International Journal
VALLIS
AUREA

Editor's note

We are delighted to present International Journal Valis Aurea (IJVA) as a result of a successful cooperation between DAAAM International Vienna and Polytechnic in Pozega. Our main objective is to publish fresh, relevant and high-quality research papers. To reach this objective, the journal aims to be accessible, engaging and challenging as well as to involve a worldwide community of scientists, professionals and experts.

The Journal enables authors to present their researches relating to advancing and improving the practice, as well as understanding information systems of the organization. The Journal accepts theoretical, methodological and empirical contributions, i.e. the works that significantly contribute the thematic fields of the Journal, i.e. management, finance, marketing, law, IT technology, agriculture, and other interdisciplinary topics. It will provide enough space for original empirical and developmental researches.

The works can be presented as:

• Theoretical, clear and empirical researches on the conception, structure, development and usefulness of interdisciplinary science being important for the progress of theory and practice.

• Paradigmatic, methodological aspects of design, development and implementation of science and practice.

• Analysis and evolution of science and practice to the social, economic, organizational and management aspects of the environment and organization.

The International Journal Vallis Aurea is a biannual journal, with the pretension to affirm the integral, holistic view of interdisciplinary research. The journal aims to unite the academic methodology and sincerity with professional focus and practices.

We are dedicated to achieve and to maintain this journal's high standards. All articles submitted for publication in this journal are subjected to a double-blind review process performed by at least two academics from the Editor's Board. Reviewers stay anonymous. Authors will receive written notification of acceptance, remarks, comments and evaluation of their articles in a timely manner. Authors are responsible for ensuring that all manuscripts (whether original or revised) are accurately typed

before the final submission. If requested, one set of proof will be sent to authors, before the final publication, which must be returned promptly.

This publication was reproduced by using the papers supplied by their authors. The layout, the figures and tables of some papers did not conform exactly to the standard requirements. In some cases the layout of the papers was rebuild. The readers are therefore asked to excuse any deficiencies in this publication which may have arisen from the above causes. The editors of Journal are not responsible either for the statements made or for the opinions expressed in this publication.

With all our hearts and sincerity, we wish to express our deepest gratitude to all the authors, reviewers, and editorial board members for their valuable contribution for this journal. We look forward to a successful cooperation.

Editors In Chief

2

EDITORIAL BOARD:

3

VALLIS AUREA

STEFANIC, EDITA (HRV)
STOPPER, MARKUS (AUT)
SUBARIC, DRAGO (HRV)
TAN, KOK KIONG (SGP)
TEICH, TOBIAS (DEN)
TOMASEVIC LISANIN, MARIJA (HR)
TORIMS, TOMS (LET)

VAARIO, JARI (FIN)
VASEK, VLADIMIR (CZS)
VASICEK, VESNA (HRV)
VOLOSHYNA, YULIANNA (UKR)
WEIGL, K. HEINZ (AUT)
WESSELY, EMIL (SK)
YOSHIDA, SUSUMU (JPN)
ZAVRSNIK, BRUNO (SLO)

4

Sivrić Hrvoje [1]

Blažević Ivona [2]

Katolik Kovačević Andreja [3]

Blaževac Antonela [4]

The Structure of the Impact of the Elements of the Promotion Mix on Selection of Sports Products in Slavonski Brod

Abstract:

The aim of the paper was to analyze the structure of the effect of the observed elements of the promotional mix on the selection of sports products in Slavonski Brod. The analysis was conducted on a sample of 385 entities. According to the results of the research, no element was considered as dominant in the structure of the influence of the elements of the promotional mix in the choice of practicing a sports product. Propaganda was slightly highlighted as the most important element of the promotional mix. It should also be emphasized that in selecting a sports product, the promotion factor, as one of the 4 marketing mix factors, achieves relatively small, only 14.5% of the frequency. The results also show that the sports product in Slavonski Brod is price-sensitive and contentually acceptable, that sporting is extremely important, but the problems of resource allocation as time are quite questionable, which is surprising. It can be said that both the product and the price are dominant as a choice which is expected from the aspect of sports consumers. This is a direct message to the sports program providers what needs to be directed on. Indirectly, however, it can be said that the promotion could and should be significantly more qualitative and quantitatively represented. First and foremost, this refers to a set of activities that enable consumers to inform about the product on market or to promote their sports products, which is probably missing out.

Keywords:
sport, students, sports product

Author´s data:

[1] Hrvoje, Sivrić, Senior lecturer, College of Slavonski Brod, Dr. Mile Budaka 1, Slavonski Brod, Croatia, hrvoje.sivric@vusb.hr

[2] Ivona, Blažević, Lecturer, College of Slavonski Brod, Dr. Mile Budaka 1, Sl. Brod, Croatia, ivona.blazevic@vusb.hr

[3] Andreja, Katolik Kovačević, Lecturer, College of Slavonski Brod, Dr. Mile Budaka 1, Sl. Brod, Croatia, Andreja.Katolik@vusb.hr

[4] Antonela, Blaževac, former student at the College of Slavonski Brod, blazevac.antonela@gmail.com

VALLIS AUREA

Introduction

The basic feature of the problem which is being investigated in this paper is the fact that in Slavonski Brod, at least as far as analyzed potential sports consumers are concerned, there is a strong need but also the desire to consume sports products and that this need and desire are never consumed. Also, according to available data, sports programs and content in the city are not lacking, but the implementation of these sports programs and content is lacking.

The aim of the paper was to structure the elements of the promotional mix, ie to determine the significance and impact of the individual element on the possible choice of sports programs according to the analyzed population. The author's assumption is that through analyzes and market research and then on the basis of the results obtained, more effective can activate the wishes and consumer needs by marketing mix tools thus ensuring better sports and economic efficiency of providers of sports products and programs in order to target their offer and promotion in a proper way thus indirectly encouraging doing sports through its activities of informing the public about the offer but also the necessity of sport. Through analyzes on a sample of 385 entities, the average chronological age of 26.7 years with a range of 17-65 years, the significance and impact of each individual element of the promotional mix in deciding the potential sports consumer for the choice of the offered sports programs was determined. Entities are regular and irregular students of the College of Slavonski Brod and unemployed persons (citizens of Slavonski Brod). The measured entities of the College are regular first and second year students in all three undergraduate professional studies as well as on the irregular study of Management. The questionnaire was shared in the 2nd semester of the academic 2015/2016. year. Interestingly, there were no exam periods and holidays during that period, so respondents were more free to look at their attitudes and thinking more realistically. All respondents voluntarily and anonymously completed the survey questionnaire. It can be noticed that according to the targeted variable, the factors of the promotional mix with its factors: propaganda, personal promotion, publicity and PR have achieved a fairly uniform result. The paper emphasizes the importance of the marketing mix elements of a specific promotional mix in this case of sports products in Slavonski Brod. The marketing center of each organization is the consumers themselves, their desires, their expectations, their needs, which means that according to them and the market, ie the competition, the organization determines the characteristics of the product or service that will be offered on the market at a certain price with certain characteristics.

