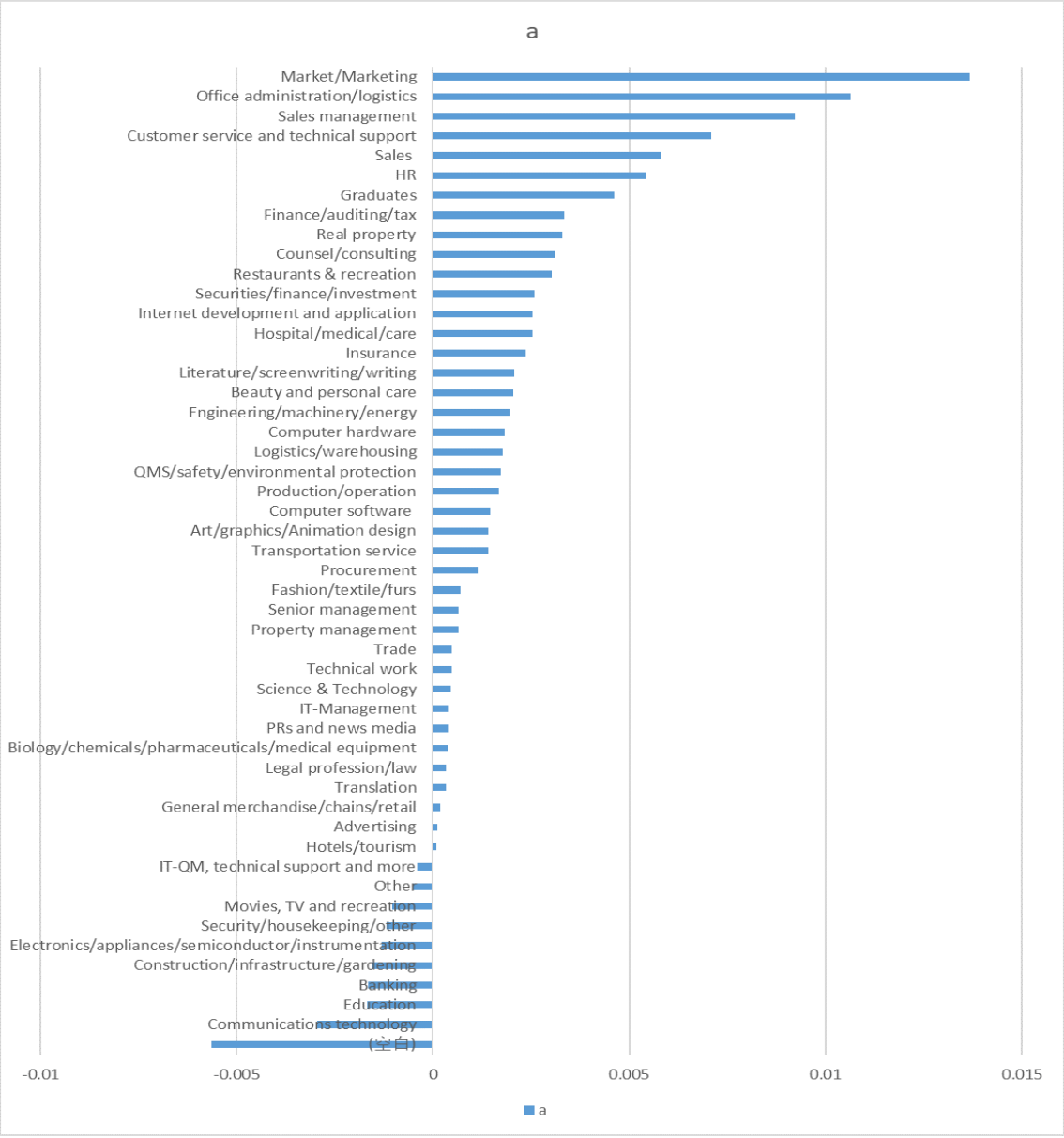


Figure 6: The average combination in the future

4.3 The inference of A-city

4.3.1 Analysis of Question 3

To infer the administrative category, possible geographical area, economic position, and hi-tech industry development of A-City, we try to divide the profession in the Annex into larger areas. And we draw on the "Professional Classification of the People's Republic of China" to divide the 50 professions involved in the Annex into 10 categories, which are Electronic information, Graduates, Translation industry, Management, Entertainment and Service, Cultural science, Logistics, Business, Foreign exchange and Other.

