

Evaluation of Multi-level Employment Psychological Pressure among College Students Based on Dynamic Optimization Models

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Abstract: In universities, the primary task of vocational education is to cultivate students' ability to adapt to social work, so employment is very important for college students. They need to think about how to find a job and how to apply what they have learned to their work. Employment is a huge psychological burden for college students, especially in the current labor market where many people are unable to find their ideal jobs, which has a certain impact on their psychology, such as conflicts, anxiety, depression, etc. Psychological problems have a significant impact on their employment and even mental health. Therefore, establishing a correct career choice perspective, cultivating various psychological qualities, and maintaining a good psychological state for college students in their career, as well as making effective adjustments to themselves, plays a very important role in their future. Therefore, this article attempted to use the GA-BP (genetic algorithm-back propagation) algorithm to construct a dynamic optimization model for evaluating the multi-level employment psychological pressure of college students. Firstly, the influencing factors of employment psychological pressure of college students were obtained from a large number of literature, and then the various influencing factors of students were investigated and collected as sample data for the GA-BP algorithm. The experiment showed that the combination of GA algorithm and BP algorithm could achieve the highest accuracy in predicting the employment psychological pressure of college students. The average accuracy of the three training results was 0.9, which was higher than the optimized accuracy of momentum algorithm, LM algorithm, adaptive algorithm, and CG algorithm.

1. Introduction

The fundamental goal of talent cultivation in universities is to serve society, so employment is of great significance to college students. How to choose a career and how to combine the knowledge learned with practical work is a question worth considering. Employment has caused great psychological pressure on college students, especially in the current severe employment

environment, which can easily lead to negative psychological problems such as conflicts, anxiety, and depression. Psychological problems have a significant impact on their employment and even mental health. Therefore, it is important to help them establish a correct career outlook, comprehensively improve their psychological quality, maintain a good psychological state, and make effective adjustments in their employment goals and psychology, which is of great significance for their future.

In Chapter 3, this article introduces the BP algorithm, GA algorithm, and multi-level employment psychological stress assessment for college students based on BP-GA algorithm. In Chapter 4, the experimental results of the employment psychological stress assessment for college students using this algorithm are presented, and a summary of the entire article is made.

2. Related Works

For psychological stress assessment, relevant experts have long conducted specialized research on this topic. Sprung J M used a cross-sectional survey design to evaluate work life balance, perceived stress, anxiety, and depressive symptoms. The path analysis results indicate that perceived stress fully regulates the relationship between work life balance and anxiety, as well as the relationship between work life balance and depressive symptoms [1]. To explore the correlation between college students' employability, learning engagement, and learning pressure, Ma Y used a structural equation model to explore the trust level of college students in various employability characteristics, and analyzed its relationship with factors such as learning engagement and cognitive stress. Research has found that there is a positive relationship between college students' understanding of employment and their engagement in learning, while there is a negative relationship between their perceived pressure [2]. Peltz J S conducted moderated mediation analysis using an online questionnaire based on cross-sectional self-report. The results showed that an increase in working hours predicted greater sleep disorders, which in turn predicted more depressive symptoms [3]. Lin C H conducted a quantitative study on athlete fatigue using the Sports Fatigue Scale and a three-dimensional model. Through empirical research on job burnout, it was found that there is a significant correlation between job burnout and work pressure. The r values for the dimensions of athlete stress, individual and overall work fatigue were 0.402-0.532. The relationship between stress and decreased sense of achievement was closest among participants of different ages and levels of exercise [4]. von Keyserlingk L aimed to explore the impact of the epidemic on academic stress among college students, and to explore the effects of individual, environmental, and other factors on academic stress among college students. Through multiple regression analysis, it was found that the level of tension among students generally increased before and after the epidemic. Students whose mental health is severely damaged due to limited educational time experience increased stress [5]. The existing psychological stress assessment techniques are only qualitative research, and there are few quantitative psychological assessments related to college students.

3. Methods

3.1 BP Algorithm

BP neural network is a multi-layer feedforward neural network based on error backpropagation algorithm [6-7]. When the network is working, it adopts a layer by layer forward operation method, and corrects parameters such as weights and thresholds through the reverse transmission of error signals until the output error of the network is controlled within the expected range. The advantage of this method is that it can automatically learn suitable sample sets and obtain reasonable rules

between data, as shown in Figure 1 [8-9].

