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DETERMINATION OF COMPETITIVE POSITIONS IN MARKETING ACTIVITIES OF RESTAURANT BUSINESS ENTERPRISES BY MEANS OF MATHEMATICAL MODELLING

ABSTRACT

The article proposes a solution to the scientific task, which consists of determining the competitive positions of restaurant business enterprises using mathematical modelling. The importance of its use for evaluating the competitiveness of restaurant business enterprises is emphasized, which provides the possibility and feasibility of carrying out a number of changes related to the reorientation of the enterprise to strategic advantages. The purpose of the work is to justify and improve methodological approaches for determining competitive advantages and marketing strategies of restaurant business enterprises by means of mathematical modelling. In order to visualize the obtained results, a model for assessing the level of use of the company's competitive potential was built using a mathematical apparatus of fuzzy logic. The developed model focuses not only on satisfying the needs and interests of consumers but also helps to form the demand for the products and services they need, taking into account the factors that influence their decision-making. The analysis and formation of the system of competitive advantages of restaurant enterprises are based on the indicators of competitiveness given in the study and the graphical presentation of the obtained models based on data sets of these indicators. The Analytical Hierarchy Process (AHP) method was used to perform a relative assessment of competitiveness, which allows to build a multi-parameter hierarchical model that reflects the level of competition of restaurants and makes it possible to calculate the fuzzy value of the integral level of competition. It is proposed to use the apparatus of game theory to choose alternative marketing strategies for increasing the competitiveness of restaurants. The results of the study indicate the need for constant adaptation of enterprises and flexibility to respond to the changing global circumstances of the business environment.

Keywords: competitiveness, restaurant business, competitive advantages, mathematical modelling, game theory, hierarchy analysis method, marketing strategy, market

JEL Classification: L10, M31

INTRODUCTION

In today's conditions, any company must assess its competitive position in order to effectively manage its business and determine its future prospects. Having received information about their competitive position, companies can determine their advantages and develop competitive marketing strategies that correspond to the realities of modern market processes. Today, success in competitive markets depends on providing high-quality services that lead to higher levels of customer satisfaction. Therefore, the assessment of the external and internal environment of the enterprise, and its competitive position is the best reflection of the restaurant's future profit. In order to remain competitive in the service sector market, enterprises need to use innovative approaches in their activities, based on constant analysis of the economic environment and forecasting of its possible changes. In this aspect, the study and application of scientific-methodical and practical approaches to increase the competitiveness of restaurant business enterprises by means of mathematical modelling is of particular relevance.

LITERATURE REVIEW

The theoretical analysis of scientific literature made it possible to establish the relevance of the studied phenomenon. Scientists emphasize that competitive advantage is what manifests itself in the process of interaction and struggle with other subjects on the market, recognition of the highest consumer value of the product and obtaining the greatest profit.

A discursive view of market categorization is given in the work of scientists Grodal, & Kahl, (2017), in which categories constructed by means of communicative exchange are distinguished. The discursive perspective points to three understudied mechanisms of category evolution: (1) interaction between market participants, (2) power dynamics between market participants and within discourse, and (3) cultural and material context. In the market environment, there is always competition between business entities. Competitive advantage is a unifying factor. If the risk is reasonably correlated with future competitive advantage, the market demands the ability to take risks (Goncharova et al., 2012; Aiyedogbon et al., 2022).

The study researchers Yujie Tang & Thoo Ai Chin (2024) underscore the importance of adaptability, alignment, and agility in gaining a competitive edge. Tanwar (2013) emphasizes that the competitiveness of any enterprise consists of several partial competitive advantages. The level of competitiveness of the enterprise is determined by the results of its competitive advantages according to all economic indicators (profitability, operational efficiency, etc.); the subject's competitiveness is characterized as the possibility of creating a new product category and effective activity on the market to achieve competitive advantages.

The theory of competitive advantages assumes that each subject of competition has an individual set of competitive advantages, such as business productivity, production and marketing skills, consumer value of goods, and management, including the achieved level of adaptation to external business conditions. Modern market conditions require changes in the formation of competitive positions by firms. The formed competitive advantage is imperative to ensure the value of the enterprise (Matti, 2020). Authors Cao, et al., (2022) highlight the innovative nature of companies' activities and the balance of interests of all links of the goods delivery system, which functions in a certain effective mode, as sources of competitive advantages.

Quantitative methods of assessing competitive advantages are gaining practical importance, and modelling has a special place among them. The essence of mathematical modelling is the selection of mathematical schemes (models) that adequately describe processes. The results of the previous study are presented in works (Stebliuk et al., 2022), where scenario modelling is proposed for the formation of strategic positions of the enterprise in the conditions of innovation and marketing orientation, which is necessary for increasing its competitive status. The expediency of using the apparatus of fuzzy sets in solving various tasks related to the selection of strategies for the development of companies in the conditions of the instability of the market environment is substantiated (Volosova, Stebliuk, 2016; Zhuravka, et al., 2023).

An interesting point of view in solving the above-mentioned problems is expressed by (Gutt, et al., 2019; Shkolnyk, et al.,2019), who, based on empirical estimates, demonstrate that an increase in the overall competition, which is measured as the total number of enterprises on the market, leads to a widening of the range and a decrease in the average distribution of ratings on market. This means that a larger market has proportionally lower-rated restaurants, while higher-rated restaurants have relatively fewer comparable substitutes and face less competition in that market.