Method

Examinee sample

The sample is composed of 385 entities, an average chronological age of 26.7 years with a range of 17-65 years. Entities are regular and irregular students of the College of Slavonski Brod and unemployed persons (citizens of Slavonski Brod). The measured entities of the College are regular first and second year students in all three undergraduate professional studies as well as on the irregular study of Management. The structure of the entity consists of 209 regular students (101 male students and 108 female students or according to the Social Department - Management 77, Agricultural Department 48 and Technical Department 84) average chronological age of 19.97 years with a range of 18-26 years, and irregular / unemployed persons (91 male entities and 85 female entities) with an average chronological age of 34.8 years with a range of 17-65 years. All respondents voluntarily and anonymously

6

completed the survey questionnaire. The questionnaire was shared in the 2nd semester of the academic 2015/2016. year. Interestingly, there were no exam periods and holidays during that period, so respondents were more free to look at their attitudes and thinking more realistically.

Variable sample

For the purposes of research, a questionnaire used for this study contained 9 particles. Apart from the preference for practicing sports or sports activities, the main question in accordance with the title of the paper was "What factors of the promotional mix" are most influenced or could affect your choice of practicing sport activities (programs) offered in the city? (Max. 2 response)". The questionnaire also included the question of evaluating the offer of sports activities in the city of Slavonski Brod with 1 - does not satisfy up to 5 - it is excellent. The last question was releated to how much money entities are willing to allocate monthly for participation in the aforementioned sports activities (programs).

Variable description:

DOB - chronological age of the entity

REDNEZ - unemployed / regular

IZVZAP - irregular / employed

VAŽ - the importance and the need to engage in sports activities generally in life

AKT - the number of weekly participation in organized sports activities over a period longer than 6 months

RAZZ - the main reason for practicing sports or sports activities, Health

RAZO - the main reason for practicing sports or sports activities, Education

RAZZA - the main reason for practicing sports or sports activities, Entertainment

RAZE - the main reason for practicing sports or sports activities, Aesthetic

RAZS - the main reason for practicing sports or sports activities, Social

RAZN - the main reason for practicing sports or sports activities, Competition

RAZNI - the main reason for practicing sports or sports activities, None

RAZD - the main reason for practicing sports or sports activities, Another reason

FAKV - factor of influence on participation in sports programs, Time

FAKF - factor of influence on participation in sports programs, Financial

FAKZ - factor of influence on participation in sports programs, Health

FAKD - factor of influence on participation in sports programs, Availability

FAKI - factor of influence on participation in sports programs, Experiences

FAKA - factor of influence on participation in sports programs, Attractiveness

FAKN - factor of influence on participation in sports programs, Lack of information

FAKDR - factor of influence on participation in sports programs, Another reason

FAUS - factor affecting the choice of practicing sports programs, Sports product

FAUC - factor affecting the choice of practicing sports programs, Price

FAUD - factor affecting the choice of practicing sports programs, Distribution

7

FAUP - factor affecting the choice of practicing sports programs, Promotion

DB - distribution factor, Vicinity

FDR - distribution factor, Working time

FDU - distribution factor, Directionality

FDT - distribution factor, Trends

FDS - distribution factor, The expertise of staff

FPP - promotional mix factor, Propaganda

FPO - promotional mix factor, Personal promotion

FPC - promotional mix factor, Publicity

FPR - promotional mix factor, PR

PON - evaluation of the offer of sports activities in Slavonski Brod

IZD - monthly seclusion for participation in sports activities

Data processing methods

Methods of results processing included descriptive statistical parameters calculating for all variables: arithmetic mean (AS), standard deviation (SD), minimum (min) and maximum (max) result.

Results and discussion

Table 1 shows descriptive measurements of the metric variables for the total sample. From Table 1 it can be seen that the average age of respondents is relatively young 26.7 years with a range of 16 to 65 years. From the aspect of the title of work it can be noticed that according to the targeted variable, the factors of the promotional mix with its factors: propaganda, personal promotion, publicity and PR have achieved a fairly uniform result. For the result achieved in the variables FPP=39,0%, FPO=37,1%, FPC=29,9% and FPR=30,1% there is a visible range of only 10% which tells us, at least in the opinion of the observed entity population, that none of the factors

tested in the structure of influence of the promotional mix is dominant. Their relation according to the frequency of respondents or their measured opinions is shown in Figure 1.

Figure 1. Relation of factor frequencies of promotional mix [source: authors]

It can be said that there are no factors that are dominant in their decision-making, or none are crucial. Their structure, by importance, makes the following order:

FPP - promotional mix factor, Propaganda = 39,0%

FPO - promotional mix factor, Personal promotion = 37,1%

FPR - promotional mix factor, PR = 30,1%

FPC - promotional mix factor, Publicity = 29,9%

Looking at the variables individually, the best result has the "FPP- promotional mix factor, Propaganda" variable of 39.0% and the worst result variable "FPC- promotional mix factor, Publicity" of 29.9%. It can be said that for the observed sample advertising in the form of paid form of promotion of sports goods is the most important element of the promotional mix in the selection. This refers to getting acquainted with the existence of, eg, a sports product or service. However, it should be emphasized that its weight in the selection of sports products still reduces the result in the variables "FAUP- factor affecting the choice of practicing sports programs, Promotion" where promotion as one of the 4 marketing mix factors achieves relatively small 14.5% frequency. By the importance of variables significantly ahead of it are shown FAUS-Sports product and FAUC-Price realized with 74.3% and 45.7%. Only variable "Faude-Distribution" has a

