Modeling of economic processes and application of software in educational process for the development of economic competencies

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Abstract. The article shows the practical application of software in the educational process in the study of economic disciplines. The analysis of economic model of attraction of investments in social and economic cluster and the software developed on it at modeling of level of profitability of budgets of different levels – federal, regional and local, under the influence of various factors is given.

1. Introduction
There are different models in various fields of science and technology today, in the age of innovation [1]. The economy is one of the sectors that are more actively developing, changing and therefore visibility in its teaching is one of the most important areas. There are also many mathematical, computer and other models in all areas of the economy. At the same time, there was a sharp jump in the development of technology, software, which allowed optimizing not only production, but also teaching [2].

The article presents the author software product used in teaching law students in the discipline "Economics" of higher and secondary special educational institutions [3]. For training of specialists of the judicial profile authors developed the software which allows modelling the level of the income in budgets of various levels – federal, regional, local, under the influence of various factors (figure 1).

Figure 1. Start window of the software product “Modeling of investment attracting to the cluster of social objects”
The authored software product was developed and used in the educational process for the development of new material and skills related to the development of professional competencies in the discipline "Economics". This makes it easier for students to master them [4].

The developed software product "Modeling of attracting investments to the cluster of social facilities" allows calculating:

- projected tax revenues to budgets of all levels and to the regional budget (figure 2) [5];
- calculation of tax revenues from attracting investments to the regional budget when applying for a tax credit. At the same time, the amount of funds for development can be changed and analysed, discussed about the changes that the program automatically performs. The analysis of factors that affect the increase or decrease in the level of budget profitability at all levels (figures 3, 4).

| Economic sectors of industry and infrastructure services of O&G cluster enterprises | Share in total production (\%) | Profit tax | Excises | Income tax | Transport tax | Wealth of companies tax |
|-----------------------------------------------|------------------|------------|----------|------------|---------------|-----------------------|
|                                               |                  | ξ percent | η percent | ζ percent | η percent | ζ percent | η percent | ζ percent | η percent | ξ percent | η percent | ζ percent | η percent | ζ percent | η percent |
| Transport companies                           | 6                | 0.22      | 0.21     | 0.17      | 0.22         | 0.21      | 0.17      | 0.22         | 0.21      | 0.17      | 0.22     |
| Timber industry complex                       | 6                | 0.28      | 0.24     | 0.12      | 0.22         | 0.24     | 0.12      | 0.22         | 0.24     | 0.12      | 0.22    |
| Chemistry and petrochemistry                 | 6                | 0.13      | 0.11     | 0.09      | 0.22         | 0.11     | 0.09      | 0.22         | 0.11     | 0.09      | 0.22   |
| Engineering                                   | 8                | 0.26      | 0.21     | 0.12      | 0.22         | 0.21     | 0.12      | 0.22         | 0.21     | 0.12      | 0.22  |
| Lifting mechanisms and cranes                | 5                | 0.28      | 0.22     | 0.09      | 0.22         | 0.22     | 0.09      | 0.22         | 0.22     | 0.09      | 0.22 |
| Mining and materials production              | 6                | 0.24      | 0.16     | 0.30      | 0.22         | 0.16     | 0.30      | 0.22         | 0.16     | 0.30      | 0.22 |
| Construction and installation sector enterprises | 30             | 0.20      | 0.19     | 0.03      | 0.22         | 0.19     | 0.03      | 0.22         | 0.19     | 0.03      | 0.22 |
| Infrastructure                               | 4                | 0.88      | 0.14     | 0.05      | 0.22         | 0.14     | 0.05      | 0.22         | 0.14     | 0.05      | 0.22 |
| Fuel and energy complex                      | 10               | 0.21      | 0.22     | 0.13      | 0.22         | 0.22     | 0.13      | 0.22         | 0.22     | 0.13      | 0.22 |
| Urban infrastructure                         | 8                | 0.18      | 0.17     | 0.21      | 0.22         | 0.17     | 0.21      | 0.22         | 0.17     | 0.21      | 0.22 |

Figure 2. Calculation of tax to the regional budget in various complexes
Figure 3. Calculation of tax revenues (the amount of development of 500 million rubles)

Figure 4. Calculation of tax revenues (the amount of development of 200 million rubles)
2. Results
The software product introduced the dependence of the share of contributions of various taxes at budget levels, taking into account the current practice of income.

