

# HIGHLIGHTING THE MANAGEMENT ELEMENTS OF THE SPORTS PROJECTS USING THE FACTORIAL ANALYSIS TECHNIQUE

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With the information explosion of the recent decades the necessity arises of existence of some problem solving realistic methods, in the conditions of an aprioric incomplete information on the processes and phenomena, in many fields such as criminology, psychology, military, marketing, economic and financial analysis, security, sport and culture. Following the analysis of the performed measurements, the determined conduct law will eventually move close to the desired conduct law, and the overall system performance will be situated on a trajectory asymptotically close to the „ideal” trajectory, the performances of the analyzed system gradually improving. Parametric and non parametric estimation methods studied in mathematical statistics have been used successfully for studying the processes of learning or training in unknown environments. In general, these methods can be considered as special cases of successive approximations of the unknown quantities. The unknown quantities may be the parameters or the form and the parameters that describe a function. But both the above situations can be treated, regarded as special cases of successive approximations of unknown parameters. In the „classical” mathematical analysis a method of approximating known functions consists in developing the initial „complex” function in a convergent series with a simpler analytical form, or in other words, with a more appropriate form. This development can be regarded as an infinite approximation process where the error can be made no matter how small including increasingly more terms.

Determining the factors that influence the evolution of a particular process under review is an important step in the substantiation of decisions to be adopted in determining an appropriate management, thereby improving the performance of the entire system, in our case the sports system. Currently the information is encoded as variables, unable to distinguish between the main factors influencing the development, the results of manifestation of the factors as a result of the previously adopted decisions being determined by the analysis of the initial information. Therefore, in practice, these hidden factors are determined using the technique generically called factorial analysis, which is rigorously founded from the scientific point of view and which aims to highlight the factors affecting overall system performance. Initially used in psychological research, taking into account the complexity of socio-economic area, this technique is successfully used in the said area, emphasizing the factors that can be found coded in the performance indicators of the phenomenon examined.

Thus, the observable variables can be interpreted as being the result of the action of the hidden factors and the purpose is to identify the said factors and the action on them

so that the results obtained are optimal from the point of view of the employed criteria. In the economic and social field the need frequently arises of measuring some information entities not directly observable, or in other words, that are not observable from the statistical point of view, for example, in some cases the managerial capability or the social status of a particular person must be measured. Based on these considerations a simplification of the original causal space is achieved, an informational synthesis being as such obtained, which is an important matter on the economic area.

Within these synthesis techniques the application of some approximations and transformations from the group of rotational transformations is tried, trying to obtain representations of the initial variables in confined spaces, with a smaller number of dimensions. These transformations and approximations must be applied so as the same to verify the condition that the distances obtained in the *new space* between objects or variables to reflect as well as possible the distances between them in the original space. The new space, resulted from the factorial analysis, is called *factor space*, *confined space* or *factorial space*.

An important hypothesis of factorial analysis is the assumption that the level of an indicator variable is formed as a result of combined influences, exercised both by common factor or factors and by an *unique factor*. In addition to these influences of a significant nature, on the level of a variable indicator the influence of measurement errors is also exercised, which influence is deemed to be negligible.

Far from having a meaning even comparable to that of common factors, the unique factor has, however, a nature similar to these factors: it influences the level of a variable indicator and has an unobservable nature. Unlike the common factor, the influence of which is evident at the level of all the indicator variables, the unique factor is characterized by the fact that his influence is of a *particular, unilateral* nature, express considered to only be exercised or expressed at the level of *an only* indicator variable. For this reason, the number of unique factors coincides with the number of indicators or tests.

In formulating the mathematical model appropriate to the factorial analysis, there is necessary the following two assumptions to be formulated:

The first hypothesis refers to the assumption that the *level* or the *values* of an assembly of random variables is formed as an exclusive result of the influence of three categories of factors:

- a set consisting of *p common factors*, the influence of which is considered to be exercised on each of the *n* variables considered;
- a set composed of *n unique factors*, the influence of which is considered to be exercised *individually*, each unique factor influencing *one and only one* of the variables considered;
- a set of *n residual factors*, the influence of which is considered to be exercised individually, as well, each factor influencing *an only variable*.

In order to highlight factors that influence the development of sport in Romania, information variables taken over from the National Agency for Sport have been used

Thus, in order to perform factorial analysis of sports area in Romania, information regarding counties were considered, which can be found in the following variables<sup>1</sup>:

➤ Number of the sports sections in each county, a variable coded as „Sports Sections”, is important because it indicates the situation existing in each county and at the same time it may be considered as an indicator showing the development level of the relevant county from sports point of view. By the existence of a large number of sports

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<sup>1</sup> The calculations were made by means of PSAW 18. The data refer to the year 2008.

sections the performance obtained by the licensed sportsmen is superior, as well, which leads to a larger number of sports medals.