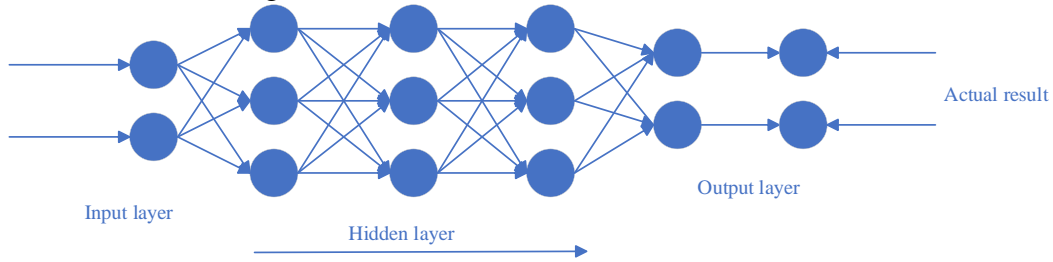


Figure 1: Neural Network Architecture

3.2 GA Algorithm

Genetic algorithm is a widely used computer model that simulates the process of biological evolution based on the genetic and natural selection mechanisms in Darwin's theory of biological evolution [10-11]. The basic process of genetic algorithm is as follows. Generally speaking, the following strategy can be used to determine the initial population: (1) based on the internal knowledge of the problem, the optimal solution is attempted to understand the spatial distribution area in the entire problem space, and then within this distribution area, the initial population is determined. (2) Several individuals are randomly generated and the best individual is selected to join the initial population [12]. As shown in Figure 2, this process is repeated until the number of individuals in the initial population reaches the predetermined size.

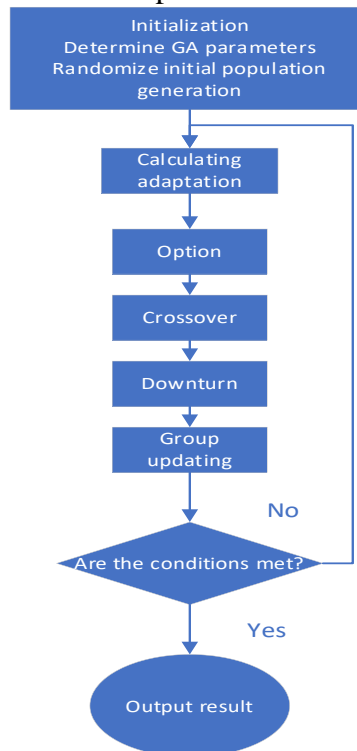


Figure 2: GA algorithm flowchart

3.3 Evaluation of Multi-level Employment Psychological Pressure among College Students Based on BP-GA Algorithm

In order to better construct a multi-level employment psychological stress assessment model for college students based on the BP-GA algorithm [13], this article reviews a large number of literature related to the psychological pressure of employment among college students and summarizes four main influencing factors, namely family pressure, personal pressure, and professional pressure, as well as academic pressure, as shown in Table 1 [14-15]. The four main influencing factors are divided into three evaluation indicators. The maximum score for the conformity of evaluation indicators is 100 points. The experiment uses the basic indicators of employment pressure among college students in Table 1 as the main questions of the questionnaire survey [16].

Table 1: Basic indicators of employment pressure for college students

| Measurement Variables | Evaluation indicators |
|-----------------------|---|
| Family stress | Poor professional background of parents X1 |
| | The family's economic base is not good X2 |
| | Parents' social status and family network are not very helpful to my work X3 |
| Self-stress | My own lack of social practice experience X4 |
| | My language skills are not good enough X5 |
| | My interpersonal skills are not good enough X6 |
| Professional stress | My major program does not match the needs of the society, which makes it difficult for me to get a job X7 |
| | The employment rate of my major or the corresponding majors in the past is not good X8 |
| | The development prospect of my major is not optimistic X9 |
| School stress | The school does not publicize the graduates well X10 |
| | The school's career guidance education is not good X11 |
| | The quality of education in the school is not good X12 |

In addition to Table 1, further psychological health measurements are conducted on the target group of college students, and sample data are obtained. The specific psychological dimensions of the college student mental health questionnaire are shown in Table 2 [17-18].

