

**THE METHODOLOGY FOR CALCULATING BASELINE INDICATORS FOR BUDGETING EXPENDITURES OF
BUDGETARY INSTITUTIONS: THE CASE OF UKRAINE**

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***Abstract.** The theoretical bases of optimization of budgetary expenditures in the field of educational services and health care are presented in this article. The research of known methods of calculations for the estimation of state higher educational establishments and institutions of protection with the use of generally accepted average production indicators, as the average annual number of students and the average annual number of beds, as well as the norms of expenditures on the named calculations, have been carried out.*

It is proposed to improve the methodology of calculating baseline indicators on the basis of generalized shortcomings of known approaches to the estimate on the basis of weighted and exponential averages at the stage of its planning by a budget institution, which allows to significantly reduce the risks of failures of financial provision of the service provision by the subjects of the budget sphere, as well as to achieve budget savings of funds.

The use of recommended approaches to calculating outgoing calculations when formulating estimates in the overwhelming majority does not require additional accounting procedures and documentation, however, from an organizational point of view, it requires strict sequence and performance of a number of preparatory work. Calculation of recommended indicators is provided on the example of 2017 statistical data.

Keywords: *financial support, planning of expenditures, cost estimates, improvement, calculations, weighted and exponential averages.*

Introduction

The dynamics of financial provision of education, health care and other branches of the budget sphere, and especially the delay in the transfer of funds that accompany it for many years, is a convincing evidence of the need to change the requirements of the accounting system as an information source for making managerial decisions.

The focus of accounting, primarily on the requests of controlling bodies and reporting to higher authorities, and not on ensuring optimization of activity, reduces the role of accounting from the position of the leverage to ensure the effective use of available resources and increase the efficiency of activities.

There are various approaches in world practice for substantiating the amount of financial provision, principles and approaches to the allocation of budget funds, their planning, control, reporting, analysis (Aung Myat Kyaw, 2015; Barr, 2005; Dutu, Sicari, 2016; Exter et al., 2004; Jongbloed B., Koelman, 2000; Kappeler et al., 2013; Nobuyuki, 2015; OECD (2010b)).

In Ukraine, such an experience is actively studied, analyzed and implemented in practice. However, an important problem is the need to take into account those initial conditions that exist in the state. In this regard, not always positive foreign experience can be realized. As regards the financial support provided from the budget in Ukraine, it is investigated both in economic (planning) and in the accounting and control areas (accounting contributes to the principle of target use, and control serves as a tool for identifying deficiencies and provides for their elimination) (Kravchenko, 2009; Matviiv, 1997; Kappeler, Solé-Ollé, Stephan, Väililä, 2013; Resolution of the Budget of Ukraine, 2002; Semenysheva, 2012).

The main document, which is the basis for obtaining financial support from the budget in Ukraine, is an estimate (Resolution of the Budget of Ukraine, February 28, 2002; the Order of the Ministry of Social Policy of Ukraine, August 23, 2013).

Considering the problem of forming this document, it is necessary to distinguish between two fundamental aspects. Firstly, the estimate should be considered as a document of accounting with its inherent characteristic – the accuracy of calculations of the volume of planned expenditure. Secondly, due to the need to ensure optimization of expenditures, the estimates should be used as a source of forecast information necessary for efficient management of budget funds.

The latter approach is especially relevant at the current stage of development of the national economy, since achieving optimization of financial support indicators is possible, first of all, on the basis of improving approaches to the selection and calculation of basic indicators as the basis for determining the amount of expenditures. For example, you can take two of the most important sectors that are funded from the budget: education (higher education) and health care.

The purpose of this work is to develop more perfect algorithms for finding baseline indicators used to calculate expenditures in budget estimates for higher education and health care institutions. Improved algorithms should provide more precise forecasting data in the estimates.

Base indicators for estimating the cost of higher education and their improvement

The most commonly indicators used to determine the expenditures (costs) of selected industries are the average annual number: beds and their turnover, visits to clinics, students / students, salaries, staff units, etc. (the Order of the Ministry of Social Policy of Ukraine, August 23, 2013).

