INFLUENCE OF SOME SITUATION-RELATED PARAMETERS ON THE SCORE IN VOLLEYBALL

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Abstract:

The situation-related parameters of top volleyball matches were analyzed in this paper: five technical tactical elements (block, defence, serve, reception of serve and spike), performed by one volleyball team throughout the competition period and during the European Champions Cup matches, were monitored. The influence of these elements on the score in a volleyball game was investigated. Two regression analysis models were used. Further, by means of numerous frequencies in descriptive statistics one model of performance efficiency for each of the five analyzed elements was designed.

Key words: volleyball, technical-tactical elements, result, regression analysis

Zusammenfassung:

Es wurden einige situationsbezogene Parameter von Spitzenvolleyballspielen analysiert, nämlich, fünf technisch-taktische Elemente (Block, Abwehr, Aufgabe, Aufgabenannahme und Schmetterschlag), die eine Volleyballmannschaft während der Spielsaison und während der Europapokalspiele ausgeführt hat. Wie diese Elemente das Endresultat beeinflussen wurde mittels zwei Regressionsanalysen untersucht.

Anhand der in der deskriptiven Statistik berechneten Frequenzen wurde ein Modell der Ausführungseffektivität für jedes analysierte Element gestaltet.

Schlüsselwörter: Volleyball, technisch-taktische Elemente, Resultat, Regressionsanalyse

Introduction

Monitoring and analyzing the volleyball game are based mostly on the efficiency evaluation of some technical-tactical elements (serve, serve reception, setting, spike, block, defence, counterattack), usually on the basis of the volleyball record (less frequently on the basis of the shorthand record of the match).

Coaches and expert teams are faced with difficulties when trying to analyze the match objectively - it stands to reason, because the monitored performances of some game elements should be compared with certain efficiency models of individual or team execution of particular elements in volleyball. The prerequisite for designing such an efficiency model of the execution of technical-tactical elements is the monitoring of a large number of high-quality matches within an approximately levelled out volleyball championship. The team being monitored for the purpose of this analysis has played in the finals of the National Championship and won the European Champions Cup in the same year.

Research objective

The objective of this research was to determine the influence of various variables of the game (serve, serve reception, spike, block, defence) on the score in a volleyball game, thus influencing the final score of the match.

In other words, the objective was to analyze the importance of 20 variables together with their contribution to either victory or defeat in each game, i.e. to see whether there are certain technical-tactical elements which significantly influenced the score in a volleyball game or whether all the technical-tactical elements analyzed in this research proved to be equally important. The sample in this research comprised 149 games played and won by one and the same team during 43 matches of the National Volleyball Championship and the European Champions Cup.

These data, collected by monitoring the matches throughout the whole competition macrocycle and processed by means of the descriptive statistics, would create the basis for designing the efficiency model for the execution of particular volleyball elements.

Research methods

ENTITY SAMPLE

This research was carried out on the sample of 149 games of the National Championship volleyball matches played by a high-performance team.

Because of the different scoring system in the fifth game (tie-break), the authors decided that the entities in data processing be the first four games (and not the whole matches). The fifth games were therefore omitted from the analysis.

VARIABLES SAMPLE

The monitoring of the matches is based on the efficiency evaluation of particular technical-tactical elements:

BLOCK

B# winning block (either a point is scored or the change of serve is awarded)

B+ positive or passive block (after a block the team has got the opportunity for the counterattack)

B- negative block (after a block the ball rebounds to the opponent's side so that the opposing team has the opportunity for a new attack)

B= either the ball has touched the blocker or the blocker has touched the net

DEFENCE

D# ideal defence (after a ball has been successfully received a quick and combined counterattack can be carried out)

D+ positive defence (it is possible to carry out the counterattack, but only by hitting a high ball)

D- negative defence (the ball comes across the net and the opponent is given an opportunity for the counterattack)

D= point loss or change of serve (only the balls that have been touched are recorded)

SERVE

S# winning serve (direct point)

S+ positive serve (the quick attack by the opponent is hindered)

S- negative serve (the opponent has the opportunity to perform a quick attack)

S= serve error

SERVE RECEPTION

SR# ideal serve reception (brings a setter into the žideal' position for the organization of the play)

SR+ positive serve reception (the team has an opportunity for a quick attack, but not for a combined attack)

SR- negative serve reception (the team hasn't any opportunity for either a quick or a combined attack - it has only an opportunity for a high ball attack)

SR= team loses a point

SPIKE

In this paper the variable spike implies both a spike after serve reception and a spike after a successfully received ball, i.e. a counterattack.

