

# Supervised Learning Evaluation Model of Students' Sports Training Efficiency Based on Random Forest Model

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## **Abstract:**

Supervised learning algorithm is widely used in industry and manufacturing. For many years, the effect evaluation of sports training only stays on the basis of qualitative experience. With the advent of high-tech era, sports training is a complex system engineering, which has been recognized by experts all over the world. Random forest has fast operation speed and excellent performance in processing big data. The existing random forest software package gives the importance of all variables. Motion analysis requires more and more quantitative analysis of the factors that restrict the influence. In order to accurately quantify and achieve the purpose of macro-control and micro analysis, this paper expounds the algorithm of supervised learning to evaluate the efficiency of students' sports training. In view of the lack of operability of some theories in the current research of sports training benefit evaluation, this paper discusses the meaning of sports training benefit, the evaluation index system of competitive benefit, and the lag of sports training "input" and "output". Based on the method of supervised learning, this paper puts forward some ideas to solve the above problems. The experimental data show that the model of evaluating the efficiency of students' sports training based on supervised learning can improve the accuracy of the evaluation of the efficiency of sports training, and provide some reference for guiding students' sports training.

**Keywords:** *Random forest model, sports training, effect evaluation, industry and manufacturing, macro control, training efficiency evaluation.*

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## I. INTRODUCTION

The quality evaluation of sports training is an important part of the whole process of training. It is to adjust, evaluate and identify the training according to the purpose and requirements of sports training, so as to make an objective value evaluation of the quality and

effect of the whole training process [1-2]. At the same time, it is also an important means to deepen the reform of physical education teaching and improve the after-school sports training.

At present, the quality evaluation of coach guidance training is still at the traditional qualitative level of experience, which can not reflect the objective value of the quality [3]. Because the evaluation of its quality often involves many factors (indicators), we should make a comprehensive evaluation according to many factors (indicators), not only from one or several factors (indicators). Secondly, in the comprehensive evaluation, we usually use the method of scoring each single index, and then weighted average. As a matter of fact, the evaluation of the factors of the comprehensive evaluation problems encountered in practice is often fuzzy, which should not be absolutely expressed by a numerical value, but should be expressed by a fuzzy set, so it is more appropriate to use fuzzy comprehensive evaluation for the evaluation of training quality [4].

According to the characteristics of sports training quality (general goal), this paper discusses the quality of coaches, the formulation of plans, the implementation of plans and the results of training [5-7]. This paper puts forward a multi-level index system of comprehensive evaluation quality, and tries to solve the problem of comprehensive evaluation of training quality by using the idea of multi-objective optimization, combining AHP and fuzzy set theory in training.

## **II. DESIGN OF COMPREHENSIVE EVALUATION INDEX SYSTEM FOR TRAINING QUALITY**

Training quality is a fuzzy concept, especially for college sports training, it is by no means to evaluate their quality with the result of a certain competition. Because it involves many factors. Therefore, when people's minds form a concept, it has a certain connotation and extension. The set of objects that conform to the concept is the extension of the concept. For training quality, there is no clear extension, but its connotation is quite complex. Therefore, we can only select a number of representative indicators to assess [8]. Considering that the whole training process is a combination of many factors, its quality is often reflected from different aspects. Therefore, in the evaluation process of all aspects, different angles, different aspects of multi-faceted evaluation, we should not only look at the final results, but also consider the role of each link in the whole process, treat them as a whole. When applying analytic hierarchy process (AHP) to analyze practical problems, first of all, it is necessary to establish hierarchical composition with high-level as the overall goal; The middle level is the criterion to be followed in decision analysis; The lower layer is the evaluation index layer.