Table 2: Psychological dimensions of the Chinese college student mental health scale [19-20]

| Serious psychological problems | General psychological problems | | General stress and adaptation to perimeter disturbance |
|--|--------------------------------------|--------------------------------------|--|
| Suicidal intent 8 | Internalizing psychological problems | Externalizing psychological problems | |
| Hallucinations, delusional symptoms ⁹ | Anxiety 1 | Dependency | School adjustment difficulties |
| | Depression 2 | Hostile aggression | Interpersonal relationship troubles |
| | Paranoia ³ | Impulsivity | Academic stress |
| | Low self-esteem ⁴ | Obsessive-compulsive | Employment stress |
| | Sensitivity ⁵ | Internet addiction | Relationship problems |
| | Social fears ⁶ | Self-injurious behavior | |
| | Somatization ⁷ | Eating problems | |
| | | Sleep disturbances | |

When applying the GA-BP algorithm, which combines the GA algorithm and BP algorithm, to neural networks, the GA genetic algorithm and BP neural network are first used to search for the optimal solution and local weight distribution space. Then, based on the BP algorithm, the optimal solution is searched in this space, overcoming the limitations and inaccuracies of pure BP training algorithms in searching for weight distribution space and optimal solution, making the GA-BP neural network algorithm a global optimization algorithm that changes according to natural selection and genetic laws, greatly improving the practicality and universality of the GA-BP neural network algorithm [21-22].

The process of modeling the employment psychological pressure of college students using GA-BP neural network in the experiment is as follows:

In the process of establishing a BP neural network, MATLAB is used to model the BP neural network, and the GA algorithm GAOT (Genetic Algorithm Optimization Toolbox) toolbox is applied in practical applications. The first step is data preprocessing. In order to accelerate the convergence speed of the network, the `premnmx` function is used to standardize the original data in the MATLAB environment. Meanwhile, the predicted data and samples obtained are preprocessed using `trammx`. Next is the selection of the network structure for the GA-BP neural network algorithm. By adding the number of hidden layers, the algorithm can improve its accuracy, but it can also increase the algorithm load, slow down learning speed, and make convergence difficult. At the same time, through the study of the learning process of traditional three-layer neural networks, it is found that better output results can be obtained by selecting the appropriate number of neurons and excitation functions [23]. Therefore, this article proposes a three-layer network structure. Finally, in the selection of excitation functions, BP neural network is a non-linear algorithm, and in the MATLAB environment, `Tansig` can be selected as the excitation function for the neural network structure. The `pureline` function is introduced in the output layer to ensure the continuity of the output.

4. Results and Discussion

4.1 Experimental Preparation

This study used a self-designed basic information questionnaire to collect basic background information of 2022 college students at the university, including their student ID, gender, age, ethnicity, major, and other basic information. The collection of basic background information is mainly for the convenience of data analysis after psychological surveys, as well as targeted tracking of students with psychological crises.

The symptom self-assessment scale used in this study is one of the most famous and widely used mental health measurement scales. This scale has a total of 90 items, based on the actual employment experience in the past week, to comprehensively evaluate an individual's recent mental state from aspects such as daily life, emotional changes, and thinking awareness. The psychological stress measurement scale has a 5-level rating for each item (1="none", 5="severe"), and the results can be divided into 12 factors, which can clearly display whether an individual has psychological symptoms and the severity of psychological symptoms.

To test the effectiveness of the multi-level evaluation model for employment psychological pressure among college students based on the GA-BP algorithm, 300 college students enrolled in 2022 were selected, including 212 males and 88 females, and 104 psychological health problems were identified in advance. The data was sourced from the school's College Student Mental Health Scale. According to the total score of the psychological measurement scale and the traditional Chinese model of mental health assessment guidelines and their correlation, the mental health of college students was divided into nine dimensions: mental illness, delusions, phobia, hostility,

depression, anxiety, interpersonal sensitivity, compulsion, and somatization. The evaluation criteria for the psychological health of college students in employment are shown in Table 3.

Table 3: Part of experimental data on the relationship between employment psychological stress indicators and influencing factors