Scientists Zhang et al., (2022) in their work study the motives of restaurants that receive positive fake reviews from the point of view of competition. The results show that more positive fake reviews from competitors can motivate a restaurant more to solicit positive fake reviews, while a market advantage over competitors (based on the valence of reviews) significantly reduces a restaurant's motivation to solicit positive fake reviews.

The successful development of an enterprise in a competitive environment is based on the presence of market demand for its products. Lu, MY and Shin (2017) examined the role of marketing communications in shaping the recognition of consumer needs and, therefore, market demand for a new product. In particular, marketing communication is modelled as a two-way process, which includes costly efforts of both firms and consumers to transfer and assimilate a new product concept. In addition, it encourages the competing firm to exert more effort, especially when the role of consumers becomes more important. Sharing innovations with a competitor serves as a mechanism that stimulates additional efforts in the process of two-way communication (Sharma, G.D. et al., 2023), (Cao, A. et al., 2022). Despite the theoretical achievements and practical results of research, there are a number of aspects of the management system of the competitiveness of public catering enterprises that require further improvement taking into account modern requirements.

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AIMS AND OBJECTIVES

The purpose of the work is to justify and improve methodological approaches for determining competitive advantages and marketing strategies of restaurant business enterprises by means of mathematical modelling. The following research stages are given:

1. Justification of the use of the mathematical apparatus of the theory of system constraints (TSC) of Eliyahu Goldratt and the theory of fuzzy sets for assessing the competitiveness of restaurant business enterprises. Determining the limitations of companies by indicators of competitiveness and decisions regarding their use.
2. The Analytical Hierarchy Process (AHP) method was used, which allows you to build a multi-parameter hierarchical model that reflects the level of competition of restaurants and makes it possible to calculate the fuzzy value of the integral level of competition.
3. Determination of the strategy of increasing competitiveness using game theory approaches.

METHODS

The work uses the methods of system analysis, systematization, generalization and specification, mathematical apparatus of fuzzy logic, expert methods, Analytical Hierarchy Process (AHP), methods of game theory, graphic method.

In order to solve management problems, which in most cases are solved under conditions of uncertainty, as well as with limited resources, incomplete information, and a lack of time, the work proposes to apply the approaches of the theory of system constraints and the tools of the theory of fuzzy sets. The mathematical apparatus of these theories makes it possible to perform a mathematical statement of the problem, to form and implement its economic-mathematical model, and in the cases of problems containing the investigated values, which are described not only by quantitative but also by linguistic characteristics.

The algorithm of practical application of TOS is formed in the form of a cycle containing the following stages:

1. Analysis of the state and determination of the limitations of the system, and its weak component.
2. Decisions on how to exploit this limitation.
3. Subordination of all processes to the adopted decision.
4. Elimination of the identified limitation, and expansion of its possibilities.

The values of the studied indicators are mostly dimensionless and subjective since they are determined by the results of a survey or by the method of expert assessments, that is, we have real conditions of uncertainty, where poorly structured and unstructured problems arise. To perform a relative assessment of competitiveness, we will use the Analytical Hierarchy Process (AHP) method, which allows you to build a multi-parameter hierarchical model, determine the pairwise relationship between indicators and evaluate the consistency of the results at all levels of the model.

The main principle of this method is to break down the elements that determine the essence of a specific problem into simple components and further process judgments using pairwise comparisons. As a result, it is possible to determine the relative degree of interaction between elements in the hierarchy and to sum up all specific scores. MAI includes procedures for integrating several statements, prioritizing criteria and finding alternative solutions. Relationships between criteria are determined by constructing a hierarchy of criteria and using pairwise comparisons to determine the importance of criteria and sub-criteria. The structure of the method is as follows: at the first level of the hierarchy, the impact of criteria - indicators of competitiveness on the common goal is studied, at the second level, the impact of alternatives on the criteria is studied, and at the third level, the impact of alternatives on the common goal is evaluated.

The development of recommendations for choosing the optimal competitive strategies of the conflicting parties is based on methodological approaches of game theory (Maschler et al., 2020).

RESULTS

Competition is the driving force of business. It is in the competition between the strongest for customers and their demand that the coolest offers are born. But before starting a fight, you should study your opponents in detail. A deep understanding of the market and all its participants is the basis for every effective business owner (Ferreira et al., 2021). A strong competitive business model is formed based on his understanding.

The following groups for analysis:

1. General information about the company: year of establishment, geography of activity, trademark, number of branches, number of employees, form of ownership, work schedule, reputation.
2. Product: quality, product parameters, assortment, certification, packaging, secondary use or disposal, service life, design, related goods/services, delivery, individual consultant, information support, possibility of return, after-sales service, guarantees.
3. Pricing policy: product cost, form of payment, currency of payment, deferred payment, crediting, loyalty program.
4. Internet resources: website, online store, pages in social networks.

In the course of the research, the information obtained during the analysis of competitors becomes important, the analysis of whose activities will enable the company to develop a set of decisions regarding the improvement of its activities.

The main problems faced by the studied company "Sushi Wok" at the current stage are the threat of losing customers due to the inadequacy of the marketing mix to the needs and demands of the target segment, as well as a decrease in profitability due to the unfavourable economic situation in the country.

