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Developing computer aided model for selecting talent players in badminton

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Abstract

The purpose of this study is to develop a decision support model for selecting the most appropriate players in Badminton via *Fuzzy Multi Attribute Decision Making* (FMADM) algorithm. Developed model has been applied on active Badminton players in age between 9 and 11 among Muğla Province by using the data of player's physical appropriateness scores and technical observation values in computer environment. In developed model, it has been ensured that using both significant criteria and the weights of criteria make results more sensitive. Finally, it is proved that model's results are appropriate and consistent.

Keywords: selecting players, optimal decision making, analytic hierarchy process, badminton

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Badminton sporunda yetenekli sporcu seçimi için bilgisayar destekli model geliştirme

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Özet

Bu çalışmanın amacı; *Fuzzy Çok Nitelikli Karar Verme (FÇNKV)* algoritması kullanılarak Badminton oyununda en uygun oyuncu seçimi için bir karar destek modeli geliştirmektir. Geliştirilen model Muğla İlinde bulunan ve halen aktif olarak spor yapmakta olan 9-11 yaş grubu Badmintonculara, fiziksel uygunluk değerleri ve teknik gözlem değerleri kullanılarak bilgisayar ortamında uygulanmıştır. Geliştirilen modelde kriter ağırlıklarının da devreye girmesi ile önemli kriterlerin öne çıkması ve sonucun daha hassas olması sağlanılmıştır. Uygulamada elde edilen sonuçların doğru ve tutarlı olduğu tespit edilmiştir.

Anahtar Kelimeler: sporcu seçimi, optimal karar verme, analitik hiyerarşi süreci, badminton

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Introduction

In statistical decision making methods, decision making is the evaluation of alternatives according to some certain criteria and then assigning some scores or values to the alternatives. According to these numerical results, an alternative best meeting all the criteria is chosen and decision has been made. Unlike these criteria described quantitatively, there are some problems involving qualitative criteria including some ambiguities and only verbally expressed so that they cannot be precisely described. In such cases, scores assigned to the alternatives on the basis of these criteria can only be obtained by means of subjective rating of them. Therefore, it is rendered possible to make a decision in a state of uncertainty by means of representation of qualitative criteria by fuzzy sets and detection of membership values of the alternatives to these sets (Nguyen and Walker, 2000) Fuzzy sets representing the criteria are formed in two ways as follows (Ballı, 2005):

- The values of the alternatives belonging to each qualitative criterion can numerically be measured and membership values are obtained by means of these measurements being evaluated on the basis of subjective opinions of the decision maker. (1st group)
- If the values of the alternatives belonging to each individual qualitative criterion cannot be measured, two pair comparison of the alternatives according to related criterion is performed and accordingly membership values are obtained (2nd group)

According to FMADM, Decision model is developed for complex problems where the quantitative criteria are represented in the two above-mentioned ways, initially, the importance levels of the criteria are determined by calculating their weights. Then all the criteria are divided into two relevant groups and alternatives are individually evaluated by applying fuzzy logic operations according to these groups and by combining the results of interim decision, ultimate decision is made. Decision making is not concluded with the selection of optimal alternative but with the ordering of alternatives according to their appropriateness by taking their priority into account.

The developed method was administered to selection of the badminton players out of the candidates on the basis of verbally expressed qualitative criteria. As first group criteria, height, weight, vertical jump, reaction time (as to sound and light), skin fold, leg and hand grip power, flexibility were taken and as second group criteria, service, clear shot, drop shot, smach shot and match observation criteria were taken. The reader may refer to Kasap et al. (1999), Shaw (1992), Ballou (1992) and Zorba (2001) for detailed coverage of all attributes. In line with the criteria, computer program was developed and the decision making was performed by means of ordering the alternatives (players) according to their appropriateness. The results proved that the decision making is appropriate and consistent.

Methods

Suppose that the related criteria and alternatives have been determined. In order to detect the precedence values of the criteria, two pair comparison technique suggested is used (Saaty,1980). According to this technique, the comparative importance level judgments of the decision maker are converted to comparative numerical values by using Basic 1-9 Scale in Table 1. Afterwards, the values of this two pair comparison are placed into two pair comparison matrix (Table 2). In this matrix, c_{ij} shows the value of the comparison of i. criterion with j. criterion. With $c_{ij}=1/c_{ji}$, it is made possible for the values coincide. Two pair comparison matrix is given below:

Table 1 Basic 1-9 Scale

Intensity of Importance value	Definition
1	equally importance
3	weakly more important
5	strongly more important
7	demonstratedly more important
9	absolutely more important
2,4,6,8	Intermediate values

