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Technology for training on modeling of economic tasks in the informatics course

Abstract: Currently, the main direction of modernization of Kazakhstan education is the assurance of its new quality. One of the most important issues in high school education is the issue of motivation. Learning modeling and its application in the course of informatics assists to approximate the subject to real life, to study the life processes, and also to see its practical value, that is, to contribute to achieving the goal of education – training of a person for future activities in society. Currently, a relatively simple Excel processor is used for relatively simple processing of numerical information and for modeling of the economic tasks. The purpose of this article is to show the features of the development of the methodological material under the title "Modeling of the economic tasks in Excel".

In the article we used the following research methods: analysis of scientific, methodical literature and the publications in periodical journals, summary and systematization of the accumulated pedagogical experience of the teachers, the methods of experimental research, including observation of the educational process in the schools of the Republic of Kazakhstan.

Key words: technology for training, education, modeling, economic tasks, Excel.

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Introduction. Currently, the main direction of modernization of Kazakhstan education is the assurance of its new quality. This can be achieved by improving the methodological system of training by including relevant content and using the modern teaching techniques.

One of the most important issues in high school education is the issue of motivation. Learning modeling and its application in the course of informatics assists to approximate the subject to real life, to study the life processes, and also to see its practical value, that is, to contribute to achieving the goal of education – training of a person for future activities in society. Modeling provides a general algorithm, both for the study of objects, processes, phenomena, and for the study of the educational material. Modeling makes it possible to influence the different types of thinking of the student, but the formation of thinking is "a process of cognition connected with discovery of the subjectively new knowledge, solution of the problem-tasks, the creative transformation of reality".

In the informatics course, not sufficient time is devoted to modeling of economic tasks, so not many tasks like these ones have been developed accordingly in the textbooks.

We should note the importance and prospects of this area. In this regard, it becomes necessary to perform the detailed analysis of the main components of the methodological system for modeling study in order to implement the integrative connections between the informatics and the disciplines of the financial and economic cycle and, accordingly, formation of skills and experience required for the school students in future professional activities.

The following intellectual skills and their components can be distinguished as general methods of learning activities that students should master in the study of the economic tasks modeling:

- ability to solve problems (posing a question, finding the necessary information to solve a problem, analysis of the problem situation, making a hypothesis);
- ability to make the mathematical modeling (definition of data, conditions and boundaries of the search for solutions, translation of the problem into the language of mathematics, application of the adequate mathematical apparatus, interpretation of the solution);

- ability to think logically (deductive and inductive reasoning, the combination of logic and intuition, argumentation of findings and conclusions);
- communicative skills (reading, writing, using the mathematical symbols and formulas, preparation of schedules, schemes and diagrams);
- ability to apply the new information technologies.

Forming of the specified types of educational activity of the school students, we thereby contribute to development of such general intellectual methods as comparison, synthesis, analysis, abstraction, which are in the base of the modeling process technology.

Currently, a relatively simple Excel processor is used for relatively simple processing of numerical information and for modeling of the economic tasks.

Application and mastering of the Excel spreadsheet processor will make it possible to maximally realize the interdisciplinary connections of the informatics, on the one hand, and the economics, on the other hand. It will also serve as the means of professions guidance and for the purpose of establishing the education profiles at the senior level of the school.

The teachers of the informatics science have the task related to development of the methodological device for teaching the modeling of economic problems in the Excel environment in the informatics course.

This problem is widely studied in local and foreign literature.

In his study, Kiyko P.V. (2017) reviews the theoretical and practical issues of teaching methods based on econometric modeling, reveals the features of econometric modeling models based on formulas and functions built-in the Microsoft Excel spreadsheet, applies the interactive teaching methods to study econometric modeling, in parallel with formation of economic thinking [1].

Gonzalez-Ruiss proposed a methodological strategy for training in modeling the dynamic scenarios from the multi-parameter data tables using Microsoft Excel as a technological tool [2]. The article provides the step-by-step guidance on how to improve teaching and learning methods for developing the financial models, which can also be used in other areas. The technology identifies the most important aspects of the financial models development, so that students and teachers can focus on a more pedagogical approach that promotes introduction of the technological tools in the classroom. This work plays a key role in teaching of financial modeling, since it provides relevant elements leading to development of the systematic thinking among the university students on the basis of cognitive activity. In addition, various contributions to research on the educational and methodological process in modeling are discussed in this paper. The financial assessment of the airport was used as a case study for validation of the proposal. As a result, this article enhances the role of computing tools and the involvement of students/teachers in development of the systematic thinking and cognitive skills.

Popovich at the 28th Conference of the Information Systems teachers, ISECON 2011 and the 4th Conference on applied research of the information systems, CONISAR 2011; Wilmington, North Carolina; United States; from November 3, 2011 to November 6, 2011, presented the paper "Improving the skills of students' counting using the combined MIS/DS course with application of the traditional and online teaching methods" [3].

