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Statistical analysis of the Ukraine's population income

One of the most important indicators characterizing the level of economic and social development of society is the income of the population, as material goods and the amount of money received or created by citizens over a certain period of time. Since the situation in the sphere of income is under constant social tension, and the main component that characterizes the standard of living of the population is the material situation, therefore, research related not only to theoretical, but also practical aspects of the standard of living is important and relevant. The article analyzes the incomes of the population of Ukraine with the help of statistical analysis and the use of computer technologies. To study the incomes of the population of Ukraine, the latest technologies and methods of data analysis, which are used to identify hidden regularities in large data sets, as well as methods and tools of statistical analysis, were used. The main procedures of data analysis were calculated and characterized with the help of modern computer technologies, namely, using one of the methods of statistical analysis of the income of the population - descriptive statistics, which was carried out with the help of Microsoft Excel software.

The results of the conducted research show that the existing inequality in terms of income and expenses of the population requires assistance to solve this problem from the side of state bodies, overcoming corruption, socialization of the population, and business. This will provide an opportunity to make effective decisions and develop development programs to increase the population's income and reduce poverty in Ukraine.

Keywords: income; profit; statistical analysis; descriptive statistics.

Actuality of theme. The socially oriented market economy of Ukraine is built on the basis of European standards, where the main indicator of efficiency and progressiveness of this type of economy is the high level and quality of life of the population. Since the situation in the sphere of income is under constant social tension, and the main component that characterizes the standard of living of the population is the material situation, therefore, research related not only to theoretical, but also practical aspects of the standard of living is important and relevant. Shady privatization of property, imperfect legislation, inflated tariffs for services lead to the enrichment of a certain number of the population and the impoverishment of another. Therefore, in order to improve the social market economy of the country, it is necessary to implement a balanced, reasonable, rationally distributed policy on regulating the income of the population with the help of available tools and methods, which include new technologies and methods of data analysis, which have recently gained significant popularity. Thus, the incomes of the population, namely their statistical analysis, deserve the attention of specialists, and all problems related to them require immediate resolution.

Analysis of the latest research and publications on which the authors rely. The main aspects of determining the essence of population incomes and the use of statistical tools, methods, and models for their study are reflected in the scientific works of many domestic and foreign scientists and practitioners, including: K.V. Vitkovska [1], V.P. Horyn [2], O.V. Hrysiuk [3], L.V. Yeliseeva [3], A.O. Kovalenko [4], N.M. Samoliuk [5], I.P. Sydor [2], A.V. Sydorova [4], A.Smith [6], D.U. Yul [7], H.M. Yurchyk [5] and others.

The purpose of the article is research and statistical analysis of the incomes of the population of Ukraine with the aim of their further improvement.

Presentation of the main material. The income policy carried out by society is an important component of the country's general socio-economic policy, as the population's income indicators are economic characteristics and characteristics of the standard of living at the same time.

The incomes of the population, namely their size and distribution, directly affect the development, use and formation of the labor potential of the country. They act as a tool by which the level of welfare of society is determined. Orienting the population to improve and increase their well-being, the market economy, along with the support of socially vulnerable population groups, needs state guarantees to ensure consumption for all citizens, primarily due to labor activity, entrepreneurship and initiative.

The essence of the income of the population consists in the direct establishment by the state of such an upper limit of the nominal wage increase that would contribute to the realization of priorities and the fulfillment of the main tasks facing the economy. In practice, there are no two completely identical options for the development of population income policy. The forms of manifestation of this policy and the implementation mechanism in each country differ in the following features, which are determined by [8]:

- the socio-economic and political development of the country;
- the nature and degree of state intervention in the issue of wage regulation;
- the social tension in society.

In the conditions of modern structural changes in the state economy and the functioning of the market mechanism, the formation, use of the population’s income and their distribution system underwent a transformation. Thus, the largest specific weight in the structure of the population’s monetary income is the payment of labor, because it ensures not only the reproduction of the labor force, but also acts as the main regulator of the labor market and becomes an important factor in the reproduction of social production. Thus, the analysis of the population’s income is an urgent issue for research.

Recently, new technologies and methods of data analysis, which are used to identify hidden regularities in large data sets, as well as methods and tools of statistical analysis, are gaining widespread use. Basic data analysis procedures are most often implemented using modern computer technologies. At the same time, existing software is used, for example, MS Excel spreadsheets, or specialized packages SPSS, STATISTICA, etc.