SP# winning spike (either a direct point is scored or the serve change is awarded)

SP+ positive spike (the ball remains on the spiker's side of the court, and a new attack is possible, i.e. after a spike the team still has the advantage to outplay the opposing team)

SP- negative spike (the opponent has the opportunity for both a quick and a combined attack)

SP= spike error (loss of point or right of serve)

Each of the four evaluations of the execution efficiency of five technical-tactical elements (block, defence, serve, serve reception and spike) were represented by separate variables (20 variables altogether).

The criterion (dependent) variable was determined as the binary defined result of each game in a match. The criterion variable was marked as follows:

- defeat in a game was marked by (0)
- victory in a game was marked by (1)

Data processing methods

The data were collected from computer records set up by means of a systematic monitoring method (shorthand and computer

record of the match) of technical-tactical elements in a match carried out by an expert statistician.

Predictor and criterion variables were processed by means of the standard descriptive procedures, i.e. the central and dispersive parameters were calculated for all variables. The efficiency index for each technical-tactical element was calculated on the basis of the sum of the results.

Further, data processing included the calculation of the predictor and criterion variables intercorrelation matrix. In the next phase, the influence of the technical-tactical elements - spike, defence, serve reception, serve, and block - on the result in each game was determined by means of regression analysis.

The SPSS (Statistical Package for Social Sciences), comprising the ENTER-model, i.e. the classical regression analysis method, and the FORWARD method, were used for data processing.

Interpretation of results

The basic statistical parameters for each variable (the assessment of the execution efficiency) for each volleyball element - serve, block, defence, serve reception, and spike - can be seen in Tables 1, 2, 3, 4 and 5. The Tables contain data on the arithmetic means for each particular variable and together with the minimum, maximum and sum values.

The analysis of Table 1 shows that the most frequent way of the execution of the serve is the so-called negative serve, i.e. the serve after which the opposing team (the serve recepients) can pass the ball in an ideal way to their setter and perform both a quick and a combined attack.

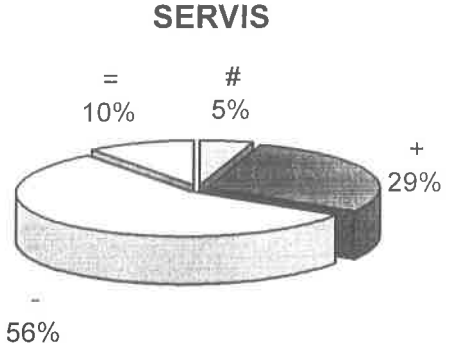
The positive serve variable is also very frequent, although, when taking into account the sum parameters of its application, it appears half as frequently throughout the whole competition season as the variable negative serve (negative serve SUM = 3289;

Table 1: The basic statistical parameters for the TE-TA element SERVE

	MEAN	MAX	MIN	SUM
Serve error (S=)	4.08	11	0	608
Negative serve (S-)	22.10	50	6	3289
Positive serve (S+)	11.20	23	1	1667
Winning serve (S#)	1.87	15	0	278

MEAN- arithmetic mean
MIN - the lowest result
MAX - the highest result
SUM - sum of results

Figure 1: The execution of the TE-TA element SERVE represented by percentages



positive serve SUM = 1667).

The arithmetic means parameter analysis shows that the variable negative serve contains more than 50% occurrences within the technical-tactical element serve.

Further, it is interesting to calculate the percentages for a group of variables of one technical-tactical element, since they could become, taking into account the quality of the monitored team (the winner of the European Champions Cup), an efficiency model to be matched either by an individual or by a team.

Figure 1 SERVE shows that an individual or a team should, if they want to be considered successful, perform: more than 5% of ace-scoring serves, more than 29% of positive serves, not more than 56% of negative serves, and not more than 10% of serve errors.

Table 2 BLOCK contains the highest values on the extremely negative pole, i.e. the block is emphasized as the group of technical-tactical elements with the largest number of errors (SUM = 1,056). The team monitored performed, on an average, about 7 block errors, and the number of frequencies in one game reached as many as 16 block errors.

