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Fuzzy based efficient Cosmetology Paradigm

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Abstract

Now a days a computerized consumer behavior is being practice to get maximum efficient results in the context of a globalized market. More attention is paid to the consumption of manufactured goods and everyday items. Much less attention is paid to the service sector, in particular medical, recreational and physical. There is also a lack of application of mathematically grounded, computer methods and models for such modeling. We propose modeling the behavior of consumers of aesthetic cosmetology services as tasks of multi-criteria decision making on a variety of alternatives. The approach to the estimation of cosmetology service by clients based on fuzzy modeling is described. Specific features of cosmetology services, marketing, communication components are determined. The main consumer criteria for assessing cosmetology services are used. A computer model in the Fuzzy Tech, specialized software product for computer fuzzy modeling, was constructed. Integrated assessments for cosmetic institutions in Kharkiv have been calculated. The results are analyzed and recommendations for improving the quality of cosmetology service, websites of cosmetology institutions, are suggested. The principles of the proposed approach, the described fuzzy model and its computer implementation can be applied to a wide range of tasks of multi criteria assessment of customer service in various social fields - retail stores, medicine, culture, health, physical educationand training, public catering, other household and domestic services.

Keywords: *Computer Modeling, Fuzzy Logic, Consumer Behaviour*

Introduction

The era of competitive market especially medical (in particular, cosmetology) services and the beginning of insurance medicine in mid-east countries, the issues of patients' interaction with healthcare institutions become very relevant. The existence of various providers of treatment services and other types of healthcare (including therapeutic and aesthetic cosmetology), the existence and operation of medical institutions of various forms of ownership create broad opportunities for patients to choose the place of medical care and a specific doctor [1].A visitor to the medical center (patient, client) should choose a specific cosmetology institution, where he will apply, in a variety of proposals with several criteria for quality, safety, price, an assortment of cosmetology services, other service parameters. That is, he faces a question of a multicriteria choice, for the solution of which it is expedient to apply appropriate scientific and practical approaches and methods [2].

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On the other hand, the cosmetic institutions themselves, their managers, marketers, other leading specialists need reliable, scientifically sound, tools (that are not too difficult in practical daily use) for monitoring the quality of their work, and self-evaluation from the perspective of potential customers. It is necessary not only to evaluate themselves but also actual or potential competitors. Therefore, there is an urgent need to develop and use appropriate, modern methods and models for this [3].

2. A literature review on cosmetology services

Beauty parlours, salons, clinics, clients' behavior literature showed that these issues are highlighted very fragmentarily, selectively, clearly not enough. Yet computational modeling is basically not provided to solve the related problems [4]. The market for these services is rapidly expanding though. Therefore, for the beauty, health, well-being industry, decision-making models are needed by both producers and consumers, taking into account the image, perceived quality, basic marketing components [5]. It presents the results of Six Sigma integration, discrete modelling and multi-criteria methods for improving beauty services, obtaining compromise

solutions about incomes, costs, use of resources and customer satisfaction. The ranking approach in accordance with the preferences of experts was used [6]. In [7], the services quality, ways of assessing client's expectations regarding the quality of care in health facilities, the perceived quality of cosmetology services were considered.

It is established that positive assessments of the customer service quality are related to the intentions to use it in the future, which ensures a high level of customer retention [8]. If the cosmetic institution supports its clients on a lifelong basis, you can achieve a higher level of client retention and reduce the number of lost customers.