One of the methods of statistical analysis of population incomes is descriptive statistics, which can be carried out using Microsoft Excel software.

Descriptive statistics is the simplest way of statistical analysis of data that quantitatively describes or summarizes an array of data. «Descriptive statistics is a set of basic statistical indicators of an empirical sample of values of a quantitative characteristic. Standard methods of their calculation, as a rule, are developed based on the assumption that the distribution is normal. The reason for this is the availability of a convenient mathematical apparatus for processing relevant data. An unfounded assumption that almost all random data obeys the normal distribution law plays an equally important role in the excessively wide application of methods designed for the analysis of normally distributed data» [9, p. 10]. The so-called law of errors, according to which their distribution is always normal, was commented on more than a hundred years ago by the famous French physicist H.Lippmann: «Everyone believes in the law of errors, because experimenters think that it is a mathematical theorem, and theorists think that it established experimentally» [9]. However, the assumption of a normal distribution often turns out to be false. That is, if the data distribution is significantly different from normal, then other methods and formulas must be used.

For the statistical analysis of the incomes of the population of Ukraine, we will use the data from the table 1.

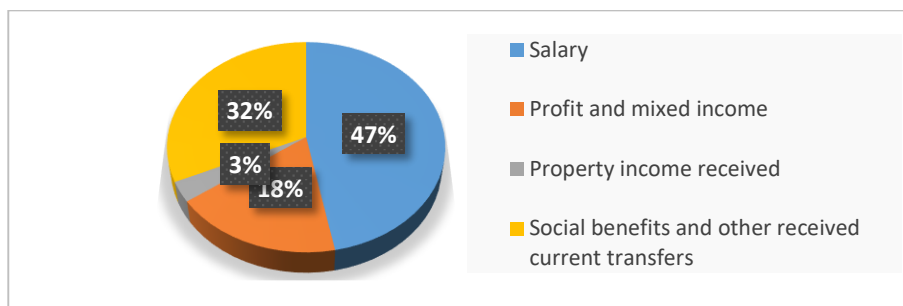
Table 1

Incomes of the population of Ukraine for 2019–2021

	2019	2020	2021
Total incomes	3744060	3972428	4698611
including:			
salary	1758588	1823487	2133647
profit and mixed income	678217	709691	893594
property income received	117003	103356	107195
social benefits and other received current transfers	1190252	1335894	1564175

Source: *built by the author based on data [10]

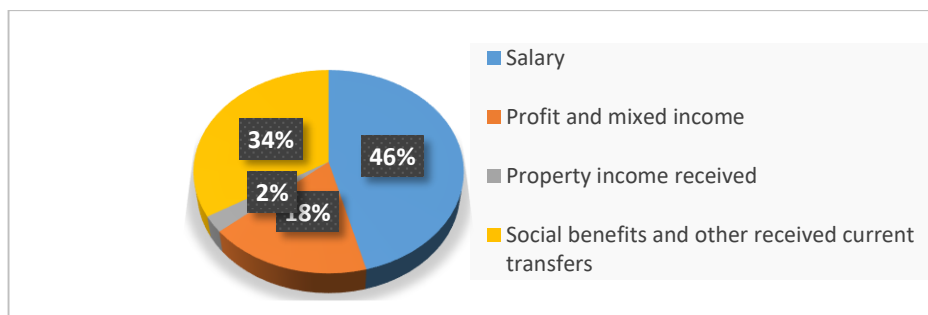
In the Microsoft Excel environment, we will build volume pie charts according to the data in the table 1 on the incomes of the population of Ukraine for 2019–2021. So, the fig. 1 shows the income of the population for 2019.



Source: *built by the author based on data [10]

Fig. 1. Incomes of the population of Ukraine for 2019

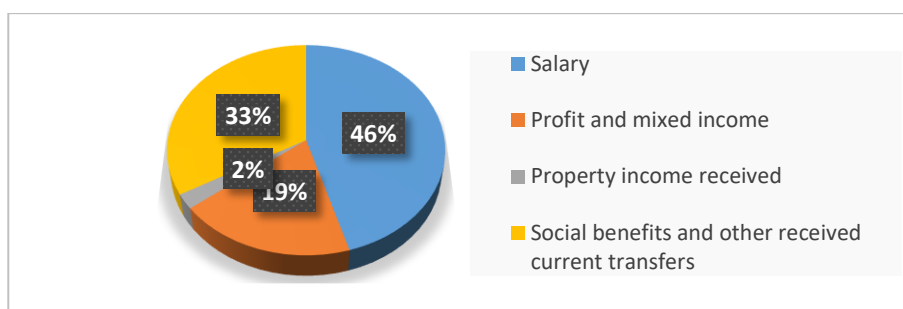
The fig. 2 shows the incomes of the population of Ukraine for 2020.



