

## **An Evaluation Model of Experimental Technicians' Job Satisfaction in Universities Based on Support Vector Machine**

Zhifeng Yao, Mintong Li<sup>a,\*</sup>

College of Mechanical and Electronic Engineering, Northwest A&F University, Yangling,

Shaanxi 712100, China

<sup>a</sup>71396474@qq.com

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*Abstract: Experimental technicians are important human resources in colleges and universities in china. Correctly mastering the trends of their job satisfaction represents an important prerequisite for colleges and universities to integrate and optimize the allocation of human resources. Based on the reconstruction of the evaluation system of the experimental technicians' job satisfaction degree, stepwise regression method was used to find out the main factors affecting the job satisfaction degree of experimental technicians according to the questionnaires. Based on this, the support vector machine evaluation model of job satisfaction degree was established. The results showed that the support vector machine possessed good accuracy of classification and operation speed, which could provide reference for the development of human resource strategy in colleges and universities.*

*Keywords: Experimental technicians, Job satisfaction, Stepwise regression method, Support vector machine (SVM)*

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### **1. INTRODUCTION**

The experimental technical team of universities integrates practical teaching, scientific research and service, and the management of instruments and equipment. It is responsible for the cultivation of students' innovative spirit and practical ability, the operation and service of scientific research platform of teachers, the maintenance and management of experimental equipment, which is an indispensable backbone in the teaching and scientific research work in Colleges and universities. The sense of profession belonging and the sense of happiness of the experimental technicians are directly related to the effectiveness of the teaching reform, the quality of personnel training and the scientific research process. Therefore, more and more universities in China begin to realize that accurately mastering the trends of the job satisfaction degree of experimental technicians is of great significance in the allocation of human resources in universities [1]. However, at present, there are few literatures aiming at the evaluation model

of job satisfaction, in which the main methods are the analytic hierarchy process [2] and fuzzy comprehensive evaluation method [3]. These methods are easily interfered by human factors and random fuzziness, which affects the accuracy of evaluation. To this end, in this paper, a comprehensive evaluation model based on support vector machine was introduced to analyze the job satisfaction degree of the experimental technicians in universities in China.

## 2. THE EVALUATION SYSTEM

Table 1 The evaluation system of the job satisfaction degree

First grade index	Second grade index	Third grade index
The overall job satisfaction degree of the experimental technicians in universities.(Y)	The work itself	the satisfaction degree of occupation(X <sub>1</sub> )
		sense of achievement in working(X <sub>2</sub> )
		the satisfaction degree of office equipment(X <sub>3</sub> )
		the satisfaction degree of working environment, facilitates and equipment, safety measures.(X <sub>4</sub> )
	Work reward	the satisfaction degree of current salary level(X <sub>5</sub> )
		the satisfaction degree of the distribution system of the allowance of experimental technicians.(X <sub>6</sub> )
		the satisfaction degree of current welfare policies ( endowment insurance, medicine insurance)(X <sub>7</sub> )
		the satisfaction degree of current salary level according to your ability and actual endeavour.(X <sub>8</sub> )
		the satisfaction degree of current salary level compared with other groups in school.(X <sub>9</sub> )
		the satisfaction degree of current salary level compared with your classmates and friends working in other companies.(X <sub>10</sub> )
	Promotion	the satisfaction degree of the promotion opportunities of the occupation and professional titles in laboratory.(X <sub>11</sub> )
		experimental technicians can be promoted by their capability.(X <sub>12</sub> )
		the satisfaction degree of the promotion mechanism of the professional titles of experimental technicians.(X <sub>13</sub> )
		the satisfaction degree of the appointment and promotion mechanism of the occupation and professional titles of experimental technicians.(X <sub>14</sub> )
		the satisfaction degree of the fairness of the quantitative assessment and evaluation of experimental technicians.(X <sub>15</sub> )
		the satisfaction degree of the relatively big development room for experimental technicians.(X <sub>16</sub> )
	Training	the opportunities to participate in outside training and academic exchange.(X <sub>17</sub> )
		the satisfaction degree of the promotion mechanism of experimental technicians' education background.(X <sub>18</sub> )
		the satisfaction degree of the participation in academy and scientific research.(X <sub>19</sub> )
	Interpersonal relationship	the satisfaction degree of the management ability and business level of direct superior.(X <sub>20</sub> )
		the satisfaction degree of the working responsibility and initiative of surrounding colleagues.(X <sub>21</sub> )
		the satisfaction degree of the communication and cooperation between colleagues.(X <sub>22</sub> )
		the satisfaction degree of the way that universities handle reasonable suggestions.(X <sub>23</sub> )
		the satisfaction degree of being respected when working in laboratory.(X <sub>24</sub> )