Approaches to budget allocation between various components of promotion (and marketing) of cosmetology services were offered [9]. Among the most important areas of research of cosmetology services are the relationships between clients and staff, the corporate loyalty of clients of beauty salons. It is noted that although positive interaction with staff and participation in the development of treatment options is very important, interaction with friends and family and associated activities also have a positive impact on the image of the beauty parlours [10]. Particular attention is paid to the study of the demand for medical cosmetology - for mainland China, Taiwan, Hong Kong, and Macau [11]. The influence of demographic variables on the demand for cosmetology is studied. It is established that demographic variables and monthly income lead to significant differences in the most desired operation and acceptable costs. It should be noted that the expected improvement in beauty from these services is limited. Despite the attractiveness of the appearance, the economic efficiency of investments in improving the beauty is ambiguous. For the average consumer, the monetary benefits of plastic surgery, cosmetic procedures are sometimes not worth the cost [12]. In connection with discontent with one's own body and manifestations of aging, people resort to various cosmetic therapies, including plastic surgery. Often, customers tend to imitate the appearance of celebrities. It is necessary to minimize the negative effects of plastic surgery and reduce the wrong motives. The Bayesian model is proposed by [13], which help to avoid the unforeseen consequences of plastic surgery in the health care system. The literature discusses the possibility for trade-offs between the clinical nature and other elements of customer service necessary to provide the service. It is noted that cosmetology clinics often do not provide the right balance between comfort and procedural possibilities. This is necessary to create loyalty and repeated calls for services. Wellness cosmetic centres have become a real force that affects health. As the interest in physical well-being increased, this type of therapy became popular among clients and medical specialists. The centres of cosmetology treatment have become attractive for a growing number of clients. As a result of the development of various applications (treatment of diseases, improvement of appearance), cosmetology centres have become an integral part of the healthcare industry. Health tourism has started and has begun to thrive.

Aesthetic medicine has become one of the fastest growing segments of health tourism [14]. To date, however, scientific research on this market is clearly not enough. Services in the field of aesthetic medicine are usually only discussed descriptively, as a subcategory of medical tourism. It is noted that the quality of cosmetology services, the organizational characteristics of the cosmetology facilities, the relationship with specialists and service personnel, has a strong influence on the assessments of consumers, especially for the elderly [15]. However, there are no quantitative models for evaluation cosmologic services by consumers of aesthetic medicine. Interesting is the comparative analysis of health tourism in Hungary and Austria, in particular, wellness services [16]. This market is globalized and competition is intensifying, which requires higher standards of service and uniqueness. It is shown that in a dynamic market for a cosmetology establishment a unique profile is needed that combines directly cosmetology services with other various accompanying service products and various similar offers.

Modern cosmetology centres offer clients an increasing number of services. They are very diverse, and include a variety of medicines, cosmetic specialists, aesthetics and hairdressing procedures, offered to clients as samples of products, profiled specialized medical and preventive packages of services, various health programs [17].An trend in recent years is that more and more often different organizations realize the importance of organizing measures to improve the health of their employees, including using wellness and cosmetology procedures. There is a growing awareness of the need for health programs in general, as a means leading to the creation of a culture of health in organizations. The notion of a culture of health is becoming increasingly important for companies. Statistics show that the number of health problems is steadily increasing [18].

As a result, labour costs are systematically increasing. To solve this problem, many companies have begun to implement health programs to improve the psycho-physical health of their employees. In particular, studies confirm the usefulness (in certain cases) of health-improving cosmetology programs in the process of forming a corporate culture of health. There are factors that limit the usability of such program. It is necessary to note the problems of the safety of services and protection of patients' personal data, these services received. All formal and technical rules that directly or indirectly affect safety standards in cosmetological health centres determine the overall safety of cosmetology services. Its level is an important competitive advantage in running a business, security is becoming increasingly important in marketing a health-oriented business. Because of the specifics of cosmetology services, there are many

different segments of such security. Among them are medical aspects as well as personal information security. It is this last element that allows customers to trust a certain beauty establishment. Only careful protection of personal information ensures the ethics and confidentiality of the provision of cosmetology services, which is extremely important for their recipient [19]. The problem of transparency in the market of cosmetology services in the context of official rules has not been solved in general. This refers to the standards of services provided (not covering some relatively new forms of cosmetology services), the interrelationships of different quality components and specific service providers.

There is a lack of transparency in the market of cosmetology services, caused by information asymmetry. It arises from the uncertainties regarding the comprehensive assessment of the quality of cosmetology service due to the lack (or insufficient use) of formalized models (including mathematically substantiated and implemented by computer technology) for multi-criteria evaluation of cosmetology services by both consumers and organizations, providing such services.

3. Criteria for comparison of cosmetology services

Table 1, depicts a popular center of cosmetology in Kharkiv. The vast majority of cosmetic institutions are located in the center which can be explained by the places of primary residence and the work of potential clients who need such services.

