The Selection Methodology of an Optimum Location for a Public Food Enterprise

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Abstract. In this article are analyzed several factors that influence the choice of the geographical location of public catering units and is developed and presented a mathematical model that allows the formation of demand for public catering services for a cafe catering unit in any part of the territory in question. When elaborating the demand function that allowed the mathematical modeling, there were taken into account several factors such as: the distances to the nearby enterprises whose employees are potential customers; distances to the blocks of flats where people who may also be potential customers live; the number of employees at each of the nearby businesses; the number of inhabitants in the residential block of flats; the service capacity of the competing enterprises and the ratio between the distances from the enterprise - competitor to the enterprise - customer. Using the method of scores provided by experts, for each group of factors were developed their significance coefficients with an influence on the choice of the public catering unit optimal location. Also, there is presented the algorithm of the model for identifying the optimal location for a new cafe-type public catering unit in the Ciocana sector in Chisinau.

Keywords: location, competition, customers, function, demand
JEL: L80

Introduction

The modern attitude towards business represents for entrepreneurs the task of choosing not the concept of a public catering unit from a certain location, but the location of the unit for the development of a certain concept. This approach is due to the priority of customer-oriented strategies in the catering industry, which contributes to the occurrence of new unique ideas, as close as possible to today's requirements, which can surprise and delight consumers of culinary production. A particular importance in selecting the type of the catering unit is the successful choice of its location, a wrong location may not be entirely the cause of business failure, but may contribute to the lack of communication between the potential customers and the services provided by the appropriate business.

Currently, for various reasons, in Moldova, there are only rare cases when restaurateurs are deciding to open a public catering unit based on well-reasoned decisions. To successfully solve this problem, it is very important to know the nature of the needs of the population in the food service. A simple and accessible methodology for entrepreneurs is needed in order to properly justify the location of future food businesses.

The issue of the rational choosing of the location of public alimentation units (PAU) has been in the spotlight of researchers in different countries. We mention the radical proposal put forward by Radchenko A.I., who argued the thesis about the location of the public catering unit in the area of the pedestrian accessibility. He concluded that catering will take precedence over household food if PAU enters the structure of the house. However, another well-known specialist in the location of public catering units, Korsekin V.I., considers that this concept has some significant disadvantages. In the opinion of the scientist, according to the specifics of the service, each public catering unit should be located so as to satisfy the demand for the services it offers in those places where a large number of people are concentrated. In the practical

implementation of this provision, it is easy to identify possible locations. But using this approach, it turns out that there are many location options and each of them, for some reason, cannot be implemented (Korsekin, Koveshnikov, & Mazaraki, 2015).

Results and Discussion

The analysis of the location plans is based on a mathematical model with the use of several algorithms. These are quite complicated calculations and entrepreneurs are not willing to use them.

They need a more accessible, simpler methodology. Lately, more and more expert scores are being used to obtain the information needed to prepare and select rational solutions. In solving many problems, the simplicity of the mathematical methodology is often more important than the expected accuracy of the results. The tendency to use simplified mathematical methods in the analysis of complex phenomena in combination with the opinions expressed by experts - specialists has gained in recent years a wide acceptance among mathematicians and economists. Many scientists conclude that "true mathematics is not a conglomeration of artificial computational techniques, but the ability to obtain correct results through reflections with a minimum of methods used (Albert, 2021, p. 83).

Based on the importance of the location of the public catering unit in ensuring its competitiveness, we set out to develop a model that allows the identification of the optimal location of a certain type of Public catering unit. For this purpose, we took as a basis the methodology proposed by the researcher from the Russian Federation, Kotelnikova A. (2021). At the same time, applying this methodology, we identified a series of inaccuracies. Therefore, during the respective calculations, we adapted some elements. The choice of location and the mathematical argumentation of this choice remain an intractable task, which is currently solved without the use of modern information technologies.

