

DIFFERENCES IN INDEXES AND VARIABLES DIRECTLY ARISING FROM THE RESULTS OF A TABLE TENNIS COMPETITION IN TWO DIFFERENT SEASONS

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Abstract

The basic aim of this research is to question to what extent the indexes and variables derived directly from the results of individual table tennis games are different in two different seasons of table tennis championships. We have examined a sample of table tennis players competing in various recreational table tennis leagues in SOKAZ (N=914 during 2006 and N=956 during 2007). We found statistically significant differences between individual variables, between the indexes of the table tennis competitor's efficiency and between the "pure statistical" variables, in two different competition seasons. Comparing the differences in variables and indexes that are the indicators for uncertainty of the competition, directions for changing competitive system can be suggested, differently on certain league levels.

Keywords: table tennis, differences, competition

Introduction

Comparing the results in different championship seasons can have at least two meanings: analysing the quality of performance of the certain players or teams in two different competitor's environments (1) and analysing the uncertainty of the competitions in certain leagues (2). In fact, both types of data could provide us information important for considering changing of the competition system (defining number of teams promoted and relegated, number of teams in one league, etc.), with a purpose of increasing uncertainty of the competition (Del Corral, 2007). The ultimate concern in high-performance sport is the final performance, whether it is at the training or on the competition. The final output that is observed is dependent on a complexity of factors. Each of them may contribute a variable amount to the performance.

Table tennis is one of the fastest ball games in the world and therefore it is difficult for the coach to notice and remember all the key elements occurring within a game or training session (Hughes & Franks, 1997; Baca et al, 2004; Leser, & Baca, 2009). Other important issue is approach with uncertainty coefficient as a method for optimisation of the competition. Coefficient of uncertainty at the competition, is an attempt to define the uncertainty of the matches in certain competition (Del Corral, 2007, 2009; Forrest & Simmons, 2002). From sports aspect, the basic and most utilitarian indicator of game quality is exactly the achieved result on a particular sports competition. Amongst different manners of quality analysis of the table tennis players' game, the basic idea of research was to seek to detect those indicators (data) for collection of which only the final result in particular competitions in larger number of events, in one table tennis game, certain sets in one table tennis game could be sufficient.

How to assess the game quality is the basic question which is set by the professionals aiming to improve result effect of table tennis player. In the world of table tennis, some studies on game analysis can be found, but in general there is a lack of literature for this discipline (Baca et al, 2004; Leser, & Baca, 2009). Sindik & Vidak (2009) tried to find out uncertainty coefficient as a method for optimization of the competition system in table-tennis leagues. Sindik (1999) performed that by implementation of variables which could directly be derived from the results of competitions, however, those variables one could reduce to a smaller number of indexes. Sindik and Juričević (2007) derived 16 indexes as the indicators of game quality, exactly based on the achieved result in a particular table tennis competition, but for former system of points in table tennis (game with two sets, played till reaching 21 points). As we can see from this short literature review, indicators of game quality can be different and more or less numerous, and the analysis using indexes and variables directly derived from the results of individual table tennis games was applied only on former system of points in table tennis (with a smaller ball, additionally).

Researching which indexes and variables directly derived from the results of individual table tennis games are different in different seasons of table tennis championships, could provide us few types of information: about indirect efficiency indicators (for example, games won), indirect indicators of the success (such as matches won in five sets) and "neutral" variables, named "pure statistical" variables (for example, number of matches played). For analysing uncertainty, we can analyse the differences between two seasons in certain direct and indirect efficacy indicators, as well as certain "pure statistical" variables.

The uncertainty can be estimated in comparison between key indicators of uncertainty (game played in five sets, turnover index, game played in five sets index, with belonging variables) and "pure statistical" variables (turnover games, games played in five sets, sets played on point difference) that are indicators of uncertainty, but always in combination with number of games played. In this research, we'll simplify our approach, assuming that absence of the differences between number of matches played in two seasons, means reliable comparing other variables and indexes. The *basic aim* of the research is to question to which extent the indexes and variables directly derived from the results of individual table tennis games are different in two different seasons of table tennis championships (in 2006 and 2007). *The goals* of the research are to determine the differences between two different competition seasons in: individual variables of the table tennis competitor's efficiency in two different competition seasons (1); indexes of efficiency, derived by summarization of several particular variables (2); "pure statistical" variables in the table tennis (3). We assumed that there are no differences between two different competition seasons toward: individual variables of the table tennis competitor's efficiency, derived indexes of efficiency. as well as in "pure statistical" variables.