Table 1. Kharkiv's cosmetic institutions

Name	Website
Lumenis	lumenis.com.ua/xarkov.html
Esthetic Cosmetology	aest-cosmetology.com.ua
Proper Cosmetology	sbahhlsephekjrcbds2aw5rqcm.com
Continent	continentdayspa.com
Feskov Clinic	beauty.feskov.com
Cosmetologist	-
Oxford Medical	kharkiv.oxford-med.com.ua
Stylus Studio	stylus-studio.com.ua
Institute Hyalual	clinic-hyalual.com.ua
Lazer House	www.laserhouse.com.ua/kharkov
Nucu Cosmetic	nucu.com.ua
Kharkiv Cosmetology Hospital	old-clinic.com.ua
Gold Clinic	gold-clinic.com
Magnifique Beauty School	magnifique.com.ua
ARLI	arli-beauty.com.ua

Further, the work of these cosmetic institutions was studied in more detail, relying on field observations with direct visits to institutions, accessible information on their websites and feedback from visitors in social networks and the Internet as a whole. z

This allowed us to propose criteria (according to which the consumer, the client of cosmetology services can preliminarily assess the relevant center, hospital, cabinets) and break them into three large groups. Each of the contains its own set of subcriteria, the implementation of which is proposed to be assessed with the corresponding scores, which are given in Table 2.

Table 2 The composition of criteria for the assessment of cosmetology institutions (points)

Internet communications and features	Services and prices	Personnel and equipment
Online Consultant (1)	Services breadth of (2)	Premises (2)
Online Registration (1)	Prices level (2)	Specialists number (2)
Online question (1)	Working time (2)	Personnel qualification (2)
Call back (1)	Work on weekends (1)	Equipment level (2)
Overall website quality (2)	Additional services (2)	The term of work in the market (2)
Information, prices (2)	Services information (2)	Exclusive services (1)
Information, discounts (2)	Location (2)	
Social networks (2)	Transport accessibility (2)	
Blogs (1)		
Comments, website(2)		
Comments, media (1)		
Photo, video materials (2)		
Online payment (1)		

For each of the above three generalized criteria, an evaluation of the listed cosmetology institutions (according to sites, visitor reviews, own observations) was carried out. Its results are given in Tables3-5. It is clear that there can be additional, exclusive, unique opportunities (offers, services, procedures) that are not of a mass character, provided by only one cosmetology clinic.But at this stage of the preliminary comparison, they should not be taken into account, since clients of such services find them not through a simple comparison and choice in the market of cosmetology services, but in other, specific ways.

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Table 3 Evaluation of Internet communications and features (points, total19 max)

	Lumenis	Esthetic Cosmetology	Proper Cosmetology	Continent	Feskov Clinic	Oxford Medical	Stylus Studio	Institute Hyalual	Lazer House	Nucu Cosmetic	Kharkiv City Cosmetology	Gold Clinic	ARLI
Online Consultant (1)	1	0	0	0	1	1	1	1	1	0	0	0	0
Online Registration (1)	1	0	1	1	1	1	0	1	1	0	0	0	0
Online question (1)	1	0	1	1	1	1	1	1	1	1	0	1	1
Call back (1)	1	0	1	0	0	1	0	0	1	0	0	0	1
Overall website quality (2)	2	0	2	1	1	1	2	1	2	1	1	1	1
Information, prices (2)	2	1	2	0	2	1	2	2	2	2	2	2	0
Information, discounts (2)	2	0	2	0	1	2	2	2	2	1	1	0	0
Social networks (2)	2	0	2	2	1	1	2	0	2	1	0	1	0
Blogs (1)	0	0	0	0	0	0	0	0	1	0	0	0	1
Comments, website (2)	2	0	2	0	1	0	0	0	2	0	2	0	0
Comments, media (1)	0	0	0	0	0	0	0	0	0	0	1	0	0
Photo, video materials (2)	2	0	2	0	0	1	2	2	2	1	2	1	1
Online payment (1)	0	0	0	0	0	0	0	0	1	0	0	0	0

Table 4 Evaluation of services and prices (points, total 15 max)