VALLIS AUREA

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 796/799-057.875(497.542Slavonski Brod); DOI 10.2507/IJVA.3.1.1.32

worse result that amounts to 9.6%. It can be said that especially the product but also the price are dominant in the selection which can be said to be expected from the aspect of sports consumers. This is also an indirect message to the providers of sports programs on which to focus. Indirectly, however, it could be said that promotion could be significantly better and more qualitatively represented. First of all, it refers to a set of activities that enable informing consumers about the product on the market or promoting their sports products, which may be missing. Personal promotion with the 37.1% achieved a quite similar result which could be concluded, and taking into account the weight of the variable "FAUP- factor affecting the choice of practicing sports programs, Promotion" according to the obtained results, immediate and direct contact with potential buyers has no significant impact. This is even less evident in the remaining 2 factors; PR and Publicity. Thus, the unpaid form of product and service promotion is not recognized by the sample as essential or it may be said that it is not at all represented in the business of a service provider which is certainly a disadvantage. From other results in Table 1, unfortunately there is a lack of weekly activities that are in contrast to the extremely high average rating for the variable "the importance and the need to engage in sports activities generally in life" of 4.4. So the interviewees are aware of the importance but still do not practice what may be the subject of new research. From an economic point of view, it is also surprising that they are monthly willing to allocate 164.00 HRK on average. Almost all programs in Slavonski Brod can be paid with this amount according to the available data from the web. And the standard deviation result of 109.0 shows that they are quite homogeneous in thinking about that topic. It is precisely in these disproportion that there is a lack of marketing mix elements. Even the offer of sports activities in Slavonski Brod is rated good.

	DOB	VAŽ	AKT	*FPP*	*FPO*	*FPC*	*FPR*	PON	IZD	*FAUS*	*FAUC*	*FAUD*	*FAUP*
AS	26,7	4,4	1,7	*39,0*	*37,1*	*29,9*	*30,1*	3,2	164,3 kn	*74,3*	*45,7*	*9,6*	*14,5*
Min	17	1	0	*expressed in %*				1	0 kn	*expressed in %*			
Max	65	5	3					5	500,0 kn				
SD	11,1	0,6	1,2					0,9	109,0				

Table 1. Descriptive indicators of metric variables, total sample [source: authors]

Due to further analysis of the obtained data, analysis of indicators was made especially for regular students / unemployed persons, irregular students / employed persons and especially for the female and male population. Descriptive indicators of metric variables, for regular students / unemployed persons are shown in Table 2.

	DOB	VAŽ	AKT	*FPP*	*FPO*	*FPC*	*FPR*	PON	IZD	*FAUS*	*FAUC*	*FAUD*	*FAUP*
AS	19,9	4,4	1,65	*37,8*	*38,8*	*31,6*	*28,7*	3,27	131,4 kn	*72,2*	*54,5*	*9,6*	*12,9*
Min	18	1	0	*expressed in %*				1	0 kn	*expressed in %*			
Max	26	5	3					5	500,0 kn				
SD	1,1	0,7	1,1					0,9	88,3				

Table 2. Descriptive indicators of metric variables, regular / unemployed [source: authors]

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 796/799-057.875(497.542Slavonski Brod); DOI 10.2507/IJVA.3.1.1.32

VALLIS AUREA

From Table 2. in which regular / unemployed students are separated as observation elements, it is noticeable that the results in the promotional mix are almost the same as in the previous table. As most important element of the promotional mix was tagged Personal Promotion, and was accounted for only 38.8%. It is evident that regular students are tracking information on sports programs and that price and program information is extremely important. On the other hand, public relations has been labeled as the least important element of the promotional mix, even though in this table there is no noticeable deviation from the previous one. Also, none of the elements can be considered as much more dominant than the others, and the differences between personal promotion and PR as the least important element are within the range of 11.2%. On the other hand regular students as a monitored group are prepared to allocate somewhat less money, 130 HRK on average, which is justified because they are unemployed and do not have a regular income. Although this fact contradicts the fact that the importance of sports has given a score of 4.4 on average while on the other hand only 1.65 are active in sports. In Table 7.3. We decided to look at the descriptive metrics for measuring variables, for irregular students / employed persons.

	DOB	VAŽ	AKT	FPP	FPO	FPC	FPR	PON	IZD	FAUS	FAUC	FAUD	FAUP
AS	34,8	4,47	1,86	40,3	35,2	27,8	31,8	3,11	203,4 kn	76,7	35,2	9,7	16,5
Min	17	2	0	expressed in %				1	0 kn	expressed in %			
Max	65	5	3					5	500,0kn				
SD	12,2	0,6	1,2					0,9	118,2				

Table 3. Descriptive indicators of metric variables, irregular / employed [source: authors]

From Table 7.3. where also students are interviewed but the irregular / employed, the results are practically the same in the promotional mix. They considered the Propaganda as the most important element, while Publicity is the least important element of the promotional mix. Statistics are somewhat different with regular / unemployed students but not too significant. The overall result of promotion in marketing mix elements is a slightly better FPO = 16.5 but again insignificant. They would set a somewhat more money than regular students on average, more specifically about 203.4 HRK on average. This information is understandable in view of the fact that they are employed and have a fixed income. They also attributed great importance to sports as well as regular students but are also quite inactive. In table 4. and 5. we decided to look at the descriptive measurements of gender variables.

	DOB	VAŽ	AKT	FPP	FPO	FPC	FPR	PON	IZD	FAUS	FAUC	FAUD	FAUP
AS	27,6	4,39	1,38	36,3	36,3	30,6	32,6	3,10	132,90 kn	75,6	47,2	8,3	11,4
Min	18	1	0	expressed in %				1	0 kn	expressed in %			
Max	65	5	3					5	500,0kn				
SD	9,3	0,7	1,1					0,9	128,0				

Table 4. Descriptive indicators of metric variables, female population [source: authors]

VALLIS AUREA

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 796/799-057.875(497.542Slavonski Brod); DOI 10.2507/IJVA.3.1.1.32

Table 4. shows female student population ranged from 18 to 65 years. Their findings regarding the importance of the elements of the promotional mix are maximally uniform. Propaganda and Personal promotion are equally important, while publicity and PR have been attributed with insignificant importance. Interestingly, distribution was rated as almost unimportant factor in the choice of sports activities, while sports products are the most important factor. This fact, however, shows that to women's population is more important what is offered (the quality of sports programs and offers), from the way of distribution. Promotion also is not an important factor influencing the choice of sports product. From the above mentioned indicators it is evident that the female population more appreciates the quality of the program and what is being offered, than the promotion itself and the mode of distribution that they labeled as a less important factor of influence. The data concerning the male populations were selected in Table 5.

