AJLLSE GLOBAL RESEARCH NETWORK

AMERICAN Journal of Language, Literacy and Learning in STEM Education
Volume 02, Issue 01, 2024 ISSN (E): 2993-2769

Econommetric Modeling of Educational System Development Using Computer Mathematics and ICT

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Abstract: This article develops conclusions and proposals based on econometric modeling of the development, of the educational system using computer mathematics and ICT.

Keywords: computer mathematics, econometric model, empirical modeling, digital economics, transformation, product development, Information Communication Technologies.

1. Introduction.

Taking into account the elements of the educational system using computer mathematics and Information Technology, an important condition for the successful development of educational technologies is, first of all, the professional training of teachers and specialists who control new integrated teaching systems and tools. All participants in the training using computer mathematics and ICT, including the administration of educational institutions, must have the required information literacy and understanding of the technologies used.

The training of specialists and the creation of conditions for the development of personality, which implies the implementation of the capabilities of computer mathematics and modern information technology, are the main goals of the higher professional education system. This task is especially relevant taking into account the high quality of training of personnel in the economic and mathematical direction, which is based on the development and use of information and communication technologies (ICT).

2. Analysis of thematic literature.

Wolfram Research, which created the computer mathematical system, is rightfully considered the oldest and largest scientist in this field. Taking has gone from our analyzes it became known that in a large number of scientific works of foreign scientists, [1,2,3,4] the computer is shown the importance of the mathematical system on its use in the educational system. In some countries, an appropriate certificate is required for this (for example, in the United Kingdom). This simplifies the implementation of information and communication technologies and increases their effectiveness.

Information and communication technologies, changing the scheme of knowledge reflection and teaching methods, actively affect the process of training and education of the student. ICT brings new educational processes to the education system, which are associated with the use of computers and telecommunications, technological equipment, software and computer systems.

They are also associated with the creation of new tutorials, which include electronic textbooks and Multimedia. These include the development of electronic libraries and archives, global and local educational networks.

V.Pankov developed a methodology for using computer mathematical systems in solving problems of economic content in a school mathematics lesson [5]. The method of introducing

computer mathematics systems into the educational system of both the University and the school is Widely represented by R.I.Ivanovsky[6, 7, 8, 9]. Bauman K.V.Titov developed the "systems of computer mathematics" course to introduce students to the latest software of this class and their capabilities related to solving mathematical problems [10, 11]. In his lecture, V.Daneev outlined the possibilities of introducing computer mathematical systems, in particular KMC mathematics, into the educational system [12].

Note that M.I.Ragulina (Omsk State Pedagogical University) considers the methodological possibilities of applying research methodology in the context of the use of computer mathematics systems, and in its implementation is possible to use in the computer mathematical systems [13]. Computer mathematical systems are used not only in secondary and higher special education, but also in the system of continuing education. Computer mathematics systems and their application to education, also considered in the works of M. E. Nadezhina (Samara) [14], T. M. Mi-syuk (Cheboksary) [15], O. A. Golovina (Koryazma) [16] AS Kirsanova (Penza). [17].

A. A.Daxer [18] in his PhD thesis created a model to study the process of improving the effectiveness of the mathematical training of future economics specialists, which is based on the introduction of the mathematical computer mathematical system into the educational process.

3. Research methodology.

The following actions and directions can be taken to develop education using computer mathematics and Information Communication Technologies:

- examination and analysis
- Analysis of how well education is carried out.
- study of new educational technologies;
- the study of new technologies to increase learning from computer mathematics and Information Communication Technologies; for example, the analysis of virtual educational platforms, online training programs, information communication tools and other information technologies;
- study of educational platforms and systems.

These provide online courses, textbooks, video lessons, and educational materials for the development of the educational system. From this it will be useful to look for interactive teaching tools - interactive textbooks, mathematical practices and educational programs for studying computer mathematics and Information Communication Technologies. These tools can help you learn mathematics and information networks. In the process of studying practices and projects, projects and practical training can be used to test mathematics and Information Communication Technologies in practice. It is especially important to observe the latest innovations, technologies and textbooks in the field of computer mathematics and Information Communication Technology. Innovations in this area are considered important for to be able to take your knowledge and skills to new levels.

As for the problem of our research, with the help of this funds, it is possible to fill in the gaps in the preparation of objects that prevent a person from successfully mastering the new content of educational and professional competencies and be used as a necessary tool in the use of ICT. The process of studying mathematical statistics and econometrics using ICT (in particular, Mathematica systems) is carried out in several stages:

- motivational (studying the material in the first year, students get acquainted with basic mathematical concepts, methods, criteria, etc.);
- preparation (second and third courses, in which students get acquainted with the basic concepts and methods of studying and analyzing statistical and economic data);
- research (fourth year, students try themselves as independent creators and the teacher acts as an assistant);

- evaluator (study material in the master's program, where the student independently finds a solution Bowl