Today, the following average annual production indicators are used, when calculating the estimates for state higher educational institutions and institutions of protection, as the average annual number of students is 1 (formula 1) and the average annual number of beds is 2 (formula 2), as well as the norms of expenditures for the named calculation indicators (Resolution of the Budget of Ukraine, February 28, 2002):

$$\overline{KS_r} = KS_{01.01.ZR} + KSP \times M_n / 12 - VS \times M_m / 12, \quad (1)$$

where $\overline{KS_r}$ – the average annual number of students; $KS_{01.01.ZR}$ – the number of students as of 01.01, preceding the planned one; KSP – the number of students accepted in the year preceding the planned one; M_n – the number of months passed since the admission of students in the previous (before the planned) year; VS – the number of graduated students in connection with obtaining the diploma of the corresponding educational-qualification level in the pre-planning year; M_m – the number of months of training for graduate students in the year preceding the planned one.

The summary of the number of students (pupils), which in modern conditions is formed due to the use of appropriate software, is the source of information on the basis of which one can calculate the above-mentioned algorithm in each educational institution. Statistical calculations are based on statistical information (Table 1).

As an example, we used 2016 and 2017 years to illustrate the proposed calculation method. This is intended to produce results that are easy to verify. But in perspective, the proposed approach should be applied using data from the reporting (n) and planned periods (n + 1).

Table 1: Dynamics of the number of students of state higher educational institutions, people

Higher education institution / Years / Indicators	2016 (n)			2017 (n+1)		
	the number of students	accepted	released	the number of students	accepted	released
A	8558	3459	3484	8748	3413	3875
B	4604	1797	1766	4561	1705	1883
C	10878	3873	3467	11121	3921	3604
In Ukraine, thousands	2364.5	425.2	505.2	2245.2	370.5	527.3

Notes: * - data from statistical information on the contingent of students of the Ministry of Education and Science of Ukraine

For example, we will calculate the average annual number of students for State University B for the reporting period 2016 and 2017 academic years. Thus, according to statistics in 2016 $KS_{01.01.ZR} = 4604$, $KSP = 1797$, $M_n = 10$, $VS = 1766$, $M_m = 7$, in 2017 – $KS_{01.01.ZR} = 4561$, $KSP = 1705$, $M_n = 10$, $VS = 1883$, $M_m = 7$.

In the given example, the calculation of the average annual number of students is carried out using the expression 1: $\overline{KSr}_{2009} = 4604 + 1797 \times 10/12 - 1766 \times 7/12 = 5071$ and $\overline{KSr}_{2010} = 4561 + 1705 \times 10/12 - 1883 \times 7/12 = 4883$.

It should be noted that the average annual number of students in 2017 at State University B decreased by 188 units. Disadvantages of these approaches are:

- significant risk of inaccuracy (the average annual number of students does not take into account the graduation of students, due to deduction due to failure, health status, on their own will, etc.);
- the fact of repeated passing by students of separate courses (in the case of negative assessment (F)) is lost, which actually causes an increase in the average annual number of students;
- ignored the number of updated students for the defense of graduation theses (those that did not appear for valid reasons or received a negative evaluation, but have the right to renewal, etc.);

These and a number of other shortcomings require changes in the order and approaches to calculating the basic calculations. The most acceptable and easy way to solve this problem is to create an additional document for the generalization of intermediate data. They can be “Calculation of expenses by code of economic classification (name and code)”.

In the case of replacement of average annual production figures (average annual number of students, pupils, groups, beds, visits, etc.), calculated on the basis of slippery mathematical variables in the mentioned document, it is necessary to provide for the possibility of displaying information about the number of students as of 01.09 years prior to the reporting date 01.01 and 01.09 of the reporting year and 01.01 of the planned year.

Regarding the studied subjects (state institutions of higher education) named average can be used in cost planning and budgeting. In this case, the formulas must be modelled as follows (Table 2).

The study of the advantages and disadvantages of the basic indicators made it possible to conclude on the feasibility of introducing into practice the calculation of the basic indicators to the weighted and exponential averages (see Table 2).

Table 2: *Recommended indicators for substantiation of expenditures of state higher educational institutions and health care institutions*

The formula for calculation	Designation	Advantages	Disadvantages
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Higher Education (State Higher Educational Institutions)