	DOB	VAŽ	AKT	*FPP*	*FPO*	*FPC*	*FPR*	PON	IZD	*FAUS*	*FAUC*	*FAUD*	*FAUP*
AS	25,9	4,47	2,11	*41,7*	*38,0*	*29,2*	*27,6*	3,30	195,94 kn	*72,9*	*44,3*	*10,9*	*17,7*
Min	17	1	0	*expressed in %*				1	0 kn	*expressed in %*			
Max	62	5	3					5	500,0kn				
SD	12,6	0,6	1,1					0,9	74				

Table 5. Descriptive indicators of metric variables, male population [source: authors]

It is noticeable that they also rate propaganda as the most important promotional mix factor, more precisely FPP = 41.7%. For male part of the population, the deviation in the importance of individual promotional mix elements is small, but not significantly higher, ranging within 13%. Like female, they have labeled the sports product as the most important factor influencing the choice of practicing sports activities. The distribution was marked as the least important element, more precisely FADU = 10.9% This fact contradicts the fact that a large part of the students mentioned Proximity as an important factor of sport. Therefore, it can be seen from the above mentioned tables that the male population is more active and that it is willing to allocate more money (the female population is slightly heterogeneous in terms of payment). Other values regarding promotions and marketing mixes are fairly uniform. Only for male, marketing promotions in marketing mix are far more significant than for women. This also points to the well-known thing that marketing activities should be done targeted. Among other results, we should highlight the following. In Table 6. there are the results that show the opinion of the respondents about the choice of three main personal reasons for practicing sports activities. Health reasons are considered the most important (91.4%), while the next reason might be a bit surprising - fun with 52.7% and aesthetic with 49.6%. It just shows that they are all aware of the importance of sport, but very few of them practice it. The cause of this is obvious lack of motivation or as part of them indicates lack of time. Although there is an illogicality in that, for example, student life allows enough time to engage in some sport at least 3 times a week. The competition mentioned only 3.10% of them, which shows that very few of them are engaged in active sports ie some sports professional. 52.70% of them as a reason for sporting mentioned fun, what was

11

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 796/799-057.875(497.542Slavonski Brod); DOI 10.2507/IJVA.3.1.1.32

VALLIS AUREA

expected. A large part of them also mentioned the aesthetic reason as a factor influencing the sport.

For women it is more important aesthetic reason for sport, while for men the foremost competition.

RAZZ	RAZO	RAZZA	RAZE	RAZS	RAZN	RAZNI	RAZD
91,40%	10,60%	52,70%	49,60%	32,20%	18,40%	3,10%	0,50%

Table 6. The reason for practicing sports activities, total sample [source: author]

Table 7. shows the results of the variables where the respondents indicated which factors influenced most of their (non) participation in sports activities. It is worrying that even 79.5% of respondents believe that there is not enough time or that lack of time is the most important factor in their non-exercise. The next factor with just 29.6% is availability. All other factors are at low levels and homogenized. The premise of the authors of this paper is that modern times with new technologies and total passivity still influence so much on the thinking of the respondents that they simply are not able to manage the resources in life, it referes mostly on time. Individually, as the main reason for practicing sports activities, women and men are very much aligned, and state health reasons and entertainment as the main reasons.

FAKV	FAKF	FAKZ	FAKD	FAKI	FAKA	FAKN	FAKDR
79,5%	23,1%	27,5%	29,6%	17,7%	18,4%	11,4%	2,6%

Table 7. Factors influencing participation in sports activities, total sample [source: author]

It can be seen that 79.5% of the observed group (total sample) indicates time as a key factor influencing participation in sports activities. It is the same result if we look at the male and female population individually. For women aesthetic reasons are more important for sport, while for men competition is more important. The other elements are fairly uniform. This fact is very interesting, but at the same time unexpected, given that the majority states healthcare as a reason for sporting, while on the other hand they state lack of time as a factor influencing participation. On the other hand, most are ready to allocate enough money to pay for almost all sports programs offered in Slavonski Brod. The main conclusion that comes from everything is that they have money, they consider sporting extremely important but they are still not engaged in sports, meaning they are unmotivated or uninterested enough.

Conclusion

Goals such as quality of life, ie managing own resources in time and space are essential social factors. Sport has entered into almost all pores of social life and its products, in any form, become more accessible to almost all layers. Through the various sports programs defined in this paper as a sports product, various sports institutions and companies make possible to achieve these goals. The aim of the paper was to structure the elements of the promotional mix, ie to determine the significance and impact of the individual element on the possible choice of sports programs according to the analyzed population. The survey was conducted through a sample of 385 entities, the average chronological age of 26.7 years with a range of 17-65 years. From this research it can be concluded that no promotional mix factor is dominant, ie decisive. Looking at the total observed population, their structure is shown in percentages: Propaganda = 39.0%; Personal Promotion = 37.1%; PR = 30.1%

12

VALLIS AUREA

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 796/799-057.875(497.542Slavonski Brod); DOI 10.2507/IJVA.3.1.1.32

and Publicity = 29.9%. Significantly different results were not obtained either in the specially observed parts of the sample (male / female or employed / unemployed). It is important to point out that, considering only the factor affecting the choice of practicing sports programs, the sports product is highly represented by over 70% compared to other factors; price, distribution and promotion. Concerning the reason for practicing sports activities, the health factor is by far the most dominant with over 90% of the frequencies. It is worrying that even 79.5% of respondents believe that there is not enough time or that lack of time is the most important factor in their non-exercise. With variable monthly allocations for sports activities, the variability is large, but all the results indicate that the prices of sports products in the city come within the respondents' scope of answers. It may in some way be concluded that there are a sports product in the city, that it is affordable and that the respondents want to consume it but that this does not happen. Probably the solution can be found in marketing and people who will connect the sports product with consumers with specific knowledge and tools.