	Lumenis	Esthetic Cosmetology	Proper Cosmetology	Continent	Feskov Clinic	Oxford Medical	Stylus Studio	Institute Hyalual	Lazer House	Nucu Cosmetic	Kharkiv City Cosmetology	Gold Clinic	ARLI
Services breadth (2)	0	0	1	2	2	1	0	0	0	1	2	2	1
Prices level (2)	0	1	0	0	1	1	1	1	0	1	2	2	0
Working time (2)	2	0	1	0	0	1	1	2	2	2	1	0	0
Work on weekends (1)	1	0	1	0	0	0	1	1	1	0	0	0	0
Additional services (2)	2	0	1	1	0	0	0	0	0	0	0	1	0
Information about services (2)	1	0	2	1	1	1	2	2	2	1	2	2	1
Location (2)	2	2	2	2	1	2	2	0	2	2	0	0	0
Transport accessibility (2)	2	2	2	2	2	2	1	0	2	2	0	0	1

Table 5 Evaluation of personnel and equipment (points, total 11 max)

	Lumenis	Esthetic Cosmetology	Proper Cosmetology	Continent	Feskov Clinic	Oxford Medical	Stylus Studio	Institute Hyalual	Lazer House	Nucu Cosmetic	Kharkiv City Cosmetology	Gold Clinic	ARLI
Premises (2)	1	0	2	2	2	1	1	0	1	1	0	0	0
Specialists number of (2)	1	0	1	1	1	2	0	1	2	2	2	2	0
Personnel qualification (2)	0	2	2	1	1	1	2	1	2	2	2	1	1
Equipment level (2)	2	0	2	1	0	0	2	0	2	2	1	1	1
Work term at the market (2)	2	2	1	2	0	2	2	1	0	1	2	0	0
Exclusive services (1)	0	0	1	1	0	0	0	1	0	0	0	1	1

4. Development of the fitness centers comparing model in FuzzyTech program

We propose to develop a model based on decision making with the application of the fluffy sets in order to further evaluate cosmetological institutions. For computer implementation was chosen a specialized software Fuzzy Tech. The general theoretical and methodological foundations for constructing similar models are presented in sufficient detail. According to the above justifications and numerical data, the input variables of the model are three generalized parameters,

