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ECONOMETRIC MODELING AND FORECASTING OF EDUCATIONAL SERVICES TO THE POPULATION OF THE REGION.

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ABSTRACT
Analyzing providing education services to the population of the region, the sequence of choosing and modeling the main factors which influence their development are represented through simulation schemes in this article. Multifactorial empirical models were built on the example of providing education services to the population of the region which is provided to the population of Kashkadarya region, forecasts were given through them and suggestions and recommendations were given on the basis of obtained results.
Key words: complex modeling, econometric modeling, differential equations, static and dynamic parameters, structural analysis, synthesis, optimization, multifactorial empirical models, regression equation, correlation coefficient, Darbin-Watson criterion, Fisher and student criteria.

I. Introduction

The development of digital (information) technologies at the present stage affects almost all spheres of economic activity. The article highlights the results of research and forecasting the quality providing education services to the population of the region of the territory based on empirical models.

The aim of the study is to increase the efficiency of using the "digital information system in the providing education services to the population of the region of the territory's population" and to develop an empirical forecasting model. The research was carried out using analysis and generalization tools to determine and classify the boundaries of the problem area. When forming an empirical forecasting model and describing its individual elements, a systematic approach and digital information technologies were used.

Of the foreign scientists in this field, the research was conducted by an English economist M.Keynes and one of the Russian scientists V.M. Granberg[5; 14], but the research of scientists of our country has studied some aspects of optimal regulation of the economic system of regions. In particular, the theoretic and methodological aspects of the complex and proportional development of the territories were considered in the works of B. Ruzmetov[15]. Despite many years of research, the issue of accurate forecasting of the development of the economic system remains relevant.

II. Methods

Interest in regressive complex-numerical econometric models and complex-numerical variable functions with statistical observation arose in the 50-60s of the XX century. G. N. Tavares and L. M. Tavares in their research they also focused

in this direction. Only in 2004, the Russian economist scientist S.G. Svetunkov for the first time created the theory of constructing complex numerical econometric models[16; 17; 18; 21]. This marked the beginning of the formation of an integrated digital economy. As noted in the studies of A.A. Afanasyeva, O.S. Ponomareva. and G.B. Kleiner "such production functions as describing the influence of production resources on the result of production, help to solve many practical issues." [19; 20]. T.V. Merkulov F.I. Prikhodko in his studies, "the advantages of complex numerical econometric modeling lie in the fact that with their help there are opportunities for solving complex problems that cannot be solved by functions with real variables." An important factor in the territorial system is the theory of optimal regulation. Its distinctive feature is analyzed and the corresponding scientific conclusions are drawn on the need for consistent application of the principle of optimality in solving the entire complex complex of problems of regulation and management of the economic process in the region[22].

III. Results and Discussion

There are two approaches to creating a digital economy: planned and market-based. For developing countries, the development of the service sector is one of the most effective ways to improve the living standards of the population. The main issue is not only to increase the share of the service sector in GDP, but also to expand its structure, increase employment, and develop modern forms and technologies of providing services that more fully meet the needs of the population. In developed countries, the service sector accounts for the bulk of the employed population, including " in the United States-80%, in Japan-more than 70%." While a number of American companies own at least 50% of the profits from production, selling services related to production[23; 24].

Empirical methods do not negate simple, traditional methods, but help to further develop them and to analyze objectively variable outcome indicators through other indicators.

The real object is presented in the form of two systems: control and controllable (control object) in econometric modeling of the development of service sectors, in the description of management processes.

In econometric modeling, the task of control systems is considered change of the variable *y(t)* in given accuracy (with permitted error) in accordance with the law. When projecting and operating automatic control systems, it is necessary to select the parameters which can ensure the required control accuracy of the *S* system, as well as its stability during the transition process.