Computer mathematics plays an important role in the management of the activities of exhibition weapons, students in the teaching of subjects, since it helps to implement the basic principle, as well as the formation of concepts, methods, maintaining interest in mathematics , leading to a high level of development of mathematical culture, mathematical language, logical thinking, validity of judgments. The proc of processing educational material presented in oral form is basically one-channel, and it is difficult to perform mental operations and program understanding (the efficiency of mastering oral information does not exceed 30%). On the other hand, the researchers found that about 90% of all the information that a person receives about the world around him, he receives with the help of vision, 9% - through hearing and only 1% - through the rest of the senses [19]. The best perception is provided by the combination of the image with verbal information ("word - clarity"). Many at the same time with visual perception

3. Analyzes and Main results.

Correlation analysis is based on determining correlation coefficients and assessing their importance,reliability. Calculation formula of the linear correlation coefficient:

$$r_{yx} = \frac{\overline{yx} - \overline{x} \cdot \overline{y}}{\sigma_x \cdot \sigma_y}$$

Where, σ_x and σ_y are, respectively, the mean deviations of the variables, x and y and are calculated using the following formulas:

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n}}, \quad \sigma_y = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \overline{y})^2}{n}}$$

Or

$$r_{yx} = \frac{\operatorname{cov}(x, y)}{\sigma_x \cdot \sigma_y} = \frac{\frac{1}{n}\sum(x_i - \overline{x})(y_i - \overline{y})}{\sigma_x \cdot \sigma_y}$$

We found it necessary to use trend models in assessing the development processes of educational services for the population of the Kashkadarya region. From providing educational services to the residents of the region, we have formed trend models in the N-indicator and exponential view of the development of each. To do this, we used the least quadratic method in generating trend models of the process.

$Y_x = a_0 + a_1 x + a_2 x^2 + \cdots + a_k x^k$ to form a trend model, the following must be done:

$F = \sum(Y - Y_x)^2 \to min$ or $F = \sum(Y - Y_x)^2 \to min$

If we can derive a partial derivative from this, we get the system of equations shown below.

$$\begin{cases} \sum Y = a_0 n + a_1 \sum x + a_2 \sum x^2 + \cdots + a_k \sum x^k \\ \sum Yx = a_0 \sum x + a_1 \sum x^2 + a_2 \sum x^3 + \cdots + a_k \sum x^{k+1} \\ \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ \sum Yx^k = a_0 \sum x^k + a_1 \sum x^{k+1} + a_2 \sum x^{k+2} + \cdots + a_k \sum x^{2k} \end{cases}$$

$Y_x = a_0 e^{a_1 x}$ For the formation of a trend model , the following work should be done:

To do that, we're going to take the natural log of both sides of the equation.

$$\ln Y_x = a_1 x + \ln a_0$$

$F = \sum(\ln Y - \ln Y_x)^2 \to \min$ or $F = \sum(\ln Y - \ln a_0 - a_1 x)^2 \to \min$

If we take a partial derivative from this, we get the following system of equations:

$$\begin{cases} \sum(\ln Y) = n \ln a_0 + a_1 \sum x \\ \sum(x \ln Y) = (\ln a_0) \sum x + a_1 \sum x^2 \end{cases}$$

We evaluate the results with the following evaluation criteria:

The Fisher F-measure is used to evaluate the significance of the regression equation. This amount of F-criterion is related to the coefficient of determination as follows:

$$F_{real} = \frac{r_{xy}^2}{1 - r_{xy}^2} \cdot (n-2), \mathrm{n} \geq 3.$$

If $\alpha = 0{,}05$ (five percent significance rate) and the degrees of freedom $k_1 = 1$ are $k_2 = n - 2$, then we find the table value of the criterion from the - F – tables of Fisher's distribution of F_{table} random variables. If this $F_{real} > F_{table}$ inequality holds, the regression equation is statistically significant.

Errors in the regression equation and random errors in the calculation of the parameters a and b the r_{xy} correlation coefficient are also affected. Therefore, standard errors m_a, m_b in the calculation of the parameters "a" and "b" are detected.

The random error of the regression coefficient is determined by the following formula:

$$m_b = \sqrt{\frac{\sum(y - y_x)^2 / (n-2)}{\sum(x - \bar{x})^2}}.$$

The random error of the regression equation parameter is given by the following formula:

$$m_a = \sqrt{\frac{\sum(y - y_x)^2}{n-2} \cdot \frac{\sum x^2}{n \cdot \sum(x - \bar{x})^2}}.$$

