FACTOR APPROACH AS UNIVERSAL MODEL OF OPTIMIZATION METHODS WITH APPLICATION IN KINESIOLOGY

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Original scientific paper

Abstract
The purpose of this paper is the definition of a new framework and protocol optimization method that is based on a factorial approach. Namely, if it can be demonstrated that the analyzed system has no linear combinations of variables, ie that the system is regular, then the optimization problem in the first step down solve *the dimensionality reduction of inequality constraints*. *This is true regardless of the objective function. In the second step, linking latent dimensions of space constraints was crucified set of nominal or continuous variables. As an example, take the indicators measuring bio-motor variables of boys aged 7 years*. *First are located extremely capable motor entities, the three of them*. *Then, the entire space is integrated into the morphological dimension. Results clearly show the strength of the protocol and wrote the entities in an easily recognizable way, defining specific morphological profile.*

Key Words: *optimization, factorization, universal model, boys, biomotorics*

Introduction

Optimization methods or methods of optimization are expensive procedures to the given conditions at a satisfactory solution, if there is a realistic solution. Optimization methods allow search of the most favorable solution of different problems. In the business economy the most used method of linear optimization that enable finding the most suitable solution to the problem in which the objective function (ie. Size we want to optimize) and restrictions have a linear shape dependence on independent variables. In practice, the most commonly used well-known method of linear optimization: linear programming, integer linear programming, transportation problem and the problem of assignment.

The emphasis is on identifying practical problems that can be solved by linear optimization, the formulation optimization model and the sensitivity analysis results optimization (Mafioli, 1986; Éppen et al., 1993; Ceric and Varga, 2004). The simplest notion can be acquired in a graphic display which have the n-dimensional system (eg in 2 dimensions), the k-dimensional system of linear constraints (the direction in Example 3), in Figure 1, where k > n, and the objective function is arbitrarily set.

This presentation obviously leads to the need to calculate the specific data that can be solved by linear programming. According to the theorem of extreme points of linear programming if there is an optimal solution to the problem of linear programming, at least one optimal solution must be in an extreme point of areas of possible solutions. This theorem shows that the search for the optimal solution can be limited to a finite number of extreme points (in this simple example is only a few points, while at the complex problems that can be a very large number).

For this purpose, for example, Simplex algorithm, which is the algebraic procedure search extreme points of the field of possible solutions to the problem of linear programming (Draščić-Ban, 2011). It is a row searched adjacent extreme point, as these extreme point is chosen the one that gives equal or better solution than the previous one.

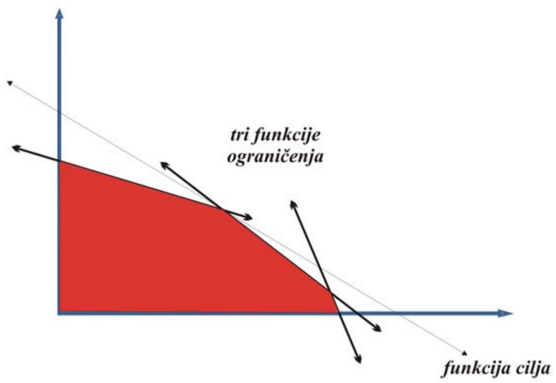

Figure 1. Example of Ssace optimization solutions with three functions constraints and objective function in two-dimensional space

If a solution exists in the field of real numbers this algorithm will be sure to find and give optimal solution. However, in the general case things are somewhat less favorable (Zangwill, 1969; Martić, 1973; Saaty, 1988). Figure 2 shows the general case of optimization problems where the solution exists and is limited to 5 function, regardless of whether or not the objective function is default.

Of course that the objective function determines the behavior of the algorithm, but we are primarily interested in the space of possible solutions, and cost function can be subsequently addressed if the appropriate way to solve the problem of space solutions.