The variables *positive block* and *winning block* observed together as compared to the variables *block error* and *negative block* show that the balance between the number of frequencies of negative (SUM block error, negative block = 1,512) and positive performances (SUM positive block, winning block = 1,562) has been established to a certain degree.

According to the Figure 2 BLOCK an individual or a team should try to perform: more than 21% of winning blocks, more than 30% of positive blocks, less than 15% of negative blocks, and less than 34% of block errors.

Table 3 emphasizes the high efficiency level of the group of variables of the TE-TA element denoting court defence - as many as 64% of successful defences throughout the season. Nowadays, an individual or a team are

Table 2: The basic statistical parameters for the TE-TA element BLOCK

	MEAN	MAX	MIN	SUM
Block error(B=)	7.09	16	0	1056
Negative block(B-)	3.06	9	0	456
Positive block(B+)	6.21	17	0	925
Winning block(B#)	4.30	10	0	637

MEAN- arithmetic mean
MIN - the lowest result
MAX - the highest result
SUM - sum of results

Figure 2: The execution of the TE-TA element BLOCK represented by percentages

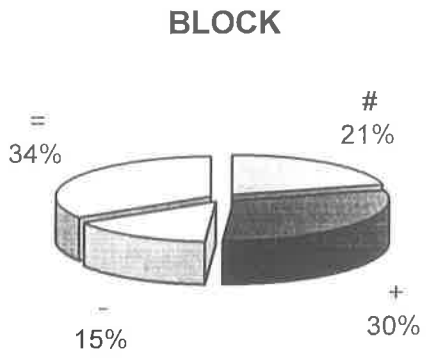
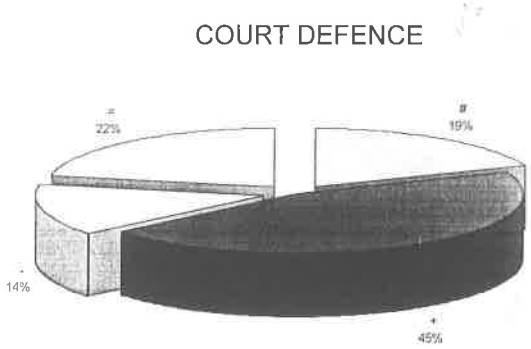


Table 3: The basic statistical parameters for the TE-TA element COURT DEFENSE

	MEAN	MAX	MIN	SUM
Defense error (D=)	4.26	13	0	635
Negative defence (D-)	2.71	11	0	404
Positive defence (D+)	8.69	22	1	1294
Ideal defence (D#)	3.84	13	0	572

MEAN- arithmetic mean
MIN - the lowest result
MAX - the highest result
SUM - sum of results

Figure 3: The execution of the TE-TA element COURT DEFENCE represented by percentages



considered successful if they perform more than 50% of successful court defences.

On an average, about 13 successful defences (the sum of positive and ideal defence arithmetic means) and 7 unsuccessful defences (the sum of defence error and negative defence arithmetic means) have been performed in one game.

According to the data from the Figure 3 COURT DEFENCE an individual or a team should try to perform: more than 19% of ideal defences, more than 45% of positive defences, less than 14% of negative defences and less than 22% of court defence errors.

Knowing that the variables *serve reception error* and *negative serve reception* denote the negative performance in the game, whereas the variables *positive serve reception* and *ideal serve reception* denote the positive performance, the conclusion can be drawn that throughout the competition season *serve reception* ranks high on the value scale (Table 4 SERVE RECEPTION). Expressed in percentages, 76% of successful serve receptions (the sum total of positive serve reception and ideal serve reception variables expressed in %) have been performed.

The arithmetic mean values of the variable *serve reception error* shows that the analyzed team makes, on the one hand, one serve reception error per game and on the other, it performs about 17 ideal serve receptions.

The high values of executing the TE-TA element *serve reception* can be explained by the fact that the experts for serve reception in the monitored team have at the same time been the best serve receiving players in the national team.

According to the data from the Figure 4 SERVE RECEPTION an individual or a team should try to achieve: more than 55% of ideal serve receptions, more than 21% of positive serve receptions, less than 20% of negative receptions and less than 4% of serve reception errors.

