Designing a model for optimal positioning of bank branches in Yasouj using adaptive Neuro-Fuzzy Inference System (ANFIS)

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Abstract
Location of bank branches is an important factor in attracting customers which increases the financial resources of banks. The branch location is thus one of the important parameters of establishing a branch in banking system. The main objective of this research is to study the parameters affecting the optimal positioning of bank branches in Yasouj. The statistical population includes all banking customers in Yasouj and the sample includes 150 randomly selected customers and method of this research is descriptive and correlational.
The results of this study show that a significant relationship is defined between independent variables that are population density, urban traffic, proximity to major markets, and security of the branch; moreover, dependent variable that is optimal positioning of bank branches is approved. However, the results show that there is no significant relationship between independent variables of ATM services and electronic services and dependent variable.

Keywords:
Optimal Positioning, Location of Bank Branches, Banking, Fuzzy-Neural

1. Introduction

Today, we live in an era in which customer centricity is profitable in business. Paying attention to customers and respecting and satisfying them is the emphasis of most organizations because they have found that business is meaningless without customers [1]. This thinking has also been raised in banks that try to attract and retain customers through applying various policies. One of these policies is to provide suitable positions and locations that are desired by customers. The more suitable the position of branches, the less the expenses the customers have to pay when they want to go to the bank and the more accessible the bank. As a result, the customer is more willing to open an account and use other banking services [2].

Deciding on the optimal positioning of bank branches is the function of special methods and factors in banking system which put the best possibility for optimal positioning in the hand of decision maker. Increase and intensity of competition, providing services in right places and locations which satisfy customers are determining factors in attracting and retaining customers. Therefore, there are branches of financial and credit institutions, including banks, in different regions so that they can cover a wider area while providing better services [3].

Fuzzy systems are knowledge-based or rule-based systems. The heart of a fuzzy system is a knowledge base which is composed of fuzzy if-then rules. A fuzzy if-then rule is an if-then statement in which some words are marked by continuous membership functions [4].

Positioning of branches in the banking system is dominated by a lot of variables and parameters and due to increasing expansion of banks and financial and credit institutions, branch positioning is evaluated in different ways with each method has different results and outputs. In this research, variables of urban traffic, population density, property prices (of rental property), distance to the branches of other banks, proximity to major markets of the city, access to ATMs, and use of electronic banking services such as Internet banking and mobile banking are examined from the perspective of adaptive neuro-fuzzy inference system. Adaptive neuro-fuzzy inference system makes use of hybrid learning rule which is the combination of gradient method and the least squares method to determine parameters. Hybrid learning algorithm is applicable only when the outputs are a linear combination of inputs [5].

Given that establishing a branch for banking system requires a great deal of primary and secondary costs and the society demands to exploit the services of financial institutions and credit and banking, all banks, whether state-owned or private, and financial institutions are seeking to reduce the costs of establishing and running the branches. A model that can affect positioning variable of branches is important and determinative. Studies carried out on banks and banking and finally on electronic banking are vast. But since banking system of Iran has been state-owned until the last few years and establishment of new branches was more under the influence of social and political terms than economic parameters; not much research or studies have been conducted in this field [6].

In order to survive and profitability, banking system has to consider factors affecting the absorption of funds in different ways. Method of positioning branches in banking system is one factor that has not been addressed sufficiently in studies carried out on domestic and international banking

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system of Iran [7]. Considering that variables of urban traffic, population density, property prices (of rental property), distance to the branches of other banks, proximity to major markets of the city, access to ATMs, and use of electronic banking services such as Internet banking and mobile banking are important factors in selecting a location to establish a bank branch, this study tries to examine and design a model that determines the weight and influence of each of these variables which are of great importance for banking system [8].

2. Objectives and Methodology

2-1. Methodology

Present study has been performed in survey mode. In survey the emphasis is on test and hypothesis to identify the type of relationship that exists between the variables. The research method is descriptive and correlational and questionnaire is used as the instrument of data collection as questionnaire is the commonest instrument of data collection. Hypotheses were tested using Pearson correlation coefficient. Regarding that the title of the study is "designing a model for optimal positioning of bank branches in Yasouj using adaptive Neuro-Fuzzy Inference System (ANFIS), the scope of the topic is designing a model for optimal positioning of bank branches in Yasouj. This research is carried out in Yasouj that is the center Kohgiluyeh and Boyer-Ahmad Province. Data is collected from 150 customers of banks in this city. This study is carried out in 2014.