In order to model the optimal location of the public catering unit of a certain type, it is necessary to determine the function of the demand depending on the location of the unit and to identify the most important factors regarding the geographical location of the PCU. These factors can be divided into the following groups:

- the distances (S) to nearby businesses whose employees are potential customers, as well as to the blocks of flats where people who may also be potential customers live. The dependence of the demand function on this factor will be considered a descending quadratic with the increasing distance at the same time (Figure 1);

- the number of employees in each of the nearby enterprises P1 ... Pn. The dependence of the demand function will be considered linear, directly proportional to the number of employees in the enterprises. n is the number of buildings in which different enterprises are located, as well as residential blocks, which tenants may be potential customers;

- number of inhabitants in residential blocks L1… .Ln. The dependence of the demand function will be considered linear, directly proportional to the number of inhabitants in each block of flats;

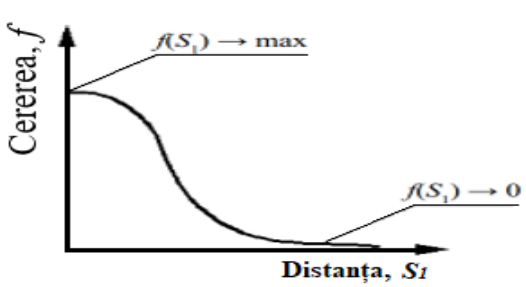


Figure 1. The dependence of demand function and distances to nearby public food units

Source: Kotelnikova (2021)

- the service capacity of the competing enterprises. For the calculation of G the following formula is applied: G = c * ∑PGi, where: Gi represents the serving capacity of the competing enterprise i, PGi - the serving capacity of the competing catering units, and c - the significance coefficient (influence) of the given factor. The dependence of the demand function will be considered linear, inversely proportional to the service capacity of the competing enterprises;

- distance ratio Kij

Kij = S2i / S 1j, where S1J -, S2i - the distance from the enterprise - competitor to the nearby customer enterprise, i = 1 ... m, j = 1 ... n.

If Kij> 1 - the enterprise - competitor is located further away from the customer enterprise than the analyzed enterprise.

If Kij = 1 - the enterprise - competitor is located at the same distance from the customer enterprise as the analyzed enterprise.

If Kij <1 - the enterprise - competitor is located closer to the customer enterprise than the analyzed enterprise.

Further, we will take as reference the demand function, identified in the methodology proposed by the author mentioned above (Kotelnikova, 2021), where i = 1..m, j = 1..n. This function can be used to calculate the demand for public food services in a sector where there are more institutions and organizations and fewer residential buildings and which does not take into account the number of inhabitants in the blocks of flats.

At the same time, analyzing the sector, which we proposed for research, we came to the conclusion that, because the sector delimited for the location of a new public food enterprise is very crowded and in the vicinity there are many offices, schools, construction sites, but also residential blocks, we opt for the location of a cafe that during the day will work with a simplified and cheaper menu and in which the self-service system will be applied, and in the evening customers will benefit with a more varied menu and customer service will be done through the waiters. In this sense, we propose the use of a modified methodology, which will also take into account the element related to the number of inhabitants in the area, according to the following formula of the demand function.

$$y = \sum_{i=1}^{n}(a * \sum 1/(\left(\frac{S_i}{1000}\right)^2 + b * P_i) - c * G + d * \sum\sum K_{ij} + e * L_i, \qquad (1)$$

where:

n - is the number of "client enterprises"; m - is the number of "competing enterprises";

S_i- distance from the "client enterprise";

P_i- the number of employees in the " client enterprise";

L_i - the number of inhabitants in the residential blocks;

G- the service capacity of the "competing enterprises";

K_{ij}- the ratio of distances between customers and competitors;

a_i, b_i, c_i,d_{ij}, c_i - coefficients of significance (influence) of the corresponding factors.