If the system becomes stable, then its behavior by time, the maximum deviation of the adjustment variable *y(t)* in the transient process, the transient process time, and others are of practical interest. The properties of different classes of automatic control systems can be concluded by the types of differential equations which most closely describe the processes in the system. The order of the differential equations and the value of the coefficients completely determine the static and dynamic parameters of the system.

The importance of econometric modeling of public service sectors is reflected in the followings:

The material, labor and monetary resources are rationally used;

It serves as a leading tool in the analysis of economic and natural processes;

it will be possible to make some adjustments during the forecasting of the development of public service sectors;

It gives opportunity not only in-depth analyzing service sectors, but also discovering their unexplored new laws. They can also be used to predict the future development of service sectors;

It facilitates mental work along with the automation of computational work, creates the opportunity to organize and manage the work of personnel of service sector on the scientific basis.

In our opinion, there are the following actual issues which are waiting for their solution, in the development of the service sector: identifying classification of the types of services which are provided to the population, evaluating the nature of the service sector, developing a system of indicators of service sectors in current situation, improving the process of econometric modeling of development of public service sectors and forecasting it through them.

Human creates and serves the object of service to himself. Because of this, it is possible to introduce the belief that services are for the human and performing the service is also a human. This means that both the producer of the services and its consumer are also human. This can be expressed as follows:

It is known that as a result of the service, the GDP of country will increase. This will be done in the following directions: a gross domestic product will be created in the conditions of market relations, as a result of service, irrespective of creating or non-creating a material wealth. Therefore, it is expedient to look at services not from the point of view of the creation of material wealth, but from the point of view of the creation of gross domestic product.

In the modern era of development of social and service sectors, the provision of services is gaining popularity. Therefore, the labor efficiency per unit of achieved output is required to be able to calculate fixed assets, material and financial costs.

Production and services have long been a part of human economic activity, social community life. The interaction among people as a social community institution of services, the existence of useful activities - are considered necessary condition of society and life of human. It should be noted that it is not exaggeration if we say that services will increase the level of development of society, not only at the level of its productive forces, but also taking into account its spiritual and enlightenment status.

In this study, we will mark public service sectors as a system by improving the development models of public service sectors as a basis for systematic analysis. At the same time, we consider a single object and the types of services as a collection of collected elements in order to achieve the goal. Namely, we will systematically study to increase the efficiency of public services and living conditions. These researched types of services are understood as interconnected integrity in their integrity. As a result of systematic analysis, the economic-effectiveness indicator will be determined.

If we consider the process as a system in the modeling of service sectors, we must choose the main influencing factors, namely, input indicators. When modeling a process, we will choose the type or appearance of the model to be generated, if we choose which

type of service sector. It is not impossible to take into account all factors in modeling, so we must choose the main influencing factors and take into account the ongoing socio-economic reforms which have been carried out in this field. The outcome factor and evaluation criteria are determined from the generated model .

It should be noted that the attitude of the population to the service sector is formed in the conditions of social ownership to production tools, a single centralized system of economic movement, limited economic independence of enterprises.

In the condition of market economy, service enterprises operate in a variety of forms of ownership, full economic independence and competitiveness. This market involves the flexible use of different methods of householding management and the choice of econometric models of service, in this case, it creates opportunity for rapid adaptation to changes in the external environment in a competitive environment.

A systematic methodology of complex problems in the field of providing education services to the population of the region on the basis of a systematic approach and general concepts. During the analysis, we take into account the internal and external environment of the service sectors. This means that it must be taken into account not only internal factors, but also external factors such as economic, geopolitical, social, demographic, environmental and other factors.

Each system of the providing education services to the population of the region includes its own service elements, while at the same time it reflects the low-level subsystem elements. In other words, the elements of the service sector will be interconnected with different systems in many ways, without interfering with each other.

The systematic approach is expedient for each element of its structural structure in ensuring the completeness of the public service system.

In order to do this, the service sector is considered as a complex system, quantitative and qualitative aspects of its expression laws are studied. Imitation has important role in the analysis of the activities of the service sector which is considered as a complex economic process.