Source: *built by the author based on data [10]

Fig. 2. Incomes of the population of Ukraine for 2020

The fig. 3 shows the incomes of the population of Ukraine for 2021



Source: *built by the author based on data [10]

Fig. 3. Incomes of the population of Ukraine for 2021

It is clearly seen from the constructed diagrams that the largest share in the total amount of income for the year is taken by wages each year, in 2019 – 47 %, and in 2020–2021 – 46 %, respectively. The second place is occupied by social benefits and other received current transfers – 2019 – 32 %, 2020 – 34 %, 2021 – 33 %. In third place is profit and mixed income, which is 18 % in 2019–2020, 19% in 2021. The smallest share in the structure of the income of the population of Ukraine is the income from property (received), in 2019 – 3 %, and in 2020– 2021 – 2 %, respectively.

For a deeper understanding of the incomes of the population, we will conduct a comparative analysis of incomes, purchases of goods and services, as well as expenditures and savings of the population according to the data in the table 2.

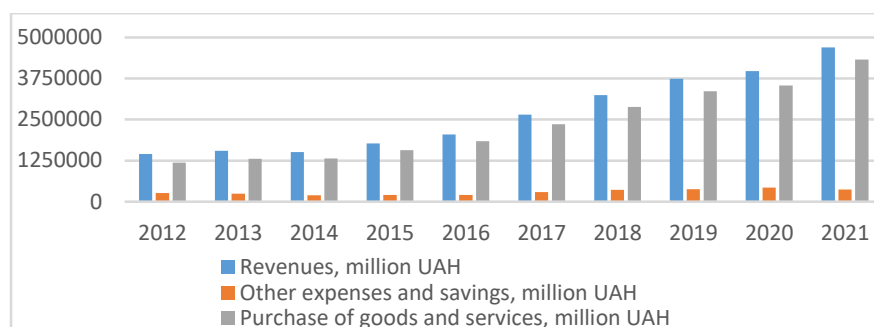
Table 2

Incomes and expenses of the population of Ukraine for 2012–2021

Year	Revenues, million UAH	Other expenses and savings, million UAH	Purchase of goods and services, million UAH
2012	1457864	263073	1194791
2013	1548733	244702	1304031
2014	1516768	200011	1316757
2015	1772016	203843	1568173
2016	2051331	211069	1840262
2017	2652082	292097	2359985
2018	3248730	363759	2884971
2019	3744060	387067	3356993
2020	3972428	437051	3535377
2021	4698611	374424	4324187

Source: *built by the author based on data [10]

We will conduct a comparative analysis of the incomes and expenses of the population of Ukraine for 2012– 2021 with the help of graphing in the Microsoft Excel environment and its characteristics (fig. 4).



Source: *built by the author based on data [10]

Fig. 4. Incomes and expenses of the population of Ukraine for 2012–2021

The fig. 4 clearly shows that the incomes of the population increase every year and exceed the costs of purchasing goods and services, which also tend to increase. However, other expenses and savings, although they are increasing, are the least and, compared to income, occupy a very small percentage of a person’s life. Thus, from the constructed graph, it can be concluded that during the studied period of 2012–2021, the population spends the most on the purchase of goods and services, which is almost equal to their income for the year.

We will conduct descriptive statistics of the incomes of the population of Ukraine for 2019–2021 (Table 3) using Microsoft Excel software.

