

EFFICIENCY OF USING INFORMATION TECHNOLOGIES FOR THE FORMATION OF STUDENTS' ECONOMIC KNOWLEDGE

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Abstract. *The article highlights the possibilities of using interdisciplinary integration by teachers of higher education institutions in preparing students for future professional activities, and describes interdisciplinary integration as a process of harmonizing curricula in the context of unified, continuous and comprehensive development of professional activities. The main part of our article briefly describes the practical significance of the subject "Econometrics" in the preparation of bachelors of economic sciences for future professional activity, which allows to reasonably forecast the economic development of enterprises, study the existing risks and use them to evaluate management decisions. It is also noted the possibility of training students through the introduction of decision-making processes in the conditions of modernization of enterprises, analysis of their economic performance and effective use of econometric methods and models, including modern information technologies, in solving practical problems in this area. The article presents a variety of software products for solving econometric problems using information technologies, including: spreadsheets (MS Excel, OpenOffice.org Calc), statistical software packages (SPSS, STATISTISA, STATGRAPHICS), programs specialized in solving econometric problems (Econometric Views, STADIA, Matrixer 3.4), mathematical packages (Mathcad, Matlab, Maple, Mathematica) and others.*

Keywords: *interdisciplinary integration, information technology, econometrics, methods of statistical analysis of correlation and regression, MS Excel spreadsheet, library of functions, trend line, forecasting.*

1. Introduction

In modern society, the level of development of a country is determined not only by the state of its economic potential, but also by the professional qualifications of specialists trained in higher educational institutions. The modern labor market places high demands on the qualifications and professional training of future specialists, and this in turn leads to increased competition among graduates. It is known that today, with the rapid development of science and technology, the volume of many scientific knowledge, concepts and ideas is growing rapidly. . This, on the one hand, ensures its differentiation with the formation of new industries and areas of science and technology, and on the other hand, breaks the prevailing boundaries between sciences and creates a process of integration.

Integration (Latin: Integratio - "restore", "replenish", "connect") refers to the process of merging parts into one whole. Interdisciplinary integration is considered as a process of mutual coordination of curricula in the conditions of a unified, continuous and comprehensive development of professional activity, and interdisciplinary integration in terms of skills formation becomes the logical basis for the self-development of a future specialist.

Interdisciplinary integration in the modern understanding is the linking of all components of the educational process of a logical direction (goals, results, content, forms and methods of teaching). It is also characterized by the content and technological connection of disciplines, current scientific and practical problems between the content and technology of professional activity of future specialists [1].

The education and training of students, their preparation for conscious engagement in their chosen profession by teachers, as well as how to organize the educational process for creativity and work are influenced by curricula, classroom resources, technical and methodological support, etc. At the same time, the learning process will be effective if it stimulates students' desire to obtain specific active knowledge and arouses their desire.

The educational material is a pedagogically correct and understandable system of knowledge, fully assimilated by students, with a clearly defined goal. The content of any subject, taking into account standard programs and standards of professional education taught in higher education, should determine the following principles and requirements:

- coordination of the current state and prospects for the development of science, technology and technological processes in relevant sectors;

- correct construction of the educational process in the development of education and training of qualified specialists;

- implementation of the principles of general and professional didactics, which is the scientific and technical basis of science as a whole;

- the presence of components that develop the technical thinking of students and contribute to the formation of the potential of future specialists in accordance with their chosen profession, etc.

In turn, professional didactics includes the following principles:

- demonstrativeness, systematization and continuity of knowledge, accessibility and expediency, conscious and active participation in the learning process, the strength of students' knowledge, the connection of theory with practice, the connection of learning with life, scientific teaching, the effectiveness of students' [2].

The subject program "Information complexes and technologies in economics" in the field of education 5230900-Accounting and Auditing (by industry) was approved in 2020 jointly with the Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan and the Tashkent Financial Institute. Based on the approved scientific curriculum, teachers emphasize the need for students to use information and communication technologies (ICT) in solving economic problems, using them to develop analysis, decision-making, knowledge, skills and abilities for practical application. economics knowledge, etc. [3].

Also in the scientific program "Econometrics", approved by the above organizations in 2020, professors and teachers are shown how to teach 3rd year students in this direction the modernization of the economics of enterprises, the introduction of decision-making processes, training in the effective use of econometric methods and models, as well as modern information technologies in analysis their economic activities [4].

In this article, based on the above, we will focus on the relevance of the use of interdisciplinary integration by professors and teachers of higher education in preparing students for future professional activities.

