

## EVALUATION OF VARIABLES OF SHOOTING FOR A GOAL RECORDED DURING THE 1997 EUROPEAN BASKETBALL CHAMPIONSHIP IN BARCELONA

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### Abstract:

The research was conducted in order to determine the size of the influence that the variables regarding throwing the ball into the basket have on the final basketball match score. For data acquisition the sample of 62 European Championship matches held in Barcelona was used. The sample of manifested variables consisted of seven standard indicators of situation-related efficiency concerning shooting and assists that were officially registered for each team. The data, gathered from the official basketball game statistics, were processed by means of basic statistical procedures, while the main research problem was analysed by applying the classical algorithm of the regression analysis. The significant difference was determined between the winning and losing teams in variables of shooting and assists, the winning teams achieving the better results. The difference in the total match score averages between the winning and losing teams was 11 points. Regression analysis revealed interesting information on the relation of the predicting variables regarding ball throws and assists with the final game score in a basketball match. Multiple and partial regression coefficients suggest that the final match score could be predicted on the basis of the predicting variables. Multiple correlation of .59 is statistically significant and there is no doubt that 35% of the variance is common to the predicting variables and to the final match score. In the partial regression coefficients three variables (SUT2NE - two-point field goal-unsuccessful, SUT3NE - three-point field goal-unsuccessful, and SLBAUS - free throws-successful) appeared to be the significant predictors. The obtained results support the tactical requirements for a high quality of the play organisation on the phase of offence, which should provide a rational selection of shootings and minimise the number of unsuccessful throws. The SLBAUS variable displays that the losing teams were repeatedly forced to commit a considerable number of personal fouls which was, from the aspect of the success criterion, i.e. the final match outcome, beneficial for the winning teams that were successful in performing free throws. This study is a continuation of the research, established long ago, on the influence of standard indicators of the situation-related efficiency on a match outcome or success in the basketball game. It opens further possibilities for enlarging the basis of knowledge concerning this important segment of exact, objective monitoring of sports games, especially basketball.

**Key words:** basketball, shooting, regression

### BEWERTUNG DER BEI BASKETBALLEUROPAMEISTERSCHAFT IN BARCELONA 1997 VERZEICHNETEN VARIABLEN DES SCHIEßENS AUF'S ZIEL

#### Zusammenfassung:

Das Ziel der Untersuchung war, den Einflussausmaß der die Korbeinwürfe betreffenden Variablen auf das Endresultat eines Basketballspieles festzustellen. Die Daten wurden aus 62 Spielen der Europameisterschaft in Barcelona abgenommen. Das Variablenmuster umfasste 7 gewöhnliche Anzeigen der situationsbezogenen Effizienz bezüglich Einwürfe und Assistenzen, die für jede Mannschaft offiziell verzeichnet wurden. Die aus der offiziellen Spielstatistik erworbenen Daten wurden mittels statistischer Grundverfahren bearbeitet, während das Hauptproblem durch den klassischen Algorithmus der Regressionsanalyse analysiert wurde. Ein statistisch bedeutender Unterschied zwischen den erfolgreichen und den verlierenden Mannschaften wurde in den Variablen der Einwürfe und der Assistenzen zugunsten des Gewinners festgestellt. Der durchschnittliche Endergebnisunterschied zwischen den Gewinnern und den Verlierern war 11 Punkte. Mittels der Regressionsanalyse wurden interessante Informationen über die Beziehung der Prädiktorvariablen des Ballwurfs und der Assistenzen mit dem Endergebnis des Spieles entdeckt. Multiple und partielle Regressionskoeffizienten zeigen, dass das Endergebnis aufgrund der Prädiktorvariablen vorausgesehen werden kann. Die multiple Korrelation von 0,59 ist statistisch bedeutend und zweifellos ist 35% der Varianz den Prädiktorvariablen und dem Endergebnis gemeinsam. Unter den partiellen Regressionskoeffizienten schienen 3 Variablen als bedeutende Anzeigen (SUT2NE - unerfolgreicher 2-Punkte-Schuß, SUT3NE- unerfolgreicher 3-Punkte-Schuß und SLBAUS - erfolgreicher Freiwurf). Die erworbenen Ergebnisse unterstützen den taktischen Bedarf nach guter Spielorganisation in der Verteidigungsphase, um eine rationale Ballwurfselektion zu ermöglichen und damit die Zahl unerfolgreicher Ballwürfe zu vermindern. Die Variable "SLBAUS" zeigt, dass die verlierende Mannschaft immer wieder dazu gezwungen war, mehrere Personalfouls zu machen, was vom Erfolgsaspekt (Endresultat) für die in den Freischüssen erfolgreiche Gewinnermannschaft günstig war. Diese Studie ist die Fortsetzung einer vor langer Zeit durchgeführten Untersuchung über den Einfluss der Standardanzeigen der situationsbezogenen Effizienz auf das Endresultat oder die Leistung in einem Basketballspiel. Sie gibt weitere Möglichkeiten, um die Kenntnisbasis in diesem wichtigen Segment der exakten und objektiven Beobachtung der Ballspiele, besonders Basketballs, zu erweitern.