Using the number of predictions for the next 3 years from Question 2, we use the same algorithm as the second question to analyze the number and proportion of the entire field, the Gray Prediction function can be concluded that the talent demand in different fields changes with time, so that we can analyze the development of the city.

We found that the talent demand index tends to be linear with time in the calculation, so it is better to choose Linear Regression instead of Gray Prediction. So we gave up the method of directly summarizing the indicators in Question 2, because the different professions in the same fields have different talent demand. And it is obviously unreasonable to treat the profession equally using the method of summarizing future indicators in Question 2. In order to avoid the difference caused by different professions, we calculate the total number of people in the field directly.

4.3.2 The establishment and resolution of the model

First, we sort the profession according to categories. And next we use the data predicted by Question2 to work out the total recruiters, posts and the total people of educational requirements of each month. We use the algorithm for quantitative demand and the algorithm for improved proportional demand to quantify and normalize the major categories monthly. Finally, we use Linear Regression to obtain the trend of quantitative demand, proportional demand and average talent demand.

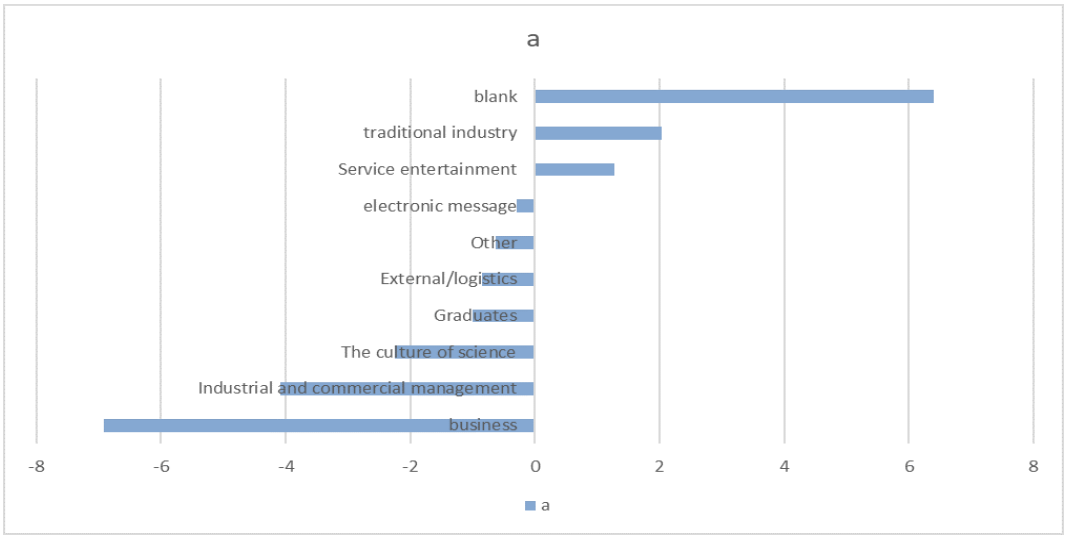
4.3.3 The results of the model

The three talent demand trends obtained from this are shown in the figure. From the change trend of average talent demand and the change trend of the total number of posts in each direction in the future, the industrial development status and other information of this region are analyzed. Except for other and blank, the specific analysis is as follows:

1. Graduates: given the largest demand for talents. The proportion is very high. In the second place on average. The increasing demand for further study after graduation can represent the development of higher education in A city.

2. Commerce: there is a great demand for talents. Proportion demand is the largest. It ranks first on average. The total number of jobs also showed an increasing trend, indicating that the business development is very good.