2-2. Objectives and hypotheses

The main objective of this study is to investigate and study some parameters affecting optimal positioning of bank branches in Yasouj. Hypothesis is the solution proposed by researcher to solve the problem. In order to formulate hypotheses, all researchers need conceptual model as a basis for identifying variables of hypotheses as well as explaining relationships between variables and their operational and conceptual definitions. In this regard, considering factors relevant to the assessment of positioning bank branches in Yasouj which are urban traffic, population density, property prices, distance to the branches of other banks, proximity to major markets of the city and security of branch location, a model will be designed as follows:

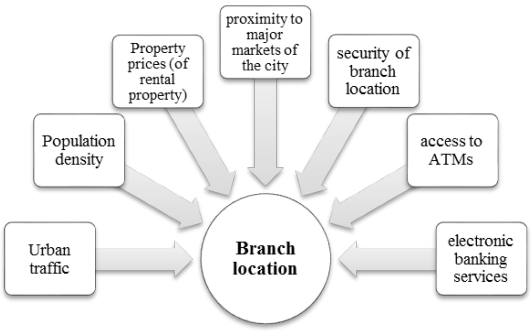

Figure 1. Conceptual model of research

After identifying and explaining independent and dependent variables, following hypotheses were formulated to be approved or rejected by data of survey:

1. There is a relationship between population density and branch positioning in the banking system in Yasouj.

2. There is a relationship between urban traffic and branch positioning in the banking system in Yasouj.

3. There is a relationship between the price or rental fee of property and branch positioning in the banking system in Yasouj.

4. There is a relationship between proximity to major markets of the city and branch positioning in the banking system in Yasouj.

5. There is a relationship between the security of selected location and branch positioning in the banking system in Yasouj.

6. The more ATMs users use, the less sensitive they are about the location of branch.

7. The more electronic banking services (such as Internet banking and mobile banking) users use, the less sensitive they are about the location of branch.

2-3. Validity and Reliability

Validity of the test is the ability of given tool to measure the trait that is to be tested and reliability is a measuring device that mainly manifests the accuracy of the results. Reliability refers to accuracy, trustworthiness, consistency, or repeatability of test results [9].

2-4. Reliability Test

At this stage, reliability test is carried out with ten variables and the results are presented in Table 1.

Table 1: Reliability test with ten variables

Number of variables	Value of Cronbach's alpha
10	0.786

As it can be seen in Table 1, the value of Cronbach's alpha coefficient equals 0.786 that is greater than 0.7; therefore, it can be said that the reliability of test is acceptable.

3. Result analysis

3-1. Descriptive statistics

Table 2: Descriptive statistics of the age of customers

Age	Frequency	Percentage of data	Percentage of Valid data	Cumulative percent
Under 30	78	52.0	52.0	52.0
30-40	38	25.3	25.3	77.3
40-50	14	9.3	9.3	86.7
More than 50	20	13.3	13.3	100.0
Total	150	100.0	100.0	

As it can be observed in Table 2, most respondents aged less than 30 years and the least frequency was in the age group of 40 to 50 years.

Table 3: Descriptive statistics of the education of customers

Education	Frequency	Percentage of data	Percentage of Valid data	Cumulative percent
Under Mater	14	9.3	9.3	9.3
B.A.	107	71.3	71.3	80.7
M.A.	26	17.3	17.3	98.0
Ph.D.	3	2.0	2.0	100.0
Total	150	100.0	100.0	9.3

Table 3 shows that respondents who do not hold diploma have the lowest frequency. Generally, it can be mentioned that the frequency of educated respondents is satisfactory in this study; the information in this table shows this in the statistical population of this study.

Table 4: Descriptive statistics of familiarity with services of banking

Verbal	Frequency	Percentage of data	Percentage of Valid data	Cumulative percent
Extremely familiar	15	10.0	10.0	10.0
Moderately familiar	56	37.3	37.3	47.3
Somewhat familiar	49	32.7	32.7	80.0
Slightly familiar	28	18.7	18.7	98.37
Not at all familiar	2	1.3	1.3	100.0
Total	150	100.0	100.0	

As it can be observed in Table 4, about 47 percent of the respondents of research population are appropriately familiar with services of banking industry and about 33 percent of the respondents have the right information about this case; therefore, respondents that have information about various services of banks are able to provide better responses to the questionnaire and research subject.