Literature

[1] Novak, I. (2006). Sportski marketing i industrija sporta, Maling, ISBN 953-95593-0-8, Zagreb

[2] Bartolucci, M.; Škorić, S. (2009). Menadžment u sportu, Odjel za izobrazbu trenera Društvenog veleučilišta u Zagrebu, Kineziološki fakultet Sveučilišta u Zagrebu, ISBN 978-953-6378-81-4, Zagreb

[3] Beech, J.; Chadwick, S. (2011). Sportski menadžment, Mate, ISBN 978-953-246-098-8, Zagreb
[4] Dizdar, D. (2006). Kvantitativne metode, Kineziološki fakultet u Zagrebu, ISBN-10 953-6378-58-2, Zagreb

13

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 796/799-057.875(497.542Slavonski Brod); DOI 10.2507/IJVA.3.1.1.32

VALLIS AUREA

PHOTO 1.
Vinski podrum | Wine Cellar
PHOTO BY: JOSIP MESIĆ

Devčić Kristina[1]

Beljo Ivana[2]

Gaćina Nikolina[3]

Minimization of the Diet Costs on the Three-Day Menu Example

Abstract:

Linear programming is a special field of applied mathematics that deals with solving optimization problems while certain conditions or constraints must be fulfilled. Aim of linear programming is to find a solution how to use or allocate a predetermined amount of resources with a predefined objective such as minimum cost, maximum revenue, maximum profit, etc. This paper presents the application of linear programming on the example of minimizing the diet costs. One of the basic human needs is the adequate daily intake of food in the body i.e. diet. In sufficient quantity food ensures the normal functioning of the human body, it gives energy for mental and physical work and raises the immune system. In this paper, the problem of diet is set to minimize the total cost of daily diet while the criteria for daily intake of a sufficient amount of all nutrients required for the normal functioning of the human body must be fulfilled.

Carbohydrates, fats and proteins give energy to the human body. Carbohydrates are first consumed, then fat, and only in the cases of starvation body translates carbohydrates into energy. Daily energy needs depend on gender, age, body mass, body height and total daily physical activity. Furthermore, a three-day menus for a group of young and middle-aged people, between 19 and 50, separately for a group of men and women is provided.

Keywords:
linear programming, costs, diet, minimization, nutrients

Author´s data:

[1] Kristina, Devčić, prof., univ.spec.oec., senior lecturer, Polytechnic Gospić, Bana Ivana Karlovića 16, 53000 Gospić, kdevcic@velegs-nikolatesla.hr;

[2] Ivana, Beljo, dipl.ing.mat., Polytechnic Šibenik, Trg Andrije Hebranga 11, 22000 Šibenik, ibeljo@vus.hr;

[3] Nikolina, Gaćina, mag.ing. techn.aliment., Polytechnic Šibenik, Trg Andrije Hebranga 11, Šibenik, nikolina@vus.hr

Introduction

Nowadays, with the help of popular softwares such as WinQSB, LINDO, MS Office Excel and other, linear programming has found its application in a large number of scientific disciplines and areas of human activities such as production, transportation and distribution, marketing, telecommunications, financial investment and planning, employee scheduling and other. This paper presents the application of linear programming on the example of minimization of the costs of diet with the aim of meeting healthy and variety diet requirements.

We have witnessed the consequences of the global finance and economy crisis that began in 2007. Ten years after the start of the crisis, some national economies are still in the process of recovery as well as the economy of the Republic of Croatia. The recovery of the national economy is closely related both to the recovery of the real sector and to the growth of household consumption. House budgets will affect decisions about purchasing goods and services, including food. On the other hand, postulates of healthy and varied diet should not be neglected. The aim of this work is to minimize the costs of diet with the criteria for daily intake of a sufficient quantity of all nutrients required for the normal functioning of the human body are fulfilled.

Linear programming

The problem of linear programming is a special case of problem of mathematical programming in which the objective function is linear, and the constraints are expressed in the form of linear equations and/or inequalities [1]. The objective in the problem of linear programming is to maximize or minimize the objective function:

$$\max/\min z(x_1, x_2,..., x_n) = c_1 x_1 + c_2 x_2 + ... + c_n x_n \quad (1)$$

with defined constraints

$$a_{11}x_1 + a_{12}x_2 + ... + a_{1n}x_n \le b_1,$$

$$a_{21}x_1 + a_{22}x_2 + ... + a_{2n}x_n \le b_2,$$

$$\vdots \qquad\qquad (2)$$

$$a_{m1}x_1 + a_{m2}x_2 + ... + a_{mn}x_n \le b_m,$$

$$x_1 \ge 0, x_2 \ge 0,..., x_n \ge 0.$$

The objective function (1) is linear, where $c_j,\ j=1,2,,...,n$ are coefficients of the objective function, and $x_j,\ j=1,2,...,n$ are structural variables. The constraints are also linear and are expressed in the form of linear inequalities.

The problem of linear programming can be written as

$$\max z = c^T x \qquad (3)$$

with defined constraints

$$Ax \le b$$
$$\qquad\qquad (4)$$
$$x \ge 0$$

where

$$c = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{bmatrix},\ x = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix},$$

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & & & \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix},\ b = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_m \end{bmatrix}.\ (5)$$

16

Linear programming addresses a large number of economic problems, they can refer to production, raw materials, labor force, market, supply, demand, imports, exports [6]. Also, there is a significant application of linear programming in the optimization of diet, transport and distribution, labor scheduling, choice of production assortment, ingredient mix problem and financial portfolio selection.

Nutrients

One of the basic human needs is the adequate daily intake of food in the body i.e. diet. In sufficient quantity food ensures the normal functioning of the human body, energy for mental and physical work and raises the immune system [5]. Nutrients include proteins, carbohydrates, fats, vitamins, minerals and water. Nutrients can be classified into two basic categories which are macronutrients and micronutrients. Macronutrients are carbohydrates, fats and proteins that are present in food in the largest share. Carbohydrates and fats supply body cells with energy, while proteins build cells and tissues [4]. Micronutrients are vitamins, minerals and trace elements that are present in food in very small quantities and are essential for the functioning of important body processes [2]. Balanced diet involves intake of 15-20% protein, 55-60% carbohydrate and 20-25% fat [3].

Proteins

Proteins are the main building elements of the cells and represent 16 to 19 percent of the body mass of the average adult man. They are essential for growth and regeneration of tissues and participate in all biochemical processes in the cells. An important function of the proteins is to replace damaged and dead cells, for example blood cells, kidneys, liver, muscles, hair, nails, teeth and bones.

The proteins are made of amino acids. The main sources of protein in food are meat, fish, eggs, milk, milk products, legumes, beans, lentils, wheat, rice, corn, barley, oats, rye.

Carbohydrates

Carbohydrates are present in food of plant origin, for example in fruits and vegetables, cereals and cereal products, milk, milk products, herbs, nuts, juices, jams, sweets, etc. According to the molecular composition, carbohydrates are divided into monosaccharide, disaccharides and polysaccharides, and by degree of digestibility into digestive and indigestive. Starch, sugars, polyols, alcoholic sugars and etc are examples of digestive carbohydrates, while indigestive carbohydrates are found mainly in food of plant origin, for example cellulose, hemicelluloses, lignin, pectin, gum, and mucilage from plant juices. These substances are referred to as fibers.