Table 3

Incomes of the population of Ukraine 2019–2021

Region	Revenues, million UAH		
	2019	2020	2021
Vinnitsia	129061	138552	158336
Volyn	72185	77720	89280
Dnipropetrovsk	360385	384511	434791
Donetsk	199322	210207	237727
Zhytomyr	97301	102465	117444
Zakarpattia	78182	84270	96551
Zaporizhya	169384	178172	202504
Ivano-Frankivsk	98587	106202	122057
Kyiv	173511	186594	227470
Kirovohrad	71713	76911	87450
Luhansk	66287	71087	82239
Lviv	216876	235055	279095
Mykolaiv	92529	99040	115244
Odesa	225458	245164	280203
Poltava	129647	138898	162018
Rivne	82555	88077	102157
Sumy	89702	96629	112196
Ternopil	68282	74502	88165
Kharkiv	245934	263215	313394
Kherson	76449	83199	95530
Khmelnysk	97560	105067	121848
Cherkasy	92887	99767	117922
Chernivtsy	58028	62695	72792
Chernihiv	76808	82929	96273

Source: *built by the author based on data [10]

Using the «Data Analysis» – «Rank and Percentile» functions, we have 3 intervals for each year. The results of the interval distribution of statistical data of population incomes by regions of Ukraine for 2019–2021 are shown in Table 4.

Table 4

Interval distribution of statistical data of population incomes by regions of Ukraine for 2019–2021

2019			
Interval		Number of observations	Region
58028	158813,67	17	Vinnitsia, Volyn, Zhytomyr, Zakarpattia, Ivano-Frankivsk, Kirovohrad, Luhansk, Mykolaiv, Poltava, Rivne, Sumy, Ternopil, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi, Chernihiv regions.
158813,67	259599,33	6	Donetsk, Zaporizhzhya, Kyiv, Lviv, Odesa, Kharkiv regions.
259599,33	360385	1	Dnipropetrovsk region
2020			
62695	169967	17	Vinnitsia, Volyn, Zhytomyr, Zakarpattia, Ivano-Frankivsk, Kirovohrad, Luhansk, Mykolaiv, Poltava, Rivne, Sumy, Ternopil, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi, Chernihiv regions.
169967	277239	6	Donetsk, Zaporizhzhya, Kyiv, Lviv, Odesa, Kharkiv regions.
277239	384511	1	Dnipropetrovsk region
2021			
72792	193458,33	17	Vinnitsia, Volyn, Zhytomyr, Zakarpattia, Ivano-Frankivsk, Kirovohrad, Luhansk, Mykolaiv, Poltava, Rivne, Sumy, Ternopil, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi, Chernihiv regions.
193458,33	314124,67	6	Donetsk, Zaporizhzhya, Kyiv, Lviv, Odesa, Kharkiv regions.
314124,67	434791	1	Dnipropetrovsk region

Source: *built by the author based on data [10]

Dnipropetrovsk region has the largest amount of population incomes by region for 2019–2021. Donetsk, Zaporizhia, Kyiv, Lviv, Odesa, and Kharkiv oblasts take second place, followed by Vinnitsia, Volyn, Zhytomyr, Zakarpattia, Ivano-Frankivsk, Kirovohrad, Luhansk, Mykolaiv, Poltava, Rivne, Sumy, Ternopil, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi, Chernihiv regions, as a percentage of the corresponding period of the previous year.

Further, using the functions «Data analysis» – «Descriptive statistics» we have the following results, which are displayed in Table 5.

Table 5

Descriptive statistics of population incomes by region of Ukraine for 2019 – 2021

Indicator	2019	2020	2021
Average	127859,71	137122	158861,92
Standard error	15302,14	16348,36	18818,33
Median	95094	101116	117683
Standard deviation	74964,88	80090,28706	92190,63
Sampling variance	5619733175	6414454081	8499111388
Kurtosis	2,66	2,60	2,11
Asymmetry	1,64	1,63	1,55
Interval	302357	321816	361999
Minimum	58028	62695	72792
Maximum	360385	384511	434791
Sum	3068633	3290928	3812686
Score	24	24	24
Biggest (1)	360385	384511	434791
Smallest (1)	58028	62695	72792
Reliability level (95.0 %)	31654,89	33819,16	38928,69

Source: *built by the author based on data [10]