**Schlüsselwörter:** Basketball, Schießen, Regression

## Introduction

Basketball, from the point of view of movement structure, as well as from the point of view of the structure of situations in the game, is one of the most complex team sports in which fast transitions from one action into the other prevail. However, basketball may be interpreted as an organised series of tasks to be performed by a player during the game. These tasks should be accomplished in such a way as to take into account the position and the role of a particular player on a team (Trninić, 1995). The results of multivariate statistical analyses, in which the data obtained from large samples of top basketball players were processed and consequently led to determining the types of players whose characteristics were in congruence, to a large extent, with the requirements put before players in actual situations in a game, were published in various scientific papers (Trninić et al., 1995, Dizdar et al., 1996, Dizdar et al., 1997).

The analysis of individual and team efficiency in sporting performance, based on standard statistical parameters in sporting games, has recently been the object of increased attention of sport experts and scientists. This type of analysis contributes to a more objective assessment both of the individual and of the team fitness levels. The performance statistics has been applied in basketball longer than in other sporting games.

However, such a way of following the performance efficiency is frequently subject to criticism (Swalgin, 1998). The reason for this criticism lies in the refusal to take into account the versatility of the playing positions, insufficient consideration of non-standard parameters (which are, for the sake of truth, rather difficult to record accurately) and the lack of uniformity of statistical forms.

It is important to mention here the research (Trninić, 1975; Milanović, 1979; Pleslić, 1994; Trninić, 1995; Birkić, 1996; Bračić, 1998) which was directed towards the evaluation of particular parameters and which definitely contributed, to a large extent, to a better understanding of the issues dealing with

performance efficiency and the determination of different types of players in basketball.

Swalgin (1994, 1998) significantly contributed to a scientific consideration of issues dealing with the analysis and evaluation of the efficiency of players playing in various positions. On the basis of a long-term research carried out on top basketball players he determined the norms for the evaluation of the situation-related efficiency of basketball players according to their playing positions and according to the time spent in the game.

Since basketball is characterised by both typical and atypical situations, an issue of objectively recording particular situation-related parameters in the game arises. For this purpose, Fédération Internationale de Basketball Amateur (FIBA) has standardised thirteen indicators of situation-related efficiency which are officially recorded in every game.

This research represents an attempt to quantify and to evaluate the variables of shooting for a goal in basketball on the one hand, and to determine the influence of these movement structures on the final score in the game on the other. The data for this research were collected during the games played at the 1997 European Championship in Barcelona.

The research was carried out in order to determine the extent of the influence of the variables of shooting for a goal on the final score of a basketball match.

This research should give an insight into the possibility of predicting the success of a basketball game on the basis of the objective recording of variables of shooting for a goal as an indicator of situation-related efficiency of the players.

## Research methods

### Entity sample

The data were collected on the sample of 62 games. The sample of entities was comprised of 124 opponents in basketball games, namely, the sixteen teams who qualified for the 1997 European Championship finals in Barcelona.

Group A	Group B	Group C	Group D
Bosnia and Herzegovina	Slovenia	Latvia	Spain
Russia	France	Italy	Croatia
Greece	Lithuania	Yugoslavia	Germany
Turkey	Israel	Poland	Ukraine

### Sample of variables

The sample of manifest variables was comprised of seven standard indicators of situation-related efficiency of shooting for a goal in basketball, which are recorded for each team.