## **III. DETERMINATION OF WEIGHT VALUE OF COMPREHENSIVE EVALUATION**

### INDEX OF TRAINING QUALITY

The comprehensive evaluation index system is multi-layered, and each index has different influence and function on its upper index. In the actual comprehensive evaluation, its function is often expressed by its different weight coefficient. However, the determination of the weight is often subjective. In order to make the weight value of each index reflect the objective actual situation as much as possible, we use the 0-4 grade scoring method to determine their relative importance weight [9-10]. The specific steps are as follows:

- (1) Draw up the expert scoring table and ask the experts to fill in separately:

**TABLE I. Grade 0-4 rating table**

IN DEX	$X_1 X_2$ ... $X_N$	SC ORE	PROPORTI ON
$X_1$		$C_1$	$C_1/\Sigma_{C_1}$
$X_2$		$C_2$	$C_2/\Sigma_{C_2}$
...		...	...
$X_n$		$C_n$	$C_n/\Sigma_{C_n}$
$\Sigma$		$\Sigma_{C_1}$	1000

Scoring method: n evaluation indicators were compared, the very important one was given 4 points, the unimportant one was given 0 points, the more important one was given 3 points, the less important one was given 1 point, and the two equally important ones were given 2 points. The total score of grade 0-4 was  $C_i = 2n(n-1)$ , where n was the number of indicators.

- (2) m experts participated in the evaluation, and the j expert scored the I index  $c_{ij}$ ,  $i = 1, 2, \dots, n$ ,  $j = 1, 2, \dots, m$ . Calculate the index score  $Z_i$ .  $Z_i = \sum_{j=1}^m c_{ij}$ ,  $i = 1, 2, \dots, n$ .

- (3) The total score was  $Z = \sum_{i=1}^n Z_i = 2mn(n-1)$ .

- (4) Calculate the weight coefficient of each index:  $A_i = Z_i / Z$ ,  $i = 1, 2, \dots, n$ .

According to the above steps, the important values of each level relative to the upper level indicators are obtained, as shown in Table 2.

**TABLE II. Index weight value of each level**

IN DEX	WEI GHT	IN DEX	WEI GHT	IN DEX	WEI GHT	IN DEX	WEI GHT	IN DEX	WEI GHT
B <sub>1</sub>	0.21	C <sub>1</sub>	0.35	C <sub>5</sub>	0.24	C <sub>8</sub>	0.27	C <sub>12</sub>	0.18
B <sub>2</sub>	0.22	C <sub>2</sub>	0.20	C <sub>6</sub>	0.41	C <sub>9</sub>	0.22	C <sub>13</sub>	0.23
B <sub>3</sub>	0.25	C <sub>3</sub>	0.16	C <sub>7</sub>	0.35	C <sub>10</sub>	0.26	C <sub>14</sub>	0.28
B <sub>4</sub>	0.32	C <sub>4</sub>	0.29	Σ	1.00	C <sub>11</sub>	0.25	C <sub>15</sub>	0.31
Σ	1.00	Σ	1.00			Σ	1.00	Σ	1.00

### III. STEPS OF COMPREHENSIVE EVALUATION OF TRAINING QUALITY

(1) The score values of each basic index are typed out by the members of the evaluation team according to the percentage system, and the average scores are calculated and filled in the table. These score values are relatively independent, and the membership function is constructed, as shown in Figure 1.

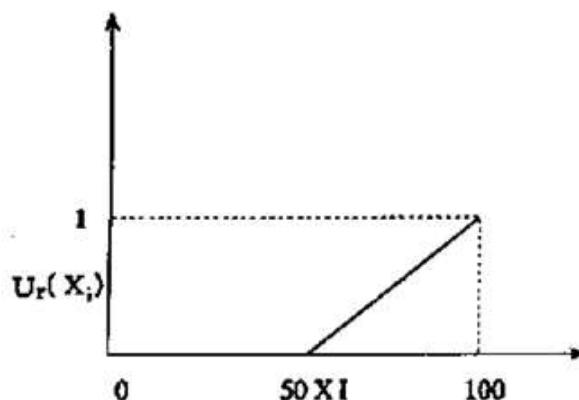


Fig 1: Graph of membership function of cardinal index

(2) Then, by substituting the average score of each index into the above function formula, the membership degree of each index relative to the comment set can be obtained, that is, the scores of different attributes can be changed into the evaluation value  $r_i$  in the range of  $[0,1]$ .

### IV. EXAMPLE APPLICATION

According to the above evaluation steps, we selected four coaches of a college sports team, and made a comprehensive evaluation on the training quality of four coaches A, B, C, D according to the four sub goals of the middle level, and sorted them according to the evaluation

value.

The score of basic indicators is the basis of the whole evaluation process. In order to make the score of basic indicators truly reflect their actual training situation, different methods are used to score different basic indicators.