Thus, from Table 5, we can draw the following conclusions that in 2019, the average value of the population income depending on the region of Ukraine is greater than the median (127859.71 > 95094), which indicates a strong ($As = 1.64 > 0.5$) right-sided asymmetry, flat top distribution ($E = 2.66 < 3$). Half of the incomes of the population have incomes up to UAH 95,094 million. The maximum amount of income is UAH 360,385 million, the minimum amount of income is UAH 58,028 million. There is a significant gap between incomes, the amount of variation is UAH 302,357 million. In 2020, the average value of the population's income, depending on the region of Ukraine, is greater than the median (16348.36 > 101116), which indicates a strong ($As = 1.63 > 0.5$) right-sided asymmetry, a flat-top distribution ($E = 2.60 < 3$). Half of the incomes of the population have incomes up to UAH 101,116 million. The maximum amount of income is 384,511 million hryvnias, the minimum amount of income is 62,695 million hryvnias. There is a significant gap between incomes, the amount of variation is 321,816 million hryvnias. And in 2021, the average value of total income is greater than the median (1606826 > 695062), which indicates a strong ($As = 0.91 > 0.5$) right-sided asymmetry, a flat-top distribution ($E = -0.86 < 3$). Half of the revenues and expenses of Ukraine have revenues and expenses of up to UAH 695,062 million. The maximum amount of income is 4698611 million hryvnias, the minimum amount of income is 104.3 million hryvnias. There is a significant gap between incomes, the size of the variation is 4698507 million hryvnias. In order to qualitatively assess the statistical analysis of income and expenditure of the population, it is appropriate to analyze the average level of income, which increases every year, as the standard of living, average salary, taxes increase.

The report of the National Bank of Ukraine states that by the end of 2022, the real incomes of Ukrainians decreased by 16 %, although there was a small increase in nominal numbers, but the situation should radically improve in the new year. According to NBU data, after a sharp drop in the first half of the year, nominal incomes of the population began to grow in the second half of 2022. To a large extent, this was influenced by payments to state employees and especially high salaries of the military. Thus, at the end of the year, the average nominal salary in Ukraine increased by 0.5 %. However, real incomes (adjusted for inflation) fell by 15.8 % last year. The National Bank of Ukraine predicts that in the next three years, the wages of Ukrainians will begin to grow again, but only in nominal numbers. This will be facilitated by the growth of spending in the military and security sectors, as well as the adaptation of the economy to work in war conditions [11].

Ukraine's economy will shrink by at least 30 % due to the Russian invasion. The International Monetary Fund [12] predicted a drop in GDP by 35 %, and the World Bank [13] says about 45 %. In March 2022, the economy followed a pessimistic scenario: real GDP decreased by 45 % year-on-year, according to an analytical report by the investment company Dragon Capital [14]. However, there are no official data for 2022, as the State Statistician Service has stopped updating statistics.

Conclusions and prospects for further research. The results of the conducted research show that uneven incomes of different strata of the population, political instability, high level of corruption, social tension, a high proportion of the poor population, the outflow of qualified labor force abroad, the prosperity of the shadow economy, which in general leads to the deterioration of the socio-economic development of Ukraine. The existing inequality in incomes and expenses of the population requires assistance to solve this problem from the side of state bodies, overcoming corruption, socialization of the population, business. This will provide an opportunity to make effective decisions and develop development programs to increase the population's income and reduce poverty in Ukraine.

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Статистичний аналіз доходів населення України

Одним з найважливіших показників, що характеризують рівень економічного і соціального розвитку суспільства є доходи населення, як матеріальні блага та сума грошових коштів, які отримані чи створені громадянами за певний період часу. Оскільки ситуація в сфері доходів знаходиться під постійним соціальним напруженням, а основною складовою, яка характеризує рівень життя населення виступає матеріальне становище, тому важливим та актуальним є дослідження, які пов'язані не лише з теоретичними, а й практичними аспектами рівня життя. У статті проаналізовано доходи населення України за допомогою статистичного аналізу та з використанням комп'ютерних технологій. Для дослідження доходів населення України використано новітні технології та методи аналізу даних, що використовуються для виявлення прихованих закономірностей у великих масивах даних, а також методики та засоби статистичного аналізу. Основні процедури аналізу даних розраховано та охарактеризовано за допомогою сучасних комп'ютерних технологій, а саме використовуючи один із методів статистичного аналізу доходів населення – описову статистику, яку було проведено за допомогою програмного забезпечення Microsoft Excel.

Результати проведеного дослідження свідчать, що існуюча нерівність за доходами і витратами населення потребує сприяння для вирішення даної проблеми з боку державних органів, подолання корупції, соціалізації населення, бізнесу. Це дасть можливість, щоб приймати ефективні рішення та розробляти програми розвитку щодо підвищення доходів населення і зниження бідності в Україні.

Ключові слова: доходи; прибуток; статистичний аналіз; описова статистика.

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