The Analysis of Indicators Aimed at the Sustainable Development of Alcohol Production using the Python Programming Language (According to the Data of the Republic of Armenia)

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Abstract:- Market of alcoholic beverages is developing dynamically in the world. This analysis was carried out on the basis of the data of the Republic of Armenia, taking into account the fact that Armenia has thousands of years of history and traditions in this field. The article considers the issues of alcoholic beverage market of the Republic of Armenia, dynamics of the economic indicators of alcoholic beverages produced and exported in Armenia at comparable prices. The applicability and relevance of the Python programming language were analyzed in order to identify the relationship between the indicators. The tendencies and trends of production, export and import of alcoholic beverages in RA were presented. By calculating the correlation coefficient, the relationship between the production and export volumes of alcoholic beverages of RA in 2017-2021 was studied. Using the basic tools of the Python programming language, a number of calculations and conclusions were made. All codes required for the calculation of correlation coefficient were also introduced, and by simply copying them into the appropriate program, it will be possible to conduct similar calculations. Moreover, this model is applicable not only in Economics, but also in other fields where there are factor and result indicators.

Keywords:- Production, Export, Alcoholic Beverage Market, Economic Indicator, Codes.

I. INTRODUCTION

In the 21st century, with exponential growth of population number, the world issue of food security becomes very urgent. According to the UN Food and Agriculture Organization (FAO), today, 1 billion people in the world are starving. For some countries, food insufficiency has become not only an obstacle to economic development, but also a serious threat to social and political instability. The choice and relevance of the topic of the article is due to the stable share of alcoholic beverages in the structure of food supply system of population and in the RA industry. Alcoholic beverages are drinks containing ethyl alcohol. Many types of alcoholic drinks are known, widely spread and consumed in almost all countries. Most of them are produced using fermentation technology. Production of alcoholic beverages is one of the profitable sectors of the RA processing industry, and the production of alcoholic beverages in the RA has a millennial history. The diversity of the country's climatic conditions provides an opportunity to obtain high-quality raw materials. The relevance of the chosen topic consists in the fact that the research aimed at the production volumes of alcoholic beverages and the expansion of export capacity enables an objective assessment of export as the overall economic potential of our country.

II. ANALYSIS OF ECONOMIC INDICATORS OF ALCOHOL PRODUCTION AND EXPORT OF RA

The selection and relevance of the subject of the current article is related to the stable share of alcoholic beverages in the population's food security system and in the RA industry. Production of alcoholic beverages is one of the profitable sectors of the RA processing industry, and, as it has been already mentioned, it has a millennial history in the RA. The diversity of the country's climatic conditions enables to obtain high-quality raw materials.

The actuality of the subject is also due to the specific weight of alcoholic products in the overall RA industrial output, increasing from 4.3 % in 2015 to 5.6 % in 2021. The entrepreneurial activity of the organizations that produce and export alcoholic beverages is not only of economic, but also of social importance importance for our country. Thousands of job opportunities have been created and unemployment has been reduced to some extent.

The integration processes taking place in the world economy in the 21st century further deepen the economic ties of different countries, which are accompanied by the activation of free movement of goods, services, objects of

intellectual activity, capital and labor between these countries, which are objective prerequisites for solving the problems concerning the export of alcoholic beverages of RA. Trade relations in RA are formed based on the requirements of economic stabilization and development of our country. Usually, small countries do not build their trade ties to gain economic and political influence in other countries, but rather to create relationships based on mutual interests.

The dynamics of production and export of alcoholic beverages in RA in 2017-2021 at comparable prices is presented. The dynamics of the above-mentioned indicators has mainly demonstrated a sustainably growing tendency. However, the decline in 2020 figures was due to the pandemic-driven economic crisis and the painful 44-day war with irreversible consequences.

The article considers the dynamics of production and export of alcoholic beverages in the Republic of Armenia as a factor and result economic indicator, as well as the relations between these two economic indicators. The corresponding indicators are introduced in Table 1.

Table 1. Dynamics of production and export of alcoholic beverages in the Republic of Armenia in 2017-2021 at comparable prices, billion drams

Dynamics of RA alcohol production [1]				
2017	2018	2019	2020	2021
98.1	95.9	124.7	103.3	131.9
Dynamics of export of alcoholic beverages from Armenia [2]				
2017	2018	2019	2020	2021
111.8	106.1	135.3	110.9	135.1

In order to better understand the dynamics of the two analyzed indicators, a calculation of the analytical indicators of the dynamics series was made. It implies the calculation of absolute increment, growth and increment rate through the base and chain methods. It is also necessary to calculate the absolute increment of one percent, which is done only through the chain method.