Table 2 Two pair comparison matrix for the criterion

	C_1	C_2	.....	C_n
C_1	c_{11}	c_{12}	.....	c_{1n}
C_2	c_{21}	c_{22}	.....	c_{2n}
....	.....	.....	.....	......
C_n	c_{n1}	c_{n2}	.....	c_{nn}

By performing the following operations on the formed two pair comparison matrix with nxn dimension, relative values of the criteria are obtained (Eminov and Ballı, 2004; Saaty, 1978):

- Total sum of the columns is found and every c_{ij} value in this column is divided by the total sum so that they are normalized; that is, they are expressed as the percentage of this column's total sum.
- Line totals of the normalized matrix are found and these give the relative importance level of the criterion corresponding to the line.

In that way, with the total sum of every line corresponding to a criterion, relative importance value vector of the criteria W={w(C_1),...,w(C_n)} is found (Eldukair, 1992).

First, W_{Cj} (j= 1,2,... p, p+1, ..., n) weights of all the criteria are calculated. In FMADM model suggested by Yager (1978), a decision matrix with mxp dimension and shown by {$C_j(a_i)$, i=1,...,m; j=1,...,p}is formed if rate of each a_i alternative's meeting C_j criterion or its membership value to the set belonging to this criterion is $C_j(a_i)\in[0,1]$. (p is the total number of criteria entering the first group). By taking into account the previously estimated importance value of the criteria w(C_j), j=1,...,p, likelihood of obtaining a_i alternative over all the criteria $D_1[a_i]$ can be calculated as decision function as follows:

$$D_1[a_i] = Min[(C_1(a_i))^{w(C_1)}, (C_2(a_i))^{w(C_2)}, ..., (C_p(a_i))^{w(C_p)}] \quad (1)$$

Over the remaining C_j, j=p+1,...,n, criteria, determination of the likelihood of obtaining a_i alternatives i=1,...,m, is realized with Saaty AHP model. For each individual criterion, values $C_j(a_i)$ for alternatives to meet the criteria are found.

According to AHP model, over all the j=p+1, ... ,n, criteria, rate of likelihood of obtaining a_i alternative $D_2[a_i]$ is estimated as follows:

$$D_2[a_i] = \sum_{j=p+1}^{n} C_j(a_i) w(C_j) \qquad j = p+1,...,n, i = 1,...m \quad (2)$$

By combining results of interim decision obtained from first and second group criteria with AND operator, final decision function for a_i alternative;

$$D[a_i] = Min(D_1[a_i], D_2[a_i]) \qquad i=1,...,m \tag{3}$$

Maximum final decision function value $D[a_i]$ will be the optimal alternative:

$$a_{opt}=Max(D[a_i]) \tag{4}$$

Results

The purpose is to select good players to play in the team. First and second group criteria were found by means of negotiations with the team coach and experts. With the help of the team coach, two pair comparisons of all the criteria were performed and two pair comparison matrix was formed for them. In Table 3, two pair comparison matrix for all the criteria is given.

Table 3 Two pair comparison matrix for all criteria

Criterion	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1-Height	1	6	1/5	1/8	1	1/7	1/2	1/5	1	1	1	3	1
2-Weight	1/6	1	1/5	1/8	1	1/6	1	1/3	1	1	1/5	1/4	1
3-Vertical Jump	5	5	1	1	1	1/6	1	1/3	1	1	1	1/5	3
4-Reaction Time	8	8	1	1	1	3	1	1	1/3	1/3	8	7	7
5- Skin Fold	1	1	1	1	1	1	1	2	1	1	3	4	4
6- Leg Power	7	6	6	1/3	1	1	4	1/4	1	1/3	4	4	6
7- Hand Power	2	1	1	1	1	1/4	1	1/4	1	1/3	1/4	1/5	1
8- Flexibility	5	3	3	1	1/2	4	4	1	1	1/3	1/4	3	4
9- Service	1	1	1	3	1	1	1	1	1	5	5	1	4
10- Clear shot	1	1	1	3	1	3	3	3	1/5	1	1/4	1/5	4
11-Drop Shot	1	5	1	1/8	1/3	1/4	4	4	1/5	4	1	1/5	4
12- Smach Shot	1/3	4	5	1/7	1/4	1/4	5	1/3	1	5	5	1	5
13- M. Observation	1	1	1/3	1/7	1/4	1/6	1	1/4	1/4	1/4	1/4	1/5	1

In order to find the values related to first group criteria belonging to the players, physical fitness and anthropometric measurements were conducted in a laboratory as given in Table 4. In the measurements, according to results obtained by administering height, weight, vertical jump, reaction time, skin fold, leg and hand grip power, flexibility membership function for each criterion was determined.