The imitation model is constructed for each sector to predict the future state of the public service sector. The following tasks should be done in order to do this (Figure 1):

forming database of service sector networks and factors which influence it;

identifying the relationship between each service sector and the factors which influence it, the factors which influence it;

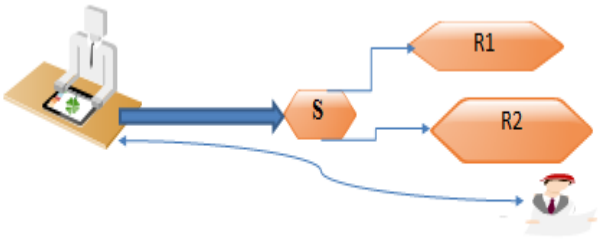

Figure 1. Scheme of systematic imitation of econometric modeling of the public providing education services to the population of the region

developing a separate model for each service sector;

examining developed models according to evaluation criteria;

forming a database forecast on the basis of certain legitimacies of factors which influence forecasting through models which are considered significant;

achieving outcome factors on the basis

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of databases and models.

In this case, special functions are reviewed, attention is paid to the algorithms of system operation. It is implied the properties which lead to the goal as function. In this case, performing functions of the system are evaluated on the basis of a functional approach. It creates opportunity to determine the activity of the system, to determine its status, to mark the management legitimacies of systems. An important aspect of this is considered appearing hierarchical subordination among these parts and reflecting it in the relative independence of these parts. This will help the population to develop an integrated systematic imitation model of all elements of its service sector on the basis of a single system.

It is expedient to study the correspondence of different values to the factors which influence to the social phenomena, not the same values, and the correlation connection of their interdependence. Because a characteristic feature of the social spheres is that it is impossible to determine a complete list (strength) of all the factors which affect this sphere.

Besides, only approximate expressions of the connections can be written using the formula. Because the number of factors which influence the living conditions of the population is so large, it is impossible to determine a complete list of them and write an equation which fully represents the connection with influencing outcome sign.

The development of the living conditions of the population is considered so incompletely connection, that different values of the results of the factor which influence it in the different time and space, correspond to each value of the factors. Hence, the total number of influencing factors will be unknown. It is expedient to study such a dependence through correlation connections.

Our task consists of evaluating the existence of strong and weak connections which influence the development of public service sectors. We use the correlation analysis method in order to perform this task. Because our goal is considered to evaluate the importance and reliability of the interdependencies which influence the development of each sector which serves the population. We measure the criterion of dependence which influences the living conditions of the population through correlation analysis, but we cannot determine the cause of the relationships.

We selected information which belong to the reporting years 2004 - 2018, these information identified the areas of service and the factors which influence them, on the basis of certain signs (Table 1).

Table 1.

providing education services to the population of the region **Kashkadarya region and the factors which influence them**

A_{axx} –providing communication and information services to the population of the region (in billion soums)	Y_1
A_t – total number of the population of region (thousand people)	X_1
O'_t – the number of teachers per thousand students in the region	X_2

We created the following functional view on the basis of the service sectors in Table 1 and the factors which influence them.

$$T_{o/x} = \varphi_7(O'_s, TFO_{bx}, MK_x, X_{tx}) + \varepsilon_7$$

$T_{o/x}$ – providing education services to the population of the region

One of the main rules of constructing a multi-factorial empirical model is considered to determine the connection densities among the factors which are selected for the model, namely, to investigate the problem of multicollinearity