The proposed model allows determining the amount of tax revenues to the regional budget in the development of funds $\chi$ aimed at solving the social problem: the production of new housing and the development of appropriate urban infrastructure.

The amount of income from the work on the development and operation of social facilities in this case can be determined by the formula:

$$F_1 = \sum_{i=1}^{m} \sum_{j=1}^{l} x_i \alpha_{ij} \beta_{ij} \gamma_{ij},$$

where $x_i$ – the share of the i-th type of work in total production, where $m$ – the number of works on the functioning and operation of social facilities;

$\alpha_{ij}$ – the share of the j-th tax in the i-th type of work, where j – types of taxes paid to the regional budget;

$\beta_{ij}$ – the rate of the j-th tax in the i-th type of work;

$\gamma_{ij}$ – the share of contributions of the j-th tax in the i-th type of work in the regional budget.

The development of funds as a result of the development and operation of social facilities inevitably entails an increase in the volume of work in related sectors of the economy, at the expense of which the filling of the regional budget is also carried out.

The revenues to the regional budget from related industries (engineering, chemical and petrochemical industries, mining, timber industry, fuel and energy complex, light industry, transport) can be defined as:

$$F_2 = \sum_{i=1}^{m} \sum_{j=1}^{l} x_i' \alpha_{ij}' \beta_{ij}' \gamma_{ij}' k_i,$$

where $x_i'$ – the total amount of invested funds;

$v_i'$ – the share of the type of work in the related sector of industry;

$\alpha_{ij}'$ – the share of tax in the value of work, at the same time, j varies from 1 to l, where j – types of taxes paid to the regional budget;

$\beta_{ij}'$ - the tax rate;

$\gamma_{ij}'$ – the share of deductions for j-tax to the regional budget;

$k_i$ - the coefficient of participation of the i-th type of work in related industries.

Among other measures aimed at solving the housing problem, it is proposed to provide a tax credit for the profit of enterprises, which is invested in the creation of social facilities. In this case, the company, returning it, pays the appropriate interest for the use of the loan. The authors assume that $S_n$ is the amount of the tax credit, $C > 0$ is the loan rate, $T$ – the period of time for which the loan is granted-the number of days of use of the tax credit, $F_3$ is the amount received by the regional budget for the use of the loan. The amount of payment for the use of tax credit can be expressed by the following dependence:
\[ F_3 = S_n \frac{C}{T} K_{kd}, \]

As a result, the total amount of tax revenues to the regional budget through the development of funds provided in the form of, for example, a tax credit, will be:

\[ F_4 = (F_1 + F_2 + F_3). \]

The software product offers a model of economic development of the cluster subjects, reflecting the distribution of financial resources among the enterprises of the cluster, which allows determining the amount of tax revenues to the budget of the region.

Let \( X_s \) is the volume of disbursements during the year in the \( S \)-th sector of the region’s economy, \( V_i \) is the volume of investment (in shares), which will be used to perform the \( i \)-th \((i=1, n)\) type of work (services) in different sectors of the economy. The sector of economy is considered as a set of legal entities, subjects of economic space and it is different in elements and their number of sets. All these elements intersect to a large extent (because of the different enterprises can simultaneously work in different sectors), but the amount of investment that will fall on a particular type of work (services), to a significant extent depends on the specific set in which this type of work will be in demand.

Let \( \alpha_{ij} \) is share of the \( j \)-th \((j=1, m)\) of tax in the total tax burden on the \( i \)-th kind of work performed; \( \beta_{ij} \) is the rate of contributions for the \( j \)-th tax in the implementation activities of the \( i \)-th type of work; \( \gamma_{ij} \) is amount of deductions for the \( j \)-th tax of the \( i \)-th type of work to the regional budget; \( K_{ri} \) is the coefficient of mutual participation of the \( i \)-th type of work in the implementation of related \( r \)-th \((r=1, n)\) works in this sector of the economy.