The job satisfaction degree of experimental technicians is a subjective, multi-level and multi index problem, which is affected not only by individual characteristics, such as ages, education, professional titles and values, but also by population characteristics, such as income and welfare. Accordingly, a three-level job satisfaction degree evaluation system was established in this paper. The first class index indicated the overall job satisfaction degree of experimental technicians. The second class index included 5 aspects: the work itself, work reward, promotion, training, and the relationship between colleagues. At the same time, each second class index included many third class indexes, and the content which the indexes expressed may be similar and not completely independent. The indexes were investigated by Likert five point scale scoring method. The satisfaction degree was divided into 5 grades: very satisfied, satisfied, general, not satisfied, very dissatisfied, which were assigned to 5, 4, 3, 2, 1. Details are shown in table 1.

### 3. SUPPORT VECTOR MACHINE THEORY

SVM is a kind of new machine learning method based on VC dimension theory and structural risk minimization principle[4]. It overcame many problems in traditional machine learning such as dimension disaster and local minimum point to a large extent, which has been applied successfully in many aspects including data mining, pattern recognition, intelligent evaluation and forecasting. Its basic idea is to map the vector quantity to a higher dimensional feature space through non-linear transformation by setting the appropriate kernel function. In this feature space, a plane in which the interval between different data point is the largest, that is the maximum interval hyper plane. In this paper, we used this model to evaluate the job satisfaction degree of experimental technicians:

$$f(x) = \text{sgn}(w^* \Phi(x) + b^*) = \text{sgn}\left(\sum_{i=1}^l a_i^* y_i \Phi(x_i) \bullet \Phi(x) + b^*\right) = \text{sgn}\left(\sum_{i=1}^l a_i^* y_i K(x_i, x) + b^*\right)$$

In this formula,  $f(x)$  indicates the job satisfaction degree of the experimental technicians and can be divided into 5 classes. The input signal  $x$  indicates the grade of the third indexes of the job satisfaction,  $w$  indicates the weight vector,  $b$  indicates the offset.

$$K(x, x_i) = \exp\left(-\frac{\|x - x_i\|^2}{2\sigma^2}\right)$$

indicates the radial basis function, in which  $\sigma$  indicates width

parameter,  $C$  is the penalty factor. Generally speaking, the SVM classification function is similar to a neural network in form, the output is a linear combination of intermediate nodes, and each intermediate node corresponds to a support vector, as shown in Figure 1.

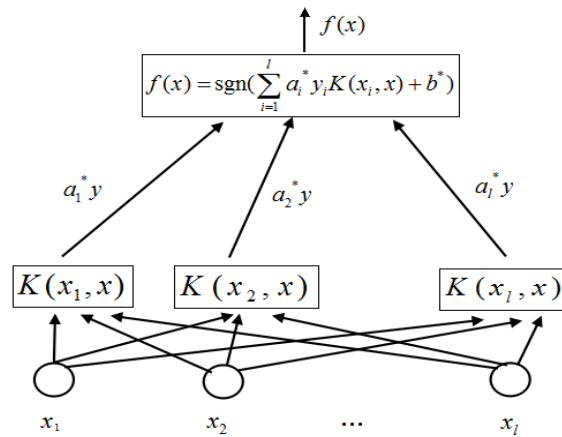


Fig.1. The structure of support vector machine (SVM)

## 4. THE EVALUATION MODEL

### 4.1 Sample source and pretreatment

The questionnaire, whose object was the experimental technicians in colleges and universities, was distributed in two forms including Wechat and online platform. The website was: <https://sojump.com/jq/9238774.aspx>. More than 200 pieces of questionnaires were collected from 13 provinces in china. In order to balance teachers' ages, professional titles, education background, degrees of satisfaction and other aspects, 126 samples were selected. Among them, 100 copies were randomly selected as training samples, and the other 26 as test samples.