17

Fats

The fats are rich, and with sugars, the cheapest source of energy. They enable the absorption of fat soluble substances, primarily vitamins A, D, E and K, which are fat soluble vitamins, and are also important for the synthesis of some hormones. The term fat refers to lipids, triglycerides, phospholipids, sterols, etc. The fat appears in two forms: liquid and solid aggregate state. Liquid fats are oils, and are derived from food of plant origin (sunflower, olives, oilseed rape, flax, wheat, corn and wheat germ). Solid fats are derived from animal products (pork fat, poultry fat and butter).

Vitamins and minerals

Vitamins and minerals in the organism are introduced in significantly smaller amounts

compared to the macronutrients, and are therefore called micronutrients. Micronutrients are essential for normal growth and development of the human body. Considering the solubility of the vitamins, we divide them into two groups: water-soluble vitamins (B-complex vitamin and vitamin C) and fat-soluble vitamins (A, D, E and K).

B-group vitamins are essential for converting carbohydrates, fats and proteins into energy as well as for their use for building and restoring the body tissue. They are found in dark green vegetables, beans, peas, cereals, meat, fish and eggs. Vitamin C is primarily an antioxidant, essential for the absorption of iron from food and the production of collagen that connects body cells. Citrus and kiwis are a rich source of vitamin C, and in vegetables in peppers in the largest amount. Vitamin D is the only vitamin that the human body can completely independently synthesize. One of the most important functions of vitamin D in the human body is absorption of calcium and phosphorus. It can be found in fish oil, eggs and milk. Vitamin A helps in growth and differentiation of epithelial tissue of the respiratory, urogenital and digestive system and in the effective functioning of the immune system, and is found in the liver, eggs and milk products.

From all minerals we can emphasize iodine and iron. Iodine is essential for normal growth and development of the thyroid gland, i.e. its main tyrosine hormone. Rich iodine sources are sea food such as sea salt, algae, fish and shellfish. The lack of iron in human diet is manifested as anemia. Animal origin food (primarily red meat) contains more useful iron than food of plant origin (legumes, integral cereals)

Proper diet

In order for the diet to be proper, it must fulfill the needs of daily energy intake and all nutrients necessary for the normal functioning of the body as well as its physical and mental health. There are numerous recommendations in the literature on what is considered a healthy diet. The most important recommendations include the following:

- take into account your body weight,
- have daily physical activity,
- eat various food following the food pyramid (Figure 1),
- eat cereal products, especially from integral grains,
- eat fruits and vegetables daily,
- choose less grease food,
- choose less sweet food and drinks,
- put less salt in food,
- moderately consume alcoholic drinks,
- make sure that food is healthy [4].

Figure 1. Healthy diet pyramid.
Source: https://www.cdm.nhg.com.sg/Diabetes/Pages/Eating-a-healthy-diet.aspx# (April 22, 2017)

Planning a healthy diet involves a lot of knowledge about the energy values of the food and the properties of each individual food item. Energy comes from the food by metabolizing fat, proteins and carbohydrates, and it is determined as a heat needed that one gram of water at a pressure of one atmosphere is warmed by 1 °C. Energy is measured in kilojoules (kJ) or kilocalories (kcal) where 1 kcal = 4.184 kJ or 1 kJ = 0.2388 kcal. Table 1 shows the energy value of one gram of each nutrient.

18

Type of nutrient	Energy value
Proteins	4 kcal/g (17kJ/g)
Fats	9 kcal/g (37kJ/g)
Carbohydrates	4 kcal/g (17kJ/g)
Vitamins and minerals	0

Table 1. Energy value of nutrients.
Source: Nutrition Value Guide, Ministry of Agriculture http://www.mps.hr/UserDocsImages/ HRANA/Vodi%oC4%8D%20o%20navo%oC4%91en ju%20hranjivih%20vrijednosti%20hrane%20- 2.%20izdanje.pdf (April 15, 2017)

Table 1 shows that proteins, fats and carbohydrates have an energy value, while vitamins and minerals are not a source of energy. As we continue to observe the energy value of nutrients, we did not take vitamins and minerals into account, only proteins, fats and carbohydrates are included.

Analysis area

Carbohydrates, fats and proteins are the main sources of energy in the human body. Carbohydrates are first consumed, then fat, and only in the cases of starvation body translates proteins into energy. Daily energy needs depend on gender, age, body mass, body height and total daily physical activity.

In this paper younger and older adults (from 19 to 50 years) are observed, depending on gender, men and women. Table 2 shows the average daily energy intake of nutrients depending on the age and gender of the person.

Type of nutrient	Label of nutritient	Recommended average daily intake of nutrients	
		19 - 50 Men	19 - 50 Women
Energy (kcal)	H_1	2300	1900
Carbohydrates (g)	H_2	316.25-345	261.25-285
Proteins (g)	H_3	57.5-86	47-71
Fats (g)	H_4	63-76	52-63

Table 2: Recommended average daily intake of nutrients.
Source: author's calculation.

For healthy diet it is very important to be in accordance with the healthy diet pyramid and to be diverse. Table 3 covers 55 food items that are commonly part of daily diet. The values of energy (expressed in kilocalories), the amounts of protein, fat, carbohydrate (expressed in gram) per 100 gram of every food item are given. In addition to the above in table 3 the corresponding average prices of certain food items are also shown.