1. Two-point field goal attempt – SUCCESSFUL (SUT2US)
2. Two-point field goal attempt – UNSUCCESSFUL (SUT2NE)
3. Three-point field goal attempt – SUCCESSFUL (SUT3US)
4. Three-point field goal attempt – UNSUCCESSFUL (SUT3NE)
5. Free throw attempt – SUCCESSFUL (SLBAUS)
6. Free throw attempt – UNSUCCESSFUL (SLBANE)
7. Assists (ASISTEN)

The criterion variables were defined in binary terms on the basis of the final scores of the basketball games (WINNERS/LOSERS).

### Data processing methods

First, the frequency of the various variables of shooting for a goal were calculated and analysed. The efficiency in particular games was determined, both for the winning and for the losing teams, as a ratio of the total number of successfully executed shots and the total number of shots directed towards the basket.

The basic descriptive (central – dispersion) parameters were assessed for each item of data regarding the shots for a goal. The correlation coefficients between the predictor variables were also calculated.

The predictive value of variables denoting successful and unsuccessful shots at the basket, with regard to a final score of the game defined in binary terms, that is, the possibility of predicting the final score of the game on the basis of the efficiency of shooting at the basket, was determined by means of the regression analysis algorithm.

The collected data were processed by means of multiple regression, in the statistical package STATISTICA FOR WINDOWS, Version 5.0.

The following were calculated:

- The basic statistical parameters: standard deviation (SD), arithmetic mean (AM), minimal value (MIN), maximal value (MAX), difference between the highest and the lowest results in a particular variable (RANGE).
- The correlation matrix of predictor variables of successful and unsuccessful shots at the basket.
- The following have been determined within the classical regression method:
  - partial regression coefficient of predictor variables ( $\beta$ ),
  - coefficient of multiple correlation between predictor variables and the criterion variable,
  - significance of multiple correlation will be tested by means of an F-test, and the statistical significance of partial regression coefficients by means of a *t*-test.

Table 1: Frequency of shooting for a goal.

	VAL	SUM	POB	%	POR	%
SUT 2 US	124	2,677	1,439	53.75	1,238	46.24
SUT 2 NE	124	2,507	1,180	47.06	1,327	52.93
TOT 2	124	5,184	2,619	50.52	2,565	49.47
SUT 3 US	124	624	311	49.83	313	50.16
SUT 3 NE	124	1,221	536	43.89	685	56.10
TOT 3	124	1,845	847	45.90	998	54.09
SLBA US	124	2,223	1,252	56.32	971	43.67
SLBA NE	124	1,062	539	50.75	523	49.24
TOT SLBA	124	3,285	1,791	54.52	1,494	45.47

## Results and discussion

### Analysis of frequencies of variables of shots at the basket

Table 1 shows the basic parameters of frequencies of shots at the basket (SUM) performed by the winning (POB) and by the losing (POR) teams.

It is evident that out of the total number of 5,184 two-point field goal attempts (both successful and unsuccessful) the winning teams performed 2,619 attempts, in other words 50.52%, whereas the losing teams performed the total number of 2,565 attempts (49.47%).

The winning teams performed a larger number of successful two-point field goal attempts (53.75%), whereas the losing teams performed 46.24% of successful two-point field goal attempts. In congruence with this, the winning teams performed a significantly lower number of unsuccessful two-point field goal attempts (47.06%), in contrast to the losing teams (52.94%).

On the whole, out of 1,845 three-point field goal attempts (both successful and unsuccessful), the winning teams performed 847 and the losing teams 998. It may be concluded that the teams who lost the game performed a larger number of three-point field

goal attempts. This speaks in favour of the fact that the defeated teams very frequently, in some parts of the game, tried to score three-point goals hastily and imprudently in order to catch up with the, mostly unreachable, advantage of the winning teams.

As for free throws, it is evident that out of the total number of free throw attempts (3,285) a larger number of free throws was performed by the winning teams (54.52% or 1,791 free throws), whereas the losing teams performed 45.47%, or 1,494 free throws.