In the scientific article "Systematic review of interdisciplinary teaching and learning in higher education" by Elisabeth J.H. Spelt and other foreign scientists, they focused on the low

level of interdisciplinary thinking in the subjects taught to students, on the factors motivating the acquisition of knowledge from two or more disciplines, their integration and development of logical thinking [5]. In his article "Interdisciplinary Trends in Higher Education," W. James Jacob noted that economics is built on modern knowledge and requires a skilled workforce and leadership to help meet the many challenges and needs that governments and societies face today. The author also emphasizes that higher education institutions cannot teach graduates to solve all current and emerging problems using a single educational source, and that interdisciplinary approaches are an important basis for meeting the urgent needs of university students today [6].

In their article "Factors of interdisciplinary integration in improving the quality of professional and pedagogical training of higher school students," Russian scientists B.N. Tokurenova and others examined the problem of interdisciplinary integration in the process of professional and pedagogical training of masters. This study also reveals the importance and significance of interdisciplinary integration as a single, unifying principle that promotes systematic thinking of students, ensuring the creation of new, integrated content, as well as the readiness and ability of graduates to implement professional competencies in solving interdisciplinary scientific problems. and practical problems [7].

G.V. Rylova's article "Interdisciplinary integration as a tool for improving the quality of training of future specialists" discusses methods and forms of organizing the educational process as one of the factors for improving the quality of training of future specialists, mechanisms of interdisciplinary integration, modular training technology [8].

Among the scientists of Uzbekistan, in the first chapter of M.H. Lutfullaev's doctoral dissertation on the topic "Theory and practice of integrating information technologies in improving the educational process in higher education (using the example of computer science and natural sciences)," the theoretical and practical aspects of improving the process are considered. They were designed. This chapter also develops the pedagogical and psychological aspects of creating electronic aids, which are presented in relation to a traditional textbook, presentation of educational materials, their search, quick change of information, etc. [9].

The second chapter of D.O. Himmataliev's doctoral dissertation on the topic "Integration of pedagogical and technical knowledge in the diagnosis of professional training (using the example of "Vocational education" in higher education)" entitled "Mechanisms for the integration of pedagogical and technical knowledge in diagnostics" covers the issues of professional training, issues of integration in technical higher education, integration of pedagogical and psychological theoretical and practical knowledge, interdisciplinary integration, integration of pedagogical and technical knowledge in the diagnosis of professional training and improving the competence of students [10].

2. Materials and methods

In preparation for the future professional activity of bachelors in the field of economics, students are expected to study the subject "Econometrics" or its individual sections as part of the main curriculum. The practical significance of the science of econometrics is that it evaluates the economic consequences of management decisions, allowing one to quantify the existing connections between events, make a reasonable forecast of economic development in a given situation, study existing risks and give their quantitative assessment. Econometric analysis provides the basis for economic analysis and forecasting and enables economic decision-making. The objectives of econometrics are to teach students the effective use of econometric methods and models, as well as modern information technologies in the implementation of decision-making

processes in the field of modernization of the economy of enterprises of different forms of ownership, analysis of their economic activities. and solving practical problems in this area.

Econometrics is a science in which, based on economic theory and real statistics, mathematical models of mass economic phenomena are built to quantify or refute certain economic assumptions and predict relevant economic indicators. Thus, the object of study of econometrics is real economic processes, the subject of which are the quantitative properties of relations in the economy.

Using the capabilities of modern computing technologies, today's computer software systems make it possible to organize tasks of statistical data processing, correlation and regression analysis, modeling and forecasting at a high quality level.

Correlation is a method of statistical analysis that allows us to determine whether a relationship exists or does not exist between variables and its strength.

Regression is a method of statistical analysis used to describe the nature of the relationship between variables (direct or inverse, linear or nonlinear).

3. Results.

Many software products exist to solve econometric problems using information technology. These include: spreadsheets (MS Excel, OpenOffice.org Calc, etc.), general statistical software packages (SPSS, STATISTISA, STATGRAPHICS, etc.), programs specializing in solving econometric problems (Econometric Views, STADIA, Matrixer 3.4, etc.), general purpose mathematical packages (Mathcad, Matlab [11], Maple, Mathematica, etc.).

The Microsoft Excel spreadsheet is one of the most effective and convenient means of digital processing of econometric data, which is effective at the stage of teaching econometrics. This software product has the advantages of having methodological assistance in solving econometric problems, wide popularity, flexibility with many statistical software packages, the ability to perform calculations using a large number of mathematical and statistical functions, calculation of the distribution of random variables and many other advantages. Practical classes in econometrics are conducted in computer laboratories, and this process ensures that students complete laboratory work. Laboratory work should include professionally oriented tasks, the solution of which should regularly introduce the content of the econometrics course and ensure its successful completion, demonstrate to students the importance of econometrics in their future professional activities and interdisciplinary integration.