➤ The number of licensed sportsmen in each county, a variable codified as „Sportsmen”, is important because it expresses the popularity of sport in the relevant county and it also may be considered as an indicator of sports clubs management efficiency.

➤ Number of coaches in each county, a variable codified as „Coaches”, is a characteristic strongly correlated with the sports performance level registered in the relevant county.

➤ Number of instructors in each county, a variable codified as „Instructors”, is important because it shows the opening of each county to the sports activity.

➤ Number of referee in each county, a variable codified as „Referees”, contains information relating to the sports competitive capability at the national and international level.

➤ Average salary in each county, a variable coded as „SalMed”, can be put in relation with the financing source necessary for practicing varied sports.

➤ Number of graduates of secondary education, a variable coded as „AbsLic”, expresses the structure of the population prone to practice varied sports.

The average number of sports sections at the level of the 42 counties of Romania is 94 with a mean square deviation of 100, with a minimum number of 17 sports sections in the Ialomita county and a maximum of 659 in the Municipality of Bucharest. The average number of sportsmen licensed by sports clubs is of 2998 with a mean square deviation of 4335, the minimum number of sportsmen is of 454 and the maximum number of sportsmen is of 28919. For the variable number of coaches the mean is of 143 coaches with a mean square deviation of 214. The average number of sports instructors is of 98 with a mean square deviation of 125, and the average number of referees is of 124 with a mean square deviation of 164. Across the 42 counties of Romania the average salary was of Lei 956, with a mean square deviation of 118. Likewise, the average number of university graduates average is 18,442 with a mean square deviation of 12,387. As one can notice, for the considered variables the average value is representative, as demonstrated by relatively low mean square deviation. Based on the consideration that on the initial variables act both common factors and unique factors in order the resulting factor structure to appropriately group the initial variables then the informational overlap between initial variables and the obtained factors must be greater than 0.5. This hypothesis is verified by means of communality, which expresses the amount of information in the initial space recovered through the factors obtained by applying this technique. The considered variables are well represented in the factorial space because for each variable a quantity of information larger than 0.5 is recovered.

### Representation of the original variables in the factorial space

**Table 1**

	<b>Sports Sections</b>	<b>Sportsmen</b>	<b>Coaches</b>	<b>Instructors</b>	<b>Referees</b>	<b>SalMed</b>	<b>AbsLic</b>
Initial Information	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Recovered Information	0.979	0.989	0.995	0.924	0.969	0.999	0.915

The reduced space so obtained is a representation of the initial space, this representation being in position to be considered as an approximation of the initial space taking into account the manner in which the variables lay in the obtained subspace. In the representation in the factorial space the number of axis is determined by taking into account the information recovered from the initial variables. Thus, in the case of the considered variable, by using two factors 96.71% of the initial variability is explained, which shows that in simplified space a correct replica is made for the seven initial variables.

#### Withheld factors

Table 2

	Initial Situation			Withheld Factors		
	Variant	Explained Variant	Cumulated Variant	Total	Explained Variant	Cumulated Variant
1	6,245	89,220	89,220	6,245	89,220	89,220
2	0,524	7,491	96,711	0,524	7,491	96,711

Following the decrease of dimensionality, two new variables will be withheld, the first of which explaining approximately 89% of the initial variability, and the second variable having a contribution of 8%, but because in the obtained structure the influence of the two factors can not be concisely identified, a rotation of the axes will be performed in order to clearly represent the influence of the obtained variables. This conversion does not change the variability obtained in the factorial space, so that by rotation the recovered information is 96.71% of the initial variables.

In order these retained factors to be in position to be interpreted the influence they have on the original variables is necessary to be tracked and for this the factor matrix representing the „correlation” between the original variables and the obtained synthesis variables is used. Hence, a classification of the variables according to the identified factors is accomplished. For the two determining factors in the sports area, taking into account the existing economic situation in Romania, the first factor is of demographic nature and the second is of economic nature. From a demographic point of view Romania find itself in a process of demographic aging and from the economic point of view the world crisis has drastically affected the activities of the main sectors of the national economy.

#### Factor Matrix

Table 3

Initial Variables	Sports Sections	Sportsmen	Coaches	Instructors	Referees	SalMed	AbsLic
Factor 1	0,332	0,926	0,925	0,916	0,925	0,350	0,888
Factor 2	0,917	0,363	0,373	0,291	0,337	0,936	0,355

As it can be seen from the associated factor matrix, the first factor is influenced by the variables: the number of sportsmen, the number of referees, the number of instructors and the number of coaches and it can be associated with demographic factor, and the second factor is associated with the number of sports sections and the average salary, i.e. the second factor is the economic factor. Following these considerations it may be noted that in the year 2008 in the Romanian sport the important factors are: the demographic factor, which means that the selection basis is considerably decreasing, and the economic factor, i.e. the investments made for sports facilities and the salaries received by the persons engaged in sports activities decrease.

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