As a result, the amount of tax revenues from the \( i \)-th type of work can be calculated by the formula:

\[ F_i = \sum_{j=1}^{m} X_s V_i \alpha_{ij} \beta_{ij} \gamma_{ij} K_{ri}, \tag{1} \]

The total amount of tax revenues to the regional budget in the development of the total amount of investment \( X_s \) in a particular sector of the economy is determined as follows:

\[ F_s = \sum_{i=1}^{n} \sum_{j=1}^{m} X_s V_i \alpha_{ij} \beta_{ij} \gamma_{ij} K_{ri}. \tag{2} \]

The proposed expression is invariant (independent) in relation to any sector of the economy, various socio-economic problems and the region in which investments are made. It is obvious that many types of work, both in elements and in their number, will vary for different sectors of the economy, as well as the coefficient \( K_{ri} \), while the values of \( \alpha, \beta, \gamma \) do not depend on which industry the investment is made [6].

Provided that the loan for the purchase of housing is provided for 5 years, the regional budget for the 6th year of the program will receive 601.6 million rubles, i.e. 20% more than the amount of tax credit [7].

In addition to the implementation of the economic model of the NAME of the main advantage of the program is the visualization given by the teacher. Data analysis is performed initially on two parameters (figure 5):

- Economic sectors of industry;
- Types of taxes.
Table 1. Tax revenues to the regional budget for the development of funds in the object of social purpose (OSP) cluster in the amount of 500 million rubles

| Economic sectors of industry and infrastructure services of OSP-cluster enterprises | Profit tax | Excises | Income tax | Transport tax | Wealth tax | Total taxes |
|-----------------------------------------------------------------------------------|-----------|---------|------------|---------------|------------|-------------|
| Transport companies                                                               | 1.15      | 0.57    | 4.95       | 0.05          | 6.72       |
| Timber industry complex                                                            | 1.52      | 0.66    | 3.60       | 0.04          | 5.82       |
| Chemistry and petrochemistry Engineering                                           | 0.91      | 19.08   | 0.40       | 1.80          | 22.22      |
| Lifting mechanisms and cranes                                                     | 1.75      | 0.76    | 4.80       | 0.07          | 7.38       |
| Mining and materials production                                                   | 1.22      | 0.50    | 2.25       | 0.01          | 3.98       |
| Construction and installation sector enterprises                                   | 1.68      | 0.58    | 12.00      | 0.08          | 14.34      |
| Service companies (insurance, banking, educational, marketing services)           | 6.82      | 3.37    | 8.78       | 0.04          | 19.01      |
| a) Fuel and energy complex (FEC)                                                  | 1.30      | 0.26    | 0.90       | 0.01          | 2.47       |
| Urban infrastructure                                                              | 1.80      | 1.00    | 9.00       | 0.10          | 11.9       |
| Total taxes                                                                        | 19.10     | 19.08   | 8.56       | 54.38         | 101.6      |

Figure 5. Choice of data analysis criterion
To specify the TYPE OF SECTOR or TYPE OF TAX

**Figure 6. Parameter choice**

It is possible to build more than 30 diagrams and histograms as a visual representation (figures 7, 8).

**Figure 7. Visualization of the process «Hoists and cranes» in economic sector**
To systematize and process the data on the calculation of the volume of tax revenues in general to the budgets of all levels, the programming language Visual Basic for Applications for MS Excel was used, which allowed automating visualization, which is an integral condition of application in the classroom [8], i.e. it is fast and convenient to work with the software product "Modelling of attracting investments in a cluster of social facilities" (certificate of state registration of Russian Russian Federal Service for Intellectual Property computer programs No. 2016617948 of September 16, 2016). In the future, it is planned to add information, data for calculations, while the VBA programming language allows responding quickly to the needs of users and, if necessary, supplementing the program with new modules.

3. Conclusion
The software product includes a system of clustering factors and a method of their calculation which is used to perform a cluster analysis of the industrial sector of the regional economy.

The program calculates the projected amount of tax revenues in general to the budgets of all levels and to the regional budget, the amount of tax revenues from attracting investments to the regional budget in the application of tax credit attracted to the cluster of social facilities on the example of the construction cluster of the region in the context of economic sectors of industry.

The visualization of economic development of the subjects of the cluster, reflecting the distribution of financial resources among the enterprises of the cluster allows determining the amount of tax revenues to the budget of the region. The results of the program are used in the educational process in the study of economic disciplines in retraining on the basis of higher and vocational education.

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