After analyzing secondary information, the most dangerous competitors of the restaurant "Sushi Wok" were chosen: sushi restaurants «MaYamy», «Murakami». Principles of choosing competitors: stage of economic development; geographic diversification; growth prospect.

The biggest threat to the activity of the Sushi Wok establishment is the establishment of the «MaYamy» chain, as they offer consumers a wide menu, which includes a children's menu and business lunches, discounts, and «happy hours». The company also tries to cover all segments at once, which is why, when building a sales promotion strategy, it offers promotions and offers that affect each market segment and provide the company with maximum efficiency in attracting customers. The company «Murakami» also has a strong position in the market, has been working for a long time and is constantly expanding its network. In addition, it has a wide range of loyal customers who prefer it over other restaurants.

Stage 1. A mathematical model of its solution using the theory of fuzzy sets is proposed. In the process of research, a decision is made to determine practical approaches to the maximum use of the limitation, and conflict within the system to overcome it.

The results of determining the competitiveness of restaurants according to the investigated indicators are given in Table 1.

Table 1. Calculation of the integrated assessment of competitiveness.

Indicators and corresponding coefficients of significance	«Sushi Wok»	«MaYamy»	«Murakami»
k1	4	5	5
v1=0,8			
k2	3	5	4
v2=0,6			
k3	5	4	4
v3=0,7			
k4	5	4	2
v4=0,7			
k5	5	5	5
v5=0,9			
k6	5	4	5
v6=0,7			
Integrated assessment of competitiveness	20.0	19.9	18.6

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The integrated assessment of competitiveness is calculated according to the formula:

$$K = \sum_{i=1}^{n} k_i v_i,\ i = \overline{1,n} \quad (1)$$

where k_i – indicators of competitiveness; v_i – significance coefficients of competitiveness indicators.

The conducted analysis made it possible to determine the following indicators for assessing competitiveness:

- k1 – width/depth of assortment – consumers seek to satisfy their need for food in the most diverse way possible;
- k2 – alternative components of the assortment - consumers want to taste not only Japanese cuisine;
- k3 – coverage of regions – the number of establishments, which increases the probability of visiting it, or the fact that the consumer should not spend more time looking for a restaurant;
- k4 – coverage of the city centre, where the majority of consumers are concentrated;
- k5 – product quality;
- k6 – quality of customer service.

Each of these indicators was evaluated on a five-point scale, and the coefficients of significance for indicators of competitiveness were determined by the method of expert evaluations; the agreement of the assessments of two experts was assessed using the linear correlation coefficient r=0,897, and the agreement of the experts' assessments according to the Student's distribution is significant with a probability of p=0,95).

The results of determining the competitiveness of companies based on the investigated indicators are shown in Tables 2 and 3.

Table 2. Evaluation of competitors by key success criteria.

Evaluation criterion	MaYamy	Murakami	Sushi Wok
Key properties product	4	4	4
Technology level	5	4	5
Quality of service	4	3	4
Special proposals	4	4	4
Points of cooperation with the audience	3	4	4
Sales channels	3	3	4
Customer interaction network	4	4	4
Market size	5	4	4
Product price	4	3	4
Total	36	33	37

Table 3. Competitive position and level of relative competitiveness of the company in the overall assessment of competitiveness.

The company name	Position	The level of relative competitiveness	The level of relative competitiveness (%)
Sushi Wok	1	0.342	34
MaYamy	2	0.340	34
Murakami	3	0.318	32

The graphic presentation of the obtained models based on arrays of data indicators is shown in Figure 1.

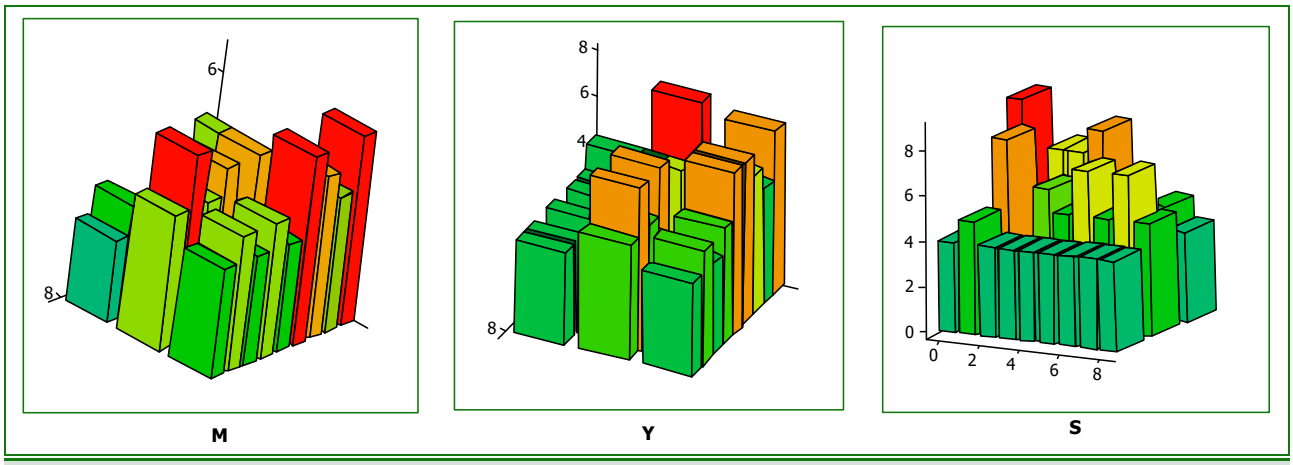

Figure 1. Graphical interpretation of competitiveness assessment models. Note: (M – company «Murakami», Y – «MaYamy», S – «Sushi Wok».