Banks make use of all their capacities to satisfy their customers properly, satisfaction is their trump card in today's financial markets.

Table 5. Descriptive statistics of satisfied of various services of banking system

Verbal	Frequency	Percentage of data	Percentage of Valid data	Cumulative percent
Extremely satisfied	11	7.3	7.3	7.3
Very satisfied	27	18.0	18.0	25.3
Moderately satisfied	65	43.3	43.3	68.7
Slightly satisfied	44	29.3	29.3	98.0
Not at all satisfied	3	2.0	2.0	100.0
Total	150	100.0	100.0	

Table 5 shows that respondents of research statistical population are satisfied of various services of banking system. For example, about 69 percent of respondents are satisfied to medium, high, and very high extent of services of banking system in Yasouj. The remarkable thing is that about 31 percent of respondents are not satisfied of various services of banks, so banks should do more research in this area to identify the major reasons in this regard so that they

can attract appropriate percentages of research population to absorb more resources.

3-2. Findings- analytical statistics

Correlational analysis is a statistical tool to determine the type and degree of relationship between a quantitative variable and another quantitative variable. The value of this coefficient lies in the range of 1 and -1 and if there is no relationship between two variables, it equals zero. Pearson correlation coefficient is a parametric method and is used for data with normal distribution or large amounts of data (Momeni, 111).

In this section, statistical tests are done according to Pearson correlation coefficient.

First hypothesis:
Null hypothesis: there is no relationship between population density and branch positioning in banking system in Yasouj.
Hypothesis 1: there is a relationship between population density and branch positioning in banking system in Yasouj.

Table 6. Testing the first hypothesis with two variables

		Branch location	Population density
Branch location	Pearson correlation coefficient	1	.937**
	Level of (two-sided) signification		.000
	Sample size	150	150
Population density	Pearson correlation coefficient	.937**	1
	Level of (two-sided) signification	.000	
	Sample size	150	150
Correlation at the level of one percent (two-sided) signification[1]			

As it is obvious in Table 6, because the value of signification is less than 0.05 according to survey data, the null hypothesis is rejected and hypothesis 1 is temporarily accepted. In other words, there is a relationship between the independent variable of population density and dependent variable of branch positioning and the value of Pearson correlation coefficient between the above variables equals 0.937 for 150 research data.

1. Signification that is briefly shown with Sig. refers to the error committed in rejecting the null hypothesis (Momeni, p. 65).

Second hypothesis:
Null hypothesis: there is no relationship between rental fee or the price of property and branch positioning in banking system in Yasouj.

Hypothesis 1: there is a relationship between rental fee or the price of property and branch positioning in banking system in Yasouj.

Table 7. Testing the first hypothesis with two variables

		Branch location	Rental fee
Branch location	Pearson correlation coefficient	1	.366**
	Level of (two-sided) signification		.000
	Sample size	150	150
Rental fee	Pearson correlation coefficient	.366**	1
	Level of (two-sided) signification	1	.366**
	Sample size		.000
Correlation at the level of one percent (two-sided) signification			

Table 7 manifests that because the value of signification is less than 0.05, the null hypothesis is rejected and hypothesis 1 is temporarily accepted and the value of Pearson correlation coefficient between the above variables equals 0.366 for 150 research data.

Third hypothesis:
Null hypothesis: there is no relationship between urban traffic and branch positioning in banking system in Yasouj.

Hypothesis 1: there is a relationship between urban traffic and branch positioning in banking system in Yasouj.

Table 8. Testing the first hypothesis with two variables

		Branch location	Urban traffic
Branch location	Pearson correlation coefficient	1	.939**
	Level of (two-sided) signification		.000
	Sample size	150	150
Urban traffic	Pearson correlation coefficient	.939**	1

	Level of (two-sided) signification	.000	
	Sample size	1	.939**
Correlation at the level of one percent (two-sided) signification			

It can be concluded from Table 8 that hypothesis 1 is temporarily accepted although the value of Pearson correlation coefficient equals 0.939.