Methods

Data collection has been performed by inspecting all the results of individuals (players-examinees) from official web page of the Table Tennis Organization of Clubs and Activities of Zagreb (SOKAZ) www.sokaz.hr. The total result of an individual in larger number of individual tennis table games, sets, games has been registered. All results were collected from two championships in the period during 2006 in 2007, from the different competition ranks in which the named team has competed. The role of judges and audience was reduced to a minimum, while games were played in three sets won.

Sample

The final sample comprised of 914 table tennis players competing in various recreational table tennis leagues in SOKAZ, during 2006, who played in leagues ranged from 1 to 20, with minimum of 36 to maximum of 59 players in each league and the final sample of 956 table tennis players competing in various recreational table tennis leagues in SOKAZ, during 2007 that played in leagues ranged from 1 to 20, with minimum of 33 to maximum of 63 players in each league. In total, in both championships, data from 1870 players are collected. In fact, we have collected the data about the same players, but partially differently distributed in various leagues. Each individual whose result was collected played at least 8 individual games in period observed, while the maximum number of individual games which the individual could play during one competition was 66.

All the players were male. The data were collected directly from the Internet players' database (website: www.sokaz.hr).

Variables

The main independent variable in this research was the year of the competition. We have analyzed two championships in different levels of leagues in SOKAZ in 2006, and two championships in different levels of leagues in SOKAZ in 2007. I.e. this variable was dichotomous (players that played in 2006 and in 2007). The other independent variable, used only for the additional interpretation of the results obtained, was the league level (1=1st to 5th league; 2=6th to 10th league; 3=11th to 15th league; 4=16th to 20th league). Indicators (direct and indirect) in the table tennis competition have been defined, which can be derived directly from the competition results.

Direct efficacy variables have been determined:

1. games won: total games won, for an individual
 2. sets won: total number of sets won, for an individual, from the total number of games played
- Other variables* were also directly derived from the results, and they are divided in two groups:
- A. indirect efficacy variables (indicators of success);*
3. games lost: total games lost (individual);
 4. sets lost: total number of sets played in which an individual lost the set;
 5. sets won with points difference: total numbers of sets won that were played on difference (won 11-9, 12-10 etc.);
 6. sets lost with points difference: total number of sets won that were played on point difference (lost 9-11, 10-12, etc.);
 7. games won played in five sets: total number of games won that were played in five sets (result 3-2 for an individual);
 8. games lost played in five sets: total number of games lost, that were played in five sets (result 2-3 for an opponent);
 9. games won after 0-2 in sets for opponent: number of games won in which an individual won after losing the first two sets (0-2 advantage of the opponent);
 10. games lost after leading 2-0 in sets: number of games lost in which an individual lost after winning the first two sets (2-0 advantage);
- B. 'pure statistical' (neutral) variables*
11. number of games played: total number of games played by an individual;
 12. number of sets played: total number of sets played by an individual;
 13. turnover games (lost after leading 2-0 and won after 0-2): total number of games won in which an individual won after losing the first two sets (0-2 advantage of the opponent) and the number of games lost in which an individual lost after winning the first two sets (0-2 advantage of the opponent);
 14. games played in five sets: total number of games played in five sets (result 3-2 for an individual or 2-3 for the opponent);
 15. sets played on point difference: total number of sets played on point difference (won 11-9, 12-10 etc. or lost 9-11, 10-12, etc.).

Indexes

Indexes in table tennis competition have been defined, which can be derived directly from the competition results (variables). These indexes are theoretically organized as a 'composition' of two particular variables - , basic 'logic' is the calculation of ratio between effectively accomplished number of cases and the maximum possible number of cases, in relation to the hypothetic indicators of efficiency in competition situations.

Direct efficacy indexes (indicators):

1. game index: ratio between the number of games won and lost in all an individual's games: total number of games won is divided by the total number of games played;

2. set index: ratio between the number of sets won and lost, in all sets in games played by an individual: total number of sets won is divided by the total number of sets played;

Indirect efficacy indexes (indicators):

3. set played on point difference index: ratio between the numbers of sets won and lost, in sets played on point difference (11:9, 12:10 etc.): the number of sets won on point difference is divided by the total number of sets played on point difference;

4. game played in five sets index: ratio between the number of games played in 5 sets, in relation to the total number of games played; the number of games played in 5 sets is divided by the total number of games played;

5. turnover index: ratio between the number of games won and lost, in which an individual won after losing the first two sets (0-2 advantage of the opponent), and in games when an individual had an advantage to the opponent leading 2-0 (and finally lost the game).