Table 4 shows the limitations identified during the research for each company.

Table 4. Determining the limitations of companies by indicators of competitiveness and decisions about their use.

The company name	Limitation	Decisions about its use
«Sushi Wok»	Alternative components of the assortment	Expanding the range of products. Creation of the most rational, diverse and optimal package of goods and services in relation to customers, competitors and the organization's own mission
«MaYamy»	Quality of customer service	Improving the quality of service. Build personalized communication with potential and existing customers using various channels, in particular, using SMS messages using Big Data
«Murakami»	Covering the city center	Expansion of the network in the city center

The formation of the assortment is preceded by the development of the optimal assortment structure of the product offer. Therefore, it is necessary to increase the range of provided services, use new technologies, build personalized communication with potential and existing clients (Figure 2).

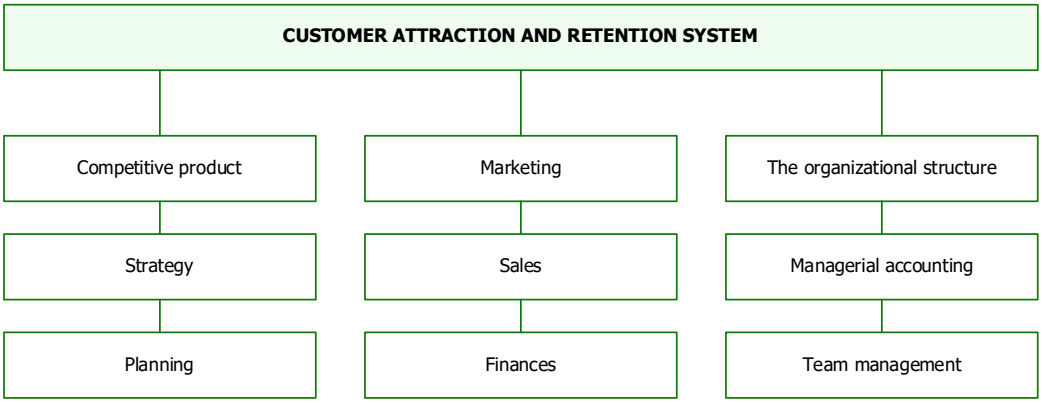

Figure 2. The main components of the customer attraction and retention system.

Stage 2. To perform a relative assessment of competitiveness, we will use the Analytical Hierarchy Process (AHP) method, which allows you to build a multi-parameter hierarchical model and evaluate the consistency of the results at all levels of the model.

We start solving the task by building a hierarchical structure that contains the purpose, indicators and alternatives (Figure 3). The top of the dominant hierarchical model is the goal — assessment of competitiveness (first level). The second level of the obtained hierarchy is formed by six indicators, according to which the assessment of competitiveness was

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performed, which clarifies the goal. At the last level, there are two alternatives: Sushi Wok, Murakami restaurants, which are evaluated according to the criteria of the second level indicators.

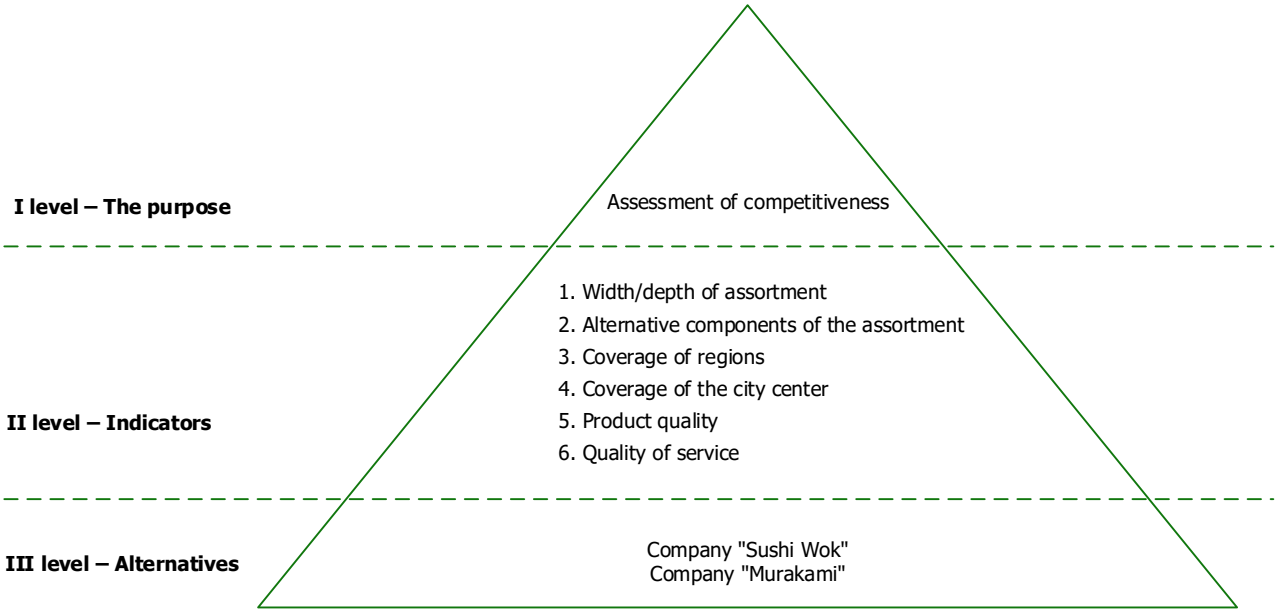

Figure 3. Algorithm levels of the method of analysis of hierarchies.

