Comprehensive Evaluation of Team Cooperation based on Multiple Regression Analysis

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Abstract. Based on multiple regression analysis, this paper establishes a comprehensive evaluation model of teamwork, and based on the data given by the D question of the 2020 Mathematical Contest in Modeling, abstracting and refining a variety of different factors as indicators, using statistical related knowledge, and SPSS software to perform multivariate linear regression analysis. We analyzed the information of 38 games and determined the success criteria of the evaluation team 0-1-3 evaluation criteria, and used the SPSS software to test the reliability and validity of the data of multiple indicators for each game, and diversified with the game results. Based on the results of SPSS multiple regression analysis, a scoring model for assessing the success of teamwork was established. The evaluation of the model is in good agreement with the actual situation. Finally, we abstract all the factors appearing in this article, extract the factors with universal effectiveness, apply to teamwork of the whole society, and find other factors that have not been considered with universal effectiveness.

Keywords: Teamwork of the Whole Society; SPSS; Multiple Regression Analysis.

1. Introduction

With the rapid development of sensors, imaging technology and computer technology, accurate capture of player movements is within the achievable range. In the context of the "big data" era, researches on the tactics and success factors of football teams through data analysis and model construction has gradually been called a trend.

At the same time, the vast majority of teams in other fields represented by football teams also have similar teamwork evaluation needs. Based on the above background and needs, we have constructed a comprehensive evaluation model of teamwork based on multivariate statistical analysis, and strive to be the team's Leaders and responsible persons for reference.

2. Determination of Team Indicators

Based on the data given by the competition topic, we summarized a number of comprehensive evaluation indicators for team cooperation, and by calculating the contribution level of each indicator, we discard the indicators that have little impact on the results of the competition, and the ones that are not discarded are the ones we ultimately use.

2.1 Screening of Indicators

Table 1. Performance indicators

Variable	Performance indicator
1	shot
2	Duel
3	Fuel
4	Free Kick
5	Goalkeeper leaving line
6	Offside
7	Left Offense

8	Offensive left
9	Offensive
10	Offensive percentage
11	Right Offense
12	Offensive right
13	Attacks in the frontcourt
14	Breaks into the restricted area
15	Passes
16	Successful Passes
17	Pass Success Rate
18	Player Passes Variance
19	Binary relation number
20	Ternary relation

According to the analyzed situation, sort out the following 20 performance indicators that may be related to success. The contribution distribution level is too low to correlate with the match result, so it is discarded.

Using SPSS for reliability analysis of factors var1-var20, the following results are obtained:

Case Processing Summary

		N	%
Cases	Valid	38	100.0
	Excluded[a]	0	.0
	Total	38	100.0

a. Listwise deletion based on all variables in the procedure.

Figure 1. Case Processing Summary

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.726	.821	20

Figure 2. Raliability Statistics

From the "Case Processing Summary" table, you can see that a total of 38 cases participated in the reliability analysis and there were no missing values.

From the measurement results of "Realiability Statistics", Crobach's Alpha value is 0.726, and the Cronbach's Alpha value based on the standardized term is 0.821. Both coefficients are above 70%, so the analyzed data has a high inherent consistency , Strong reliability

In terms of effectiveness analysis, the KMO value is required to be above 0.9, indicating that it is very suitable for factor analysis; 0.8--0.9: very suitable; 0.7--0.8 is suitable; 0.6-0.7 is acceptable; 0.5--0.6 indicates poor; below 0.45: should be abandoned.

According to the standard, abandon var5 and Goalkeeper leaving line (0.338). When doing the validity analysis of the first 18 influencing factors alone, it is found that the KMO of Offside is too low (0.146), so var6 is dropped.

2.2 0-1-3 Integral Mode

According to the points rules of the world football league standings, when a team loses the game, the total score of the team will not change. When a draw occurs, the team's points will increase by 1, and when the team wins, the team's points will increase by 3.

Using this point model, the team's points are variable21, and using this as the independent variable, multiple regression analysis is performed on var1-var20 to get:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.659[a]	.434	-.163	1.39849

a. Predictors: (Constant), VAR00020, VAR00012, VAR00006, VAR00003, VAR00013, VAR00005, VAR00002, VAR00010, VAR00004, VAR00017, VAR00018, VAR00019, VAR00001, VAR00011, VAR00015, VAR00014, VAR00009, VAR00007, VAR00016

Figure 3. 0-1-3 mode analysis results

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	VAR00008	.[b]	.	.	.	.000

a. Dependent Variable: VAR00021

b. Predictors in the Model: (Constant), VAR00020, VAR00012, VAR00006, VAR00003, VAR00013, VAR00005, VAR00002, VAR00010, VAR00004, VAR00017, VAR00018, VAR00019, VAR00001, VAR00011, VAR00015, VAR00014, VAR00009, VAR00007, VAR00016

Figure 4. Variables removed

Let var21 be the dependent variable and perform multiple regression analysis on var1-var20 respectively. The R values are as follows:

Table 2. R value of each variable in 0-1-3 mode

variable	R	variable	R
~~Var1~~	~~0.048~~	Var11	0.232
Var2	0.237	Var12	0.145
~~Var3~~	~~0.017~~	Var13	0.216
~~Var4~~	~~0.053~~	Var14	0.319
~~Var5~~	~~0.275~~	Var15	0.176
~~Var6~~	~~0.147~~	Var16	0.174
~~Var7~~	~~0.006~~	Var17	0.144
~~Var8~~	~~0.079~~	Var18	0.292
~~Var9~~	~~0.034~~	Var19	0.267
~~Var10~~	~~0.144~~	Var20	0.363

Because the correlation gap between the variables is too large, considering the overall correlation is not large, the "0-1-3" integration model is used. And the performance indicators are Var2, Var11, Var12, Var13, Var14, Var15, Var16, Var17, Var18, Var19, Var20.