This document describes the process designed to develop the quantitative course and the Excel-based course that combines BOTH the results of the information management system (MIS) modeling and decision making (DS) modeling and establishes the foundation for higher-level quantitative courses, such as operational management, finance and strategic management.

It is possible to adopt this foreign experience for teaching of the economic problems modeling in the schools of our country.

The purpose of this article is to show the features of the development of the methodological material under the title "Modeling of the economic tasks in Excel".

Methods. In the article we used the following research methods: analysis of scientific, methodical literature and the publications in periodical journals, summary and systematization of the accumulated pedagogical experience of the teachers, the methods of experimental research, including observation of the educational process in the schools of the Republic of Kazakhstan.

The stating experiment was performed which resulted in the following conclusions:

- in the informatics course, not sufficient time is devoted to the issue of economic tasks modeling, therefore not so many similar tasks have been provided in the textbooks

- the capabilities of Excel, such functions as PS, IF, CDF, SUMM IF, SUMM IF IMN, SUMM PR are used to the limited extent. They are actively used in the practice of banks and other financial organizations.

Results. According to the standard program, the Section "Modeling" is studied within the structure of the modern informatics course (find the program, preferably the last one).

In this article, let's review the methodological approaches to the study of the economic problems modeling in Excel.

Solution of the economic problems is based on the special methods of financial calculations, the range of which is quite wide.

As an example of solving the economic problem in Excel, let's take the analysis and planning of the credit operations.

Analysis and planning of the credit operations is one of the most important and widespread tasks in the banks' practice. There are three areas of solution:

• development of the loan repayment plan adequate to the terms of agreement;

• assessment of the loan cost, taking into account all payments and receipts;

• analysis of the effectiveness of the operation for the creditor and the loaner.

The essence of credit operations planning is to develop the terms of the loan and its repayment schedule. The term and amount of the loan, the duration of the grace period, the amount and type of the interest rate, interest payment methods and the methods of loan repayment are determined in the planning process.

As a rule, repayment of loans for a period of more than one year is made by the equal payments evenly distributed in time. This method of repayment is often referred to as loan depreciation.

The main task of loan income planning is reduced to calculation of the component elements of payments and their distribution over time. In practice, two repayment methods are commonly used:

- repayment of the main loan in equal amounts;
- repayment of the whole debt in equal amounts.

Let's introduce the following symbols:

D is the amount of loan;

r is the loan interest rate;

n is the total loan period;

m is the number of interest charges periods in a year;

t is the period;

SDt is the payment on the main loan in the period t;

SRt is the loan interest in the period t;

CFt is the value of periodic payment in the period t;

Dt is the debt balance at end of period.

Task 1. According to the client we have the amount of loan is 10000000, the loan interest rate - 17%, the total loan period – 10, the number of interest charges periods in a year – 10 and the period -8. We need to find the payment on the main loan in the period t, the loan interest in the period t, the value of periodic payment in the period t, the debt balance at end of period.

We use formulas and model the problem in Excel (picture 1).

1. Payment on the main loan in the period t (picture 2): $SRt = \frac{D}{n}$
2. Loan interest in the period t (picture 3): $SRt = \frac{D}{n} * r$
3. Value of periodic payment (picture 4):
$$CFt = SRt + SDt$$
4. Debt balance at end of period (picture 5):
$$D = CFt * n - CFt * t$$

A	B	C
Amount of loan	D	10000000
Loan interest rate	r	17%
Total loan period	n	10
Number of interest charges periods in a year	m	2
Period t	t	8
Payment on the main loan in the period t	SDt	1000000
Loan interest in the period t	SRt	340000
Value of periodic payment in the period t	CFt	1340000
Debt balance at end of period	Dt	2680000

Picture 1. Model the task 1 in Excel

	A	B	C
1	Amount of loan	D	10000000
2	Loan interest rate	r	17%
3	Total loan period	n	10
4	Number of interest charges periods in a year	m	2
5	Period t	t	8
6			
7			
8	Payment on the main loan in the period t	SDt	=C1/C3
9	Loan interest in the period t	SRt	340000
10	Value of periodic payment in the period t	CFt	1340000
11	Debt balance at end of period	Dt	2680000

Picture 2. Modeling formula of payment on the main loan in the period t

	A	B	C
1	Amount of loan	D	10000000
2	Loan interest rate	r	17%
3	Total loan period	n	10
4	Number of interest charges periods in a year	m	2
5	Period t	t	8
6			
7			
8	Payment on the main loan in the period t	SDt	1000000
9	Loan interest in the period t	SRt	=C8*C2*C4
10	Value of periodic payment in the period t	CFt	1340000
11	Debt balance at end of period	Dt	2680000