Table 5 shows that the highest values can be

Table 4: The basic statistical parameters for the TE-TA element SERVE RECEPTION

	MEAN	MAX	MIN	SUM
Serve reception error (SR=)	1.30	7	0	194
Negative serve reception (SR-)	6.07	16	1	905
Positive serve reception (SR+)	6.64	18	1	990
Ideal serve reception (SR#)	17.24	33	1	2,568

MEAN- arithmetic mean
MIN - the lowest result
MAX - the highest result
SUM - sum of results

Figure 4: The execution of the TE-TA element SERVE RECEPTION represented by percentages

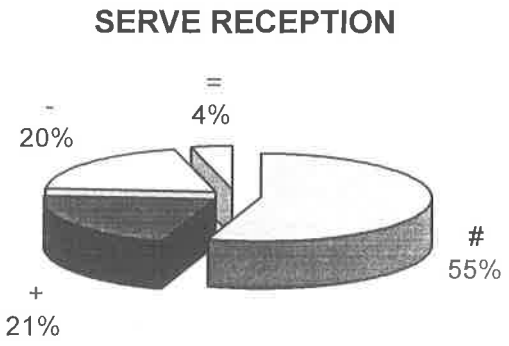
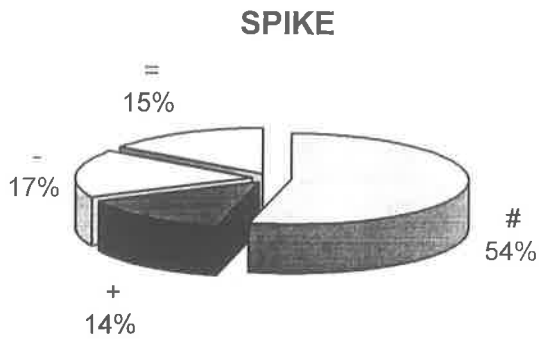


Table 5: The statistical parameters for the TE-TA element SPIKE

	MEAN	MAX	MIN	SUM
Spiking error (SP=)	6.62	14	0	986
Negative spike (SP-)	7.64	22	0	1138
Positive spike (SP+)	6.32	19	0	942
Ideal spike (SP#)	24.13	43	9	3596

MEAN- arithmetic mean
MIN - the lowest result
MAX - the highest result
SUM - sum of results

Figure 5: The execution of the TE-TA element SPIKE represented by percentages



found on the extremely positive pole, which emphasizes the high efficiency of a spiker. Expressed in percentages, about 68% of successful spikes (the sum of positive and winning spike variables expressed in %) have been performed. This is definitely a very high value, especially if we take into account the fact that the TE-TA element *spike* implied spiking after the reception of the ball and spiking after the successfully received ball (spike from the counterattack). On an average, 24 successful spikes and 7 spike errors have been performed per game.

Nowadays, a team having the spiking efficiency higher than 60% is considered to have high quality spikers, and consequently high quality setters. This is also confirmed by the data from Table 5 - as many as 43 successful spikes have been performed in one game (variable winning spike).

According to the data from the Figure 5 SPIKE an individual or a team should try to perform: more than 54% of winning spikes, more than 14% of positive spikes, less than 17% of negative spikes, and less than 15% of spike errors.

The analysis of the predictor variables intercorrelation matrix reveals a large group of statistically significant variables at the level of significance .01 and .001, i.e. at the level of 95% and 99% of explicability (Table 6).

Only the variable S# is not significantly connected with any other variable, which can be explained by its nature, which is manifested in a volleyball game as direct scoring of a point when the ball initially enters the game.

The highest correlation values are expressed by variables winning spike and negative serve (.71) at the level of significance of 99%. This can be explained by the assumption that after