Table 4 Measurement values of the all criteria for players

Players	Height	Weight	V. Jump	R.Time	Skinfold	L.Power	H.Power	Flexibility
Selenay	155	37	17	15.3	3.50	37	8	46
Kerem	146	36	18	18.7	4.35	31	11	49
Merve	145	33	22	13.3	2.77	33	10	47
Caner	156	35	17	16	4.32	32	11	51
Nazlı	144	36	20	15.3	2.95	37	13	48
Hande	146	35	19	16	3.33	34	11	47
Güray	160	40	20	16.7	3.67	38	13	45
Çağatay	142	35	18	17	3.57	31	11	49
Bengisu	148	34	19	17.3	3.11	36	12	50
Mehmet	144	32	20	15	3.41	37	13	51
Elif	140	35	17	15.3	3.33	37	10	46
Metin	149	38	18	18.6	4.03	31	11	49

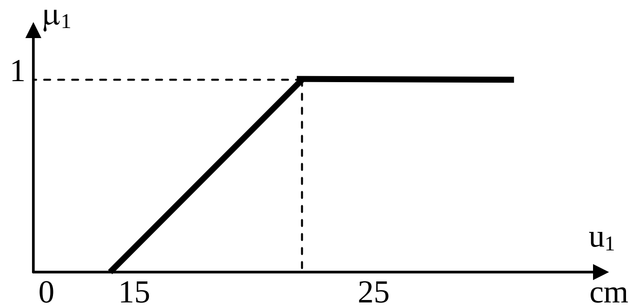

Figure 1 Membership function for vertical jump criteria

The membership function obtained by taking the opinions of the specialist into account for vertical jump is plotted in Figure 1 and mathematically described as follows:

$$T(u;\,15,\,25) = \begin{cases} 0 & \text{for} \quad u<15 \\ (u-15)/(25-15) & \text{for} \quad 15 \le u \le 25 \\ 1 & \text{for} \quad u>25 \end{cases} \qquad (5)$$

The weights of the criteria were found as explained in previous section by processing the two pair comparison matrix of the criteria (Table 5) and consistency rate for these weights were accepted as it was 0.060<0.10.

Table 5 Criteria Weights

Criteria	**Weight**	**Criteria**	**Weight**	**Criteria**	**Weight**
Height	0.051	Weight	0.031	Vertical Jump	0.063
Reaction Time	0.133	Skin Fold	0.079	Leg Power	0.118
Hand Grip Power	0.041	Flexibility	0.102	Service	0.097
Clear shot	0.089	Drop shot	0.079	Smach Shoot	0.097
M. Observation	0.019				

	D1(a)	D2(a)	D(a)
1	0.116	0.020	0.020
2	0.004	0.059	0.004
3	0.068	0.022	0.022
4	0.036	0.329	0.036
5	0.187	0.018	0.018
6	0.106	0.023	0.023
7	0.088	0.146	0.088
8	0.013	0.092	0.013
9	0.048	0.017	0.017
10	0.214	0.122	0.122
11	0.116	0.044	0.044
12	0.004	0.108	0.004

Figure 2 Final decision function values $D[a_i]$

NO1	NAME	D(a)
1	SELENAY	0.02
2	KEREM	0.004
3	MERVE	0.022
4	CANER	0.036
5	NAZLI	0.018
6	HANDE	0.023
7	GÜRAY	0.088
8	ÇAĞATAY	0.012
9	BENGİSU	0.017
10	MEHMET	0.122
11	ELİF	0.044
12	METİN	0.004

Figure 3 Ordering of the alternatives according to D[a_i] values

Final decision function values are shown in Figure 2 and alternatives are ordered according to final decision function values in Figure 3. According to this ordering, first five people will be selected. Accuracy and consistency of the results of decision making obtained were checked. The results were compared with the coach's ordering and correlation coefficient was found to be r=1. This shows that the results obtained are considerably good.

Discussion and Conclusion

Decision making was realized through the combination of the results of these two interim decisions. In both cases, weights of the criteria were determined so it was made possible to detect the important criteria and to render the results more sensitive. The target of the decision making as set as determination of the best alternatives (players) and their being put into order of precedence. The results obtained from the application proved to be accurate and consistent.

Science of sports studies the ability for sports by considering social structure, organization of the training, and in particular, psychological conditions. In the scientific selection process realized in computer environment, increases the training efficiency of the coach and selection performed in the computer environment better motivates the players. Players can better see their weaknesses in comparison with the other players through scientific selection process. Thus, the number of the players aiming higher performance and competition increase and higher performance is targeted in shorter time span. As a result, formation of a stronger team is made possible.

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