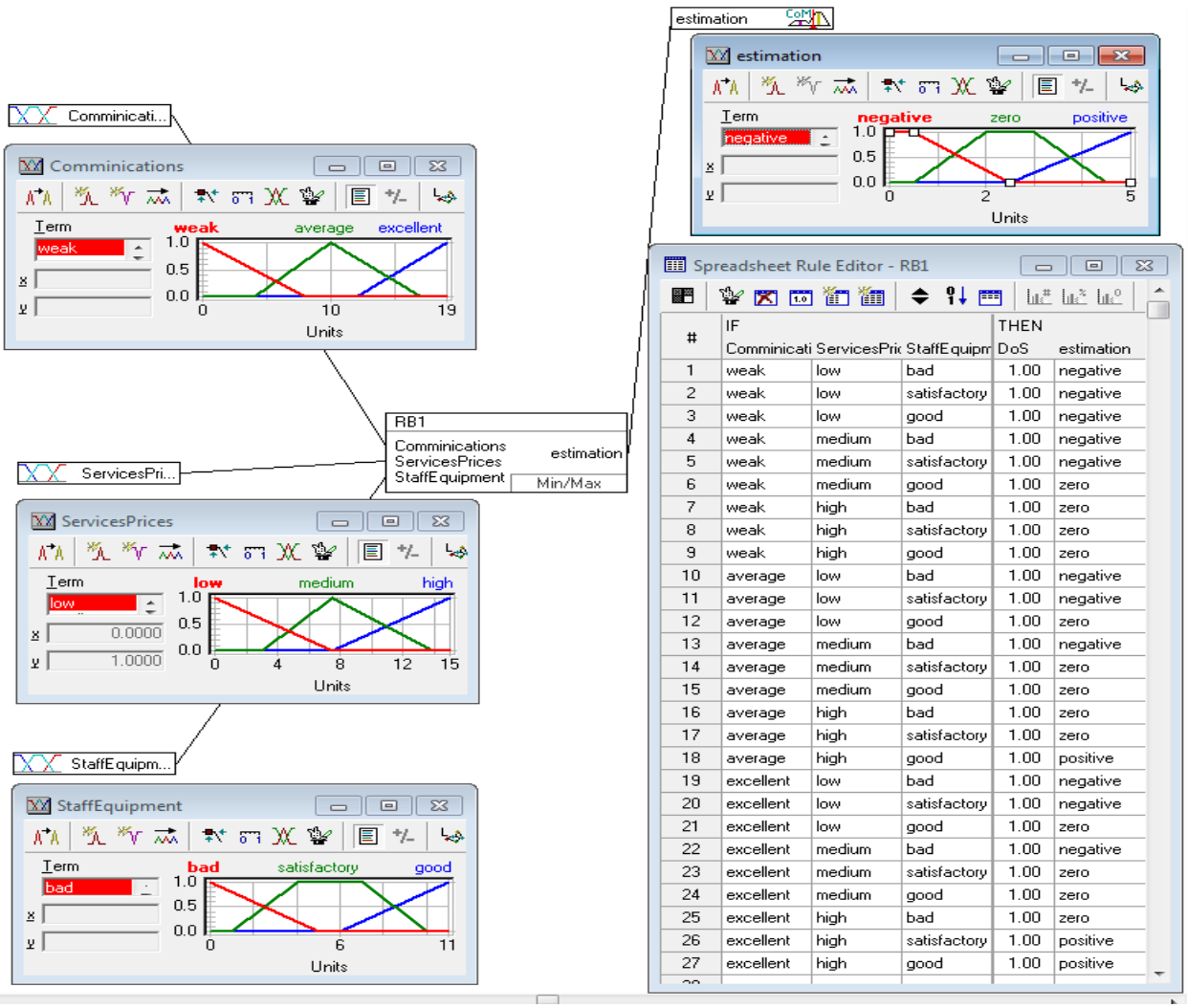
namely: *Communications* (the sum of the assessment for individual sub-criteria may range from 0 to 19 points; their verbal estimates - weak, average, excellent), *Services Prices* (range from 0 to 15 points; their verbal estimates - low, medium, high), *Staff Equipment* (range from 0 to 11 points; their verbal estimates – bad, satisfactory, good).

According to the requirements of the chosen computer algorithm for constructing the model, we will represent each of the parameters (that is, the evaluation criteria) in the form of a so-called linguistic variable with three terms. They can be represented graphically by the corresponding piecewise-linear membership functions.

Similarly, the output parameter (the resulting estimate) will be obtained on a five-point scale: *Estimation* (range from 0 to 5 points; their verbal estimates – negative, zero, positive). Specific numerical parameters for constructing the input and output membership functions described above are presented in Table 6. The general view of the model as a whole (with open windows, where the above membership functions are depicted) is shown in Figure 1.

Table 6 Numerical values for the membership functions of input and output variables

Variable	Term	level 0	Increase from 0 to 1	level 1	Decreasefrom 1 to 0	level 0
Comminications (0-19) points	Weak	-	-	-	0 - 8	8 – 19
	Average	0 - 4	4 - 10	10	10 - 17	17 – 19
	Excellent	0 - 12	12 - 19	19	-	-
ServicesPrices (0-15) points	Low	-	-	-	0 - 7	7 -15
	Medium	0 - 3	3 - 8	8	8 - 14	14 –15
	High	0 - 8	8-15	15	-	-
StaffEquipment (0-11) points	Bad	-	-	-	0 - 5	5 – 11
	Satisfactory	0 - 4	1 - 4	4 - 7	7 - 10	10 – 11
	Good	0 - 6	6 - 11	11	-	-
Estimation (0-5)points	Negative	-	-	0 - 0.5	0.5 - 2.5	2.5 – 5
	Zero	0 - 0.5	0.5 - 2	2 - 3	3 - 4.5	4.4 – 5
	Positive	0 - 2.5	2.5 - 5	5	-	-