Table 6: The predictor variables intercorrelation matrix

	S=	S-	S+	S#	SM=	SM-	SM+	SM#	B=	B-	B+	B#	P=	P-	P+	P#	O=	O-	O+	O#	CRIT
S=	1.00																				
S-	.07	1.00																			
S+	.17	-.04	1.00																		
S#	-.00	-.23*	.13	1.00																	
SM=	.23*	.40**	.24*	-.06	1.00																
SM-	-.10	.40**	.00	-.21*	.38**	1.00															
SM+	.24*	.12	.36**	.05	.32**	-.07	1.00														
SM#	.36**	.71**	.50**	-.01	.47**	.25*	.30**	1.00													
B=	.02	.56**	27**	-.11	.39**	.30**	.26**	.56**	1.00												
B-	.01	.30**	.16	-.09	.21*	.42**	-.10	.26**	.30**	1.00											
B+	.12	.37**	.25*	.03	.23*	.21*	.27**	39**	.19*	.02	1.00										
B#	.05	.28**	.24*	-.16	.05	.05	.08	.22*	.18	.14	.21*	1.00									
P=	.22*	.15	.07	-.00	.05	.08	-.00	.20*	.10	.14	.13	-.04	1.00								
P-	.10	.37**	.20*	-.00	.46**	.37**	.21*	.45**	.42**	.34**	.16	.12	.16	1.00							
P+	.21*	.44**	.24*	-.04	.41**	.36**	.08	.53**	.34**	.23*	.35**	.20*	.26**	.34**	1.00						
P#	.38**	.57**	.30**	-.10	.55**	.31**	.33**	.67**	.48*	.13	.24*	.18	.08	.17	.14	1.00					
O=	.13	.40**	.32**	-.03	.29**	.26**	.18	.46**	.25*	.04	.43**	.22*	.10	.12	.27**	.54**	1.00				
O-	.11	.36**	.05	-.08	.29**	.48**	-.09	.34**	.10	.25*	.12	.05	.08	.24*	.33**	.32	.05	1.00			
O+	.10	.35**	.25*	-.09	.34**	.22*	.47**	.40**	.34**	.10	.49**	.24*	.09	.26**	.38**	.17	.24*	.03	1.00		
O#	-.21*	.07	.10	.02	.17	.25**	-.05	.08	.08	.13	-.02	-.09	.03	.10	-.02	.09	.11	.01	-.26**	1.00	
CRITT	-.23*	-.01	.17	.24*	-.37*	-.29*	-.06	.08	-.14	-.03	.09	.26**	-.18	-.19*	-.01	-.29**	-.17	-.11	.08	.02	1.00

a poor initial serve (variable *negative serve*) the monitored team has performed the elements *block*, *court defence*, *setting in counterattack*, and especially *spike in counterattack* well. High correlation emphasizes the importance of the attack and the domination of a spiker, because it is in the counterattack that the largest number of spikes are performed after a highly set ball (the so-called III tempo when the opponent forms a group block). High correlation of the variables *winning spike* and *negative serve* expresses the necessity of separating the elements *spike after serve reception* and *spike after a warded-off ball* in future analyses.

The second highest value in predictor variables intercorrelation matrix (.67) can be seen between the variable *ideal serve reception* (SR#) and the variable *winning spike* (SP#) at the level of significance of .001. High correlation between these variables has been expected up to a point. In volleyball game such a high and significant correlation can be explained by the assumption that a ball ideally passed to the setter results in serve reception by a successfully organized attack, i.e. by a successful spike performed by the same team.

Therefore, in top volleyball, a team should try to perform as dangerous serves as possible, even at the cost of making an error, because otherwise an opponent will perform an organized, highly unpredictable and most often successful spike. The best volleyball teams in the world perform, according to statistical data, more than 30 serve errors per match.

Among other things, the structure and the essence of the volleyball game can be explained by the two highest and statistically significant predictor variables intercorrelations. Volleyball, as distinct from other team sporting games, does not possess defensive tactics and the opponent can be stopped in his efficiency only if outplayed by the team which scored more points or achieved more serve changes. The team returning the serves (and not attacking by means of serves) and trying to defend itself by blocking (and not by scoring a point by blocking) is doomed to failure.

By observing the correlation between the predictor variables groups of particular technical-tactical elements and the predictor variables groups of other technical-tactical elements in the correlation matrix the statistically significant relations in the group of variables SPIKE and the group of variables SERVE RECEPTION can be noticed.

The classical regression analysis has been used to calculate which variables are the most important ones to influence either the victory or the defeat in a game, i.e. which variables have the highest prediction value with regard to the criterion.

The analysis of Table 7 shows the correlation between the whole system of independent variables and the dependent variable (Multiple R) - this correlation amounts to .79 which explains 63% of the common variability (R square). Such correlation is significant at the error level of .001 (critical value is calculated by F-distribution).

Since the F-distribution is calculated as a distribution of the quotient of two variances, two degrees of freedom have been determined. The first degree of freedom equals the number of predictor variables (df1 = n), and the second is determined by the number of entities minus the number of predictor variables minus one (df2=N- n-1).