I step. We choose the investigated objects (alternatives) for the comparison of indicators - restaurants "Sushi Wok" and "Murakami".

II step. Selection of indicators (criteria) for comparison, in this case it is *k1, k2, k3, k4, k5, k6.*

III step. To establish the relative importance of the elements of the hierarchy - indicators k1, k2, k3, k4, k5, k6, we use a quantitative scale of value intensity: 1 - equal importance; 3 – moderate advantage; 5 – significant advantage; 7 – significant advantage; 9 – a strong advantage; 2, 4, 6, 8 are intermediate values.

IV step. We build a matrix of the first level of the hierarchy - the results of a pairwise comparison of the corresponding indicators according to the specified intensity scale - the row and column numbers correspond to a certain indicator:

$$M1 := \begin{pmatrix} 1 & 3 & 4 & 5 & \frac{1}{7} & \frac{1}{6} \\ \frac{1}{3} & 1 & 3 & 2 & \frac{1}{5} & \frac{1}{3} \\ \frac{1}{4} & \frac{1}{3} & 1 & \frac{1}{3} & \frac{1}{5} & \frac{1}{3} \\ \frac{1}{5} & \frac{1}{2} & 3 & 1 & \frac{1}{6} & \frac{1}{3} \\ 7 & 5 & 5 & 6 & 1 & 3 \\ 6 & 3 & 3 & 3 & \frac{1}{3} & 1 \end{pmatrix}$$

V step. We calculate the components of the eigenvector for each row of the matrix using the formula of the geometric mean value

$$v_i = \sqrt[n]{P_{j=1}^{n} k_{ij}, i, j = \overline{1,6}} \quad (2)$$

that is, we determine the value of the root of the sixth order from the product of the values of the corresponding row:

$$v_1 = \sqrt[6]{1 \cdot 3 \cdot 4 \cdot 5 \cdot \frac{1}{7} \cdot \frac{1}{6}} = 1{,}061;\ v_2 = \sqrt[6]{\frac{1}{3} \cdot 1 \cdot 3 \cdot 2 \cdot \frac{1}{5} \cdot \frac{1}{3}} = 0{,}715;\ v_3 = \sqrt[6]{\frac{1}{4} \cdot \frac{1}{3} \cdot 1 \cdot \frac{1}{3} \cdot \frac{1}{5} \cdot \frac{1}{3}} = 0{,}35$$

$v_4 = \sqrt[6]{\frac{1}{5} \cdot \frac{1}{2} \cdot 3 \cdot 1 \cdot \frac{1}{6} \cdot \frac{1}{3}} = 0{,}505$; $v_5 = \sqrt[6]{7 \cdot 5 \cdot 5 \cdot 6 \cdot 1 \cdot 3} = 3{,}829$; $v_6 = \sqrt[6]{6 \cdot 3 \cdot 3 \cdot 3 \cdot \frac{1}{3} \cdot 1} = 1{,}944$.

We get eigenvector *v (1,061; 0,715; 0,35; 0,505; 3,829; 1,944).*

The sum of the components of the eigenvector will be considered as its absolute value

$$V = \sum_{i=1}^{n} v_i, \quad i = \overline{1, 6}$$

$V = 1{,}061 + 0{,}715 + 0{,}35 + 0{,}505 + 3{,}829 + 1{,}944 = 8{,}405$.

VI step. We calculate the components of the priority vector by normalizing the eigenvector by dividing each component of the eigenvector by its absolute value:

$$vp_i = \frac{v_i}{V}, \quad i = \overline{1, 6}$$

As a result, we get the components of the priority vector:

$vp_1 = \frac{v_1}{V} = 0{,}126$; $vp_2 = \frac{v_2}{V} = 0{,}085$; $vp_3 = \frac{v_3}{V} = 0{,}042$; $vp_4 = \frac{v_4}{V} = 0{,}06$; $vp_5 = \frac{v_5}{V} = 0{,}456$; $vp_6 = \frac{v_6}{V} = 0{,}231$.