19

VALLIS AUREA

Food item (100g)	Label	Energy (kcal)	Carbohydrates (g)	Proteins (g)	Fat (g)	Price (kuna)
Milk (0,9% milk fat)	A_1	40	4,7	3,3	0,9	0,65
Milk (3,2% milk fat)	A_2	66	4,7	3,3	3,2	0,62
Yogurt (2.8% milk fat)	A_3	40	5	4	4	1,20
Sour cream (12% milk fat)	A_4	192	3	3	18	2,20
Cream cheese (23% mm)	A_5	115	6	13	5	4,99
Fresh cow cheese	A_6	72	4	15	3	3,47
Gauda cheese	A_7	367	0	27	30	1,63
Mozzarella cheese	A_8	227	0	20	17	8,26
Liver pate	A_9	440	1	12	40	6,50
Ham	A_{10}	147	0	23	6	6,68
Chicken breasts	A_{11}	110	0	23	1	7,50
Turkey breasts	A_{12}	111	0	25	1	7,50
Pork steak	A_{13}	120	0	21	4	6,00
Mixed meat, ground	A_{14}	253	0	20	19	4,00
Egg	A_{15}	167	1	13	11	1,52
Hake	A_{16}	88	0	17,2	0,85	5,05
Cod	A_{17}	76	0	17	1	5,20
Trout	A_{18}	112	0	18	2	4,00
Sardine in oil	A_{19}	240	1	24	14	9,51
Tuna in oil	A_{20}	303	0	24	21	13,82
Rice	A_{21}	368	79	7	1	2,03
Oat flakes	A_{22}	402	66	14	7	1,20
White bread	A_{23}	237	47	7	2	1,48
Corn bread	A_{24}	220	31	5	9	1,90
Rye bread	A_{25}	222	47	7	1	1,82
Pasta	A_{26}	390	72	13	3	1,85
Apple	A_{27}	52	12	0	0	1,00
Pear	A_{28}	55	12	0	0	1,70
Pineapple	A_{29}	56	13	0	0	2,00
Orange	A_{30}	54	9	1	0	0,90
Banana	A_{31}	99	23	1	0	1,20
Dry fruits	A_{32}	252	56	3	1	4,16
Jam	A_{33}	261	66	0	0	2,38
Tomato	A_{34}	19	3	1	0	2,00

20

Food item (100g)	Label	Energy (kcal)	Carbohydrates (g)	Proteins (g)	Fat (g)	Price (kuna)
Red onion	A_{35}	42	9	1	0	0,50
Leek	A_{36}	38	6	2	0	0,30
Pepper	A_{37}	28	5	1	0	3,00
Mushrooms	A_{38}	24	3	3	0	0,32
Salad	A_{39}	14	2	1	0	0,30
Cucumber	A_{40}	10	2	1	0	1,30
Carrot	A_{41}	35	7	1	0	0,70
Potato	A_{42}	85	19	2	0	0,85
Pork fat	A_{43}	900	0	0	100	2,00
Butter	A_{44}	755	0	1	83	6,64
Margarine	A_{45}	720	0	0	81	2,30
Sunflower oil	A_{46}	928	0	0	100	1,10
Pumpkin oil	A_{47}	900	0	0	100	12,28
Olive oil	A_{48}	900	0	0	100	9,93
Chocolate for cooking	A_{49}	564	63	14	28	4,39
Orange juice	A_{50}	47	11	1	0	0,95
Apple juice	A_{51}	47	12	1	0	0,95
Bright beer	A_{52}	45	4	1	0	1,07
Red wine	A_{53}	66	0	0	0	3,19
Wight wine	A_{54}	70	0	0	0	4,91
Boiled water	A_{55}	0	0	0	0	0,58

Table 3: Energy value of nutrients, amount of carbohydrates, proteins, fats ad associated unit prices.
Izvor: http://www.vjezbaj.com/kalorijska-tablica/ (April 20, 2017)
http://www.fitness.com.hr/prehrana/nutricionizam/Tablica-kalorija.aspx (April 20, 2017)
https://www.konzum.hr (April 20, 2017)

In order to solve the diet problem by applying linear programming, it is necessary to determine the objective function as well as all the conditions and constraints that must be fulfilled. Let the choice of food items is made from Table 3 and let $x_1, x_2, .., x_n$ are quantities of each food item $A_1, A_2, .., A_n$, where $n = 55$. Furthermore, let $c_1, c_2, .., c_n$ be unit prices (prices per 100 g) of each individual food item $A_1, A_2, .., A_n$. The objective function is

$$\min z(x_1, x_2, .., x_n) = c_1 x_1 + ... + c_n x_n. \tag{6}$$

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 613. 2:519.852; DOI 10.2507/IJVA.3.1.2.33

VALLIS AUREA

This function provides the minimum value of total food price required for one day, and the constraints that must be fulfilled are obtained from the recommended daily amounts of nutrients. Let b_j be recommended daily amounts of nutrients H_j and let a_{ij} be amounts of protein, fat, carbohydrates shown in Table 3, where $i = 1,...,55$, and $j = 1,2,3,4$. In the label a_{ij} the index i is a label for food item A_i, and the index j is a label for a type of nutrient H_j.

In order to recommended daily intake of all nutrients be fulfilled, the following conditions must be met

$$\sum_{i=1}^{55} a_{ij} x_i \geq b_j , \qquad (7)$$

where $j = 1,2,3,4$ indicate the type of nutrient.

Additional conditions are also introduced

$$x_i \geq 0 , \quad \forall i = 1,...,55;$$
$$x_i \leq 0.3 \quad za \quad i = 1,2,50,51,55;$$
$$x_i \leq 0.2 \quad za \quad i = 3,4,33,52,53,54;$$
$$x_i \leq 0.5 \quad za \quad i = 5,9,32;$$
$$x_i \leq 1 \quad za \quad i = 6,7,8,19,20,22,..,25,35,36,41;$$
$$x_i \leq 0.1 \quad za \quad i = 10,46,...,49;$$
$$x_i \leq 2.5 \quad za \quad i = 11,...,14,38;$$
$$\qquad (8)$$
$$x_i \leq 3.5 \quad za \quad i = 16,17,18;$$
$$x_i \leq 2 \quad za \quad i = 21,26,...,31,37,40,42;$$
$$x_{34} \leq 1.5 ;$$
$$x_{39} \leq 3 ;$$
$$x_{15} \leq 1.8 ;$$
$$x_i \leq 0.15 \quad za \quad i = 43,44,45.$$

There is a condition of non negativity of structure variables x_i, $\forall i = 1,...,55$ to avoid meaningless solutions, since the amounts of food cannot have negative values, and constraints to the maximum amounts of each food item in order to make the menus as diverse as possible have been introduced. In addition, in order to make the menus as varied as possible, with the daily constraints of the daily intake of certain food items, the restriction of the repeating of main food items in the three-day menu was introduced such as: types of milk and milk products, types of meat, type of fish and its products and types of bread. The diet problem is solved using Solver in MS Excel.

Three-days menus

Conducted analysis provided three-day menus for men and women between 19 and 50 years. When calculating, and respecting all the above constraints, it was taken into account that in three-days menus for both groups, at least one meal (lunch or dinner) is a fish, one vegetable meal (a meal that does not include meat and fish as well as their produces). Also, when calculation it was taken into account the minimum price of the daily menus since the lowest possible price violates the postulates of healthy diet.

