Talent Demand Forecasting Model with Practicability Based on the Theory of ARIMA

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Abstract. The urban development depends on talents, meanwhile, different types of talent demand affects the development direction of a city. The actual talent demand is affected by many factors, and can reflect the economic capacity of a city to a certain extent. Our goal is to predict the potential talent demand of A-City in the next three years. First, we establish a multiple regression model and come to the conclusion that the relationship between talent demand and job demand is linear and desired profession has a positive effect on talent demand while desired educational background has a negative effect on talent demand. Based on the above analysis results and the theory of ARIMA, we establish a talent demand forecasting model. Finally, we predict the talent demand and three factors of A-City in the next three years.

Keywords: Multiple regression model; ARIMA.

1. Introduction
Inviting wits and attracting talents is one of the highlights for many cities over the past couple of few years [1]. Beijing, Shanghai, Wuhan, Chengdu, Xi’an, and Shenzhen are actually competing for talents with various policies [2]. 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 [3]. As talent demand is closely related to urban development, it is crucial to establish a model to evaluate talent demand to ensure the sustainable and stable development of cities [4].

2. Basic Assumptions About A-City
(1) Suppose that A-City is located in China.
Assume that the collected data on talent demand in A-City are accurate.

3. Model Establishment
3.1. Multiple Regression Model
Firstly, we define two variables: \( f_{ob} \) and \( f_{ob} \). 
dp is the ratio of tpp and trp:

\[ f_{dp} = \frac{tpp}{trp} \]  

(1)

eb is the ratio of tpp and tdp:

\[ f_{eb} = \frac{tpp}{tdp} \]  

(2)

\( tpp \) is total posts, \( trp \) is total recruiters, \( tdp \) is total demand. Through data quantization and processing, we can know that the influence of expected occupation and education background on talent demand is far less than that of employment demand. Therefore, we first used MATLAB for image analysis of talent demand and employment demand, and determined that the two comply with the linear relationship. According to the obtained expectation occupation and expectation education background, the linear relationship between talent demand and the three is:

\[ F_{sw} = \sum_{j=1}^{n} p_{sw} \times (K_1 \times \sum_{e=1}^{n} f_{sw} + K_2 \times \sum_{e=1}^{n} f_{sw}) \]  

(3)

\( p_{sw} \) is job demand. SPSS software is used for multiple linear regression analysis of the three data sets, and \( K_1 \) and \( K_2 \) values can be calculated by assuming the expressions[5]. Then, we make curve fitting for talent demand and work demand, and obtained the results shown in Figure 1.

![Figure 1](image.png)

**Figure 1** The relationship between job demand and talent demand.

In Figure 1, we can find there’s a linear relationship between job demand and talent demand. The curve fitting coefficient \( k \) is 0.1293. Then, we use the software SPSS to get the related coefficient \( k_1 \) and \( k_2 \).
From Figure 3, we can see that the talent demand doesn’t completely obey the normal distribution. In other words, the multiple linear regression exists error. Finally, we can get $k_1:0.965$ and $k_2:-0.087$. We randomly put a set of data ($x_0=1$, $y_0=13.09$) into multiple regression equation and then we can get the coefficient $k=0.098$. The error is 0.0313.

The final multiple regression equation can be expressed as:

$$
F_{id} = \sum_{d=1}^{n} p_{id} \times (0.141 \times \sum_{e=1}^{n} f_{ie} - 0.011 \times \sum_{e=1}^{n} f_{ie})
$$

From the equation, we can come to the conclusion that the relationship between talent demand and job demand is linear and desired profession has a positive effect on talent demand while desired educational background has a negative effect on talent demand. In other words, the higher the desired profession is, the lower the talent demand is needed.