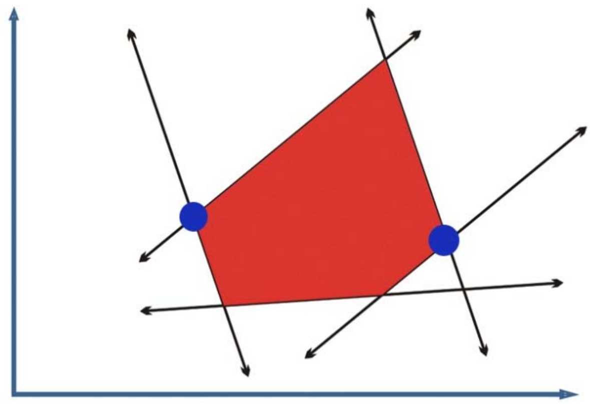

Figure 2. Example of general space optimization solutions with five function limitations in two-dimensional space regardless of the objective function

As can be seen, in this solution is generally to k > n and the often k >> n. It is obvious also that in these situations is not entirely certain that the methods of detection points to provide a credible solution, as well as integral, and in particular that, the finding may not be optimal, because optimality further depends on your position and with that of set constraints optimal solution set (Bronson, & Naadimuthu, 1997). Of course, we cannot act in a way that we do not care for that kind of optimization solutions if it is in space solutions, but then obviously it does matter where from, for example, the above extreme dark marked points is the solution occurred. It seems to be a little simplified and rationalize these solutions but provided higher reliability and less intervention by the person who set the terms of optimization. In this way the whole thing strongly objectifies.

Factor analysis

Factor analysis is generally a full set of procedures, which serves to reduce the dimensionality of a multidimensional space (Bonacin, 2008). This reduction is not carried out only for the reason that analyzes the structure to simplify and understandable, but primarily for the reason that "seizes" latent mechanisms in a multidimensional stretched space exists. This is because of these mechanisms depend measurable events that we see on a conventional scale initially been detected. Based on projections of individual manifest indicators identify factors or latent mechanisms. In this case, for the purposes of this study, it can be said that the factor analysis could be quite beautifully used to optimize the function of limitations, where the number of function limitations should be equal to the number of dimensions of space in which the whole thing played out. This is shown in chart 3. And as can be seen also, it is certain that there is always a solution! In a general linear model in which the system is regular, ie. there is no linear combination of one series derived from other series, this proposition leads us into a situation that is a function of restrictions still as much as the dimensions of space, which certainly leads to optimal solutions at multiple coordinates (Pardalos & Rosen, 1987; Hlupić & Kalpić, 2009).

Thus, the problem reduces to the factor in the factorization, ie. reducing the dimensionality of feature constraints, where k = n. A situation whereby n> k we will not discuss, because in the same logic and the same conditions of regularity, it is not difficult to imagine the reduction of dimensionality of space dimensions on the order of functions, so it's again k = n.

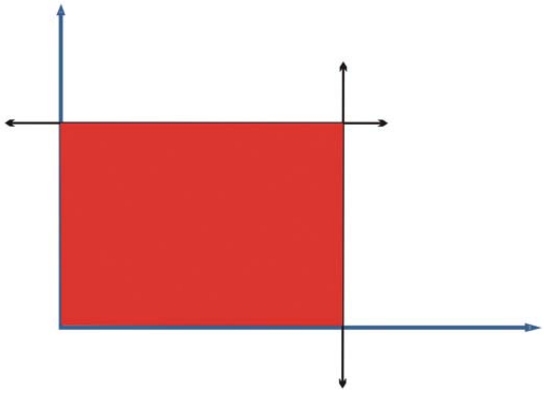

Figure 3. Example of space previously shown a general optimization solutions 5-function limitations factored in two-dimensional space regardless of the objective function

In figure 4, swe can ee the final set of potential information obtained by factorization with oblique rotation - typically orthoblique (Bonacin, 2008). This solution allows to haul axis space are not necessarily orthogonal, but can be in any relations. This setting allows the fundamental problem certainly a higher level of optimization for any defined as a problem or task. The solution space is curved but the truth is its linearity is unquestionable and in essence is nothing more than oblique mapping some of the possible solutions as the graph 3, with the known matrix transformation in the oblique system.