Three-day diet menu for men between 19 and 50 years

For men aged 19 to 50 years with meeting of all the above constraints, the following three-day menu is obtained:

1st day - 22,21 kuna
BREAKFAST:
2 dcl orange juice, 13 g gauda cheese, 100 g corn bread, 1 apple, 10 g chocolate for cooking
LUNCH:
1 dcl sour cream, 50 g turkey breasts, 100 g pasta, 250 g mushrooms, 1 dcl olive oil, 3 dcl apple juice
DINNER:

VALLIS AUREA

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 613.2:519.852; DOI 10.2507/IJVA.3.1.2.33

22

3 dcl milk, 100 g oat flakes, 50 g dry fruits

2ⁿᵈ day - 33,29 kuna
BREAKFAST:
2 dcl milk 3,2% mm, 10 g margarine, 20 g jam, 100 g white bread, 15 g dry fruits
LUNCH:
50 g pork steak, 2 potatoes, 1 onion, 1 tomato, 1 pepper, 1 cucumber, 100 g salad, 0,3 dcl sunflower oil, 2 dcl boiled water
DINNER:
0,5 dcl sour cream, 100 g pasta, 1 leek, 1 pepper, 3 dcl boiled water

3ʳᵈ day - 42,07 kuna
BREAKFAST:
2 dcl yogurt, 50 g ham, 50 g rye bread, 10 g margarine, 1 banana
LUNCH:
150 g trout, 100 g white breaad, 1 tomato, 1 cucumber, 0,3 dcl sunflower oil, 2 dcl red wine
DINNER:
1 egg, 50 g tuna in oil, 100 g rice, 1 tomato, 2 dcl boiled water

Three-day menu for men is sorted by price, ranging from 22. 21 kuna to 42.07 kuna.

Three-day diet menu for women between 19 and 50 years
For women aged 19 to 50 years with meeting of all the above constraints, the following weekly three-day diet menu is obtained:

1ˢᵗ day - 19,82 kuna
BREAKFAST:
2 dcl milk 3,2% mm, 50 g oat flakes, 10 g chocolate for cooking, 1 orange
LUNCH:
80 g mixed meat, 100 g pasta, 1 tomato, 1 onion, 0,1 dcl olive oil, 2 dcl apple juice

DINNER:
0,8 dcl sour cream, 120 g mushroom, 1 leek, 1 potato, 2 dcl boiled water

2ⁿᵈ day - 31,10 kuna
BREAKFAST:
3 dcl orange juice, 30 g mozzarella, 80 g corn bread, 15 g tomato
LUNCH:
50 g pork steak, 2 potato, 1 onion, 200 g salad, 1 carrot, 0,3 dcl sunflower oil, 2 dcl orange juice
DINNER:
3 dcl yogurt, 30 g dry fruit, 1 banana

3ʳᵈ day - 31,22 kuna
BREAKFAST:
2 dcl yogurt, 15 g gauda cheese, 15 g ham, 50 g rye bread, 1 apple
LUNCH:
100 g trout, 150 g rice, 1 leek, 0,2 dcl sunflower oil, 3 dcl boiled water
DINNER:
2 eggs, 1 tomato, 1 pepper, 0,1 dcl olive oil, 30 g rye bread, 2dcl boiled water

Three-day menu for men is sorted by price, ranging from 19.82 kuna to 31. 22 kuna.

Conclusion

This paper deals with linear programming as a special case of mathematical programming. The objective function and constraints in the linear programming problem are given in the form of linear equations or inequalities. In this paper, special emphasis is placed on the application of linear programming with the aim of minimizing the diet costs on the example of a three-day menu, with the aim of meeting the conditions of healthy and varied diet. Objective function is defined as a total value of the daily diet, expressed in kunas. Constraints are

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 613. 2:519. 852; DOI 10.2507/IJVA. 3.1. 2. 33

23

VALLIS AUREA

defined in accordance with healthy diet postulates on recommended daily intake of nutrients. The paper proposes three-day menus for men from 19 to 50 years and for women from 19 to 50 years. The results showed that the price of a healthy and varied daily menu for men ranges from 22.21 kuna to 42.07 kuna and for women from 19.82 kuna to 31.22 kuna. The reason for lower daily menu prices for women is related to a lower amount of recommended average daily intake of nutrients (carbohydrates, proteins and fat) than is the case with men.

Literature

[1] Neralic, L. (2012). Uvod u matematičko programiranje 1, 4. izdanje. Element, ISBN 978-953-197-563-6, Zagreb

[2] Gaćina, N. (2016). Prehrana u turizmu - hrana i turizam, Veleučilište u Šibeniku, Šibenik

[3] Lambaša Belak, Ž. (2006). Tehnologija hrane, Visoka škola za turistički menadžment u Šibeniku, Šibenik

[4] Katalinić, V. (2011). Temeljno znanje o prehrani, Sveučilište u Splitu, Kemijsko-tehnološki fakultet u Splitu, Split

[5] Mahan, L.K. & Escott-Stump S. (2008). Krause's Food and Nutrition Therapy, 12 edition, Saunders Elsevier, ISBN: 987-1-4160-3401-8, St. Louis

[6] Crnjac Milić, D. & Martinović, M. (2012). Povijesni pregled implementacije matematike i statistike u ekonomiju. Ekonomski vjesnik, Vol. 25, No. 2, (prosinac 2012) page numbers (340-346), ISSN: 0353-359

[7] Vodič za navođenje hranjivih vrijednosti hrane, 2. izdanje, siječanj 2013., Republika Hrvatska Ministarstvo poljoprivrede, Available from: http://www.mps.hr/UserDocsImages/HRANA/Vodi%C4%8D%20o%20navo%C4%91enju%20hran jivih%20vrijednosti%20hrane%20-2.%20izdanje.pdf Accessed: 2017-04-22

[8] https://www.cdm.nhg.com.sg/Diabetes/Pages/Eating-a-healthy-diet.aspx#.WPvCpWclHIU Accessed: 2017-04-22

[9] http://www.vjezbaj.com/kalorijska-tablica/ Accessed: 2017-04-20

[10] http://www.fitness.com.hr/prehrana/nutricionizam/Tablica-kalorija.aspx Accessed: 2017-04-20

[11] https://www.konzum.hr/ Accessed: 2017-04-20

24

VALLIS AUREA

International Journal - VALLIS AUREA • Volume 3 • Number 1 • Croatia, June 2017
UDK 613.2:519.852; DOI 10.2507/IJVA.3.1.2.33

CONTENTS