3. Industrial and commercial management: both the quantity and proportion of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The culture of science
Industrial and commercial management
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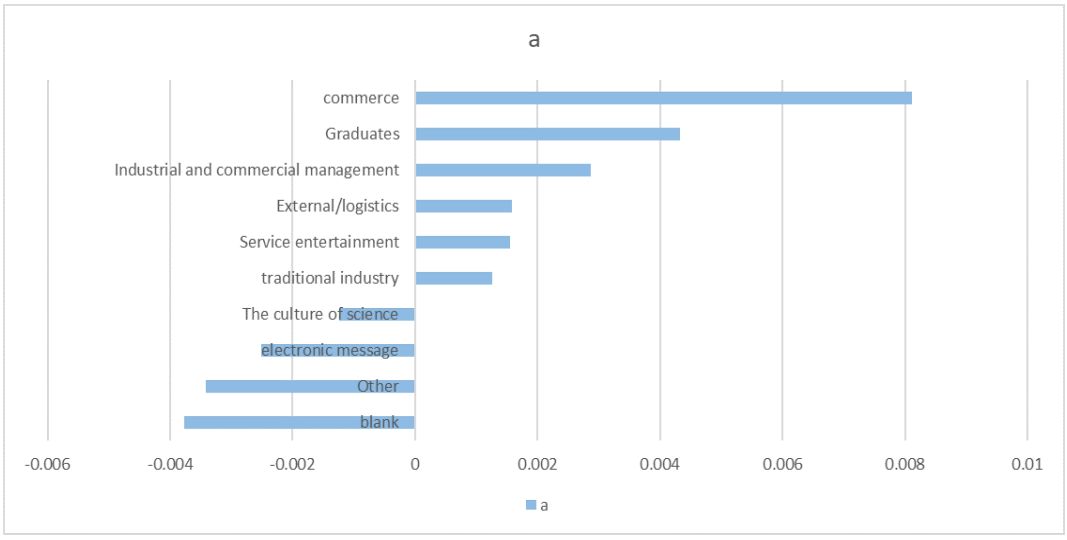
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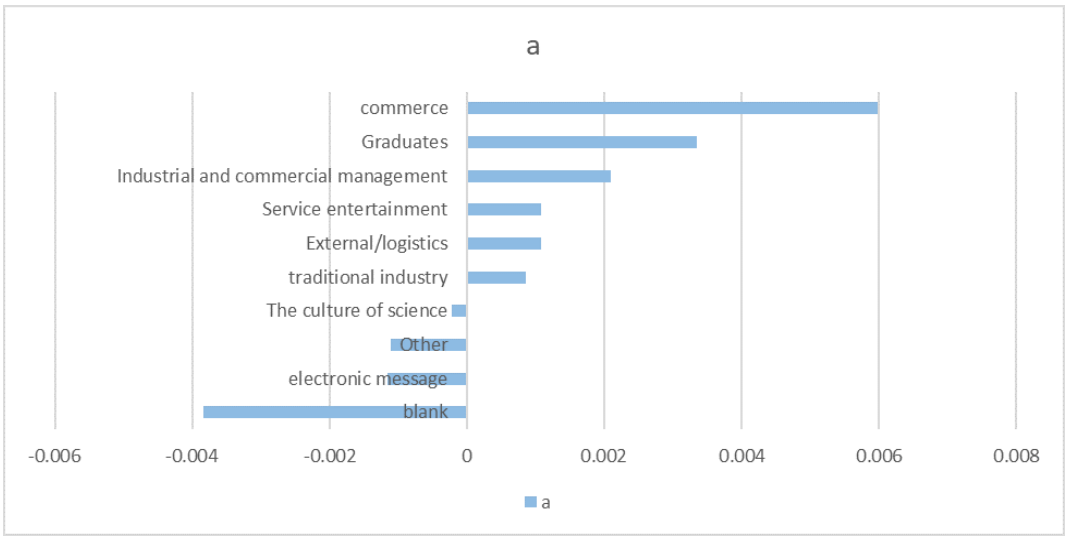
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talents are in great demand. Third on average. The administrative outlook is good.

4. Service entertainment, external/logistics, traditional industry, the culture of science: both proportion demand and quantity demand change slightly. Average demand was also relatively flat with no significant difference.

5. Electronic message is quantized. The distribution of proportional type and average type is the lowest. The number of jobs is also decreasing, indicating that the development is not good.

In conclusion:

1. The development situation of hi-tech industry development of a-city is not very good.
2. Economic position rises steadily with a good prospect.
3. The administrative category should be in a place with a high administrative status and a good prospect of business administration, which may be a first-tier or second-tier city.
4. Based on the above, a-city can be basically judged to be located in northeast China.

4.4 The model of Question 4

4.4.1 The results of the model

Table 1: The Employment Report for College Students

	Work	Self-employed	Enlisted in army	Entrance	Unemployed & others
2017	78.7	2.9	0.4	10.8	7.2
2016	78.8	3	0.4	10.3	7.5
2015	78.9	3	0.5	10.1	7.5
2014	80.6	2.9	0.4	8.9	7.9
2013	81.8	2.3			7.9
2012	82.4	2			8.5
2011	82.1	1.6			9.3
2010	83.5	1.5			9.9

Statistical data shows that the educational structure of graduates in China is basically stable every year. In the past five years, the proportion of higher vocational college graduates, undergraduate graduates and graduate graduates has basically maintained at 5:14:1. However, the scale of graduates is increasing year by year. For example, the largest proportion of undergraduates is increasing by an average of 200,000 per year. Even if only about 5.6% of graduates are graduates, the number of graduates will increase by 120,000 to 20,000 per year. From the current policy point of view, the scale of undergraduate graduation will continue to grow in the future.