As so far, no significance coefficients of the factors influencing the choice of the optimal location of a public catering unit have been developed, we resorted to the provision of scores by experts. This method involves the use of qualitative and quantitative information. In some cases, qualitative characteristics must be quantified, meaning that we must assign them a form of quantitative expression. In this sense, it is usually used to provide scores by experts. In order to give to the information validity and trustworthiness, the following conditions were met:

• The involvement of a sufficient number of experts. The number of experts we used to determine the coefficients is 10 people;

• Ensuring that experts are competent in the researched issue;

• Lack of ambiguity and clarity of questions asked. We have endeavored to clearly formulate the questions, which would give the possibility of giving objective answers;

• The independence of the opinion of each expert. Each expert was independent in the exposures he made. Each expert expressed his opinion separately, without consulting each other or anyone else. The data in regards to the weight of these factors are presented in Table 1.

Table 1. The factors share with an influence on the location of a catering unit of the type - self-service café

Criteria / Experts	Distances to nearby businesses, whose employees are potential customers	Number of employees at each of the nearby businesses	Number of competitors catering enterprises	The ratio of distances from the enterprise - competitor to the surrounding enterprise-customer	The number of population near the catering unit	Total
The weight /share						1,00
The average	0,204	0,274	0,239	0,084	0,199	1,00

Source: made by the authors

Scaling by dividing by 1000 was applied to the distance indicators.

To develop the mathematical model, it is necessary to select a specific area in Chisinau. It can be a district, street, sector or the whole city. In this area (territory map), is indicated the existing public enterprise unites, the possible locations for the location of the new public food enterprises and of the "client enterprises".

Let's analyze the model functionality taking the example of Chisinau city. On the map of the city we will indicate the existing catering enterprises, the possible locations of new enterprises and client enterprises (any lot of potential customers, enterprises, educational institutions, hostels, residential buildings, leisure complexes, residential blocks, etc.).

The main condition for development of the model is the possibility to determine the demand value at any point in the delimited sector. Knowing the function of demand in any place of the analyzed territory, can be found the most efficient location for a new food enterprise of a certain type. Manually calculating all possible location options is an impossible task. For this purpose, we will use economic-mathematical modeling. To implement the model, it is necessary either a database with the necessary parameters of then public catering units for the studied region, or an electronic map of the street, sector or city, which will automatically determine some of the parameters.

In the Republic of Moldova there is a National Geographic Information System (NGIS) which is a unique integrated system for collecting, storing and processing information about geographical objects in interaction with data from other basic information systems, which consist of unified departmental and territorial geographic information systems of state and regional importance, integrated based on a unique system for identification and coding of the evidence objects on the territory of the Republic of Moldova.

NGIS aims to present information in the form of a spatial terrain model, with the possibility of modeling the situation and spatial analysis in order to obtain objective primary information about the objects with natural potential on the country's resources in order to increase the soundness, quality and efficiency of administrative decisions in the interests of the civil society development. But due to the lack of statistical data, it is currently not possible to

use this system to determine the optimal location of the public enterprise unit. For this reason, we present the model proposed by us, using the electronic map Yandex Maps, which is currently the most popular electronic map system, representing an electronic guide of organizations combined with the map of the city.

For the elaboration of the mentioned model we will go through the following steps (Figure 2).

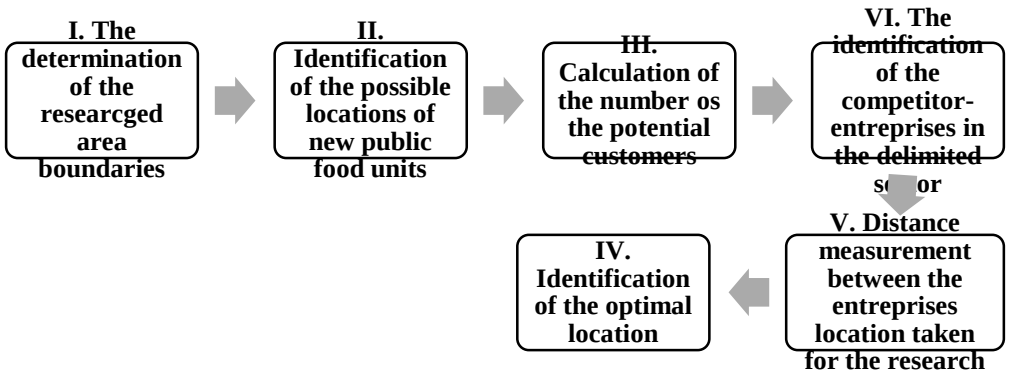


Figure 2. The algorithm of the optimal location identification model for a new catering unit - cafe type