Problem. Based on the statistics of Table 1, consider the dependence of annual revenue (variable y , million soums), given for twelve transport enterprises, on the average annual number of trucks (variable x).

Table 1. Statistics obtained from transport companies

n	1	2	3	4	5	6	7	8	9	10	11	12
x	15	18	22	25	27	31	34	37	40	45	48	48
y	235	250	247	260	287	262	307	280	357	410	389	311

Solving. This problem using statistical analysis methods of correlation and regression using an MS Excel spreadsheet and carry out the forecasting process.

We check, based on the source data, whether there is a relationship between the variables in this problem.

Table 2. Calculation of values corresponding to the problem

	A	B	C	D	E	F
1	<i>n</i>	<i>x</i>	<i>y</i>	<i>x</i>²	<i>y</i>²	<i>xy</i>
2	1	15	235	225	55 225	3 525
3	2	18	250	324	62 500	4 500
4	3	22	247	484	61 009	5 434
5	4	25	260	625	67 600	6 500
6	5	27	287	729	82 369	7 749
7	6	31	262	961	68 644	8 122
8	7	34	307	1 156	94 249	10 438
9	8	37	280	1 369	78 400	10 360
10	9	40	357	1 600	127 449	14 280
11	10	45	410	2 025	168 100	18 450
12	11	48	389	2 304	151 321	18 672
13	12	48	311	2 304	96 721	14 928
14	Bcero	390	3 595	14 106	1 113 587	122 958

To do this, first of all, using a MS Excel table, we display the following values in accordance with table 1.

The correlation coefficient is checked at the following time intervals:

change interval -1 and 1;

Close to -1, strong negative linear correlation;

Close to +1, strong positive linear correlation;

Near 0 there is a weak linear relationship.

The formula for calculating the correlation coefficient is as follows:

$$R = \frac{n \sum xy - \sum x * \sum y}{\sqrt{(n * \sum x^2 - (\sum x)^2) * (n * \sum y^2 - (\sum y)^2)}} \quad (1)$$

$$R = \frac{12 * (122958) - (390) * (3590)}{\sqrt{[12 * (14106) - (390)^2] * [12 * (1113587) - (3590)^2]}} = 0,846$$

Let's consider two different ways to automatically calculate the solution to the above problem. For this we use the f_x function library of the MS Excel spreadsheet.

The Function Library is a standard set of functions in the Insert Function of an MS Excel spreadsheet. In it, functions are sorted by fields and activated using the f_x -key on the toolbar [13].

Method 1: In the first method, we use the CORE square root function. In cell A16 enter R=, in cell B16 enter =(12*F14-B14*C14)/SQRT((12*D14-B14^2)*(12*E14-C14^2)) and press ENTER to get result.

Method 2. In the second method, we use the CORREL function from the f_x category - Function Library → “Statistical”. Then enter R = in cell A17, =CORREL(B2: B13, C2: C13) in cell B17 and press ENTER to get the result. We can see that the results are the same in both cases.

To check the result at a confidence level of $\alpha = 0,05$, use the following formula:

$$t = \frac{R}{\sqrt{\frac{1-R^2}{n-2}}} \quad t = \frac{0,846}{\sqrt{\frac{1-0,716}{12-2}}} = 5,015$$

Here ($n - 2$ degrees of freedom). Based on the t-test statistics, we can conclude that there is a strong positive correlation between, $R = 0,846 \rightarrow x$ and y [14].

In the next step, we build a linear pairwise regression model, corresponding to the regression statistical analysis method, to describe the nature of the relationship between the variables. Its parameters are estimated using the ordinary least squares method. Its formula is as follows:

$$Y = bX + a \quad (3)$$

To determine the coefficients of the regression equation, we use the following formulas:

$$a = \frac{\sum y * \sum x^2 - \sum x * \sum xy}{n * \sum x^2 - \sum x * \sum x} \quad a = \frac{3595 * 14106 - 390 * 122958}{12 * 14106 - 390 * 390} = 160,58$$

$$b = \frac{n * \sum xy - \sum x * \sum y}{n * \sum x^2 - \sum x * \sum x} \quad b = \frac{12 * 122958 - 390 * 3595}{12 * 14106 - 390 * 390} = 4,2771$$

Based on the above formulas, you can derive the values of a and b using an MS Excel spreadsheet. Also, for a complete regression analysis of the problem in a MS Excel table, you must first enter the “Data Analysis” - Data Analysis item. To do this, in the MS Excel table, select “File” → “Options” → “Add-ins” → “Management” → “Excel Add-ins”, use the “Go...” button to select “Analysis package” and press OK. After this, in the “Data” menu section, the data analysis (information) item “Data Analysis” will be created. Using this point, questions can be analyzed using a number of methods. One of them is this method of regression analysis. Below we will look at regression analysis of this problem. The data analysis item “Data Analysis” is launched and “Regression” is selected, in the range from “Input interval Y:” to the table (C2:C13) and in accordance with “Input interval X:” (B2:B13), the specified numbers are entered from using the mouse. In accordance with the “Output parameters” item, specify the output location and click OK. After this, the results of regression statistical analysis of this task are displayed.