From the table above, we can further find that, the flow direction of college graduates has reached stability after five years of development since 2010. Over the past

Table 2: National Statistical Bulletin on the Development of Education

	higher vocational college graduates	undergraduate graduates	graduate graduates
2017	247.04	735.83	57.8
2016	244.47	704.18	56.39
2015	236.26	680.89	55.15
2014	221.23	659.37	53.59
2013	199.77	638.72	51.36

four years, the proportion of fresh job seekers has basically stabilized at about 80% and fluctuated on a small scale considering the annual increase of the current student base. In the future, the scale of fresh job seekers will continue to expand. In addition, with Prime Minister Li Keqiang's call for "Mass entrepreneurship and Innovation" at the Summer Davos Forum, the proportion of new graduates who are engaged in independent entrepreneurship has also reached about 3% after several years of climbing and maintained in the past two years. It is worth noting that nowadays, the graduation trend of college students has become more diversified. Recruitment, civil service exams, college students and village officials have become another choice for new students. However, the proportion of students who make such choices is not high, and in recent years it has also shown a certain downward trend. The report shows that in 2015, there were 13,7898 college graduate Village Officials on the job. In 2016, the number dropped to 102,563. Under the background of the expansion of graduate scale, the decline of the number of village officials on the job reflects that more graduates are going to work and start their own businesses.

To sum up, we have observed that the structure of the flow of graduates has been stable. However, in the future, there will be more graduates who hope to get the opportunity and support of entrepreneurship. We suggest that A-city should set up an innovative industrial park and increase the introduction of innovative talents. While meeting the needs of current students, we should create an innovative image of the city, enrich the industrial culture of the city, influence the innovative atmosphere of the city, and promote the development of urban technology.

4.5 The letter written to the school authorities

As students of computer science department of our school, we have recently made a series of analysis on the employment situation of college students and want to take the liberty of express some views on the professional construction of our school. Computer-related fields are currently more important and popular areas and its talent gap is relatively large at the same time. In order to improve students' professional quality and better meet the needs of the industry, we have the following ideas.

First of all, we found that in recent years, both industry and academia had paid much attention to artificial intelligence. Many start-ups related to AI were also founded in the AI related directions and became industry unicorns, the most representative among which are Deephi Technology, SenseTime and so on. However, there are not many courses about AI in the school curriculum. Considering the complexity of the field of artificial intelligence itself, it is not suitable for general opening. And we believe

that schools can set up artificial intelligence professional classes specifically targeted at cultivating high-level talents in the AI field in order to meet the needs of the era.

Secondly, we have noticed that the positions of semiconductor electronics and relevant professions have also increased in recent years. Software and hardware are interdependent. In recent years, the development of computer field, especially artificial intelligence, has put forward higher requirements for the computing ability of computers, which also accelerates the development of computer hardware field. We can see that Intel, NVIDIA, AMD and other companies have continuously introduced a new generation of hardware devices to increase the computing ability of computers in recent years. As the basis of the hardware field, the integrated circuit industry has also become the focus. Overseas, Xilinx, a giant in the field of FPGA, has introduced several ASIC chips for large-scale computing, and in China, Cambricon, a chip company, has gradually risen. Currently, the integrated circuit industry in each region of our country, besides Jiangsu, are very weak and they all badly need to be strengthened. The development of integrated circuit industry, which is closely related to computer, needs talents with computer literacy. Therefore, we believe that the cultivating talents of computer can increase investment in the training of computer hardware and the optional courses on semiconductor and integrated circuit should be offered to enable computer hardware-loving students to contribute wisdom to the computer hardware and integrated circuit industry better after graduation.

Thirdly, the academic and industrial circles of computer specialty have different requirements for students' abilities. For example, teamwork ability and good code style are very necessary in industry. However, this is not the concern of academics. We also found that many students' programming style is very confusing. Such students will not be favored by enterprises when they are employed. Therefore, we hope that school, through social practice, internship, inviting enterprise lecturers to give lectures and so on, can make students have more opportunities to contact with enterprises and improve their soft skills.