Absolute increment (Δy) is the difference between the levels of the dynamics series, which shows by how many units the level of the series has increased or decreased in a certain period of time. Absolute increment can be calculated both against the initial and also directly against the previous level. In this view, the base and chain absolute increment of dynamic series are distinguished. The absolute base increment is equal to the difference between the comparable/reference (y_i) and baseline (y_{i-t}) levels, expressed in the same units via which the levels are measured:

[1] Website of the Statistical Committee of the Republic of Armenia: www.armstat.am

[2] Website of the State Revenue Committee of the Republic of Armenia: www.petekamutner.am

$$\Delta y_{i/i-t} = y_i - y_{i-t} \ (1).$$

The absolute chain increment is equal to the difference between the following (y_i) and previous (y_{i-1}) levels:
$$\Delta y_{i/i-1} = y_i - y_{i-1} \ (2).$$

➤ *The rates of growth and increment.*
The absolute increment reflects the absolute growth rate. The intensity of changes in the dynamic series levels is assessed through the current and previous or base levels relation. That indicator is accepted to call growth factor, while in percentagewise it is called growth rate. The growth rate per the base method is calculated through relating the comparable level (y_i) to the baseline (y_1) one.
$$T_{P_{i/1}} = \frac{Y_i}{Y_1} 100\% \ (3).$$

If the immediately preceding level is taken as the base, we get the chain growth rate:
$$T_{P_{i/i-1}} = \frac{Y_i}{Y_{i-1}} 100\% \ (4).$$

The growth factor shows, how many times the compared level (if the factor is greater than one) is higher the base one or what is its share in it (if it is less than one). In order to express the changing value of the absolute increment in the dynamic series levels by the relative values the rate of increment is determined, which is also base and chain.

The base increment rate is calculated through the following formula:
$$T_{npy_{i/1}} = \frac{Y_i - Y_1}{Y_1} 100\% \ (5).$$

The formula for calculating chain increment is as follows:
$$T_{npy_{i/i-1}} = \frac{Y_i - Y_{i-1}}{Y_{i-1}} 100\% \ (6).$$

The increment factor is one unit lower than the growth factor, while the increment rate – by 100 % against the growth rate:
$$T_{npyi/i-1} = T_{pyi/i-1} - 100\% \ (7).$$

The value *of 1% absolute increment* of the dynamics series is determined by relating the absolute increment to the rate of increment:

$$A|\%| = \frac{\Delta Y_{i/i-1}}{T_{npy/y-1}100} = \frac{Y_i - Y_{i-1}}{\frac{Y_i - Y_{i-1}}{Y_{i-1}}100} = \frac{1}{100}Y_{i-1} = 0,01Y_{i-1} \ (8).$$

The mentioned indicator has an economic significance only in case of calculating it via chain method. [3]

The indicators of 2017 year were selected as those of base year. The results of computation are introduced in Table 2.

[3] I. И. Eliseeva – ''General theory of statistics, edited by chl.-corr''. M.: Finance and statistics, 2004, p 449 - 454.

Table 2. Computation of analytical indicators of the dynamics of production and export of alcoholic beverages in the Republic of Armenia in 2017-2021

Date	Indicator, billion drams	Absolute increment, billion drams		Growth rate, %		Increment rate, %		1% Increment rate $A\|\%\|$, billion drams
		base	chain	base	chain	base	chain	
Dynamics of alcoholic beverages production in the Republic of Armenia								
2017	98.1	0.0	-	100.0	-	0,0	-	-
2018	95.9	-2.2	-2.2	97.8	97.8	-2.2	-2.2	0.981
2019	124.7	26.6	28.8	127.1	130.0	27.1	30.0	0.959
2020	103.3	5.2	-21.4	105.3	82.8	5.3	-17.2	1.247
2021	131.9	33.8	28.6	134.5	127.7	34.5	27.7	1.033
Dynamics of export of alcoholic beverages from the Republic of Armenia								
2017	111.8	0.0	-	100.0	-	0.0	-	-
2018	106.1	-5.7	-5.7	94.9	94.9	-5.1	-5.1	1.118
2019	135.3	23.5	29.2	121.0	127.5	21.0	27.5	1.061
2020	110.9	-0.9	-24.4	99.2	82.0	-0.8	-18.0	1.353
2021	135.1	23.3	24.2	120.8	121.8	20.8	21.8	1.109

The data in Table 2 prove that both the production of alcoholic beverages and their export increased in RA during the period under study. Particularly, in 2021, alcohol production in RA increased by 34.5% compared to 2017, or by about 33.8 billion drams expressed in comparable prices. The export volumes in the same period increased by 23.3 billion drams or by 20.9 % in comparable prices. In the five-year of investigations both indicators decreased only in 2020, which is related to anti-epidemic economic restrictions. In particular, the production volume fell by 17.2 % and the export volume – by 18 %.