| Number | X1 | X2 | X3 | X4 | X5 | ... | X12 | Y |
|--------|-------|-------|-------|-------|-------|-----|-------|---|
| 1 | 91.44 | 34.37 | 60.18 | 7.75 | 26.49 | ... | 44.18 | 7 |
| 2 | 31.14 | 84.2 | 12.32 | 56.47 | 41.95 | ... | 73.14 | 1 |
| 3 | 59.97 | 30.16 | 4.48 | 54.63 | 19.56 | ... | 79.37 | 6 |
| 4 | 24.76 | 60.43 | 50.04 | 85.86 | 46.91 | ... | 99.9 | 7 |
| 5 | 53.31 | 27.36 | 21.25 | 35.97 | 11.6 | ... | 82.54 | 8 |
| 6 | 20.98 | 52.81 | 66.83 | 15.38 | 52.53 | ... | 71.06 | 2 |
| 7 | 90.4 | 79.96 | 71.07 | 92.08 | 73.79 | ... | 46.71 | 5 |
| 8 | 70.6 | 38.8 | 0.2 | 75.57 | 35.39 | ... | 21.24 | 4 |
| 9 | 22.5 | 18.72 | 38.09 | 49.97 | 72.67 | ... | 77.29 | 2 |
| 10 | 58.3 | 68.51 | 90.63 | 49.13 | 97.76 | ... | 58.22 | 4 |
| 11 | 9.96 | 0.69 | 76.24 | 86.49 | 30.16 | ... | 52.92 | 2 |
| 12 | 40.9 | 29.11 | 36.67 | 54.5 | 68.47 | ... | 93.73 | 3 |
| 13 | 6.96 | 0.99 | 68.96 | 71.27 | 44.28 | ... | 33.25 | 2 |
| 14 | 97.39 | 70.11 | 63.69 | 21.88 | 75.37 | ... | 67.76 | 3 |
| 15 | 85.38 | 4.5 | 11.72 | 48.06 | 59.49 | ... | 71.63 | 5 |
| 16 | 5.69 | 34.37 | 98.11 | 23.87 | 61.68 | ... | 89.67 | 9 |
| 17 | 44.16 | 62.77 | 48.15 | 82.08 | 59.36 | ... | 16.38 | 3 |
| 18 | 53.75 | 27.2 | 9.52 | 81.13 | 85.82 | ... | 56.83 | 1 |
| 19 | 28.37 | 89.38 | 6.5 | 93.37 | 0.51 | ... | 99.96 | 3 |
| 20 | 31.76 | 26.39 | 27.95 | 19.57 | 68.34 | ... | 74.72 | 3 |
| 21 | 45.3 | 27.5 | 40.57 | 84.57 | 31.32 | ... | 19.39 | 1 |
| 22 | 90.95 | 70.58 | 33.37 | 37.43 | 79.96 | ... | 16.67 | 7 |
| 23 | 5.54 | 38.03 | 87.16 | 91.98 | 11.51 | ... | 2.4 | 4 |
| 24 | 90.59 | 43.37 | 16.76 | 13 | 24.26 | ... | 60.12 | 8 |
| 25 | 31.42 | 66.35 | 78.58 | 66.59 | 2.58 | ... | 7.82 | 8 |
| 26 | 37.67 | 7.67 | 50.37 | 91.94 | 96.29 | ... | 31.35 | 5 |
| 27 | 63.32 | 30.54 | 24.76 | 8.38 | 28.29 | ... | 48 | 1 |

4.2 Network Parameter Settings and Testing

The number of neuron nodes contained in the hidden layer of a BP neural network can reflect the overall nonlinearity, but it is difficult to determine the optimal number of hidden layer nodes when setting parameters. If there are too many hidden layer nodes, not only would it slow down the learning speed of the network, but it is also prone to overfitting; if the number of hidden nodes is too small, it would cause the training and application of the entire network to fail. By analyzing the accuracy of the sampled data, the degree of influence of each node number on the model was determined, thereby determining the optimal number of hidden layer nodes.

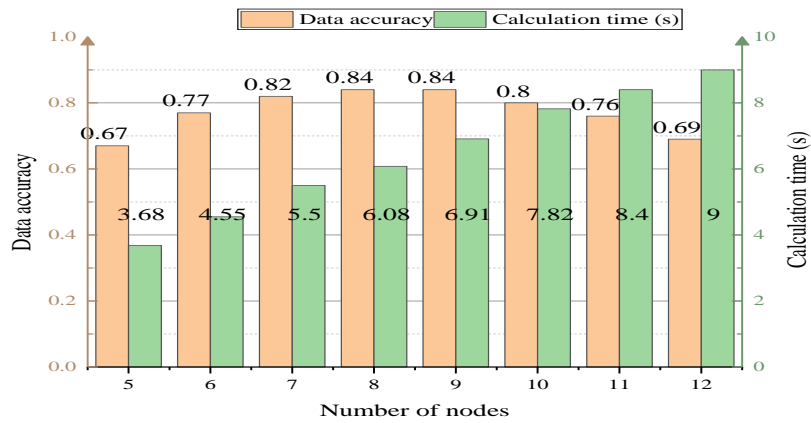


Figure 3: Algorithm accuracy and computation time for the number of nodes in different hidden layers

From Figure 3, it can be seen that when the number of nodes increased from 5 to 12, the accuracy of the data increased from 0.67 to 0.84, and then decreased to 0.69. The complexity of the algorithm increased due to the increase in the number of nodes, and the calculation time of the algorithm continued to increase, from 3.68 seconds to 9 seconds. In order to achieve short computation time and high accuracy of the algorithm's output results, it can be seen from the graph that when the number of nodes was 8, the computation time of the algorithm was 6.08 seconds, with an accuracy of 0.84, which was the optimal number of hidden layer nodes (because the accuracy was the highest, the computation time was only 0-2.4 seconds higher than the number of nodes 5, 6, and 7).