$\overline{KS} = \frac{\sum_{i=1}^4 S_i}{4}$ <p>Simple sliding.</p>	<p>(3) \overline{KS} – average annual number of students; S_i – the number of students correspondingly as of 01.09, preceding the reporting year, 01.01 and 01.09 of the reporting year and 01.01 of the planned year; n – length of smoothing (calculation period).</p>	<p>It allows you to determine the beginning of a new trend and its end, the angle of inclination of the indicated indicator can determine the rate of trend change. The value of such significance also lies in ensuring the smoothing of gaps (leaping of indicators). The number of months of training can be used to ensure greater smoothing, including session – 10.</p>	<p>Delay in input and output, as well as the assignment of identical weights both for new (last) and old (for historical periods) indicators.</p>
$\overline{WKS} = \frac{\sum_{i=1}^4 S_i \times W_i}{\sum_{i=1}^4 W_i}$ <p>Weighted slide.</p>	<p>(4) W_i – the weighted value for the indicator of the i-th period (as of 01.09, the year preceding the reporting year – 1.0, 01.01 – 1.1 and 01.09 – 1.2 reporting and 01.01 – 1.3 planning years).</p>	<p>It enhances the values of the latest indicators, since they are closest to the real (actual) status.</p>	<p>It does not take into account such levers as demographic situation, need for specialists, standard of living (the possibility of potential customers of educational services to pay for them).</p>

$\overline{EKS} = \frac{\overline{EKS}_{t-1} \times (4-1) + 2 \times S_t}{4+1}$ <p>Exponential slide.</p>	<p>(5)</p> <p>\overline{EKS}_{t-1} – the average number of students of the previous period.</p>	<p>It gives more attention (weight) to the number of students in the last period, allows you to respond promptly to current changes.</p>	<p>It has a certain level of error.</p>
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An important argument in favor of applying the recommended approach in education is the fact that, in accordance with the requirements of the Bologna Convention in Ukraine, the procedure for providing educational services has been changed in terms of permission for students to independently choose the period of mastering the disciplines envisaged by the curriculum. In this regard, there are disagreements between the number of students and the hours of teaching load during the school year. In addition, some students due to failure are obliged to undergo individual training courses repeatedly.

Basic indicators for estimating the costs of the medical institution and their improvement

Medical institutions operating at the expense of budgets (state or municipal), while planning their expenses, also use a common methodology. It includes the need to calculate projected basic performance indicators.

In particular, medical institutions of Ukraine in the formation of cost estimates use an indicator that is calculated by the formula (the Order of the Ministry of Social Policy of Ukraine, August 23, 2013):

$$\overline{KL} = PKL + KVL \times M_f \div 12, \quad (2)$$

where \overline{KL} – the average number of beds in a hospital; PKL – transitional number of beds as of 01.01 of the planned year; KVL – the number of new beds; M_f – the number of months of operation of the newly-built beds before the next period.

Let's take for example Regional Clinical Communal Hospital to calculate the average annual number of beds in a medical institution, where there are $PKL = 835$ beds in the state as of 2017, in connection with the completion of repairs $KVL = 12$ new beds, $M_f = 7$. Therefore \overline{KL} – the average annual number of beds

in a medical institution is calculated using the expression 2: $\overline{KL} = 835 + 12 \times 7 + 12 = 842$

Disadvantages of these approaches are:

- the number of beds as of 01.01 of the planning year requires taking into account the changes that occurred after the inventory, which is carried out before the preparation of annual reports (as of 01.10 of the reporting year); the number of new beds represents only a planned introduction, although there are situations requiring the urgent deployment of new beds (catastrophe or epidemic));

- relativity and abstraction of the calculated indicators used to substantiate the revenue and expenditure by the budget (the average annual number of beds and the number of bed days determined by it indirectly characterizes the result of the operation of inpatient type of treatment facilities. Moreover, it would be more reasonable to use such indicator as the number treated patients);

- ignoring of new forms and methods of providing services by budget institutions (in the field of education development of distance and other types of training, in the field of health is a common form of day care).

Regarding the studied subjects (health care institutions) named average can be used in cost planning and budgeting. In this case, the formulas must be modelled as follows (Table 3).

Table 3: Recommended indicators for substantiation of expenditures of state health care institutions

The formula for calculation	Designation	Advantages	Disadvantages
Healthcare			
$\overline{KPX} = \frac{\sum_{i=1}^{12} PX_i}{12}$ <p>(6)</p> <p>Simple sliding.</p>	\overline{KPX} – average annual number of treated patients; PX_i – the number of treated patients for each month of the year, respectively.	It characterizes not abstract (beds), but concrete information indicating the scope of activity.	It does not take into account possible changes resulting from repairs or closure of activities (Closing the department to quarantine, etc.).
$\overline{WPX} = \frac{\sum_{i=1}^{12} PX_i \times W_i}{\sum_{i=1}^{12} W_i}$ <p>(7)</p> <p>Weighted slide.</p>	\overline{WPX} – average annual weighted number of treated patients; W_i – weighted value for the indicator of the i-th month.	It allows the use of weighting factors to choose more significant periods (values) and more precisely than the simple	It does not take into account the dynamics of the population growth rate.

		average reflects the trend of indicator.	
Exponential average.	$\overline{EPX} = \frac{\overline{EPX}_1 \times (12-1) + 2 \times PX}{12+1} \quad (8)$	\overline{EPX}_{t-1} – the average value in the previous period.	All monthly rates are used in the calculation, which makes the calculation closer to the real value. It does not take into account the dynamics of the population growth rate.