(1) Observation method: the members of the evaluation group are on the scene, obtain the first-hand information of the training in the natural state, and then make a score, which is mainly used for the score of basic indicators such as training attitude, means use, observation and guidance, and training atmosphere.

(2) Inspection method: check whether their training plan is in line with the reality, with certain pertinence.

(3) Investigation method: through holding a forum, filling in a written survey form, visiting students and parties, to understand the situation and make assessment.

(4) Test method: according to the actual situation provided by the coach, the members of the evaluation group measure the team members' performance on the spot.

#### 4.1 Basic index score and evaluation results

The members of the quality evaluation team score each of the 4 coaches and 15 basic indicators, and then calculate the average score of each basic indicator as the score of the basic indicator (see Table 3).

Then, the score value is substituted into the membership function to calculate the membership degree, which is the evaluation result of the basic index (see Table 4).

**TABLE III. Basic index score results**

COACH	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	X <sub>10</sub>	X <sub>11</sub>	X <sub>12</sub>	X <sub>13</sub>	X <sub>14</sub>	X <sub>15</sub>
A	72	85	83	79	62	65	72	74	91	89	84	68	75	77	80
B	83	80	65	75	86	92	74	83	90	87	68	75	86	87	79
C	91	77	83	85	79	85	67	78	82	84	92	88	78	76	74
D	89	74	90	76	84	88	79	87	75	67	72	78	84	86	91

**TABLE IV. Evaluation results of basic indicators**

COACH	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	X <sub>10</sub>	X <sub>11</sub>	X <sub>12</sub>	X <sub>13</sub>	X <sub>14</sub>	X <sub>15</sub>
A	0.44	0.7	0.66	0.58	0.24	0.3	0.44	0.48	0.82	0.78	0.68	0.36	0.5	0.54	0.6
B	0.66	0.6	0.3	0.5	0.72	0.84	0.48	0.66	0.8	0.74	0.36	0.5	0.72	0.74	0.58
C	0.82	0.54	0.66	0.7	0.58	0.7	0.34	0.56	0.64	0.68	0.84	0.76	0.56	0.52	0.48
D	0.78	0.48	0.8	0.52	0.68	0.76	0.58	0.74	0.5	0.34	0.44	0.56	0.68	0.72	0.82

4.2 Evaluation of composite index

According to the mathematical model of basic index weight and composite index evaluation, the evaluation results of all composite indexes can be calculated.

**TABLE V. Composite index evaluation results**

COMPOSITE INDEX	EVALUATION VALUE	A	B	C	D
B1	B(1)	0.5 68	0.5 44	0.6 95	0.6 48
B2	B(2)	0.3 35	0.6 85	0.5 45	0.6 78
B3	B(3)	0.6 83	0.6 37	0.6 79	0.5 08
B4	B(4)	0.5 17	0.6 43	0.5 6	0.7 13

4.3 Comprehensive evaluation of general objectives

According to the mathematical model of composite index weight value and overall target comprehensive evaluation, the results of their training quality are calculated, and the method is the same as above (see Table 6).

It can be seen that the training quality level of the four coaches is D, C, B and A.

**TABLE VI. Comprehensive evaluation results**

COACH	A	B	C	D
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Comprehensive evaluation value	0.5 29	0.6 3	0.6 15	0.6 4
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## V. CONCLUSION

(1) The fuzzy comprehensive evaluation of sports training quality in this paper is applicable to all levels of training (including professional teams) in principle. The established multi-level index system is aimed at the commonness of the general training process. In view of the different characteristics of different training, the above indexes can be adjusted according to different situations.

(2) The evaluation of training quality is a relative concept. It only ranks the relative training quality of the evaluation objects, not absolutely reflects the level of a coach.

(3) The scientificity and rationality of the evaluation index system is based on the comprehensive evaluation model. According to the four aspects of B layer, the evaluation index system of training quality is designed, which can more comprehensively and accurately reflect the whole process of training.

(4) The key to the accuracy of comprehensive evaluation is the establishment of the score and weight of each basic index. There are certain "subjective" factors in the evaluation and weight determination of indicators, but this kind of "subjective" must not be understood as "arbitrary" or even "taking what one wants". This "subjective" should be based on the analysis and research of objective reality, and should be the reflection of objective reality.

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