Finally, total efficacy index is the sum of three indexes (set play on difference, game played in five sets, turnover index), as a hypothetic measure of total player's efficacy.

Data Analysis

All data analysis was performed using the SPSS 15.0 package. Descriptive statistics for all variables and indexes are calculated. In order to determine differences in the achievement of table tennis players in two different competition years (2006 and 2007), by using variables and indexes of competitive efficacy in table tennis, we carried out t-tests. Then, by applying the discrimination analyses, we also established factors of differences for indexes and variables of competitive efficacy in table tennis, in relation to the two competition years in SOKAZ and to the competition level. Then we tested the correlation between the league in which a player plays and all indexes and variables of competitive efficacy, directly deduced from the results.

Results

In Table 1 are presented the results of discrimination analysis, in relation to the dependent variable year of competition (2006 or 2007), we notice that the group centroids are quite distant

.457 (the year of 2006) and -.327 (the year of 2007). Based on the discrimination function, 66.7 % of initially grouped cases could be correctly classified. The discrimination function statistically significantly differentiates indexes of efficiency at table tennis players in 2006 and 2007. ANOVA results showed statistically significant differences between two seasons in total efficacy index, but also in game played in five sets index. That is to say, it was demonstrated that table tennis players in the competitions of the SOKAZ leagues in 2006 (in relation to 2007) were statistically significantly more successful in matches played in five sets indexes.

In Table 2 it is noticeable that the values of 'pure statistical' variables, in comparison with 2006 and 2007, in two cases differentiate statistically significantly. That is to say, it was demonstrated that among 'pure statistical' variables, there is a statistically significant difference in the number of turnover games (higher number in 2007) as well as in games played in five sets (higher number in 2007). In Table 3 having examined the results of discrimination analysis, in relation to the dependent variable year of competition (2006 or 2007), we notice that the group centroids are quite distant -.267 (the year of 2006) and .256 (the year of 2007). Based on the discrimination function, 61.3 % of initially grouped cases could be correctly classified. The discrimination function statistically significantly differentiates variables of efficiency in table tennis players in 2006 and 2007. ANOVA results showed statistically significant differences between two seasons in the following variables: won games after 0-2 in sets for opponent (higher results in 2007), lost games after leading 2-0 in sets (higher results in 2007), lost sets with difference (higher results in 2007), won games played in five sets (higher results in 2007), lost games played in five sets (higher results in 2007). In Table 4 is showed that the most of indexes and variables (directly deduced from the competition results), but also 'pure statistical' variables, are negatively and very low, but statistically significantly correlated with the league level in which table tennis players compete. In other words, in the more qualitative competitive leagues, there are more equalised games, games played in five sets or even turnover games, as well as sets played on difference.

In Table 5, the discrimination analysis is performed in relation to the dependent variable SOKAZ league categories (for 2006 and 2007 together). Based on the discrimination function, 31 % of initially grouped cases could be correctly classified. The first discrimination function statistically significantly differentiates indexes of efficiency in table tennis players in 2006 and 2007, as per the leagues' competitive 'strength'. ANOVA results statistically significantly differentiate the following variables: games played in five sets index (higher results in 'stronger' leagues), turnover games index (also higher results in 'stronger' leagues, however the highest in the SOKAZ leagues 11-15).

Table 1. Factors of differences in indexes of efficiency at table tennis players (between 2006 and 2007)

Discrimination function		Eigen value	Wilk's λ	Canonical correlation	χ^2 (degrees of freedom)			p
Discrimination function		.149	.870	.361	227.423 (6)			<.01
Variables	Wilk's λ	Correlation with a discrimination factor	F-test (1.1636)	p	M 2006	σ 2006	M 2007	σ 2007
game index	.998	.117	3.355	>.05	.4621	.2385	.4391	.2583
set index	.998	.118	3.415	>.05	.4625	.1940	.4434	.2146
set play on difference index	.999	.090	2.000	>.20	.4498	.1817	.4336	.2564
game played in five sets index	.991	.244	14.564	<.01	.3804	.2535	.3299	.2717
turnover games (lost after leading 2-0 and won after 0-2)	.998	.113	3.129	>.10	.1173	.2193	.0994	.1904
total efficacy index	.885	.931	211.718	<.01	1.8146	.8313	1.2590	.7083

Table 2. Differences in variables of efficiency at table tennis players and in 'pure statistical' variables (between 2006 and 2007)