It will be advisable to change not only the approach to calculating the average annual rate for the health sector, but also the choice of its other base. Instead of the average annual number of beds (bed-days), the number of treated patients should be used, since such a measure more accurately characterizes the outcome of the activities of medical institutions (institutions) for the provision of services.

The use of such values in this case will allow for a greater degree to avoid disproportions in the planning and implementation of calculations to the estimate (which is formed before the beginning of the planning year and approval of the corresponding budgets).

It is strategically important for the public health sector to provide medical services to the population. Accordingly, it is expedient to choose the number of treated patients for a successful indicator and not the number of beds and bed-days.

However, it is important for this branch of the national economy to take into account not only current trends related to morbidity but also the dynamics of population as a factor, which also has a direct impact on the average annual performance of medical institutions (institutions). Therefore, in the calculation formula it is expedient to apply the correction factor.

It should express the tendency of the population. Since depending on the region it may be different, the coefficient is recommended to be calculated using statistical data at least in the regions of Ukraine. It is proposed to calculate such a coefficient by the following formula:

$$K_{zn} = \frac{N_n}{S_n}, \quad (9)$$

where K_{zn} – the coefficient of growth (decrease) of population; N_n – the birth rate (persons); S_n – mortality (persons).

For example, let's consider the growth rate (decrease) in Ternopil region in 2017 (n+1).

According to the statistics, there are $N_n=11807$ persons and $S_n= 14682$ persons, therefore $K_{zn} = \frac{11807}{14682} = 0,8$.

Given this factor, the calculation formulas will look as follows:

$$\overline{WPX} = \frac{\sum_{i=1}^{12} PX_i \times W_i}{\sum_{i=1}^{12} W_i} \times K_{zn} \quad (10)$$

$$\overline{EPX} = \frac{\overline{EPX}_{i-1} \times (12-1) + 2 \times PX_i}{12+1} \times K_{zn} \quad (11)$$

Let's consider for health care institutions for example the procedure for calculating the average annual weighted number of patients treated in a hospital for 2017.

\overline{WPX} is calculated on the basis of expression 10:

$$\overline{WPX} = \frac{1,3 \times (1670 + 1583 + 1639 + 1659 + 1597 + 1677 + 1630 + 1643 + 1549 + 1599 + 1640 + 1643)}{1,3 \times 12} + \frac{1549 + 1599 + 1640 + 1643}{1,3 \times 12} \times 0,804 = 1508,443$$

The main components of the annual weighted number of treated patients are shown in Table 4.

Calculate the exponential average number of treated patients in the hospital in 2017 according to the expression 11:

$$\overline{EPX} = \frac{1627 \times (12-1) + 2 \times 1670}{12+1} \times 0,804 = 1423,174$$

In this case, an indicator has been obtained that differs significantly from that used in the modern practice of creating distemper costs. The recommended approach is more accurate performance indicator.

Table 4: Average annual weighted number of treated patients for 2017.

Months	PX_i	W_i	K_{zn}	$PX_i * W_i$	\overline{WPX}
i					
1	1670	1.3	0.804	2171	1508.443

2	1583	1.3	0.804	2057.9	
3	1639	1.3	0.804	2130.7	
4	1659	1.3	0.804	2156.7	
5	1597	1.3	0.804	2076.1	
6	1677	1.3	0.804	2180.1	
7	1630	1.3	0.804	2119	
8	1643	1.3	0.804	2135.9	
9	1549	1.3	0.804	2013.7	
10	1599	1.3	0.804	2078.7	
11	1640	1.3	0.804	2132	
12	1643	1.3	0.804	2135.9	
Amount		15.6		25387.7	

Of course, other opportunities to improve the methodology for calculating the baseline, by which you can set a certain amount (rate) of costs, cannot be ignored. But the proposed approach maximally takes into account the existing information base of planning. This base is laid in the current Ukrainian accounting methodology.