4.3 BP Algorithm Models with Different Learning Methods

In order to find the most suitable learning method for this study, a level evaluation dataset of student employment psychological pressure was selected to test the incremental momentum algorithm, BP-GA algorithm, adaptive learning algorithm, CG (Conjugate Gradient) algorithm, and LM (Levenberg Marquardt) algorithm. Through network training, the model was randomly selected for testing, and the accuracy of different learning methods in predicting the test dataset was compared. The results are shown in Figure 4.

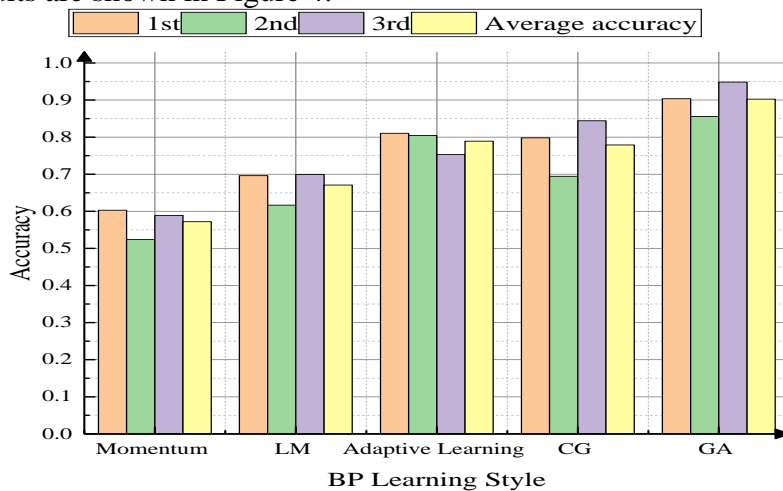


Figure 4: The accuracy of the BP algorithm model for predicting employment psychological pressure among college students with different learning methods

In order to avoid the inaccuracy of the prediction model for college students' psychological stress caused by local optimization of the BP algorithm, different learning methods were used for optimization. As shown in Figure 4, the combination of GA algorithm and BP algorithm achieved the highest accuracy of the prediction model for college students' employment psychological stress. The average accuracy of the results of three training sessions was 0.9, which was higher than the optimized accuracy of momentum algorithm, LM algorithm, adaptive algorithm, and CG algorithm.

4.4 Comparison of GA Algorithm before and after Optimization of BP Model

Table 4: Comparison of prediction results between GA-BP model and BP model

| Model Diagnostic Results | | Corrects | Errors | Diagnosis rate (%) | Modelling time (s) |
|-----------------------------|-------------|----------|--------|--------------------|--------------------|
| Mental Health | BP Models | 130 | 26 | 97.53 | 3.2938 |
| | GA-BP model | 150 | 6 | 98.58 | 2.1587 |
| Psychological Abnormalities | BP Models | 131 | 13 | 97.27 | 3.6704 |
| | GA-BP model | 141 | 3 | 98.05 | 2.7982 |

The comparison results of the two detection models are listed in Table 4. The training time of BP neural network was 3.2938 seconds; after genetic algorithm optimization to reduce the input of the input layer, the training time of the GA-BP neural network was shortened to 2.1587 seconds. At the same time, the prediction results of the detection model have also significantly improved, with the diagnostic rate of mental health increasing from 97.53% to 98.58% after optimization, and the diagnostic rate of checking for psychological abnormalities increasing from 97.27% to 98.05%. The experimental results show that optimizing neural network algorithms can improve training accuracy, shorten training time, and provide a certain factual basis for schools to detect the psychological health of college students under employment pressure.

5. Conclusions

In recent years, with the continuous increase in the number of Chinese college students, the issue of college student employment has gradually become a focus of widespread attention from all sectors of society. On the one hand, the employment ability of many college students has not met expectations, and at the same time, their career planning is relatively vague. As graduation approaches, employment pressure gradually increases; on the other hand, the adjustment of China's industrial structure and the current situation of social development have put forward more requirements for the cultivation of high-quality and high skilled talents. College students with weak professional abilities and low comprehensive literacy are facing the dilemma of being eliminated in the fierce employment competition, and even unemployed after graduation. Therefore, this article discussed a multi-level evaluation model for employment psychological pressure among college students based on GA-BP. Relevant data on employment psychological pressure among college students was collected to create sample data for the mathematical model construction of GA-BP neural network. Finally, the feasibility of the algorithm was demonstrated through experiments.

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