Fourth hypothesis:
Null hypothesis: there is no relationship between proximity to major markets of the city and branch positioning in banking system in Yasouj.

Hypothesis 1: there is a relationship between proximity to major markets of the city and branch positioning in banking system in Yasouj.

Table 9. Testing the first hypothesis with two variables

		Branch location	Proximity to major markets
Branch location	Pearson correlation coefficient	1	.823**
	Level of (two-sided) signification		.000
	Sample size	150	150
Proximity to major markets	Pearson correlation coefficient	.823**	1
	Level of (two-sided) signification	1	.823**
	Sample size		.000
Correlation at the level of one percent (two-sided) signification			

As it can be seen in Table 9, because the value of signification is less than 0.05 according to research data, the null hypothesis is rejected and hypothesis 1 is temporarily accepted. In other words, the value of Pearson correlation coefficient between the above variables equals 0.823 for 150 research data.

Fifth hypothesis:
Null hypothesis: there is no relationship between the security of branch location and branch positioning in banking system in Yasouj.

Hypothesis 1: there is a relationship between the security of branch location and branch positioning in banking system in Yasouj.

Table 10. Testing the first hypothesis with two variables

		Branch location	Security of branch location
Branch location	Pearson correlation coefficient	1	.76**
	Level of (two-sided) signification		.000
	Sample size	150	150
Security of branch location	Pearson correlation coefficient	.76**	1
	Level of (two-sided) signification	1	.76**
	Sample size		.000
Correlation at the level of one percent (two-sided) signification			

According to Table 10, null hypothesis is rejected and hypothesis 1 is accepted. The value of Pearson correlation coefficient equals 0.760 for 150 research data.

Sixth hypothesis:
Null hypothesis: there is no relationship between services of ATMs and branch positioning in banking system in Yasouj.

Hypothesis 1: there is a relationship between services of ATMs and branch positioning in banking system in Yasouj.

Table 11. Testing the first hypothesis with two variables

		Branch location	Services of ATMs
Branch location	Pearson correlation coefficient	1	-0.016**
	Level of (two-sided) signification		.000
	Sample size	150	150
Services of ATMs	Pearson correlation coefficient	-0.016**	1
	Level of (two-sided) signification	1	-0.016**
	Sample size		.000
Correlation at the level of one percent (two-sided) signification			

Hypothesis 1 is rejected according to Table 11. In other words, there is no relationship between the independent variable of services of ATMs and dependent variable of research. It can be said that for customers in Yasouj,

changes in the services of ATMs do not have any effect on the location of bank branches.

Seventh hypothesis:
Null hypothesis: there is no relationship between electronic banking services (such as Internet banking and mobile banking) and branch positioning in banking system in Yasouj.

Hypothesis 1: there is a relationship between electronic banking services (such as Internet banking and mobile banking) and branch positioning in banking system in Yasouj.

Table 12. Testing the first hypothesis with two variables

		Branch location	Electronic banking services
Branch location	Pearson correlation coefficient	1	.067**
	Level of (two-sided) signification		.000
	Sample size	150	150
Electronic banking services	Pearson correlation coefficient	.067**	1
	Level of (two-sided) signification	1	.067**
	Sample size		.000
Correlation at the level of one percent (two-sided) signification			

As it is observed in Table 12, there is no relationship between the independent variable of electronic banking services (such as Internet banking and mobile banking) and dependent variable of research.

This researcher believes that perhaps the most important cause of non-existence of relationship is that users use less Internet services and mobile banking in Yasouj. While if using Internet banking services becomes institutionalized among users, they will have less physical presence in branches.

3-3. Designing a model in a fuzzy environment

Many variables are involved in positioning bank branches which is the subject of this investigation. The most important variables include urban traffic, population density, proximity to major markets of the city, lying on the main streets of city. It should be noted that two other variables of the security and price of branch property were introduced; however, since in hypothesis testing, the existence of a relationship between these two independent variables and the dependent variable of study was rejected according to research data, they are not included in design and implementation section.

To design a fuzzy model, all above variables are classified in three levels of: low, medium, and high.

Table 13. Representing variables at different levels

No.	Variable	Various dialects (various levels)				
1	Urban traffic	Very high	high	medium	Low	Very low
2	Population density	Very high	high	medium	Low	Very low
3	Proximity to major markets of city	Very high	high	medium	Low	Very low
4	Lying on main streets	Very high	high	medium	Low	Very low

To simplify the design, the above-mentioned four variables are considered as pairs in tables 8 and 9.