This seems logical, because the teams who lost the games, lost them, very frequently, because they were forced to make many personal fouls. It is well-known that the violations, which result in free throws awarded to the attacking teams, mostly occur when individual players, and consequently the whole team, demonstrate the technical, tactical and fitness-related weakness. The result of this weakness is then the large number of free throws awarded in favour of the winning teams.

Table 2 displays data on the successfulness of the attempts to shoot for a goal performed by the winning (POB) and by the losing (POR) teams. It must be stressed that the indicators of total efficiency (TOTAL) of teams that played the games in the European Championship are an issue here.

Table 2: Frequencies of successful shots at the basket of winning and losing teams.

	TOTAL	SUCCESS.	%
2 UKUP	5,184	2,677	51.64
2 POB	2,619	1,439	54.94
2 POR	2,565	1,238	48.26
3 UKUP	1,845	624	33.82
3 POB	847	311	36.72
3 POR	998	313	31.36
SLBA UKUP	3,285	2,223	67.67
SLBA POB	1,791	1,252	69.91
SLBA POR	1,494	971	64.99

The analysis regards two-point field goal attempts, three-point field goal attempts and free throw attempts. As for the variables of two-point field goal attempts, an average total efficiency of 51.64% was achieved, which is, when compared with the standards of major competitions, rather low, because it is expected that this value be approximately 60%. It is logical that the winning teams achieved a significantly greater efficiency in scoring two-point field goals (54.94%) in comparison with the losing teams (48.26%). As for the two-point field goal attempts, the efficiency of the winning teams was 6.5% higher than the efficiency of the losing teams.

are enhanced, and a more and more systematic play on defence makes an easy completion of a scoring attempt difficult, which was not the case in previous periods of the development of the basketball game. On the other hand, the play on offence is more and more demanding. This especially holds for the play without the ball, so that both the individual and the team actions preceding the reception of the ball are complex and difficult. The energy and the mental reserves are, in congruence with the previously said, lower in the moment of realisation. These conditions lead to a lower efficiency in the variables of shooting for a goal.

Table 3: Basic statistical indicators of variables of shooting for a goal and the assists made.

	NUMBER OF TEAMS	MEAN	MIN	MAX	RANGE	SD
SUT 2 US	124	21.58871	11	33	22	4.95674
SUT 2 NE	124	20.21774	11	34	23	4.99521
SUT 3 US	124	5.03225	0	13	13	2.57232
SUT 3 NE	124	9.84677	3	22	19	3.54310
SLBA US	124	17.92742	1	40	39	6.83269
SLBA NE	124	8.56451	2	18	16	3.75086
ASISTEN.	124	12.67742	3	25	22	4.57911

As for the three-point field goal attempts, it is evident that the average total efficiency of 33.82% was achieved, which means that every third attempt was completed successfully. The winning teams achieved as much as 36.72% and the losing teams 31.36%. The efficiency of scoring three-point field goals in the winning teams was 5.5% higher than the efficiency of the losing teams. The total efficiency regarding the free throws was 67.67% - the winning teams achieved the efficiency 5% higher than the efficiency of the losing teams, 69.91% and 64.99% respectively.

It may be concluded that the efficiency of shooting for a goal at the 1997 European Championship in Barcelona was not at the level that was to be expected at such a competition. The reasons are to be found in the competition level of the participating teams and in the model of play, which has been displayed recently. Such a model of play is in congruence both with the development trends of the preparation of basketball players and with the referring criteria. On the one hand, the physical characteristics and the tactical knowledge of the players on defence

#### Analysis of basic statistical indicators of variables of shooting for a goal

Table 3 shows the basic statistical indicators of variables of shooting for a goal.

The variables show a satisfactory discriminant level, because, in the interval between the minimal and the maximal score, they are always within the range of between 4.4 and 5.7 standard deviations. The dispersion of results around the achieved arithmetic means is good enough.

Table 4 shows the statistical parameters for the winning teams, and Table 5 displays the basic statistical parameters of the variables of shooting for a goal for the losing teams. Both in the winning and in the losing teams, the discriminant level of variables is satisfactory, because it is, within the minimal and the maximal score interval, between 4.0 and 5.5 standard deviations.

Table 4: Basic statistical indicators of variables of shooting for a goal and of assists in winning teams.