### 3.2. Talent Demand Forecasting Model

Based on the above model analysis results and through the search and application of data, we can get the total number of students employed in China and the number of Chinese students entering the talent market. The multivariate fitting analysis is carried out by using Matlab and it is concluded that both of them follow a certain functional relationship, and thus infer that this relationship can express the
influence coefficient of a city on the employment situation of the whole country[6]. Therefore, we can build up the actual talent demand of A-City equal to the number of people who enter the job market in A-City and the number of people who do not enter the market in A-City.

\[ P_{ad} = p_{ip} + K_1(p_{cd} - p_{cud}) \] (5)

\( P_{ad} \) is talent demand in China market, \( K_1 \) is defined as the coefficient of influence of municipality A-City on the national employment situation. The total number of Chinese students employed and the number of Chinese entering the talent market can be determined by entering the website of Chinese human resources market. Because of this dynamic quantity is related to time, we choose ARIMA model (time series model) to analyze it. The demand for talents of various industries in each year, talents tend to enter the industry development, and the industry's tendency to education level of talents can be regarded as a random time series formed with the passage of time. Through the randomness, stationarity, seasonality and other factors of the potential talent demand on this time series. Based on the ARIMA Model, we can predict the job demand and talent demand varied from industries to industries in the next three years[7].

| Forecast | Model | 2019 | 2020 | 2021 |
|----------|-------|------|------|------|
| Sales management | Forecast | .009112690 | .0277068 | .02172668 |
| Translation | Forecast | .0005389 | .0009007 | .00112027 |
| Legal profession/law | Forecast | .0070356 | .0071493 | .00715424 |
| PRs and news media | Forecast | .0079969 | .0079969 | .0079969 |
| Science&Technology | Forecast | .001012724 | .001012724 | .001012724 |
| Fashion/textile/furs | Forecast | .003444014 | .004621701 | .005481011 |
| Advertising | Forecast | .003294034 | .003287527 | .003240616 |
| Senior management | Forecast | .00496554 | .00496554 | .00496554 |
| Literature/screenwriting/ Writing | Forecast | .008003507 | .0050218 | .00201311 |
| Computer hardware | Forecast | .001592207 | .001592207 | .001592207 |
| Procurement | Forecast | .002515539 | .002878260 | .003059182 |
| Movies, TV and recreation | Forecast | .00449716 | .005491562 | .006513406 |
| Trade | Forecast | .002035763 | .002835763 | .002835763 |
| Banking | Forecast | .007603482 | .008438043 | .011364204 |

Note: Since the paper is limited, we only give part of the whole data.

**Figure 4.** Job demand and talent demand.

From Figure 4, we can divide these industries into three parts. The first part, the talent demand of sales and some other industries has a downward trend. The second part, such as senior management and legal profession/law maintain the fluctuation within a certain range so that they are almost the same in the next three years. The third part, such as IT-Management and banking has a upward trend. Although the job demand of sales and sales management is high, the trend is down. Some industries such as IT-Management and banking, are chosen by more and more people in the next three years. A-city needs more and more people above bachelor. The employees above bachelor are easier to get the job. Some of the important result prediction views are shown below.
Figure 5. The talent demand of sales.

Figure 6. The job demand of sales management.

Figure 7. The job demand of banking and construction.
We can obtain the talent demand of China in the next three years by using ARIMA Model and the tendency of the talent demand is decreasing. As shown in the Figure 9 and Figure 10, the correlation between China and A-City is closely related. In other words, the prediction of A-City is rational.

**Figure 8.** The job demand production.

**Figure 9.** The talent demand of China and A-City.

**Figure 10.** Comparison between China and A-City.
4. Strength and Weakness

4.1. Strength
(1) We established the multiple regression model reasonably and build a rational relationship between talent demand and desired profession, desired educational background.
(2) We set a proper linear coefficient K which can intuitively reflect that the actual talent demand of A-City and China.
(3) The ARIMA Model we choose can perfectly predict the talent demand which is related with time. We also predict the talent demand of China. Then, we compare and verify the double so that the result of modeling is more practical.

4.2. Weakness
(1) Since the data has certain error and one-sidedness, we only establish the multiple linear regression model. However, the practical model may be difficult non-linear relationship.
(2) The talent demand forecasting model has some limitations and is not applicable to special cities with abnormal changes of talent demand and national development.

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