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of the connection among the selected factors. To do this, the correlation coefficients among the factors are calculated in order to do this, and when x_i and y_i variables accept the values of $i = 1,...,n$, they are considered the most common indicator which shows the linear relationship between x and y, and the correlation coefficient. It is calculated as follows[25]:

$$r_{xy} = \frac{Cov(x, y)}{\sqrt{Var(x)}\sqrt{Var(y)}}. \quad (1)$$

The value $Cov(x, y)$ in the dividend of the fraction of equation (1) is determined by the following ratio:

$$Cov(x, y) = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$$

and it is called the covariance of the variables x and y and it is found as follows:

$$Cov(x, x) = Var(x),$$
$$Cov(y, y) = Var(y). \quad (2)$$

The correlation matrix among the factors which influence the development of each sector of the service sector in Kashkadarya region, was calculated in the program Eviews 9. For example, we have selected the number of teachers per thousand students in the region, the total expenditures of improving the living standards of the population of the region, the expenditures for public education in the region and providing household goods and computer repair services to the population of the region as factors which influence modeling quality education services. We carry out an autocorrelation analysis in order to determine if there is not multicollenity among these factors (Table 5).

Table 2.
Correlation matrix among factors which influence the educational service sector to the population of the region

Covariance					
	Y7	X_{14}	X_{12}	Y_{11}	X_{19}
Y7	4010.294				
Correlation	1.000000				
t–Student criteria	-----				
Probability	-----				
X_{14}	-138.6083	10.00907			
Correlation	-0.691838	1.000000			
t–Student criteria	-3.454672	-----			
Probability	0.0043	-----			
X_{12}	3329.935	-111.4473	3648.468		
Correlation	0.870547	-0.583200	1.000000		
t–Student criteria	6.378583	-2.588556	-----		
Probability	0.0000	0.0225	-----		
Y_{11}	5322.235	-225.5928	4488.000	7498.544	
Correlation	0.970549	-0.623455	0.558043	1.000000	
t–Student criteria	14.52601	-5.232830	6.023860	-----	
Probability	0.0000	0.0002	0.0000	-----	
X_{19}	23178.60	-871.1318	20535.46	31352.95	137403.0
Correlation	0.987418	-0.542829	0.717173	0.776769	1.000000
t–Student criteria	22.51411	-4.000576	8.298609	16.43436	-----
Probability	0.0000	0.0015	0.0000	0.0000	-----

All above-mentioned factors are taken in order to create a multi-factorial empirical model on the (3) factors which influence the development of each sector of the public service sector, and it is examined how their importance are in the model.

It is expedient to use a linear and hierarchical multi-factorial econometric model on the basis of its evaluation criteria according to its condition for each sector of the service sector.

We use the least squares method to construct and analyze an econometric model between public service sectors and the factors which influence them.

The linear multi-factorial econometric model has the following view:

$$Y = a_0 + a_1x_1 + a_2x_2 + \cdots + a_nx_n \quad (4)$$

Here: y - the outcome factor; $x_1, x_2, ..., x_n$ - Influencing factors.

The following system of normal equations is constructed to find the unknown parameters

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$a_0, a_1, a_2, \dots, a_n$ in the model (4):

$$\begin{cases} na_0 + a_1\sum x_1 + a_2\sum x_2 + \dots + a_n\sum x_n = \sum y \\ a_0\sum x_1 + a_1\sum x_1^2 + a_2\sum x_1x_2 + \dots + a_n\sum x_nx_1 = \sum yx_1 \\ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \\ a_0\sum x_n + a_1\sum x_1x_n + a_2\sum x_2x_n + \dots + a_n\sum x_n^2 = \sum yx_n \end{cases} \quad (5)$$

The hierarchical multi-factorial econometric model has the following view:

$$Y = a_0 * x_1^{a_1} * x_2^{a_2} * \cdots * x_n^{a_n} \quad (6)$$

Here: y - the outcome factor; $x_1, x_2, \dots, x_n$ - Influencing factors.