	NUMBER OF TEAMS	MEAN	MIN	MAX	RANGE	SD
SUT 2 US	62	23.20968	13	33	20	5.20131
SUT 2 NE	62	19.03226	11	31	20	4.27331
SUT 3 US	62	5.01612	1	13	12	2.58299
SUT 3 NE	62	8.64516	3	15	12	2.92023
SLBA US	62	20.19355	3	40	37	6.96322
SLBA NE	62	8.69354	3	18	15	3.82652
ASISTEN	62	14.25806	4	25	21	4.65158
REZ.	62	81.40323	61	108	47	10.84686

Table 5: Basic statistical indicators of the variables of shooting for a goal and of assists in losing teams.

	NUMBER OF TEAMS	MEAN	MIN	MAX	RANGE	SD
SUT 2 US	62	19.96774	11	30	19	4.14083
SUT 2 NE	62	21.40323	11	34	23	5.40327
SUT 3 US	62	5.04839	0	12	12	2.58258
SUT 3 NE	62	11.04839	3	22	19	3.72156
SLBA US	62	15.66129	1	30	29	5.93391
SLBA NE	62	8.43548	2	16	14	3.70033
ASISTEN.	62	11.09677	3	21	18	3.94515
REZ.	62	70.67742	43	94	51	11.59674

In general, it may be said that the dispersion of results around arithmetic means is good. The last variable in Tables 4 and 5 concerns the average number of scored goals achieved by the winning and by the losing teams, respectively. It is evident that, on the average, the winning teams scored 81.40 goals, and the losing teams 70.67 goals. The average score of all the games at the European Championship was 81:70, which means that the winning teams won with an 11-goal difference on the average.

It is indicative to mention that the smallest number of goals scored by the winning teams was 61, and the biggest 108, whereas the smallest number of goals scored by the losing

teams was 42 and the largest 94. Therefore, it may be concluded that the variables of shooting at the basket on the whole and also those regarding the winning and the losing teams separately represent a good source of data necessary for an extensive insight into successful and unsuccessful shooting for a goal at the 1997 European Championship in Barcelona.

**Correlation between predictor variables**

The values of correlation between the predictor variables are presented in Table 6.

The correlation matrix of predictor variables

Table 6: Correlation matrix of predictor variables.

	SUT 2 US	SUT 2 NE	SUT 3 US	SUT 3 NE	SLBA US	SLBA NE	ASIST.
SUT 2 US	1.00	-0.14	<b>-0.28</b>	-0.21	-0.06	0.07	<b>0.46</b>
SUT 2 NE		1.00	<b>-0.25</b>	-0.15	0.04	0.20	<b>-0.24</b>
SUT 3 US			1.00	<b>0.28</b>	0.04	-0.16	<b>0.30</b>
SUT 3 NE				1.00	-0.23	0.03	-0.11
SLBA US					1.00	<b>0.20</b>	0.06
SLBA NE						1.00	0.00
ASISTEN.							1.00

of two-point field goal attempts, of three-point field goal attempts, of free throw attempts and of assists does not contain high correlation coefficients. They are mostly to be found within the range between .19 and .46 in the positive direction. There exists also a certain number of negative correlations, which vary between -.24 and -.28. The significantly high positive correlations ( $P < 0.01$ ) between particular variables should be emphasised. The highest correlation is manifested between the variables *assists* (ASIST) and the number of *successful two-point field goal attempts* (SUT2US). A successful assist is a prerequisite for a successful two-point field goal attempt. It should be mentioned that in the FIBA system of statistical records of events in the game, an assist is only regarded as a direct passing of the ball which then leads, under the basket, to a successful field goal. Therefore, the passing of the ball which then leads to attempting a field goal from a distance is not regarded as an assist, and the importance of this technical-tactical element, in terms of tactics, is well-known.

A successful assist enables a successful two-point field goal attempt. The relationship between the number of assists (ASISTEN) and the number of three-point field goal attempts (SUT3US) should be emphasised. A successful assist creates the conditions for an open shot which frequently results in a successful three-point field goal attempt. The teams who perform a larger number of successful three-point field goal attempts are, in terms of tactics, much superior, because a good organisation of play on offence, together with good assists, enables a large number of successful three-point field goal attempts.