4. Discussion

Another method for speeding up the solution of a particular problem using an MS Excel spreadsheet is to create a trend line on this scatter plot. A trend line in an MS Excel spreadsheet is a graph of the approximate forecasting function based on the statistics provided. This approximate prediction helps determine the outcome by increasing the number of x and y values to plot the function [14]. To solve the problem using a trend line in a scatter plot, the following work is carried out;

1. Use the mouse to select the range from B2: C13;
2. In the “Insert” menu section, select “Diagrams” → “Scatter” → “Scatter with straight lines and markers”;
3. On the resulting chart, right-click on any point, select the “Add trend line..” command and select “Show equation on chart” to create the following chart (Figure 1)

Thus, the regression equation coefficients corresponding to the least squares equation were determined using an MS Excel spreadsheet, and their values were: $a = 160,6$; $b = 4,277$. The regression equation has statistical significance at $\alpha = 0,05$: observed F-statistic value is 25,15; The critical value of Fisher's test is 4,96; the detection coefficient is 0,716. The value of coefficient b of the regression equation shows that an increase in the number of cars by one leads to an average annual increase of 4,277 million soums.

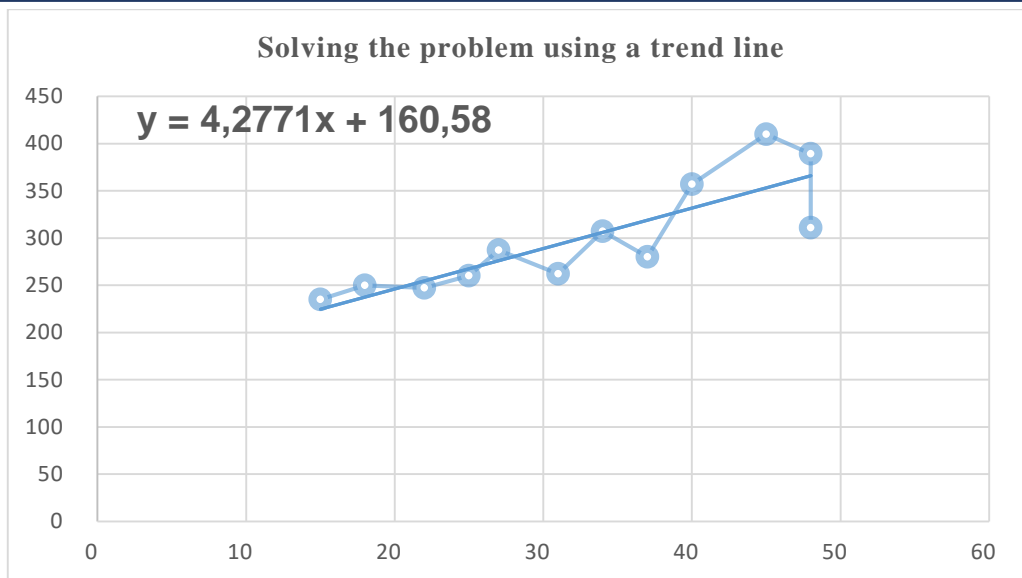


Figure 1. Description of this problem using a trend line

5. Conclusions

1. Due to the rapid development of industry and the economy, the changing worldview of people and the need for innovation, every year new disciplines appear in the process of higher education aimed at solving professional problems. When there is a need for such special disciplines as “Digital Economy”, “Investment Project Management”, “Enterprise Economics and Innovation Management” and others, it is difficult to find interdisciplinary connections with other cyclical disciplines [15].

2. With the regular use of integrated tasks performed in practical and laboratory classes when teaching students, professional activities carried out through interdisciplinary integration allow us to deepen the assimilation of acquired knowledge [16].

3. A graduate who has perfectly mastered professional skills will be able to successfully compete in the labor market and achieve creative thinking in solving problems related to professional activities.

Advanced experts will agree that interdisciplinary integration must be introduced into the educational process of higher education using interactive pedagogical methods, hardware and software when preparing students for professional activities [17].

4. In improving the quality of education and preparing students for professional activities, the use of interdisciplinary integration leads to effective results [18].

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