If we take the substitution in the model (6) by the natural logarithm, then we have the following view:

$$\ln(y) = \ln(a_0) + a_1\ln(x_1) + a_2\ln(x_2) + \dots + a_n\ln(x_n) \quad (7)$$

In model (7), if we make the definitions $\ln(y) = y'$, $\ln(a_0) = a_0'$, $\ln(x_1) = x_1'$, $\ln(x_2) = x_2'$, $\dots$, $\ln(x_n) = x_n'$ then we get the following view:

$$y' = a_0' + a_1x_1' + a_2x_2' + \dots + a_nx_n'. \quad (8)$$

The following system of normal equations is constructed to find the unknown parameters $\grave{a_0}, \grave{a_1}, \dots, \grave{a_n}$ in the model (8):

$$\begin{cases} n\grave{a_0} + \grave{a_1}\sum x'_1 + \grave{a_2}\sum x'_2 + \cdots \grave{a_n}\sum x'_n = \sum y' \\ \grave{a_0}\sum x'_1 + \grave{a_1}\sum x'^2_1 + \grave{a_2}\sum x'_1x'_2 + \cdots \grave{a_n}\sum x'_1x'_n = \sum x'_1y' \\ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \\ \grave{a_0}\sum x'_n + \grave{a_1}\sum x'_nx'_1 + \grave{a_2}\sum x'_nx'_2 + \cdots \grave{a_n}\sum x'^2_n = \sum x'_ny' \end{cases} \quad (9)$$

If this system of normal equations (9) is solved analytically by several methods of mathematics, then the values of the unknown parameters $\grave{a_0}, \grave{a_1}, \dots, \grave{a_n}$ $\grave{a_0}, \grave{a_1}, \dots, \grave{a_n}$ are found.

In order to have multi-factorial empirical models of the processes, several options were calculated in the Eviews 9 program and appropriate results were obtained. For example, builds an empirical model for providing quality educational services to the population of the region is built in table 6 and it is shown their importance using criteria in the evaluation of this model and its parameters.

If there is not autocorrelation in the residuals of the outcome factor, then the value of the calculated DW criterion will be around 2.

Table 2.
Build an empirical model to provide educational services to the population of the region

Method: the least squares method				
Variable	Model coefficients	Standard errors	t-student criteria	P-value
X_{14}	4.954385	0.660405	7.502044	0.0000
X_{12}	-0.282665	0.047388	-5.964887	0.0001
Y_{11}	0.320081	0.078184	4.093951	0.0022
X_{19}	0.169310	0.019435	8.711392	0.0000
C	-263.7938	35.03946	-7.528476	0.0000

R – determination coefficient	0.917418	The average value of the dependent variable	66.87333
Flattened R – determination coefficient	0.906386	The standard deviation of the dependent variable	65.54955
Standard error of regression	3.940818	Akayke's information model	5.841855
The sum of the squares of the remains	155.3005	Schwartz's information model	6.077872
The value of the maximum similarity function	-38.81391	Hannan-Quinn criter.	5.839341
F–Fisher criteria	965.8553	DW-Darwin-Watson criteria	2.369623
Prob(F-Fisher criteria)	0.000000		

It was determined that the value of the DW criterion which were calculated the empirical models which were constructed for each sector of the service sector was higher than the table value. This indicates that there is not autocorrelation in the residues of outcome factor. The Fisher and Student criteria were calculated and the

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calculated value was compared with the table values, the magnitude of it was determined that they were higher than the table values.

The results of the analysis of the empirical models constructed for each sector of the public service sector in the region are presented .

$$Y_7 = \underset{t}{\underset{(-7,528)}{-263,794} + \underset{(7,502)}{4,954} * X_{14} - \underset{(-5,965)}{0,283} * X_{12} + \underset{(4,094)}{0,320} * Y_{11} + \underset{(8,711)}{0,169} * X_{1}}$$

The parameters which were taken into account in the models which were built for each service sector (for linear regression equations) consist of different indicators. Therefore, it is necessary to calculate the coefficients of elasticity in the analysis. For example, we calculated the coefficients of elasticity in the analysis of the model built for the sector of communication and information services to the population of the region (Table).

Table 12.