### 4.2 The analysis of the affecting factors by stepwise regression method

The 23 dimensional factors (third class indexes) which affect the job satisfaction degree of the experimental technicians in colleges and universities expressed may be similar and not completely independent. Therefore, the stepwise regression method was used to eliminate the redundancy and reduce the influence of irrelevant factors on the evaluation model. The specific process was as follows: the contribution rate and cumulative contribution rate of each index were calculated, and the main influencing factors were extracted according to the contribution rate and the cumulative contribution rate. In order to highlight the interpretation ability of the model, a strict variable selection criterion was given: that is, when variable significance P value is less than 0.05, the index will be lead into regression equation; when it is greater than 0.1, the index will be removed from regression equation. If P is between 0.05 and 0.1, this variable quantity will be continuously pull in and removed until there will be no variable quantity be pull in or removed [5].

Through stepwise regression analysis by SPSS 22.0 software, we found that among the 23 dimensional factors affecting the job satisfaction degree of the experimental technicians, the 6 factors including the satisfaction degree of current salary level (X5), the satisfaction degree of

the appointment and promotion mechanism of the occupation and professional titles of experimental technicians (X14), the satisfaction degree of the relatively big development room for experimental technicians (X16), the satisfaction degree of the distribution system of the allowance of experimental technicians (X6), sense of achievement in working (X2), the satisfaction degree of being respected when working in laboratory (X24) made the most contribution to R2 , indicating that the experimental technicians paid more attention to the six factors. So the six factors were selected as the significant influencing factors of the job satisfaction degree of experimental technicians.

### 4.3 Model design

The model of the job satisfaction degree of the experimental technicians in colleges and universities based on SVM was built by Matlab2014a software and SVM tool case Libsvm. The model was composed of three layers, and the input layer was the 6 significant factors after the stepwise regression analysis, and the output layer was the 5 levels of satisfaction degree. In this paper, Radial Basis Function was made as the kernel function of SVM model. Because penalty factor C and kernel function parameter 'g' were the main factors influencing the classification performance of support vector machines, the K-fold cross validation were used to optimize parameter 'c' and 'g'. The results of the optimization of the parameters were shown in figure 2.

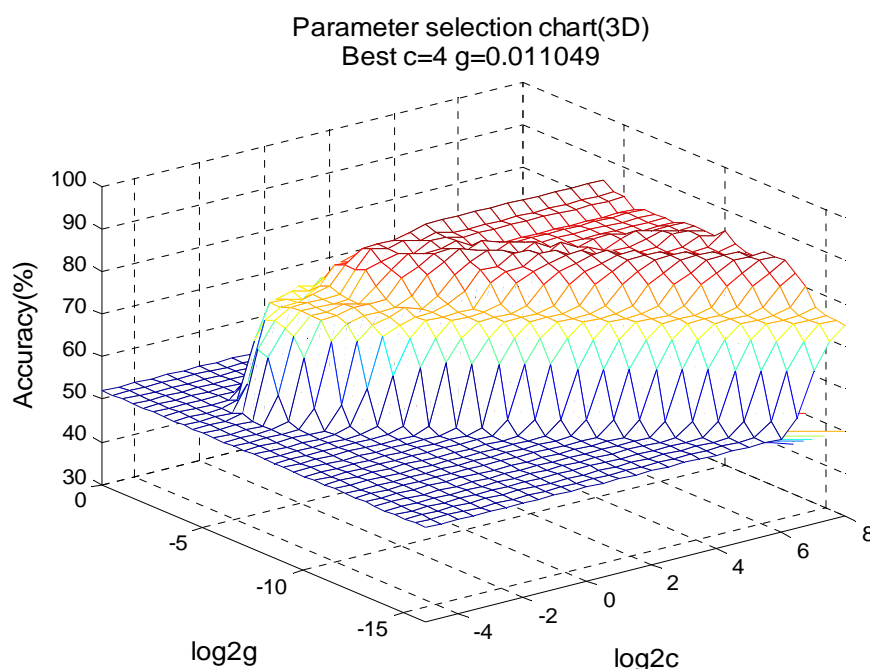
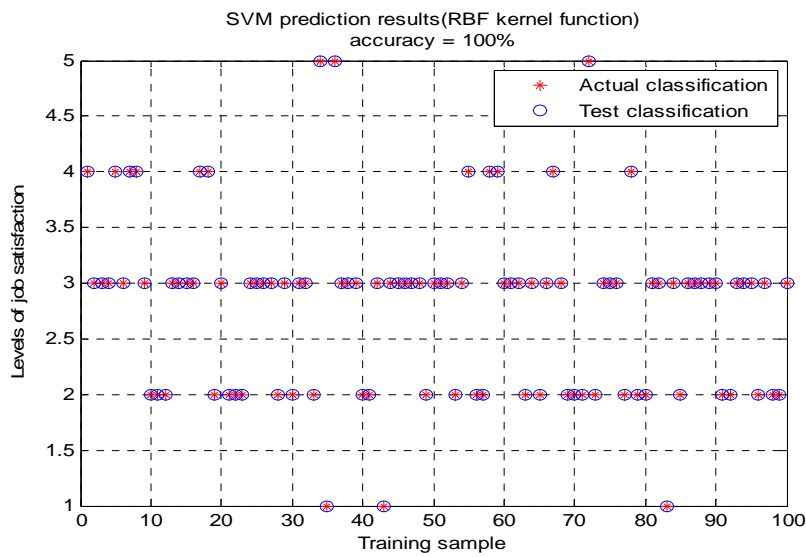