Vector of priorities *VP (0,126; 0,085; 0,042; 0,06; 0,456; 0,231).*

VII step. We build a matrix of the second level for calculating the index of agreement of local priorities by adding to the matrix of the first level a column of the components of the vector of priorities

$$M2 := \begin{pmatrix} 1 & 3 & 4 & 5 & \frac{1}{7} & \frac{1}{6} & 0.126 \\ \frac{1}{3} & 1 & 3 & 2 & \frac{1}{5} & \frac{1}{3} & 0.085 \\ \frac{1}{4} & \frac{1}{3} & 1 & \frac{1}{3} & \frac{1}{5} & \frac{1}{3} & 0.042 \\ \frac{1}{5} & \frac{1}{2} & 3 & 1 & \frac{1}{6} & \frac{1}{3} & 0.06 \\ 7 & 5 & 5 & 6 & 1 & 3 & 0.456 \\ 6 & 3 & 3 & 3 & \frac{1}{3} & 1 & 0.231 \end{pmatrix}$$

To build a matrix column of judgments to calculate its components, we add the elements of each column of the matrix and multiply by the corresponding component of the priority vector:

$$\lambda_j = \left(\sum_{i=1}^{n} k_{ij} \right) \cdot vp_j, \quad i, j = \overline{1, 6}$$

$\lambda_1 = \left(1 + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + 7 + 6\right) \cdot 0{,}126 = 1{,}863$; $\lambda_2 = \left(3 + 1 + \frac{1}{3} + \frac{1}{2} + 5 + 3\right) \cdot 0{,}085 = 1{,}091$; $\lambda_3 = (4 + 3 + 1 + 3 + 5 + 3) \cdot 0{,}042 = 0{,}798$; $\lambda_4 = \left(5 + 2 + \frac{1}{3} + 1 + 6 + 3\right) \cdot 0{,}06 = 1{,}04$; $\lambda_5 = \left(\frac{1}{7} + \frac{1}{5} + \frac{1}{5} + \frac{1}{6} + 1 + \frac{1}{3}\right) \cdot 0{,}456 = 0{,}932$; $\lambda_6 = \left(\frac{1}{6} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + 3 + 1\right) \cdot 0{,}231 = 1{,}194$.

We get a matrix column of judgments:

$$\lambda = \begin{pmatrix} 1{,}863 \\ 1{,}091 \\ 0{,}798 \\ 1{,}04 \\ 0{,}932 \\ 1{,}194 \end{pmatrix}$$

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We define the maximum value of the judgment matrix as the sum of the components of this column:

$\lambda \sum_{j=1}^{n} \lambda_j,\ j = \overline{1,6}_{max}$.

So, we have λ_{max}

The index of agreement of local priorities (IP) is calculated according to the formula:

$IP = \frac{\lambda_{max}}{n-1}$,

where n is the number of compared indicators (6 in this study).

Thus, as a result of the calculations, we get the index value: IP=0,183.

VIII step. We perform a pairwise comparison for each indicator on the intensity scale to build a matrix of the third level according to the above algorithm.

Indicator *k1* – width/depth of the assortment.

$$M_{31} = \begin{pmatrix} 1 & 3 \\ \frac{1}{3} & 3 \end{pmatrix}$$

The eigenvector has components: $v_{31} = \sqrt{1+3} = 2$; $v_{32} = \sqrt{\frac{1}{3}+1} = 1{,}155$.

The sum of the components of the eigenvector: $V_3 = v_{31} + v_{32} = 3{,}155$.

We normalize this vector and get the components of the priority vector:

$vp_{31} = \frac{v_{31}}{V_3} = 0{,}634$; $vp_{32} = \frac{v_{32}}{V_3} = 0{,}366$.

Values of the components of the matrix column of judgments: $\lambda 3_1 = \left(1 + \frac{1}{3}\right) \cdot 0{,}634 = 0{,}845$; $\lambda 3_2 = (3+1) \cdot 0{,}366 = 1{,}464$.

We get a matrix-column of judgments: $\lambda 3 = \begin{pmatrix} 0{,}845 \\ 1{,}464 \end{pmatrix}$.

We define the maximum value of the judgment matrix as the sum of the components of this column: $\lambda 3_{max}$.

The index of agreement of local priorities (IP1):

$IP = \frac{2{,}309-2}{1} = 0{,}309$.

Next, we similarly perform pairwise comparisons for other indicators. The results of the calculations and the obtained values of the components of the priority vectors, the maximum values of the judgment matrices and the indices of agreement of local priorities for each indicator are summarized in Table 5.

Table 5. Results of pairwise comparison for the third level.

Restaurant	Matrix	Components of the priority vector	The maximum value of the judgment matrix	The index of agreement of local priorities
k1– width/depth of assortment				
Murakami	$\begin{pmatrix} 1 & 3 \\ 1/3 & 1 \end{pmatrix}$	0.634	2.309	0.309
Sushi Wok		0.366		
k2 – alternative components of the assortment				
Murakami	$\begin{pmatrix} 1 & 4 \\ 1/4 & 1 \end{pmatrix}$	0. 667	2.499	0.499
Sushi Wok		0.333		
k3 – coverage of regions				
Murakami	$\begin{pmatrix} 1 & 1/3 \\ 3 & 1 \end{pmatrix}$	0. 366	2.121	0.121
Sushi Wok		0.634		
k4 – coverage of the city centre				
Murakami	$\begin{pmatrix} 1 & 1/5 \\ 5 & 1 \end{pmatrix}$	0. 309	2.683	0.683
Sushi Wok		0.691		
k5 – product quality				
Murakami	$\begin{pmatrix} 1 & 1/2 \\ 2 & 1 \end{pmatrix}$	0. 414	2.121	0.121
Sushi Wok		0.586		
k6 – quality of service				
Murakami	$\begin{pmatrix} 1 & 2 \\ 1/2 & 1 \end{pmatrix}$	0. 586	2.121	0.121
Sushi Wok		0,414		

IX step. We summarize the results using the principle of synthesis. We determine the sum of products of the components of the priority vector for the restaurant by the components of the priority vector for the indicators, having previously summarized their values in Table 6.