Calculations of the exponential average number of treated patients for 12 months of 2017 have been made in Table 5.

Table 5: *Exponential average number of treated patients for 2017*

PX_i	K_m	\overline{EPX}
1670	0.804	1423.174
1583	0.804	1411.516
1639	0.804	1419.02
1659	0.804	1421.7
1597	0.804	1413.392
1677	0.804	1424.112

1630	0.804	1417.814
1643	0.804	1419.556
1549	0.804	1406.96
1599	0.804	1413.66
1640	0.804	1419.154
1643	0.804	1419.556

The designation of Table. 4 and 5 are shown in Table. 3.

It should be noted that the use of recommended approaches to the calculation of baseline (outgoing) estimates in the formation of estimates in the vast majority does not require additional accounting procedures and documentation; however, it requires strict sequence and performance of a number of preparatory works from an organizational point of view.

Conclusions

Using the estimate only to substantiate the opening of allocations to budget institutions and obtain financial support contradicts the essence of the estimate as a planning document, which significantly limits its use to evaluate possible alternative projects. Therefore, it is advisable to use the budget to formulate the strategic principles of development as a source of relevant information in order to make optimization management decisions in terms of revenues and expenditures of budget institutions.

In this case, it is important to base such basic indicators that more accurately reflect the results of the activities of budget institutions and provided by the accounting system.

Due to the improvement of the methodology of calculations at the planning stage of the estimate institution budget it will significantly reduce the risks of financial support for the provision of services by the subjects of the budget sphere, as well as to achieve savings in budget funds. The information base for obtaining data to calculate the calculation indicators, which are the basis for calculating the estimates of costs (in the scientific literature, they are also called production indicators), can be the existing accounting and reporting system.

However, some of these indicators are not currently formed in the accounting system of budgetary institutions, so their introduction requires a proper organization of work and document circulation.

In addition, it is expedient to formulate the calculations to the budget in the form of corresponding table documents, which are formed using modern software, taking into account that computer facilities are used in budget institutions. In this case, a detailed accounting model will have a completely new form of documentation in its structure and will require the introduction of appropriate configuration changes and upgrade software.

F1Book on the page ActiveX is used in our research when design and calculation. This component allows you to embed in an Excel spreadsheet application that the user can fill in with the corresponding numbers, and the component will perform by the given calculation formulas and immediately display their results in the specified centers.

Valuable in such approaches is that they presuppose the maintenance of qualitative parameters of services provided by budgetary institutions. Actual in modern conditions is the decision of optimization problem, which simultaneously provides for improvement of quality and reduction of volumes of expenses used for rendering of services.

This, in turn, requires the development of indicators for assessing their quality that is, assessing the performance of these budget institutions. Taking into account the specific and intangible nature of services that are the result of the activities of budgetary institutions of various sectors (education (depending on the level), health care, culture, management, etc.), the indicators of their quality assessment cannot be uniform and unified. Therefore, this direction of research is sufficiently relevant and promising.

In practice, the implementation of the proposed approach to the calculation of the basic indicators in the formation of the budget estimates of the higher education and healthcare institutions will provide more accurate prediction of the volume of expenditures for the provision of educational and medical services. A positive point is the fact that the method is economical in terms of working time and easy for automation. In addition, it does not require additional accounting work.

In the future, other scenarios for improvement of the basic indicators for calculations to the estimate are also possible. We consider it expedient also to take into account those indicators which are given in the statistics of a specific branch functioning at the expense of budgetary funds. Longer time intervals (2 years or more) can be used to achieve better compliance with the estimated baseline indicators. Taking into account the dynamics for 5 years will probably give even better and more accurate basis of research. We used 2 adjacent years (2016 and 2017) to facilitate the illustration of the proposed approach, for which it is already possible to check the result.

We only need to compare the actual costs of the estimate with those obtained on the basis of our proposed basic calculation indicators for this. In the future, this will be the next stage of our study. Also, due to budget funds in Ukraine there are other branches (for example, the branch of culture), prospects are to study the possibilities of improving the methodology for calculating basic calculation indicators to the estimates in cultural institutions (state and communal club and entertainment institutions, libraries, etc.).

In addition, it is advisable to develop in future studies related to the computerization process of forming the budget. Including in the part of carrying out calculations of sliding values is in relation to the basic indicators, considered by us above.

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