III. CORRELATION ANALYSIS OF ECONOMIC INDICATORS OF RA ALCOHOL PRODUCTION AND EXPORT USING PYTHON PROGRAMMING LANGUAGE

The relation between the alcoholic beverages production in Armenia and export volumes in 2017-2021 by means of computation of correlation coefficient has been studied in the current article. *Correlation* is a statistical dependence between random variables, which does not have a strictly functional nature and the change of one random variable leads to a change in the mathematical expectation of the other variable. In the case of pairwise correlations, the goal of correlation analysis is to determine the density of association between two features, which is quantified by the correlation coefficient. In the theory of statistics, various calculation formulae have been developed and used in practice. We'll use the following ones:

$$r_{xy} = \frac{\overline{XY} - \bar{X}\bar{Y}}{\sigma_x \sigma_y} \quad (9)$$

$$\sigma_x = \sqrt{\overline{X^2} - \overline{(X)^2}} \quad (10)$$

$$\sigma_y = \sqrt{\overline{Y^2} - \overline{(Y)^2}}^{\,4} \quad (11),$$

Where X is a factor index, and Y is the result index. Let's choose the export of alcoholic beverages from RA as a factor indicator, and the production of alcoholic beverages as a result indicator. The calulations have been conducted through the Python programming language, which are introduced below via figures:


```python
import math


class CorCalculator:
    exports = []
    production = []

    def __init__(self, exports, production):
        self.exports = exports
        self.production = production

    def __round(self, num):
        return round(num, 2)

    def __calculate_square(self, items):
        return [self.__round(num**2) for num in items]

    @classmethod
    def calculate_average(cls, items):
        return cls.__round(cls, sum(items) / len(items))

    @classmethod
    def calculate_sum(cls, items):
        return cls.__round(cls, sum(items))

    def calculate_square_of_exports(self):
        return self.__calculate_square(self.exports)

    def calculate_square_of_production(self):
        return self.__calculate_square(self.production)

    def calculate_multiple(self):
        return [
            self.__round(num * self.production[index])
            for index, num in enumerate(self.exports)
        ]
```

Fig 1. Computation of correlation coefficient through Python programming language

Using the code in the figure and making use of the data of Table 1, computations have been conducted; the results are presented in Table 3.

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[4] G. V. Vardanyan. Basics of Econometrics, Yerevan 2003, p. 11

Table 3. Computation of correlation coefficient of the alcoholic beverages production and export indicators in the Republic of Armenia

Date	Value index of the export of alcoholic beverages from Armenia, billion drams	Value index of alcoholic beverages production in RA, billion drams	X_i^2	X_iY_i	Y_i^2
2017	111,8	98,1	12499,2	10967,6	9623,6
2018	106,1	95,9	11257,2	10175,0	9196,8
2019	135,3	124,7	18306,1	16871,9	15550,1
2020	110,9	103,3	12298,8	11456,0	10670,9
2021	135,1	131,9	18252,0	17819,7	17397,6
Total	599,2	553,9	72613,4	67290,1	62439,0
Average	119,8	110,78	14522,7	13458,0	12487,8

Using the data in table 3 and formulas 9, 10 and 11, let's continue the calculation of the correlation coefficient applying the Python programming language. To perform the calculation of the specified formulas, let's add the second part to the already existing code, which is presented in Figure 2 below.

Fig 2. Code for calculating correlation coefficient data in the Python programming language.

The analytical result changes depending on what the correlation coefficient is equal to. Upon the correlation coefficient it is possible to identify whether the relationship between two indicators is strong or weak, directly or inversely proportional. Let's add the next part to the point we have already written, after which our code will look complete. The mentioned added part is introduced in Figure 3.

Fig 3. The code for displaying the final result of the correlation coefficient data calculation in the Python programming language

The applicability of the formula is purpose-oriented. Entering the initial/baseline data (production and export), the formula (code) performs calculation, gives the analysis of the relationship between the two economic indicators. The factor and result indicators are entered in the code, after which the latter calculates the correlation coefficient and gives the analytical result, which is addressed in figure 4.

Fig 4. Computation of the correlation coefficient using the Python programming language

It should be noted that the calculation model and programming codes used in the article are also applicable in the international arena. The relationship between the factor and output indicators of each branch of the economy of any country can be analyzed using the code in the article. Moreover, this model is applicable not only in economics, but also in all those areas where there are factor and result indicators.

IV. CONCLUSIONS

Thus, according to historical sources, the production of alcoholic beverages in the Armenian world has a millennial history. The production of alcoholic beverages is one of the rapidly developing sub-branches of the RA economy, provided with both local and imported raw materials. In 2021, alcohol production in Armenia increased by 34.5% compared to 2017, or by about 33.8 billion drams expressed in comparable prices. In the same period, export volumes increased by 23.3 billion drams or 20.9% at comparable prices. Within the five-year study period both indicators decreased only in 2020, which is due to anti-epidemic economic restrictions. In particular, the production volume was reduced by 17.2%, and the export volume - by 18%.

As the correlation coefficient calculation indicates, there is a direct relationship between the production and export of alcoholic beverages from Armenia. In case of direct relationship the increase or decrease in the values of factor attribute entails to the increase or decrease in the values of result attribute. In other words, the increase in the volume of alcohol export leads to the increase in the latter's production in RA and vice versa. The export of alcohol from RA is a factor indicator - the volume of exports increased during 2017-2021 - and the production of alcohol in RA is a result indicator, which is affected by the change of the factor indicator.

REFERENCES

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[4]. I. И. Eliseeva – ''General theory of statistics, edited by chl.-corr". M.: Finance and statistics, 2004, p 449 - 454.