3. Determination of Multiple Regression Equations

Let the dependent variable be var21 (0-1-3 integration mode), and perform multiple regression analysis on the remaining variables to obtain:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.596[a]	.355	.005	1.29332

a. Predictors: (Constant), VAR00020, VAR00012, VAR00006, VAR00013, VAR00005, VAR00002, VAR00017, VAR00018, VAR00019, VAR00011, VAR00015, VAR00014, VAR00016

Figure 5. Residual variable analysis results

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-7.341	9.242		-.794	.435
	VAR00002	.010	.009	.290	1.213	.237
	VAR00005	.016	.159	.019	.101	.920
	VAR00006	.061	.148	.076	.413	.683
	VAR00011	-.003	.012	-.125	-.270	.789
	VAR00012	1.866	5.102	.144	.366	.718
	VAR00013	.016	.017	.478	.954	.350
	VAR00014	-.017	.024	-.357	-.700	.491
	VAR00015	.010	.028	.616	.353	.727
	VAR00016	-.032	.040	-1.850	-.783	.441
	VAR00017	.114	.131	.691	.874	.391
	VAR00018	.002	.002	.354	1.086	.288
	VAR00019	.129	.168	.304	.770	.449
	VAR00020	.023	.022	.347	1.043	.307

a. Dependent Variable: VAR00021

Figure 6. Multiple regression coefficients in 0-1-3 mode

The coefficient B is too small and the error is large. To reduce the error, let the dependent variable be var22 (0,100,300 integration mode). Multiple regression analysis was performed on the remaining variables. According to the characteristics and calculation methods of the multiple regression analysis, the Model Summary part was unchanged.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-734.119	924.202		-.794	.435
	VAR00002	1.040	.858	.290	1.213	.237
	VAR00005	1.607	15.891	.019	.101	.920
	VAR00006	6.098	14.751	.076	.413	.683
	VAR00011	-.323	1.194	-.125	-.270	.789
	VAR00012	186.579	510.226	.144	.366	.718
	VAR00013	1.639	1.719	.478	.954	.350
	VAR00014	-1.702	2.433	-.357	-.700	.491
	VAR00015	.990	2.806	.616	.353	.727
	VAR00016	-3.160	4.034	-1.850	-.783	.441
	VAR00017	11.426	13.069	.691	.874	.391
	VAR00018	.202	.187	.354	1.086	.288
	VAR00019	12.911	16.765	.304	.770	.449
	VAR00020	2.341	2.245	.347	1.043	.307

a. Dependent Variable: VAR00022

Figure 7. Multiple regression coefficients in 0-100-300 mode

Get the multiple regression equation:

Score=Var22=1.04Var2-0.323Var11+186.579Var12+1.639Var13-1.702Var14+0.990Var15-3.160 Var16+11.426Var17+0.202 Var18+12.911Var19+2.341Var20-734.119

4. Design Analysis of Effective Teams and General Models

In teamwork, the tacit cooperation between players is one of the important factors that make the team stand out.

Second, evaluate the player's performance with contribution value, and then consider the overall situation of cooperation in depth (in this article, the binary and ternary configuration), and explore whether the contribution value of each multiple configurations is more average and better. Assume that the contribution value of the entire relationship is the average contribution of the internal staff, the team integration under the 0-1-3 integral model is used as the dependent variable, and the variance of the contribution values of multiple multivariate relationships is used as the dependent variable for multiple regression analysis.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.124[a]	.015	-.012	1.30442

a. Predictors: (Constant), VAR00025

Figure 8. Relevant results of binary relations

It can be seen that the average of the contribution of the multiple configuration has a small correlation with the success rate of the game and cannot significantly affect the result of the game. On the contrary, when other players on the field are not performing well, a group of players perform well and cooperate well, but can Improve morale to a certain extent. As mentioned earlier, the rapid action and the use of a reasonable offensive line have all improved the winning rate.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.010[a]	.000	-.028	1.31450

a. Predictors: (Constant), VAR00026

Figure 9. Relevant results of ternary relationship

5. Conclusion

Based on multiple regression analysis, this paper establishes a comprehensive evaluation model of teamwork based on the data provided.

In summary, the main components of an excellent team can be listed:

- A Common goal
- Tacit cooperation
- Morale boost
- Reasonable staffing structure

In order to measure team performance, it is also necessary to capture information on the feedback mechanism and communication frequency of teamwork, the accuracy of the division of labor of the team, the overall incentive mechanism of the team, team cohesion, and the trust of members.

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