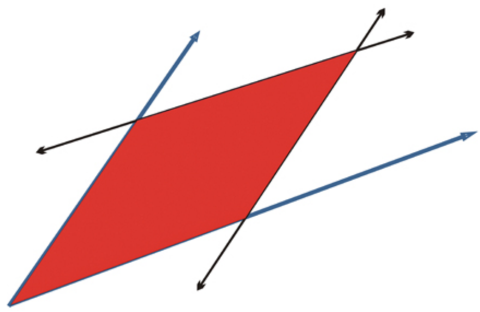

Figure 4. The case as previously with the relaxed limit orthogonality system

Example results and discussion

Although examples of these considerations can be given in any scientific discipline (education, medicine, economics, ...), here will be displayed in the field of kinesiology. Let therefore there is a collection of 249 entities aged 7 to 26 described biomotor variables of which 14 morphological (body height - AVIT, leg length - ADUN, length of arms - ADUR, wrist diameter - ADRZ, knee diameter - ADIK, shoulder width - ASIR , width of the pelvis - ASIK, Body weight - ATEZ, Volume forearm - circumference -AOPL, kicking - AOPK, Medium scope chest - circumference -AOKG, upper arm skinfold - AKNN, skinfold back - AKNL and skinfold abdomen), then 11 motor (Steps aside - MKUS, polygon backwards - MPOL, Taping hand - MTAP, Taping foot - MTAN, bent in sitting foot - MARD, Standing on the bench for balance - MP2O, Long jump from place - MSDM, throwing balls into the distance - MBLD, running 20 ms high start - M20V, raising troops from lying - MDTS, and endurance in higher joint - MVIS) and one functional (run three minutes - FT3M). Let there is a set of targeted restrictions which are out of this mass wants for any purpose draw just those entities. Then the set of constraints to be reduced to a set of dimensions that determine the initial space in which the entities are spread applied variables. Suppose that we are interested in three of the fittest by latent motor dimensions, but we do not know what the morphological space is. Then we simply factorize motor area and find the ones that have the most value to motor factors. When we locate them, they will result in the value of the factor associated with the initial coordinate system, in this case defined with 14 morphological dimensions. Then we will determine their position in the morphological space which we define 14 dimensional framework and designed the morphological profile of the fittest motor entities. Of course, we could have taken otherwise defined set of entities, eg. those on motor dimensions are between +1.5 and +2.5 standard deviations, and spend the same procedure, but it is only a question of the definition of entities of interest and not a problem. According to the results of the factor analysis, we obtained three easily recognizable factors, the first of which can be identified as a general energy motor status, the other as a control motor status, and the third leg explosiveness. They then mapped entities with the highest sum of projections on such factors with the restriction that no value should be less than 0.45 (this can be changed arbitrary).

Table 1. Ortoblique final matrix in motor dimensions

	OBQ1	OBQ2	OBQ3
MKUS	-0.07	**-0.38**	0.32
MPOL	-0.31	-0.14	**0.33**
MP2O	**0.33**	0.16	-0.11
MPRR	0.19	**-0.38**	-0.23
MTAP	-0.03	**0.73**	-0.09
MTAN	-0.03	**0.80**	-0.03
MSDM	0.23	0.05	**-0.63**
MBLD	**0.67**	-0.05	-0.05
M20V	0.01	0.01	**0.80**
MDTS	**0.63**	-0.18	-0.18
MVIS	**0.65**	-0.12	-0.03
MT3M	**0.80**	0.27	0.64
	OBQ1	OBQ2	OBQ3
OBQ1	1.00	0.37	-0.44
OBQ2	0.37	1.00	-0.33
OBQ3	-0.44	-0.33	1.00

These three entities were the E049 with the total sum by a factor of 2.79 (value of 0.45, 0.85, 1.49), then the entity E222 with a total amount of 1.87 (value of 0.55, 0.66, 0.66) and entity E051 with the sum of 1.79 (value of 0.55, 0.64 , 060). These three entities have the most desirable values in the sample with all the positive aspects of motor skills. Their morphological status is shown in Table 2. The morphological status of the three separated entities shows, compared to the whole sample, features especially developed longitudinally and transversality, therefore the growth of hard tissue (other than the diameter of the knee). At the same time, the volume (the volume of muscle) is slightly below average and adipose tissue markedly below average, then registered lower values of the soft tissue in relation to the whole sample. This testifies to the possible development in the direction of an athletic constitution but not completely, but with some prominent graceful structure.