Variable	Year	Mean	Std. Deviation	t-test
<i>turnover games (lost after leading 2-0 and won after 0-2)</i>	2006	1.7287	1.5291	-7.897**
	2007	2.2922	1.3367	
<i>number of games played</i>	2006	48.6050	19.2216	-.254
	2007	48.8335	19.6422	
<i>sets played on difference</i>	2006	25.7057	12.9246	.987
	2007	25.1141	12.9941	
<i>games played in five sets</i>	2006	10.5602	6.0788	-6.216**
	2007	50.3791	197.8613	
<i>number of sets played</i>	2006	186.0022	74.3351	1.120
	2007	182.1183	75.5400	
won sets	2006	95.5449	51.7219	.696
	2007	93.8723	52.1783	
lost sets	2006	90.3184	40.1856	1.080
	2007	88.3037	40.4112	
won games	2006	25.0864	15.8935	-.367
	2007	25.3602	16.3367	
lost games	2006	23.9376	13.0267	.787
	2007	23.4733	12.4579	

**t-test significant at $p < .01$ *t-test significant at $p < .05$ (Shaded: pure statistical variables)

Table 3. Factors of differences in indexes of efficiency at table tennis players (between 2006 and 2007)

Discrimination function		Eigen value	Wilk's λ	Canonical correlation	χ^2 (degrees of freedom)			p
Discrimination function		.068	.936	.253	123.486 (6)			<.01
Variables	Wilk's λ	Correlation with a discrimination factor	F-test (1.1867)	p	M 2006	σ 2006	M 2007	σ 2007
won games after 0-2 in sets for opponent	.979	.555	39.386	<.01	.8643	1.0451	1.1475	.9031
lost games after leading 2-0 in sets	.978	.570	41.489	<.01	.8643	1.0175	1.1467	.8752
won sets with difference	1.000	.006	.004	>.20	12.8643	7.3851	12.8890	8.9429
lost sets with difference	.997	.203	5.291	<.05	12.8282	6.8554	19.9120	92.8649
won games played in five sets	.980	.545	37.939	<.01	5.2867	3.7435	25.6607	99.9336
lost games played in five sets	.980	.544	37.836	<.01	5.3151	3.4656	25.6974	100.1199

Table 4. Correlation between indexes and variables in our research with the league rank in SOKAZ (2006 and 2007 together)

VARIABLES OF EFFICIENCY									
won games	lost games	won sets	lost sets	won games played in five sets	lost games played in five sets	won turnover games	lost turnover games	won sets with difference	lost sets with difference
-.169**	-.100**	-.242**	-.200**	-.234**	-.231**	-.090**	-.084**	-.236**	-.231**
PURE STATISTICAL VARIABLES									
number of games played		number of sets played		games played in five sets		turnover games (lost after leading 2-0. won after 0-2)		sets played on difference	
-.224**		-.298**		-.282**		-.176**		-.259**	
INDEXES OF EFFICIENCY									
game index	set index	set play on difference index		game played in five sets index		turnover games (lost after leading 2-0 and won after 0-2)		total efficacy index	
-.035	-.046*	.046*		-.113**		-.061*		-.049	

**correlation significant at $p < .01$ * correlation significant at $p < .05$

Table 5. Factors of differences in indexes of efficiency at table tennis players in 2006 and 2007 (between four levels of SOKAZ leagues)

Discrimination function		Eigen value	Wilk's λ	Canonical correlation	χ^2 (degrees of freedom)			p
Discrimination function 1		.017	.977	.129	37.258 (12)			<.01
Discrimination function 2		.006	.993	.080	10.427 (6)			>.10
Variables	Wilk's λ	Correlation with a discrimination factor	F-test (3.1593)	p	M 1-5	M 6-10	M 11-15	M 16-20
set play on difference index	.996	.244	2.069	>.10	.4406	.4666	.2417	.4289
game played in five sets index	.988	.803	6.404	<.01	.3841	.3802	.2620	.3141
turnover games (lost after leading 2-0 and won after 0-2)	.989	.696	5.637	<.01	.1451	.1009	.1868	.0917
total efficacy index	.997	.393	1.591	>.10	1.5411	1.5437	.8027	1.4404