A very significant correlation between the number of unsuccessful three-point field goal attempts (SUT3NE) and the number of successful three-point field goal attempts (SUT3US) means that the teams who perform a large number of successful three-point field goal attempts also perform a large number of unsuccessful three-point field goal attempts, which is logical, since there are teams which force the execution of three-point field goal attempts during the whole game.

The correlation between unsuccessful free throw attempts (SLBANE) and successful free throw attempts (SLBAUS), and the unsuccessful two-point field goal attempts

(SUT2NE) implies that a larger number of free throw attempts means a larger number of both successful and unsuccessful free throw attempts. The number of unsuccessful free throw attempts (SLBANE) positively correlates with the number of unsuccessful two-point field goal attempts (SUT2NE), because both variables denote an unsuccessful realisation.

As for negative correlations, there exist three interesting correlation coefficients whose values are between -.28 and -.24. The first one is the one between the number of successful three-point field goal attempts (SUT3US) and the number of successful two-point field goal attempts (SUT2US). The second one is the one between the number of successful three-point field goal attempts (SUT3US) and the number of unsuccessful two-point field goal attempts (SUT2NE). Namely, the teams who display a high shooting accuracy also display a quality distribution of both two-point and three-point field goal attempts.

Naturally, the negative correlation between the number of successful three-point field goal attempts and the number of unsuccessful two-point field goal attempts may suggest that the teams who execute unsuccessful two-point field goal attempts very frequently decide to execute the three-point field goal attempts, and, speaking in percentages, they do score a significant number of these goals. Additionally, there are teams that predominantly shoot from a three-point line, and consequently achieve a corresponding result. Negative correlation between the assists (ASISTEN) and the number of unsuccessful two-point field goal attempts implies that a larger number of successful assists influences the smaller number of unsuccessful two-point field goal attempts.

#### **Regression correlation between predictor variables of shooting for a goal and the analysis regarding the final score of a basketball game.**

Table 7 presents the results of the regression analysis of correlations between predictor variables of shooting for a goal and the criterion variables which define the final score of the games played at the European Championship in Barcelona. The multiple

Table 7: Multiple and partial regression coefficients of correlations between the predictor variables of shooting for a goal and assists, and the criterion variable defined as the final score in the game.

	BETA $\beta$	ST. ERROR OF BETA	f (116)	P - level
SUT 2 US	0.19	0.10	1.92	0.06
SUT 2 NE	- 0.22	0.08	- 2.74	0.01
SUT 3 US	0.01	0.10	0.09	0.92
SUT 3 NE	- 0.26	0.08	- 3.04	0.001
SLBA US	0.28	0.08	3.49	0.001
SLBA NE	0.02	0.08	0.26	0.79
ASISTEN.	0.16	0.10	1.60	0.11

MR = .59300498, RD. = .35165490, ADJUSTED R. = .31253,

F (7.116) = 8.9882, P < .0000

STA. ERROR OF ESTIMATE: .41625

regression coefficients say that the final score of the game shares 35% of the common variance with the variables of successful and unsuccessful shooting for a goal, that is, 35% of the final scores in the games may be explained by using the variables which are the subject of this research. The multiple correlation (.59) is statistically significant ( $P < 0.01$ ) and it may be concluded that the success, that is, the final score in basketball games, significantly (.99) depends on the effects in the variables of shooting for a goal and assists.

The results of the partial influence of the particular variables of shooting for a goal and of the assists on the success, that is, the final score in a basketball game, offer useful pieces of information that can be used in practice. From the partial regression coefficients and the  $\beta$ -vector it may be concluded, in congruence with their  $t$ -value and significance, that only three variables appear as significant predictors ( $P < 0.01$ ) of the final score in a basketball game. These three variables are: *unsuccessful three-point field goal attempts* (SUT3NE), *unsuccessful two-point field goal attempts* (SUT2NE) and *successful free throw attempts* (SLBAUS).

The variable *successful free throw attempts* (SLBAUS) has the biggest positive projection (.28) on the final score of the game. This variable differentiates well between successful and unsuccessful teams. As many successful free throw attempts as possible are needed for success in a basketball game. This implies accuracy on the one hand, and on the other, it means that one team tries to force the

opposing team to commit as many personal fouls as possible, which, in terms of tactics, means the superiority of one team, and the weakness of the other, in which case this appears to be the only means with which they will try to prevent the quality play of the opposing team.