Table 14. Description of rules for two variables of traffic and population density

traffic and population density	Very high	High	Medium	Low	Very low
Very high	1	2	3	0	0
High	2	2	3	0	0
Medium	2	3	0	0	0
Low	3	0	0	0	0
Very low	0	0	0	0	0

Table 15. Description of rules for two variables of proximity to major markets and main streets

proximity to major markets and main streets	Very high	High	Medium	Low	Very low
Very high	1	2	3	0	0
High	2	2	3	0	0
Medium	2	3	0	0	0
Low	3	0	0	0	0
Very low	0	0	0	0	0

It is obvious that rules with first grade importance have more impact on output (i.e. branch positioning) and rules with second and third grade importance are next priorities. Each of research variables can also be expressed as follows.

In other words, graph expression of variables will be beneficial for implementing them better in fuzzy context.

The ultimate goal of this research is to design a model for optimal positioning of branches in banking system in Yasouj.

The dialect of questions is just fuzzy in the questionnaire which is prepared on the basis of 5-point Likert scale.

Table 16. Dialect of the items of questionnaire

Very high	high	medium	Low	Very low
Strongly agree	agree	Neither agree or disagree	Disagree	Strongly disagree

This dialect provides a proper context for designing a fuzzy system.

As in statistics, the view of population is unknown to the scholar, and scholar tries to estimate the view of population according to research data, in fuzzy area, behavior of the system is unknown to scholar and scholar tries to design a model according to research data and to train data in ANFIS in accordance with some training rules so that the designed model has the behavior of a system.

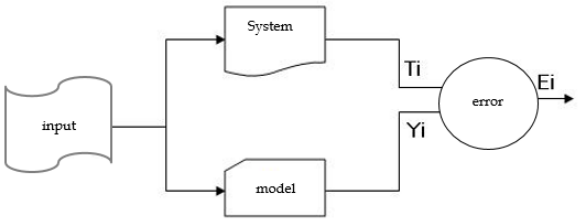

Figure 2. Design model

Obviously, this system is associated with error; and the proposed model tends towards the system increasingly by determining fuzzy rules.

In research model, error rate begins at 0.19215 and decreases to 0.1575 at different stages through learning process and will be consistent at this value. The overall overview of designed fuzzy model is as follows:

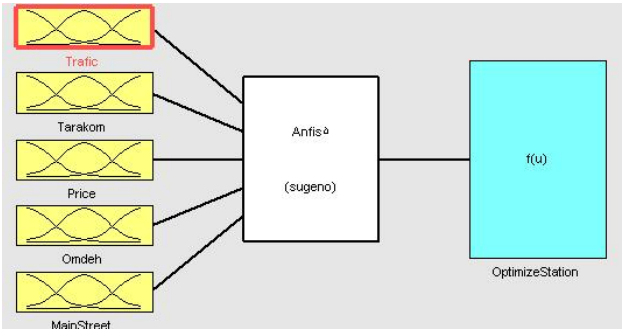

Fig. 3 Overall overview of designed fuzzy model

This model has estimated fuzzy model on the basis of input data of research such as population density, urban traffic, price or rental fee of the branch property, proximity to major markets and so on according to determined rules.

For example, the model proposes an optimal place for bank branches according to changes in input data, and on the basis of enacted rules in Fuzzy model. One output or suggestion of model is presented here:

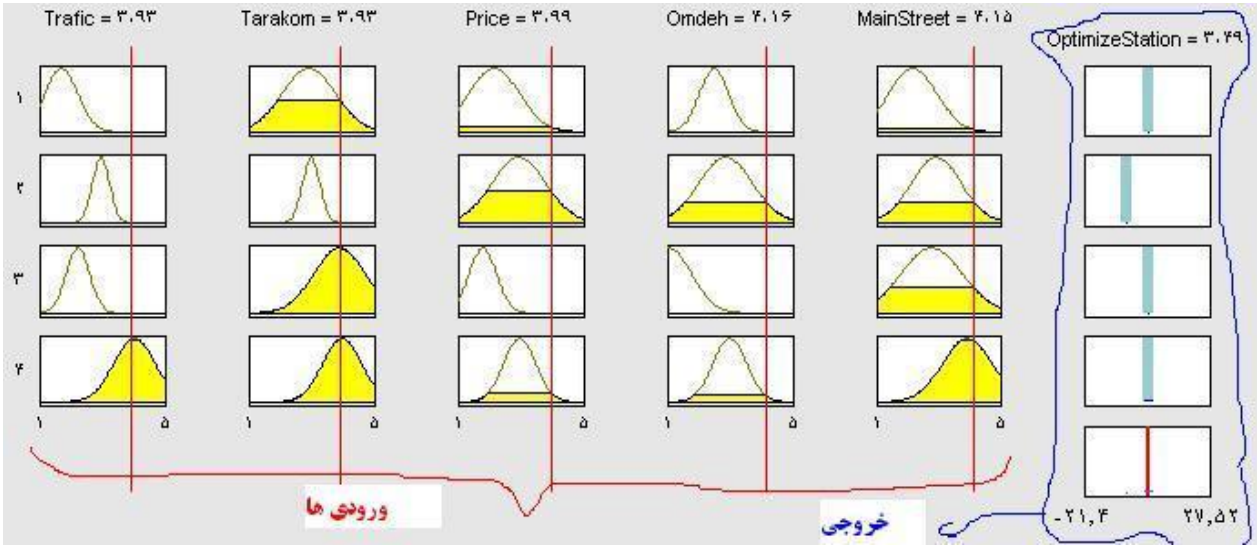

Fig. 4 Model for the optimal proposed location of bank branches

As it can be seen in the figure, the vertical red line shows the amount or value of input data for each variable.

Designed model proposes an output based on different values of input. Another example is presented below:

Fig. 5 Proposed model

Therefore, designed model dynamically determines the ability of positioning bank branches optimally based on the value of input variables.

4. Conclusions and recommendations

About 76 percent of men and 24 percent of women participated in completing and obtaining information for this study. Usually in communities like Yasouj that have nomadic context, men are more willing to participate in studies, and the data of this research manifests this case in a proper manner.

Frequency for participants is relatively appropriate. Indeed, people aged less than 30 years are the most frequent respondents with the frequency of 52 percent, and respondents aged from 40 to 50 years were the least frequent respondents with the frequency of approximately 9%. In fact, young people are more willing and energetic to participate in social activities such as scientific research.

Respondents' level of education is one of the significant parameters in scientific research. It can be said that educated people tend to offer more detailed information. In this study, nearly 90 percent of the respondents hold diploma to Ph.D. degrees.

In this study, employees with the frequency of 66 have the most participation and retirees with the frequency of 2 have the least participation.

The point of this study is that about 25% of customers have accounts only in state-owned banks and about 4 percent of customers have accounts in private banks; and most customers that are 71 percent have accounts in both private and state-owned banks. Regarding the appropriate and acceptable distribution of customers in the state-owned and private banks, the results of this study can be generalized to all banking customers in the research community.

Different advertisements of banks presented on various media provide a powerful tool to introduce their services and performance. Almost half of the respondents stated that banks should commit in their advertisements to offer appropriate and acceptable services.

Customer-centricity and customer satisfaction are trump cards of all economic enterprises. Almost 25 percent of respondents of research population with very high and high dialects are very satisfied of banking system. Almost 25 percent of respondents with very low and low dialects are not satisfied of the performance of banks in Yasouj.

However, this study and similar studies can provide appropriate solutions to enhance customer satisfaction of banking system.

Almost 25 percent of respondents with very low and low dialects are not satisfied of the location of branches in Yasouj and about 60 percent are satisfied of the location of branches relatively. However, most customers of research population may become satisfied of the branch locations through applying appropriate and low-cost solutions.

Descriptive statistics state that customers of research population desire that banks lie in busy areas of the city; and about 23% of the customers with disagree and strongly

disagree dialects are unhappy with the establishment of banks in crowded places.

Proximity of banks to major markets may be beneficial and useful for both the sellers and the buyers. Almost 90% of respondents of research population argue the issue. The more users make use of electronic banking services, such as internet banking and mobile banking, the less they need to be physically present. Information obtained from the data of this research shows this clearly. About 9% of users in Yasouj state that electronic services do not reduce the amount of physical presence in bank branches.

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