The random error of the linear correlation coefficient is determined by the following formula:

$$m_r = \sqrt{\frac{1 - r^2}{n-2}}$$

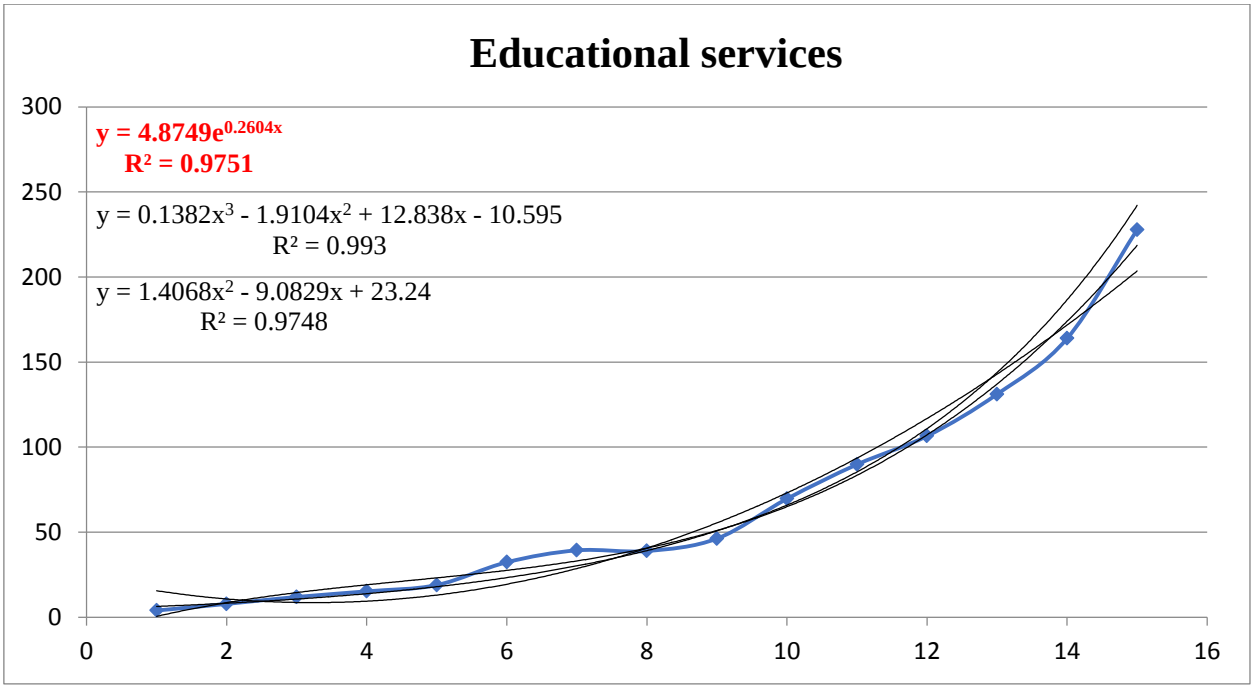
Evaluating the statistical significance of the parameters of the regression equation can also be done using the Student-t criterion (where the number $n-2$ and $\alpha = 0{,}05$ of degrees of freedom and the table values of the character t are found in the Student distribution table). It shall be calculated as:

$$t_a = \frac{a}{m_a}, \quad t_b = \frac{b}{m_b}, \quad t_r = \frac{r_{xy}}{m_r}.$$

The parameters are statistically significant if the original values of t found are greater than its table value ($t_a > t_{table}$, $t_b > t_{table}$, $t_{rxy} > t_{table}$ i.e., , ,), and the parameters are not statistically significant.

We define each service network as Y, and then use the observations to generate trend models over time t.

Table-1. Trend model of the volume of educational services to the population of Kashkadarya region



As you can see in the graph, when we choose an exponential function, we get a regression equation with the exponential function $y = 4{,}8749e^{0{,}2604x}$, where $R^2 = 0{,}9751$ and the exponential function is the educational function, with an F-criteria score of 507, t-criteria is 22.52. When we choose a linear function, we get a linear regression equation where $R^2 = 0{,}993$ and $y = 0{,}1382x^3 - 1{,}9104x^2 + 12{,}838x - 10{,}595$. This gives an F-criteria count of 1844.14 t-meson is equal to 42.94 Table 1.

Table 2. Trend models of services and service sector in Qashqadarya region by sectors

Types of services	Regression equations	F-criteria	t-criteria
Educational services	$Y_1 = 4{,}874e^{0{,}260t}$ $R^2 = 0{,}975$	507	22,52
	$Y_2 = 0{,}138t^3 - 1{,}910t^2 + 12{,}83t - 10{,}59$ $R^2 = 0{,}993$	1844,14	42,94

On the basis of the trend models , we calculated that the forecast of the 5-year development process of service industries can reach the following result (Table 2).

Table-3. Forecast of educational services in Qashqadarya region obtained through trend models (in billions)

Indicators	2023 year	2024 year	2025 year	2026 year	2027 year	2028 year	2029 yer
Educational services	312,28	405,0	525,3	681,2	883,52	1145,9	1486,1

The service sector is expected to grow 1.3 times in 2024 compared to 2023 and 4.75 times by 2029 compared to 2023.

5. Conclusion and suggestions.

In conclusion, our analysis shows the need to study the specific scientific and methodological foundations of the management system of the education service sector, to determine the main directions of activity in this sphere, to develop a mechanism for effective management of its activities, to create an effective management system in education, as well as to form the structure of management activities. Increasing the effectiveness of management mechanisms in the educational and service sectors of the region, effective entity of the organizational and economic mechanism of the sector should be considered as the main direction in the process of ensuring economic development.

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