Picture 3. Modeling formula of loan interest in the period t

	A	B	C
1	Amount of loan	D	10000000
2	Loan interest rate	r	17%
3	Total loan period	n	10
4	Number of interest charges periods in a year	m	2
5	Period t	t	8
6			
7			
8	Payment on the main loan in the period t	SDt	1000000
9	Loan interest in the period t	SRt	340000
10	Value of periodic payment in the period t	CFt	=C9+C8
11	Debt balance at end of period	Dt	2680000

Picture 4. Modeling formula value of periodic payment

	A	B	C
1	Amount of loan	D	10000000
2	Loan interest rate	r	17%
3	Total loan period	n	10
4	Number of interest charges periods in a year	m	2
5	Period t	t	8
6			
7			
8	Payment on the main loan in the period t	SDt	1000000
9	Loan interest in the period t	SRt	340000
10	Value of periodic payment in the period t	CFt	1340000
11	Debt balance at end of period	Dt	=C3*C10-C5*C10

Picture 5. Modeling formula of debt balance at end of period

To verify the correctness of the solution, we shall use the following formulas.

Task 2. Calculate the amount to be stored on the deposit so that 400,000 tenge could be resulted after four years. The interest rate is 20% per year. Interest is calculated quarterly.

Let's show the initial data in Table form (picture 6).

	A	B
1	Future amount (FA)	400 000p.
2	Interest rate (per year)	20%
3	Periodic payments (pay)	0%
4	Number of payments per year	4
5	Period of deposit, years	4
6	Total number of periods (kper)	16
7	Current amount of deposit	

Picture 6. Model the task 2 in Excel

Since the interest rate does not change during the entire period, we use the PS function (rate; kper; pay; fa; type) (picture 7).

PS is one of the financial functions that returns the present (to the current moment) value of loan or investment based on a constant interest rate. The PS function can be used both for periodic fixed payments (for example, for mortgages or other loans), as well as for future value, which is the purpose of the investment.

PS (rate; kper; pay; fa; type)

Rate is the interest rate for the certain period. For example, if a car loan is received at 10 percent per annum and payments are made on a monthly basis, the interest rate per month will be 10%/12 or 0.83%. As the value of the "rate" argument it is necessary to enter 10%/12, 0.83% or 0.0083 in the formula.

Kper is the total number of payment periods for annuity. For example, if a loan is received for 4 years to buy a car and payments are made monthly, the loan has 4*12 (or 48) periods. As the value of the "kper" argument it is necessary to enter the number 48 in the formula.

Pay is payment made in each period and not changing throughout the entire period of rent. Usually, the "payout" argument is included in basic payments and interest payments, but other fees or taxes are not included. For example, a monthly payment on a four-year loan of 10,000 R at 12 percent per annum will be 263.33 R. As the value of the "payout" argument, the number 263.33 should be entered in the formula.

fa is the required value of the future amount or the balance after the last payment. If the argument is omitted, it is assumed to be 0 (the future amount of the loan, for example, is 0). Let's suppose it is required to accumulate 50 000 R. for payment of a special project for 18 years: in this case, the future amount is 50 000 R. Then, assuming that the specified interest rate will remain unchanged, you can determine what amount should be stored up each month.

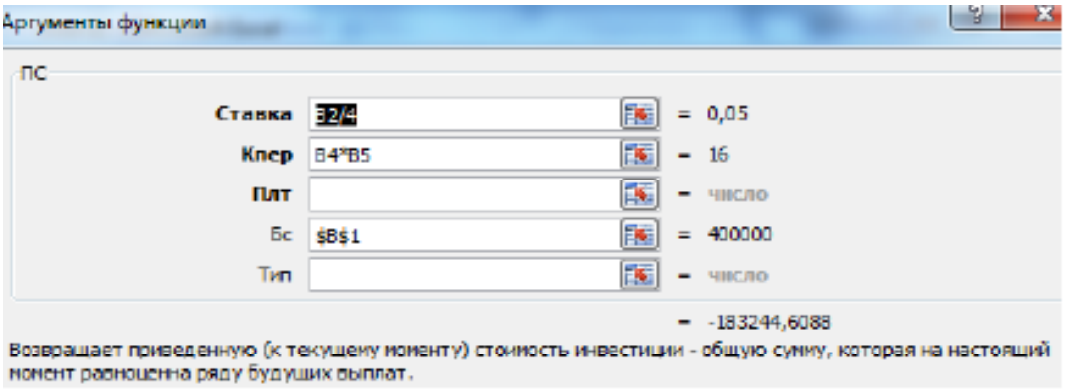
Type is the number 0 or 1, means the date of payment (table 1).

Table 1.