The remaining 37% of the explanation of the total variability of both the independent variables and the dependent variable can be assigned to other features that have not been analyzed here (e.g. groups of variables for the element setting, referee's mistake, etc.).

Table 7 shows that all independent variables have been inserted into the regression equation, and the t-testsignificance at the level of .001 has been calculated for the following variables: SR# (ideal reception), S# (winning serve), S+ (positive serve), S- (negative serve), SR- (negative serve reception), B# (winning block), SR= (serve reception error). Predictor and criterion variables correlation coefficient has been tested on the basis of t-distribution, the degrees of freedom being df=N-n-1 (i.e. the number of entities minus the number of predictor variables minus one).

Further, the survey of the Table 7 leads to the conclusion that the variable SR# (ideal serve reception) has the largest (BETA = -.59) statistically significant contribution to the explanation of the correlation with the criterion (the negative BETA sign is the result

Table 7: Classical regression analysis

Multiple R	.79467
R Square	.63150
Adjusted R Square	.57392
Standard Error	.27196
Regression	20 DF
Residual	128
F = 10.96782	Signif F = .0000

Variables	B	SE B	Beta	T	Sig T
S=	.00014	.01579	.00068	.009	.9929
S-	.02863	.00846	.49075	3.382	.0010
S+	.03732	.01004	.39323	3.717	.0003
S#	.05482	.01411	.23028	3.885	.0002
SR=	-.05527	.01824	-.17832	-3.030	.0030
SR-	-.03671	.01110	-.26949	-3.307	.0012
SR+	-.01762	.01036	-.15956	-1.701	.0913
SR#	-.03764	.00921	-.58873	-4.085	.0001
SP=	-.03049	.01215	-.22454	-2.510	.0133
SP-	-.00812	.00783	-.09298	-1.037	.3015
SP+	-.00611	.00856	-.05335	-.714	.4764
SP#	.01990	.00988	.33347	2.013	.0462
B=	-.01711	.01021	-.13666	-1.675	.0964
B-	-.00278	.01208	-.01553	-.231	.8180
B+	.00043	.00994	.00305	.043	.9654
B#	.04224	.01339	.20511	3.156	.0020
D=	-.01962	.01221	-.12425	-1.607	.1106
D-	.00666	.01453	.03387	.459	.6470
D+	.01297	.00912	.12424	1.421	.1576
D#	.01871	.00898	.13960	2.082	.0393

MULTIPLE R- multiple correlation
R SQUARE- determination coefficient
STAND ERROR – multiple correlation standard error
SE B- standard error
BETA- standardized regression coefficient
T - t- test

of the Horst phenomenon). This shows that one of the most important assumptions for the outcome in a game is the accurate passing of the received serve to the setter.

As emphasized previously, the elements SERVE RECEPTION and SERVE have the highest BETA values, meaning that these volleyball elements have the highest predictive value with regard to the result in a game. It should be stressed that the variable winning block also realized a statistically significant contribution to the criterion prediction (BETA = .21), at the level of significance of 99%). This means that the analyzed team has played well in the defence phase.

Seen through the prism of a volleyball game, the winning block, which scores the point directly, turns out to be very important for winning the game. By means of descriptive statistics, on an average a little more than 4 winning blocks have been obtained, which amounts up to almost one third of the points scored in a game.

Another regression analysis method (FORWARD) was also used in order to isolate the predictor variable which has the most significant autonomous contribution to the explanation of the criterion variable.

FORWARD method first analyzes the predictor variable which has the largest

Tablica 8: Regresijska analiza FORWARD

VARIJABLA	B	SE B	BETA	T	SIGN.T
SM=	1-.050	.010	-.373	-4.879	.000,

B - nestandardizirani regresijski koeficijent
SE B- standardna pogreška B
BETA- standardizirani regresijski koeficijent
T - t- test
SIG T - značajnost t-testa

Zaključak

Na uzorku od 149 setova utakmica seniorskog prvenstva Hrvatske za muškarce i Kupa prvaka Europe u odbojci 1990. godine provedena je klasična regresijska analiza pobjede ili poraza u svakom odbojkaškom setu na temelju pet odbojkaških elemenata (prikazanih kroz 20 varijabli).