Table 2. The morphological status of the three specials entities in motor

	E049	E220	E051	AVG-	AVG
AVIT	132.07	131.73	138.43	**134.08**	128.43
ADUN	73.10	75.47	78.23	**75.60**	71.44
ADUR	53.20	52.33	58.17	**54.57**	53.00
ADRZ	4.33	4.30	4.20	**4.28**	4.19
ADIK	7.20	7.97	7.07	**7.41**	7.74
ASIR	27.27	27.00	30.17	**28.15**	27.24
ASIK	21.30	20.50	22.30	**21.37**	20.30
ATEZ	25.17	27.17	27.17	**26.50**	27.02
AOPL	16.73	16.83	15.90	**16.49**	17.79
AOPK	25.03	25.57	24.57	**25.06**	25.76
AOGK	56.03	59.70	58.90	**58.21**	60.68
AKNN	9.30	10.53	10.40	**10.08**	11.44
AKNL	4.27	6.13	6.03	**5.48**	7.01
AKNT	4.93	5.07	5.77	**5.26**	7.43

(FILE entity => E049, E220, E051, AVG E = average of three isolated entities, AVG = overall average in the sample of 249 entities)

If this was an adults sample you would possibly describe them as potential handball players, goalkeepers in football, basketball guards, aspiring volleyball, taekwondo fighters and the like. But not for example, gymnasts, judokas, weightlifters, etc. As can be seen, the optimization model is spawned typically and best representatives of the motor profile of children aged 7 years, and that profile has proven to be consistent in morphological space.

Conclusion

For the purpose of this work was made a special protocol and algorithm which defined a new framework for optimization purposes of identification phenomena in kinesiology, although the same could be applied in other areas such as medicine, pedagogy, economy and the like. The foundation of the whole process is the definition of optimization in a way that limits factor functions and reduce to a finite set and target latent mechanisms is by (dimension) is equal to the area in which the whole calculation takes place. In this way it is avoided the problem of multiple solutions and the optimal solution to a given problem is only one.

For example, the selected set of 249 boys aged 7 to 26 described biomotor variables. Optimization has allocated three motor fittest according to the set parameters and then expressed their morphological profile. It is obvious that all three were very similar morphological characteristics dominated tendency sporty type of constitution but with the influence of gracious materials and expressed the development of hard tissue, with markedly smaller amount of fat folds.

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FAKTORSKI PRISTUP KAO UNIVERZALNI MODEL OPTIMIZACIJSKIH METODA S PRIMJENOM U KINEZIOLOGIJI

Sažetak

Svrha ovog rada bila je definicija novog okvira i protokola optimizacijskih metoda koji je utemeljen na faktorskom pristupu. Naime, ukoliko je moguće dokazati da u analiziranom sustavu nema linearnih kombinacija varijabli, tj. da je sustav regularan, tada se problem optimizacije u prvom koraku svodi na redukciju dimenzionalnosti funkcija ograničenja. Ovo vrijedi neovisno o funkciji cilja. U drugom koraku se povezuju latentne dimenzije sustava ograničenja sa prostorom koji je razapet skupom nominalnih ili kontinuiranih varijabli. Za primjer su uzeti pokazatelji biomotoričkih dimenzija dječaka uzrasta 7 godina. Prvo su locirani ekstremno motorički sposobni entiteti, njih troje. Zatim je cijeli prostor integriran u morfološke dimenzije. Rezultati su jasno pokazali snagu protokola i pisali entitete na lako prepoznatljiv način definirajući specifičan morfološki profil.

Ključne riječi: *optimizacija, faktorizacija, univerzalni model, dječaci, biomotorika*

Received: June 22, 2014
Accepted: December 20, 2014

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