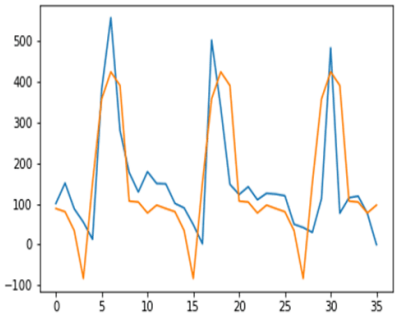
5 Model checking

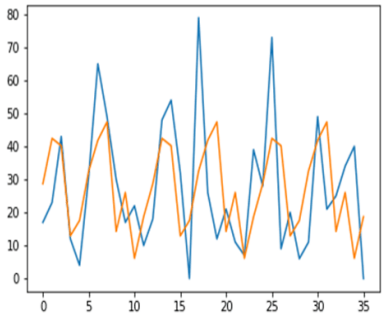
FFT rationality test

The accuracy of FFT algorithm is related to the sampling rate, which is related to the sampling density in this paper. However, due to less data and lower sampling density, the result may be inaccurate. Therefore, it is a necessary step to judge the degree of fitting between the two. In this paper, residual analysis is used to determine the degree of fitting.

For example: profession HR, confidence c=s=0.36

Profession Computer Hardware, confidence c=s=0.09





6 Model evaluations

6.1 Strengths of the model

- When quantifying talent demand, this paper adopts two different quantization methods, and the final result is more reasonable.
- By analyzing the fitting effect of FFT algorithm, this paper classifies occupations according to their periodicity.The algorithm of FFT periodic separation with 3 times frequency is used to predict the periodicity effectively.
- This paper quantifies the degree of dependence between profession and education level, which fully guarantees the accuracy of correlation between profession and education level.

6.2 Weaknesses of the model

- Although the paired comparison matrix of multi-attribute decision making in this paper does not have a great impact on the final ranking, when the influencing factors are increased to three, the value of the paired comparison matrix will have a great impact on the final ranking.
- In the calculation of education factor, although the data and multi-attribute decision making are well combined, the principle is relatively complex.

6.3 Improved method

- What needs to be improved most in this paper is the model of talent demand algorithm.Although multi-attribute decision making can well quantify the talent demand composed of two factors, when the number of factors increases, neural network algorithm can be used to train multiple influencing factors with known data, and finally a more reasonable algorithm can be obtained.

References

[1] *National Statistical Bulletin on the Development of Education*

[2] *Report on the Development of College Student Village Officials in China from 2016 to 2017* School of information science and Engineering, 2011.6.25

[3] *Employment Report of Undergraduates in China,Social Science Literature Publishing House*

Appendices

The code of principal component analysis:

```
def fourier(list, name, save_flag=False):
    y = np.array(list)
    x = np.arange(0, 1.0, 1.0/len(y))
    yy = fft(y)
    yreal = yy.real
    yimag = yy.imag
    xlist = np.arange(0, 1.0, 1/len(y))
    ylist = []
    for x in xlist:
        yyy = 0
        for item in range(0, len(yreal), 3):
            yyy += np.sqrt(yreal[item]*yreal[item]+yimag[item]*yimag[item])/
                len(y)*np.cos(2*np.pi*item*((x)-0.2)+np.arctan(yimag[item]/
                yreal[item]))
        yyy -= 0.5*np.sqrt(yreal[0]*yreal[0]+yimag[0]*yimag[0])/len(y)*np.cos
            (2*np.pi*0*(x)+np.arctan(yimag[0]/yreal[0]))
        for item in range(0, len(yreal), 3):
            yyy += np.sqrt(yreal[item]*yreal[item]+yimag[item]*yimag[item])/
                len(y)*np.cos(2*np.pi*item*((x)+0.2)+np.arctan(yimag[item]/
                yreal[item]))
        yyy -= 0.5*np.sqrt(yreal[0]*yreal[0]+yimag[0]*yimag[0])/len(y)*np.cos
            (2*np.pi*0*(x)+np.arctan(yimag[0]/yreal[0]))
        ylist.append(yyy/2)
    ymean = y.sum()/len(y)
    #plt.plot(xlist, ylist)
    ylistmean = sum(ylist)/len(ylist)
    multy = []
    for item in ylist:
        multy.append(item*float(ymean/ylistmean))
    delta = [(y[i]-multy[i]) for i in range(len(y))]
    under = sum([(y[i]-ymean)**2 for i in range(len(y))])
    up = sum([delta[i]**2 for i in range(len(y))])
    if save_flag:
        fig = plt.plot(xlist, y)
        fig = plt.plot(xlist, multy)
        plt.savefig("image/Fourier/"+name.replace('/', '_')+".png")
    plt.show()
    return 1-up/under
```