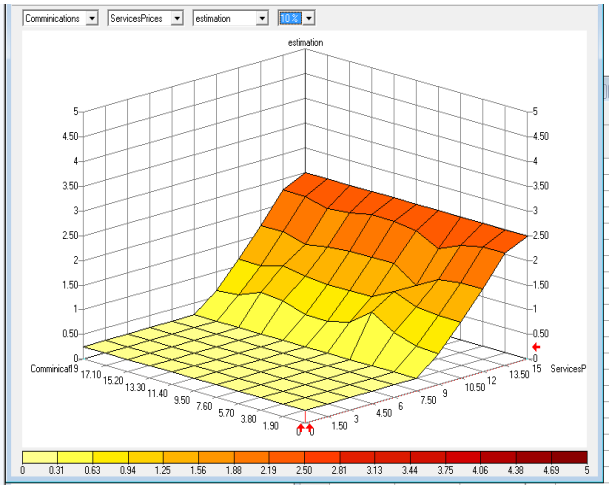


In addition to the input variables (represented by the membership functions), the model contains a set of decision rules (estimations). It is a complete search of variants of combinations of all possible linguistic values (terms) and a corresponding conclusion on the evaluation (ie one of the terms of the output variable). In our case, there are 27 such rules. The applied software product provides many different settings and presentation forms for the model built. One of the most interesting and useful for further analysis is the possibility of obtaining so-called fuzzy inference surfaces [20]. They are two-dimensional graphic images reflecting the dependence of the final result (final evaluation) on any pairs of two input parameters (variables) of the model. These surfaces clearly depict the dependence of the results on the input data. It is possible to establish areas of strong influence of a sharp change in an individual input parameter on a generalized estimate. Such surfaces for our model are shown in Figure 2 (pairs of input variables: on the left - *Communications* and *ServicesPrices*, in the center - *Communications* and *StaffEquipment*, on the right - *ServicesPrices* and *StaffEquipment*).

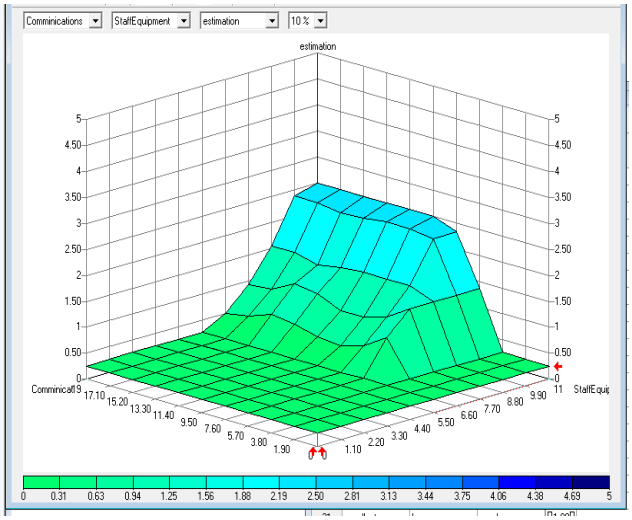
5. Model application for the assessment of Kharkiv cosmetic centers

The model was developed for calculating the integrated assessment on the basis of the criteria defined below for cosmetic institutions in the city of Kharkov and divided into three principal groups. An example of input of initial data and obtaining the result (calculated for the center for laser cosmetology and laser hair removal *Stylus Studio*) is shown in Figure 3. The input data can be entered either from the keyboard (in the numeric input field) or from the slider value control at the bottom of the window. There is also a set of buttons for activating various additional service capabilities of the software itself (FuzzySystem program

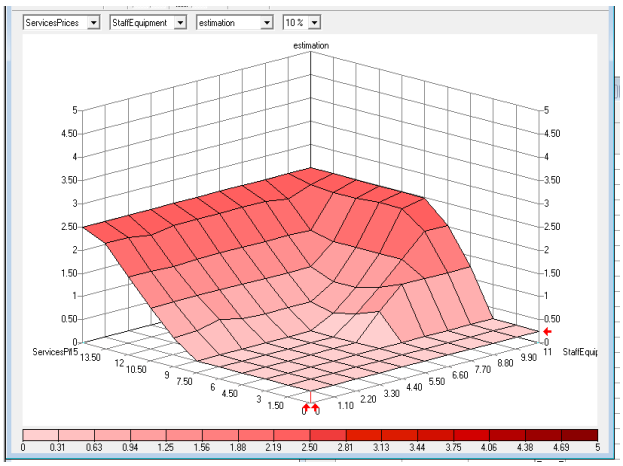
The obtained numerical results of calculations (generalizing scores in points on a five-point system) for all the cosmetological institutions selected for consideration are given in Table 7.