Type	Term of payment
0 or omitted	At the end of period
1	At the start of period

Filling in of arguments:

1. Rate is 20%/4, since the interest is calculated quaterly.
2. Kper is 4*4 (total term of deposit * number of charge periods per year).
3. Pay is 0. We do not write anything, because the deposit will not be replenished.
4. Type is 0.
5. FA is the amount we want to receive at the end of the deposit term.



Picture 7. Using the PS function

The depositor needs to invest this money, so the result is negative (picture 8).

	A	B
1	Future amount (FA)	400 000р.
2	Interest rate (per year)	20%
3	Periodic payments (pay)	0%
4	Number of payments per year	4
5	Period of deposit, years	4
6	Total number of periods (kper)	16
7	Current amount of deposit	-183 245р.

Picture 8. Model the task 2 in Excel

To verify the correctness of the solution, we shall use the following formula: PS = FA/ $(1+\text{rate})^{\text{kper}}$. Let's substitute the values: PS = 400 000 / $(1 + 0.05)^{16}$ = 183245.

So, Microsoft Excel solves several economic problems, including analysis and planning of the credit operations, the analysis of operations with securities, calculation of asset depreciation parameters, etc.

The following results were obtained during the study:

1. Tasks have been developed for the senior school for modeling of the economic processes, which are used directly in the work of banks.
2. The following intellectual skills and their components can be distinguished as general methods of learning activities that students should master in the study of the economic tasks modeling:
   - □ ability to solve problems (posing a question, finding the necessary information to solve a problem, analysis of the problem situation, making a hypothesis);
   - □ ability to make the mathematical modeling (definition of data, conditions and boundaries of the search for solutions, translation of the problem into the language of mathematics, application of the adequate mathematical apparatus, interpretation of the solution);

- □ ability to think logically (deductive and inductive reasoning, the combination of logic and intuition, argumentation of findings and conclusions);
- □ communicative skills (reading, writing, using the mathematical symbols and formulas, preparation of schedules, schemes and diagrams);
- □ ability to apply the new information technologies.

3. A stating experiment was carried out to establish the actual state of the studied object, a statement of the initial parameters. The main goal was to fix the realities. They will be the starting points for the transformative experiment, which aims to create and test the effectiveness of new methods that can improve the achieved level.

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Информатика курсында экономикалық есептерді модельдеуге оқыту технологиясы

Аннотация. Қазіргі таңда Қазақстандық білім беруді жаңғыртудың басты бағыты оның жаңа сапасын қамтамасыз ету болып табылады. Жоғары мектептегі білім берудегі ең маңызды проблемалардың бірі – ынталандыру мәселесі. Модельдеуге оқыту және оны информатика курсында қолдану пәнді зерделеуді шынайы өмірге жақындастыруға, өмірлік процестерді зерттеуге, сондай-ақ оның қолданбалы мәнін көруге көмектеседі, яғни білім беру мақсатына қол жеткізуге – адамның қоғамдағы болашақ іс-әрекеттерге дайындалуына ықпал етеді. Қазіргі уақытта сандық ақпаратты салыстырмалы түрде жеңіл өңдеуге, экономикалық есептерді модельдеу үшін іс жүзінде баламасыз құрал ретінде Excel кестелік процессоры пайдаланылады. Бұл мақаланың мақсаты «Excel ортасында экономикалық есептерді модельдеу» тақырыбындағы әдістемелік материалды әзірлеудің ерекшеліктерін көрсету.

Мақалада біз келесі зерттеу әдістерін пайдаландық: мерзімді басылымдарда ғылыми, әдістемелік әдебиеттер мен жарияланымдарды талдау, оқытушылардың жинақталған педагогикалық тәжірибесін қорыту және жүйелеу, эксперименттік зерттеу әдістері, сонымен бірге ҚР мектептерінде өтіп жатқан оқу барысын бақылау.

Түйін сөздер: оқыту технологиясы, білім, модельдеу, экономикалық тапсырмалар, Excel.

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Технология обучения моделированию экономических задач в курсе информатики

Аннотация. В настоящее время главным направлением модернизации казахстанского образования является обеспечение его нового качества. Одна из важнейших проблем в обучении в старшей школе - проблема мотивации. Обучение моделированию и его использование в курсе информатики помогает приблизить изучение предмета к реальной жизни, изучению жизненных процессов, а также увидеть ее прикладное значение, то есть способствовать достижению цели образования - подготовки человека к будущей деятельности в обществе.

Для относительно несложной обработки числовой информации и моделирования экономических задач практически безальтернативно используется табличный процессор Excel. Цель данной статьи - показать особенности разработки методического материала по теме «Моделирование экономических задач в среде Excel». Использованы следующие методы исследования: анализ научной, методической литературы и публикаций в периодической печати, обобщение и систематизация накопленного педагогического опыта учителей, методы экспериментальных исследований, в том числе наблюдение за учебным процессом в школах РК.

Ключевые слова: технология обучения, образование, моделирование, экономические задачи, Excel.

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