Source: made by the authors

Thus, using the proposed algorithm we will go through all the steps in order to identify the optimal location for a new public food unit.

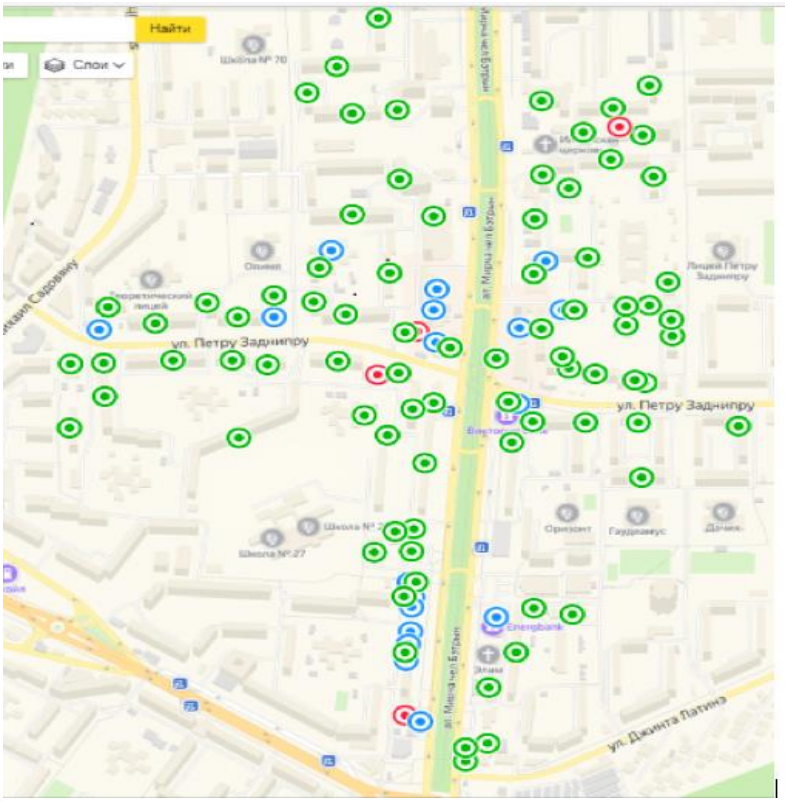
Stage I. In order to select and delimit the boundaries of the studied area, we used the website of Chisinau City, Yandex Maps[1], etc., data on the evolution of the network of public catering units located in the Chisinau city.

Stage II. Identifying the possible locations of a new catering enterprise – typa cafe that will operate during the day in the self-service mode and starting with 18.00 customer service will be done through waiters. As an example of implementation of this model, we will delimit the area that includes the main artery of the Ciocana sector - 1-22 Mircea cel Bătrân Boulevard and 1-15 Petru Zadnipru Street. The map of the researched area is shown in Fig. 3. On the map we will indicate in circles of different colors the client companies, the public catering units that are the competitors for the unit which follows to be located and the places where it is possible to open a new cafe.

Stage III. Identifying client enterprises in the studied area and determining the number of potential clients. Analyzing the food companies in the researched area and the number of potential customers, we determined that the most suitable blocks in which the cafe can be located are: Mircea cel Batran alley 1, 8, 15A and P. Zadnipru street, 9. For an efficient operation of the cafe located in the researched area, there must be a demand for the services provided. In order to do this, in the studied area are determinate the places with the highest demand and the distance from them to the possible location of the café[2]. It is necessary to establish the location that will ensure a higher level of competitiveness of the new cafe.