The next significant correlation is the negative projection of unsuccessful three-point field goal attempts (-.26). This means that the winning teams execute a smaller number of unsuccessful three-point field goal attempts, which further means that the accuracy of shots executed from a distance is an important variable and that success in the game depends on it, which is in congruence with the results obtained by Milanović (1978). Namely, the author discusses the necessity of executing as few unsuccessful field goal attempts from a distance as possible, as an important criterion necessary to win the basketball game. When considering the fewest possible number of unsuccessful three-point field goal attempts as the criterion of successfulness in the game, then this implies a strict selection of shots, a very rational organisation of play on offence and a large number of open shots. Meeting these requirements decreases the number of unsuccessful shots to the smallest possible number.

The partial regression coefficient between the number of unsuccessful two-point field goal attempts and the final score in the game (-.22) may be explained in the same way. This means that the winning teams execute a smaller number of unsuccessful two-point



field goal attempts than the losing teams. The teams that outplay the defence of the opposing team and that are thus in a position to control the shots executed either from under the basket or from a half-distance have, as a rule, a greater chance of winning the game.

## Conclusion

The research was carried out in order to determine the influence of variables of shooting for a goal on the final score in a basketball game. The data were collected on the sample of 62 games played at the 1997 European Championship in Barcelona. The sample of manifest variables was comprised of seven standard indicators of situation-related efficiency of shooting for a goal and of assists, both being recorded during the games for each team. The results that were collected on the basis of the statistics of the basketball games were processed by basic statistical procedures, whereas the main issue of the research was dealt with by means of the classical regression analysis algorithm.

It may be concluded that the successfulness of shooting for a goal was not a positive characteristic of the games played during the 1997 European Championship in Barcelona and that the achieved efficiency was below the level expected at such a competition. All the variables of shooting for a goal had the satisfactory metric characteristics. A significant numerical difference between the winning and the losing teams was determined in the variables *successful shots* and assists. The winning teams achieved better results.

Interestingly, the smallest number of points scored in one game by a winning team was 61, and the largest 108, whereas the smallest number of points scored by a losing team was 43, and the largest 94. The average difference in the games between the winning and the losing teams was 11 points.

The regression analysis offered useful pieces of information about the correlation between the predictor variable of shooting for a goal and assists on the one hand, and the final score in a basketball game on the other. The multiple and the partial regression coefficients show that the final score of the game significantly depends on the accomplishment

of shooting for a goal from different distances. The multiple correlation (.59) is statistically significant and there is no doubt that the predictor variables share 35% of the common variance with the final score in the basketball games. The teams that won the game executed fewer unsuccessful three-point field goal attempts, fewer unsuccessful two-point field goal attempts and more successful free throw attempts.

The obtained results speak in favour of tactical requirements regarding a quality organisation and realisation of play on offence, on which it is much more important to provide a rational selection of shots and execute as few unsuccessful attempts as possible. The variable regarding the execution of successful free throw attempts implies that the defeated teams were forced to commit a large number of personal fouls. Consequently, the successful execution of free throws by the teams in whose favour these throws were awarded appeared to contribute to winning the game.

The improvement of this type of research in the near future could be accomplished by undertaking either of two directions in the investigations. The first research direction concerns the analysis that would encompass all thirteen situation-related indicators. The result might be a more comprehensive, but still more clearly defined presentation of the influence the particular variables have on the final outcome of basketball matches. The second research direction should focus on the issues of influence that only certain variables or even the whole system of standard performance indicators have on the performance a particular team achieves in a league all-round system of competition, where each team plays against every team. The analysis accomplished within the so defined frame of competition should probably provide more distinct information about the level of influence the observed elements of performance might have on the eventual match outcome.

This research is the continuation of the research that was started a long time ago and that dealt with the influence of standard indicators of situation-related efficiency on the success in a basketball game. It opens further possibilities of supplementing the existing knowledge about this important segment of monitoring and evaluating the successfulness in sporting games, especially in basketball.

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