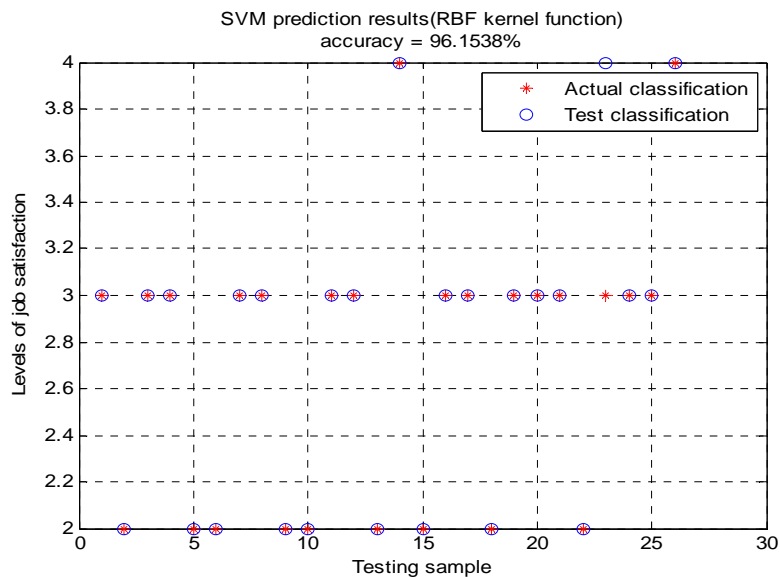
Fig. 2. The optimization process of parameters 'c' and 'g' in SVM model

#### 4.4 The analysis of the results of the experiment

100 samples were selected to train the model, and 26 test samples were used to conduct the confirmation. The results were shown in figure 3. The accuracy of the training sample was 100%, the accuracy of the test sample was 96.15%, and the test time was about 2.3 seconds. The results showed that because the relationship between the job satisfaction degree and the evaluation class was non-linear, great evaluation results could not be obtained by using traditional linear model. As a kind of learning algorithm of artificial intelligence, SVM could solve the small sample problem, nonlinear problem, and local minima, and other practical problems, and it possessed better accuracy of classification and speed of operation.



(a) Training samples



(b) Test samples

Fig. 3 The results of job satisfaction of experimental technicians in Colleges and Universities

## 5. CONCLUSION

In this paper, according to the questionnaires, the significant influencing factors affecting the job satisfaction degree of the experimental technicians in colleges and universities were obtained through stepwise regression method. On this basis, the SVM evaluation model of the job satisfaction degree was established to achieve the intelligent judgment of the five degrees of the job satisfaction. The results showed that SVM had good classification accuracy and faster operation speed, and possessed certain application value.

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