Table 6. Results of pairwise evaluation of indicators.

	k1	k2	k3	k4	k5	k6	Generalized result
	0.126	0.085	0.042	0.06	0.456	0.231	
Murakami	0.634	0. 667	0.366	0.309	0.414	0.586	0.49
Sushi Wok	0.366	0.333	0.634	0.691	0.586	0.414	0.51

Thus, a comparison of the competitiveness indicators of restaurants "Sushi Wok" and "Murakami" favours the restaurant "Sushi Wok" in the ratio of 0.51:0.49.

All transformations and calculations were performed in the MathCAD system of symbolic mathematics.

Stage 3. Management of the competitive behaviour of a catering enterprise is based on the development and effective implementation of a balanced and justified competitive marketing strategy that provides competitive advantages in the long term. The company needs to adjust its marketing strategy in the market, develop an effective market coverage strategy and improve the assortment policy according to the new target segments in order to increase sales without further loss of financial stability.

We will apply the methods of game theory to determine strategies for increasing the competitiveness of restaurants "Sushi Wok" and "Murakami".

To determine the lower and upper prices of the game, we will make a table of the game according to its matrix:

$$A := \begin{pmatrix} 4 & 3 & 5 & 5 & 5 & 5 \\ 5 & 4 & 4 & 2 & 5 & 5 \end{pmatrix}$$

The lowest price of the game:

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$\alpha = \max_j \min_i a_{ij} = max\{3;\ \ 2\} = 3$

Top game price:

$\beta = \min_i \max_j a_{ij} = min\{5;\ 4;\ 5;\ 5;\ 5;\ 5\} = 4$

So, we have the problem of game theory in mixed strategies and, since $\alpha \neq \beta$, then this problem has no saddle point.

To determine the price of the game V, let's make a system of equations:

- According to B_j indicators (by matrix columns)

$$\begin{cases} 4x_1 + 5x_2 = V \\ 3x_1 + 4x_2 = V \\ 5x_1 + 4x_2 = V, \\ 5x_1 + 2x_2 = V \\ 5x_1 + 5x_2 = V \end{cases}$$

where $x_1 + x_2 = 1$

- By restaurants "Sushi Wok" and "Murakami" (by rows of the matrix):

$$\begin{cases} 4y_1 + 3y_2 + 5y_3 + 5y_4 + 5y_5 + 5y_6 = V \\ 5y_1 + 4y_2 + 4y_3 + 2y_4 + 5y_5 + 5y_6 = V' \end{cases}$$

where $y_1 + y_2 + y_3 + y_4 + y_5 = V$.

If we choose the restaurant "Sushi Wok" with probability x_1=1 (x_2=0), we will get 4; 3; 5; 5; 5; 5. For "Murakami" x_2=1 (x_1=0) we get 5; 4; 4; 2; 5; 5.

Then we have a system of equations from the selected strategies:

$\begin{cases} 3x_1 + 4x_2 = V \\ 5x_1 + 2x_2 = V \end{cases}$ under the condition $x_1 + x_2 = 1$.

Since the right-hand sides of the equations of the system are equal, we equate their left-hand sides:

$3x_1 + 4x_2 = 5x_1 + 2x_2 \quad \Rightarrow \quad 2x_2 = 2x_1 \quad \Rightarrow \quad x_1 = x_2$ under the condition $x_1 + x_2 = 1$.

So, x_1=x_2=0,5.

The price of the game:

$V = 3 \cdot 0{,}5 + 4 \cdot 0{,}5 = 3{,}5$.

We choose the dominant columns - response strategies to B_1 and B_2.

Then we have a system of equations:

$\begin{cases} 3y_2 + 5y_4 = V \\ 4y_2 + 2y_4 = V \end{cases}$ under the condition $y_2 + y_4 = 1$.

Since the right-hand sides of the equations of the system are equal, we equate their left-hand sides:

$$3y_2 + 5y_4 = 4y_2 + 2y_4 \quad \Rightarrow \quad \begin{cases} -y_2 = -3y_4 \\ y_2 + y_4 = 1 \end{cases} \quad \Rightarrow \quad \begin{cases} y_2 = 3y_4 \\ 4y_4 = 1 \end{cases} \Rightarrow \begin{cases} y_2 = \frac{3}{4} \\ y_4 = \frac{1}{4} \end{cases}$$

The price of the game: $V = \frac{9}{4} + \frac{5}{4} = \frac{14}{4} = 3{,}5$

The price of the game in both cases coincided, which confirms the correctness of the calculations.

So, using with equal probabilities 0,5 strategies to increase competitiveness according to the specified indicators, we are guaranteed to get an increase in profits. Among the listed indicators, it is necessary to attract alternative components of the assortment with a probability of 0,75 and to increase the coverage of the city centre, where the majority of consumers are concentrated, with a probability of 0,25. To demonstrate such a strategy, companies face the difficult task of identifying and evaluating their competitive advantages and making decisions regarding further actions to increase competitiveness by maintaining and developing existing and forming new competitive advantages.

DISCUSSION

Theoretical and practical aspects of the competitiveness of restaurant business enterprises are the subject of active scientific discussions by a wide range of scientists. We consider it necessary to pay attention to the presence of various methods of assessing the competitive advantages of enterprises.