League levels: 1-5 league, 6-10 league, 11-15 league, 16-20 league,

Discussion and Conclusions

The main research findings comprise a conclusion that there are differences in characteristics of table tennis matches in the SOKAZ leagues, on both levels of indexes and variables, which can be directly deduced from the results of table tennis matches. The total efficacy of table tennis players in 2006 was statistically significantly higher than in 2007, which can be a consequence of statistically insignificantly higher results for turnover index and game played in five sets index, which are however additive components for total efficacy index. So, this result could be consequence of the low or moderate high but statistically significant and positive correlations between all efficacy indexes (except turnover games) in both championship seasons. (These results are not presented here, because of prolixity). The reason for it could be the fact that competitions in various championships can be equalised to a different extent, even when a relative competitive efficacy is almost practically identical, which is shown by the game index and set index values. It can probably be justly assumed that most of differences in variables of table tennis player efficacy are conditioned directly by the fact

that in the 2007 championships there were a lot more turnover games and games played in five sets, which could have been the consequence of equalised competition in some or most of the league competitions in SOKAZ. In the more qualitative competitive leagues, there are more equalised games. Upon examination of the results of our research, we can assume that more present equalisation of competitions in certain competition seasons is the consequence of the equalisation's fluctuation in certain leagues, where a 'concentration' of higher or lower number of qualitative teams occasionally occurs. It is possible that the aforementioned characteristics of the achievement of table tennis players in the large-scale recreational table tennis competition, such as the one in SOKAZ, significantly differ, depending on a competition season, or on the level of more seasons. The competition in individual leagues or in more leagues becomes less or more equalised. Relevant fault of all efficiency indicators (indexes and variables) directly derived from the competition results is the fact that the total result does not need to necessarily be the real 'measure' of players' competition efficiency. In practical situations in competition, it might come to players

being 'laid-back' in situations of more significant result advantage or 'fall back' in relation to the opponent, 'predictions' of convincing victory or defeat, 'playing' with anticipatory inferior or 'superior' opponent during the entire event (Sindik & Vidak, 2009). We should not forget that we are not talking about top-quality table tennis, but recreational table tennis; therefore we should be additionally careful in generalizing these results. However, in average and in 'result-wise more equalized' competitions, suggested efficiency indicators could be useful hypothetically. One of the main limitations of this study was the structure of the samples: we compared the same people, distributed in different (or same) leagues. However, important aim of this study was to analyse how redistribution of the players can have an influence on different uncertainty of the individual and team games (Sindik & Juričević, 2007). Using of t-test and discrimination analysis (for independent samples) in fact contribute to the possibility of making Type 2 error: in two different seasons half of total number of teams (as well as team members) remain in the same league level, while three teams became relegated and three teams promoted. So, we have a situation of mixed independent/dependent sample, when we are comparing the same league in two seasons. Second important limitation was the missing data about the age of the players. These data were not available from our sources (Internet database), but we can assume that the age average and range remain approximately the same, inside certain league).

It could be very interesting to compare the players, according to their age, in the interaction with league level where they play, in future studies. Also, it could be interesting to analyze female players, comparing with male ones (in case of SOKAZ leagues we could have only very small sample of female players, because they play only in two leagues). Other demographic information also misses in our study, as well as the influence of family, but these data could be collected in future research.

However, it is desirable to in any case inspect the proposed variables and indexes (direct and indirect indicators) of player's efficacy in future researches, on the sample of examinees of elite table tennis players', maybe not only male, and from different age groups. We can also use more indirect indicators of player's efficacy, as did Sindik & Juričević (2007), on the two sets won and 21 points won point-system. Significant differences in two different competition seasons between individual variables of the table tennis competitor's efficiency, between indexes of efficiency and between 'pure statistical' variables in the table tennis. So, we reject all three hypothesis. It was proved, that we can estimate the level of uncertainty in competition, simply comparing players' efficiency during too championship seasons. On the base of such indicators, competition system can be adjusted, especially in league levels with less uncertainty competition in current championship, comparing with previous season.

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RAZLIKE U INDEKSIMA I VARIJABLAMA IZRAVNO PROIZLAZEĆIM IZ REZULTATA STOLNOTENISKOG NATJECANJA U DVIJE RAZLIČITE SEZONE

Sažetak

Osnovni cilj ovog istraživanja je pitanje u kojoj se mjeri indeksi i varijable izvedene izravno iz rezultata pojedinačnih stolnoteniskih mečeva razlikuju u dvije različite stolnoteniske sezone. Ispitan je uzorak stolnotenisača koji se natječu u raznim rekreativnim stolnoteniskim ligama SOKAZ-a (N=914 u 2006. godini i N=956 u 2007. godini). Pronađene su statistički značajne razlike između pojedinih varijabli, indeksa stolnotenisačeve učinkovitosti i za "čiste statističke" varijable, u dvije različite sezone natjecanja. Uspoređujući razlike varijabli i indeksa koji su pokazatelji neizvjesnosti natjecanja, mogu se predložiti upute za promjenu sustava natjecanja.

Ključne riječi: stolni tenis, razlike, natjecanje

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