(a) Pairs of input variables



(b) Communications and Service Prices



(c) Communications and StaffEquipment

Figure 2. Obtained fuzzy inference surfaces for generalized cosmetology institutions estimation

Table 7 Calculated generalized assessments for Kharkiv cosmetic centers

Name	Scores
Proper Cosmetology	3,6
Lumenis	3,4
Lazer House	3,1
Nucu Cosmetic	2,8
Stylus Studio	2,7
Oxford Medical	2,3
Kharkiv City Cosmetology Hospital	2,3
Feskov Clinic	2,1
Institute Hyalual	2,0
Gold Clinic	2,0
Continent	1,7
Esthetic Cosmetology	0,3
ARLI	0,3

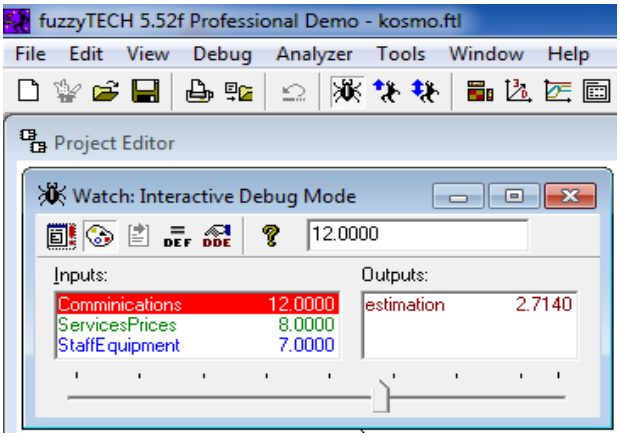


Figure 3 View of input window and output of the result (data for *Stylus Studio*)

The table shows the distribution to four main groups: leaders in the market of cosmetology services (green color grades), close to the leaders (yellow), middle (orange) and explicit outsiders (red).

It should be noted that not high (at first glance) assessments of leaders are due to the fact that even for them there are certain significant drawbacks from the point of view of the visitor, patient, client (high prices, insufficient comprehensive list of services, lack of communication with consumers). At the same time, no one is using new, modern marketing communications capabilities (for example, QR codes for mobile devices, special versions of smartphone websites, electronic payment through bank cards).

A common drawback is also a weak reflection of customer feedback. In particular, the reviews give the impression of artificial, false, irrelevant, do not inspire confidence because of the lack of specifics, time-binding and the like.

Conclusions

The model presented can be used both to compare the cosmetic institutions that exist in the cosmetology services industry and to self-analyze the function of a different cosmetic institution. It allows to identify the strengths and weaknesses of your and competitors, determine which improvements in the individual components of service, marketing communications, the quality of the services themselves are necessary. Corresponding actions to address the identified shortcomings may lead to an increase in the assessment of the institution by the public, patients, visitors, potential clients.

Monitoring of the current level of the generalized assessment of the functioning and marketing interaction with the clients of the cosmetology company with the help of the developed model can be carried out more quickly, with less time spent at acceptable accuracy (both market experts and top managers of cosmetic institutions).

It is clear that the model can be significantly improved and refined due to the concretization and expert-analytical justification of the type and parameters of the functions of linguistic terms, as well as the correction of the rules for accepting fuzzy inference and their relative importance. Also, depending on the situation (set research objectives), individual criteria for evaluation can be adjusted (supplemented, limited or rearranged).

Moreover, the proposed approach as a whole (and the model itself, with its appropriate adjustment) are quite generalized. Therefore, they can be successfully used for a wide range of tasks of multi-criteria evaluation of the level of service, service, marketing components in the provision of various services by the relevant enterprises (and institutions) to the population. Such institutions include, in particular, pharmacies, medical institutions (in the context of the introduction of insurance medicine), other enterprises providing various servicing, domestic and commercial services.

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