Economically correct construction of a mathematical model of the problem and the possibility of further interpretation of the obtained results are important components of the success of the research (Skrynkovskyy et al., 2022). To make managerial decisions in conditions of uncertainty, lack of resources, lack of information and lack of time, the methods of the theory of system constraints (TSO) of Eliyahu Goldratt and the methods of the theory of fuzzy sets should be used. This concept is based on the fact that a system has only one constraint at any given time (Balan, 2020). Focusing on eliminating this limitation can lead to significant breakthroughs in the company's operations. In other words, turns limitations from a source of problems into a source of benefits. In order to win back the market share and increase it, it is necessary to develop the competitiveness of the product, otherwise, the company will lose customers, will lower the price, and will not be able to cover costs. The company's product should be the best choice for the customer today. In addition, it is necessary to ensure omnichannel, in other words, to be represented in several sales channels at once and influence the attraction of the audience in them. To achieve this, it is necessary to be in dialogue with the audience and the market and respond to its request with an up-to-date offer, at the same time study competitors and build a strong competitive product based on multivariate solutions. Competitiveness is determined by the current position of the company, the market demand for its products, the ability to attract financial resources and the level of the management team (Vlasenko et al., 2020; Khanin, et al., 2019). Unforeseen circumstances always arise, which require the evaluation of measures and the introduction of certain adjustments based on the comparison of planned and actual costs in order to further correct the developed competitive strategy. Such adjustments may relate to the long-term direction and nature of business activity, target indicators and the way to achieve them.

So, despite a significant amount of scientific research on assessing the competitiveness of enterprises, there is no universal method. Each modern method has its own shortcomings, which reduce the practical value of research results. The imperfection of individual evaluation methods affects the variety of approaches to the process of researching competitive advantages and the limited possibilities of their application.

CONCLUSIONS

Under the conditions of globalization, expansion of borders, growth of saturation of markets, diversification of activities, strengthening of competition and growing differentiation of customer needs, assessment of competitiveness and determination of marketing strategies becomes one of the most important tasks of enterprises. In view of the entire set of features that accompany the process of preparing and making management decisions in the field of ensuring the competitiveness of the enterprise, the relative assessment of the competitiveness of restaurants by means of the method of analyzing hierarchies and determining the strategy of increasing competitiveness using game theory approaches is carried out in the work. A mathematical model of its solution using the theory of fuzzy sets is proposed. Methods based on this theory allow you to properly formalize the raw data for analytical work. The work defines the limitations of the studied restaurants in terms of competitiveness indicators and decisions regarding their use. Management of the competitive behaviour of a catering enterprise is based on the development and effective implementation of a balanced and justified competitive strategy that provides a competitive advantage in the long term. The competitive strategy of the enterprise allows you to answer the question of how the enterprise competes in the target market, how it withstands competitive pressure and

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wins in the competition. This study has important theoretical and practical significance for understanding and using competitive advantages in the restaurant business and does not exhaust the outlined problem and needs further development.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ВИЗНАЧЕННЯ КОНКУРЕНТНИХ ПОЗИЦІЙ У МАРКЕТИНГОВІЙ ДІЯЛЬНОСТІ ПІДПРИЄМСТВ РЕСТОРАННОГО БІЗНЕСУ ЗАСОБАМИ МАТЕМАТИЧНОГО МОДЕЛЮВАННЯ

У статті запропоноване виконання наукового завдання, яке полягає у визначенні конкурентних позицій підприємств ресторанного бізнесу за допомогою математичного моделювання. Наголошено на важливості його використання для оцінювання конкурентоспроможності підприємств ресторанного бізнесу, що дає можливість та стверджує доцільність проведення низки змін, які стосуються переорієнтації підприємства на стратегічні переваги. Метою роботи є обґрунтування та вдосконалення методичних підходів до визначення конкурентних переваг і маркетингових стратегій підприємств ресторанного бізнесу засобами математичного моделювання. З метою унаочнення одержаних результатів побудовано модель оцінювання рівня використання конкурентного потенціалу підприємства за допомогою математичного апарата нечіткої логіки. Модель, яка не лише фокусується на задоволенні потреб та інтересів споживачів, а й допомагає формувати попит на необхідні їм продукти й послуги, ураховуючи фактори, що впливають на ухвалення ними рішень. В основу аналізу й формування системи конкурентних переваг підприємств ресторанного господарства покладено наведені в дослідженні показники конкурентоспроможності та графічне представлення отриманих моделей за масивами даних цих показників. Для виконання відносного оцінювання конкурентоспроможності використано метод аналізу ієрархій (MAI (Analytical Hierarchy Process (AHP)), який дозволяє побудувати багатопараметричну ієрархічну модель, що відображає рівень конкуренції ресторанів і дає змогу розрахувати нечітке значення інтегрального рівня конкуренції. Запропоновано використання апарата теорії ігор для вибору альтернативних маркетингових стратегій щодо підвищення конкурентоспроможності ресторанів. Результати дослідження вказують на необхідність постійного пристосування підприємств і гнучкості для реагування на мінливі глобальні обставини бізнес-середовища.

Ключові слова: конкурентоспроможність, ресторанний бізнес, конкурентні переваги, математичне моделювання, теорія ігор, метод аналізу ієрархій, маркетингова стратегія, ринок

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