Na izračunatim podacima deskriptivne statistike može se izraditi model uspješnosti izvođenja pojedinih odbojkaških elemenata. S obzirom na kvalitetu praćene ekipe (pobjednik Kupa prvaka Europe), to može postati model prema kojemu se pojedinac ili ekipa mogu uspoređivati, bilo da izvode vježbe na treningu ili igraju utakmice (tablica 9).

Na osnovi rezultata matrice interkorelacije moće se zaključiti da najveća veza (.71) varijabli SM# i S- objašnjava važnost skupine varijabli elementa smeča (u kojemu je sadržan i smeč nakon prijema servisa i smeč nakon obranjene lopte), odnosno, povežemo li izračunatu korelaciju s odbojkaškom igrom, to bi značilo da ekipa koja posebno dobro izvodi obrambene elemente s dominirajućim kontranapadom, ima i najveće šanse za uspjeh na utakmici.

Promatrajući grupacije varijabli možemo zaključiti da se najveće i statistički značajne veze nalaze između varijabli smeča i varijabli prijema, što govori o važnosti prijema servisa za realizaciju smeča.

Rezultati regresijske analize pokazuju visok koeficijent multiple korelacije između prediktorskih i kriterijske varijable (Multiple R = .79), što govori da ishod seta i skup prediktorskih varijabli objašnjava 63% zajedničke varijance. Statistički značajan T-test na razini od 99% imalo je sljedećih 7 varijabli: P#, S#, S+, S-, P-, B# i P=. Na temelju klasične regresijske analize može se reći da objašnjenju pobjede ili poraza u setu najviše doprinose skupine varijabli tehničko-taktičkih elemenata servisa i prijema servisa.

Metodom regresijske analize FORWARD izdvojena je samo ona vrijednost koja samostalno statistički značajno doprinosi objašnjenju kriterijske varijable, tj. pobjede ili poraza u odbojkaškom setu. Treba istaknuti da najveći samostalan doprinos objašnjenju kriterija ostvaruje varijabla koja ne pripada grupacijama ni servisa ni prijema servisa, već varijabla SM= koja se u igri prepoznaje kao greška smeča.

Na temelju tih rezultata moglo bi se trenerima preporučiti da u svom daljnjem radu posvete znatno više pažnje i rada smanjenju grešaka u napadu (napad nakon prijema servisa i napad nakon obrane) i grešaka u prijemu servisa, a da "pojačaju" servis, pa i po cijenu većeg broja grešaka.

Tablica 9: Postotni model izvedaba TE-TA elemenata

	SERVIS	BLOK	OBRANA POLJA	PRIJEM SERVISA	SMEČ
#	**5%** i više	**15%** i više	**19%** i više	**55%** i više	**54%** i više
+	**29%** i više	**30%** i više	**45%** i više	**21%** i više	**14%** i više
-	**56%** i manje	**15%** i manje	**14%** i manje	**20%** i manje	**17%** i manje
=	**10%** i manje	**34%** i manje	**22%** i manje	**4%** i manje	**15%** i manje

to the conclusion that the highest and the statistically most significant correlations are to be found between the elements spike and serve reception, which tells us about the importance of the serve for the completion of the spike.

The results of the regression analysis show a high multiple correlation coefficient between the predictor and criterion variable (Multiple R = .79) which means that the outcome in the game and the group of predictor variables are characterized by 63% of common variance. The following 7 variables had a t-test statistically significant at the level of 99%: SR#, S#, S+, S-, SR-, B# and SR=. On the basis of the classical regression analysis it can be said that the groups of variables for the technical-tactical elements *serve* and *serve reception* have the largest influence on the explanation either of the victory or the defeat.

By means of the FORWARD regression analysis method only that value which has a statistically significant autonomous contribution to the explanation of the criterion variable, i.e. the victory or the defeat in a volleyball game, has been isolated. It should be emphasized that the largest autonomous contribution to the explanation of the criterion has been realized by the variable which belongs neither to the group of variables for the element *serve* nor to the group of variables for the element serve reception. It was realized by the variable SP= , in other words *spike error.*

These data lead to the conclusion that the coaches should pay significantly more attention to reducing both the number of errors on attack (attack after the serve reception and attack upon successful defence) and the number of errors in serve reception. On the other hand, the serve should be improved, even at the cost of making more errors.

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