Elasticity coefficient of the empirical model which is built to provide educational services to the population of Kashkadarya region

$T_{o'k}$- model coefficients of providing education services to the population of the region			
Variable	Model coefficients	Standardized coefficient	Elasticity coefficient
X_{14}	4.954385	0.247513	3.810989
X_{12}	-0.282665	-0.269612	-0.485385
Y_{11}	0.320081	0.437684	0.435337
X_{19}	0.169310	0.991042	1.183737
C	-263.7938	NA	-3.944678

The results of the elasticity coefficient of parameters of the empirical model which is built in Table 12 show that the multifactorial empirical model which is built for the development of educational services to the population of the region (Y_7) gives the following results: if the number of teachers per thousand students in the region (X_{14}) increases by 1%, the volume of providing educational services to the population of the region (Y_7) will increase by 3,81%, if total expenditures related to improving the welfare of the population of the region (X_{12}) increases by 1%, the volume of providing educational services to the population of the region (Y_7) will decrease by 0,49%, if the amount of providing household goods and computer repair services (Y_{11}) increases by 1%, the volume of providing educational services to the population of the region (Y_7) will increase by 0,44%, and if the amount of expenditures for public education in the region (X_{19}) increases by 1%, the volume of providing educational services to the population of the region (Y_7) will increase by 1,18%.

In this regard, the method of econometric modeling was used in order to obtain the planning values of service sectors in the region, and it was made forecast.

We achieved the following efficiency when we analysed them with empirical models: As we can see from the table 13, the consistent implementation of the priorities which was set out in the Decree of our President "On the Action Strategy for the five priority areas of development of the Republic of Uzbekistan in 2017-2021", empirical models which is built in order to develop service sector to the population of Kashkadarya region in the future and forecasting results which are obtained with taking into account the ongoing reforms in this sector, show the followings:

Table 13.

Forecast of service sectors for the population of Kashkadarya region (billion soums / thousand soums)

Indicators	2019 (real)	Forecast years					
		2020	2021	2022	2023	2024	2025
$T_{o'k}$ – providing education services to the population of the region Y_7/	287,90	380,64	501,95	657,77	854,66	1098,7	1397,6
per capita	88,65	115,04	148,96	191,73	244,77	309,3	386,7
	23,86	30,51	39,46	51,52	67,81	89,8	119,4

Providing real estate services (Km_x)

will increase by 1,13 times in 2020 compared to 2019, and by 2,20 times by 2025.

IV. Conclusions

It is expedient to separate econometric modeling of providing education services to the population of the region . Because development of each sector of the service sector has a positive impact on development of another sector. Therefore, the use of econometric models in the form of interconnected equations system has particular importance in development of service sectors. Together with this, the organizational-economic mechanism of development of service sectors represents a hierarchical system of interconnected elements and groups (subjects, objects, principles, forms, methods and tools) at different levels, as well as their interrelationships, innovative infrastructure form relationships with market participants.

According to forecasts which was carried out, the total volume of services which are provided to the population of Kashkadarya region is expected to increase by 3,46 times by 2025, at the expense of saving the current trend. Providing educational services sector is expected to increase by 4.85 times by 2025 compared to 2019, providing health care services sector is expected to increase by 2,68 times by 2025.

It is expedient to pay essential attention to the innovation factor for the sustainable development of the service sector for the population of the region in the future. It is necessary to encourage innovative ideas and newly opened service sectors, to encourage the factors which create conditions for the development of high-quality service sectors for developing and organizing service sectors on the basis of innovation in the region.

It is necessary to econometrically model the management plans for the elimination of imperfections in the way of achieving the social goals which are set for the economic growth and living standards of the population and the development of the living conditions of the population. During 2017-2021 years (also, in next periods), it is expedient to develop long-term forecasts (2020-2025) in order to plan policy and projects which will be accepted as the part of action strategy of regional development of the region, plan technologic modernization and service sectors, intensive development of infrastructure, orient them to the welfare of the population.

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