[1] https://yandex.ru/maps/10313/kishinev/?ll=28.892783%2C47.047327&mode=search&oid=33945018739&ol=biz&sll=37.622504%2C55.753215&sspn=0.611115%2C0.382594&text=chisinai%20mircea%20el%20batran&z=16.74

[2] https://map.md/ru?number=1&q=bd.%20Mircea%20cel%20B%C4%83tr%C3%AEn#15.05/47.0402/28.88935



- client enterprises
- competitor entreprises
- new entreprises

Figure 3. Electronic map of the delimited sector for the study

Stage IV. Identifying in the studied area the competitors for the respective type of unit and calculating the maximum number of consumers that can be deserved during a day in these units. These calculations are made based on the loading schedules of the cafe lounges and the number of existing seats in them.

As the model we used takes into account the competing companies in the field of catering services, we identified in the area 22 catering companies that could compete with the cafe which follows to be opened.

Stage V. Measuring the distances between the enterprises taken for research. The distance between the competing companies and the location of the new cafe was calculated using the Yandex Maps map using the route and ruler tools, the estimated number of potential customers was found out from their employers. In order to determine the number of inhabitants in the residential blocks, was found the number of apartments in each block and multiplied by three, considering that on average in each apartment live 3 people. We are aware that the real number of inhabitants will be slightly different from the one we calculated. This could be considered as a limit for the research in question. On the other hand, our attempts to identify the exact number of tenants could not be realized. No institution has this indicator, if we take into account the fact that some apartments are uninhabited, others are offered for rent. At the same time, the data of the National Bureau of Statistics show that the average number of a household in the Republic of Moldova, according to the latest census is 2.9 people[3].

Stage VI. In this last stage we will identify, following the respective calculations, the optimal location of the proposed cafe, using the function proposed by us.

[3] https://statistica.gov.md/newsview.php?l=ro&idc=30&id=5582

$$y = \sum_{i=1}^{n}(a * \sum 1/(\left(\frac{S_i}{1000}\right)^2 + b * P_i) - c * G + d * \sum\sum K_{ij} + e * L_i \quad (2)$$

The calculations were performed in MS Excel: the request for the cafe services in each of the 4 possible locations. The generalized calculations are presented in Table 2.

Table 2. The demand in the proposed locations for the opening of the new cafe, people

	Possible location	Demand
I	Mircea cel Bătrân, 1	419
II	Mircea cel Bătrân, 8	2229
III	Mircea cel Bătrân, 15A	3851
IV	Petru Zadnipru, 9	4015

Thus, the optimal location for the new cafe is Petru Zadnipru Street 9, and the most unsuccessful location is the address Mircea cel Batran Alley, 1.

The calculations led us to the conclusion about the opportunity to create an automated model (software) for the automatic determination of all the necessary distances and the calculation of demand for any area and for the city as a whole. It should be noted that the demand function depends on a much larger number of factors, and the more factors are taken into account, the more accurate the demand function model is, ant the more complex it is as the same time.

Conclusions

A successful location means a large flow of visitors, a higher revenue and, consequently, profit for the business. However, nowadays, for various reasons in Moldova, there are very rarely cases when the entrepreneurs are deciding to open a catering establishment based on well-reasoned decisions. But not in vain, the selection of the optimal location of public catering units is the subject of study of several researchers, who confirm that the successful location of the unit is just as important, such as: quality of food production, quality of services, staff training, etc.

The choice of location and the mathematical argumentation of this choice remain an intractable task, which must be solved by using modern information technologies.

The calculations presented in this article demonstrate the opportunity of creating an automated (soft) model for the automatic determination of all necessary distances and the calculation of demand for any area, as well as for the city as a whole.

It should be noted that the demand function depends on a much larger number of factors, and the more factors are taken into account, the more accurate and complex the demand function model is.

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