THE MAIN ASPECTS REGARDING THE USE OF STATISTICAL INDICATORS IN ECONOMIC ANALYZES

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Abstract

The economic data are very important in the sense that, on the basis of them, the concrete results obtained by the national economy over a period of time are calculated or estimated. The statistical population or statistical community refers to and includes all economic entities. In order to be able to summarize the results of each economic entity in its structure, it is necessary to calculate some quantities in order to accurately certify the results obtained. In this sense, the statistical indicators calculated in Romania by the National Institute of Statistics, and internationally by Eurostat (the two specialized institutions use the same methodology to ensure international comparability of data) that can be interpreted, analyzed and used to estimate the perspective. future developments.

Statistical indicators are calculated in absolute or relative terms and they reveal a number of aspects specific to the economic results obtained over a period of time. For example, we use the average sizes, the sizes of the variation of economic phenomena, the sizes regarding the comparative study of the results obtained in territorial profile, but also the evolution in time of the same indicator. The latter reveals how that statistical quantity has evolved, which reflects the way in which the resources of the national economy have been used, reflects the quality of the labor force and many other aspects that lead to decisions usable by the managerial factor of the national economy.

Within these economic indicators, a series of coefficients of variation and correlation are calculated that highlight the way in which the factors influencing the economic evolution are interconditioned and lead to concrete results in time.

This article highlights the theoretical aspects that we must take into account when calculating such quantities usable in economic studies and analyzes.

Keywords: *statistical indicators, absolute and relative quantities, coefficients, statistical tests, variation, evolutions, economic phenomena.*

JEL Classification: *C10, C13*

Introduction

In this article, the authors highlighted the important aspects of statistical indicators, as well as their role in macroeconomic econometric analyzes.

In the article, the authors analyzed, one by one, a series of statistical indicators, starting with the indicator most used in financial-economic analysis which is the average. Thus, the arithmetic mean of the population, the arithmetic mean of the sample, the weighted arithmetic mean and the arithmetic mean of a random variable were approached. Given the level differences of the variables and their degree of dispersal, the amplitude and dispersion of a sample and that of the random variable were also addressed. In this context, the normal Gaussian distribution, the standardized normal Laplace distribution and the t-Student distribution were analyzed.

Starting from the existence of causal relations in the economy, which is determined by the sensitivity of one variable in relation to the modification of another variable, a series of coefficients were analyzed such as Pearson covariance, Pearson linear correlation coefficient, autocorrelation coefficient, determination coefficient and elasticity.

The article is accompanied by graphs that better highlight the results of the study.

Literature review

Anghelache (2008) is a reference work in economic statistics. Anghelache and Anghel (2016) studied the correlation between several economic variables. Anghelache and Anghel (2014) analyzed the main models applied in economic analyzes. Anghelache and Capanu (2000) highlighted the main indicators used in economic analyzes. Anghelache, Mitruţ and Voineagu (2010), as well as Anghelache, Isaic-Maniu, Mitruț, Voineagu and Dumbravă (2007) presented the main aspects regarding macroeconomic statistics. Bardsen et al. (2005) referred to a number of elements related to macroeconomic modeling. Bărbulescu and Gavrilă (1999) presented the fundamental notions of enterprise economics, while Ciobanu (2006) focused on the performance of entities. Davidson and Mackinnon (2004) investigated a number of econometric methods. The main aspects of the economic analysis are analyzed by Gheorghiu (2012), Lazăr and Lazăr (2012), as well as by Spătaru (2011). Katona (2004) dealt with the ways of financing SMEs. Iacob (2019) highlighted the importance of applying statistical-econometric tools in economic studies.

Methodology, data, discussions, results

Statistics is the science, but also the method of data collection, presentation, analysis and interpretation of them for the study of mass socio-economic phenomena. Like any other science, statistics uses specific notions and terms such as: statistical population, sample, random variable, probability distributions, estimators, statistical hypotheses, acceptance tests, axioms, laws, theorems, statistical indicators, etc.

The statistical population or the statistical community, represents the totality of the entities with common observable features, such as the totality of the economic entities with the same object of activity CANE Rev.2. A population is considered fully defined if all the elements that make it up can be identified and each element is researched. For very large populations, considered practically infinite, this scientific approach can be performed on a small community, called selection or sample community. By statistical processing of the data collected from the analyzed sample are obtained estimators that are extrapolated to the population to which the sample belongs, if the sample is representative of the studied characteristic and the statistical hypothesis by which the estimator is consistent for the statistical indicator of the population is accepted.

The most common statistical indicator in financial-economic analyzes is the average. The average expresses the mean level, the typical value, most likely for the data set used, being less affected by random perturbations that may influence the level indicator.

In the statistical sense, the arithmetic mean, or initial moment of the first order, of the individual values $x_1, x_2, \dots x_n$ of the numerical characteristic X represents that value $\bar{x}$ that would be registered if all the influencing factors had acted constantly at the level each recording unit.

• Arithmetic mean of the population, μ(x):

$$\mu(x) = \frac{1}{N}\sum_{i=1}^{N} x_i \qquad (1)$$

where:

x_i= The observed individual values of the variable X;

N= Total number of entities in the population.

• Arithmetic mean of the sample, $\bar{x}$:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad (2)$$

where:

x_i= the observed individual values of the variable X;

n= Total number of observations, or sample size.

• Weighted arithmetic mean:

$$\bar{x} = \frac{\sum_i^n x_i * f_i}{\sum_i^n f_i} \qquad (3)$$

where:

x_i = the observed individual values of the variable X;

f_i = frequency of occurrence of x_i.

• Arithmetic mean of a random variable, M(x):

$$M(x) = \sum_i x_i * p_i \qquad (4)$$

where:

x_i= the observed individual values of the random variable X;

p_i= probability of occurrence of x_i.

• The amplitude is calculated as the difference between the maximum level and the minimum level of a variable. The calculation relationship is:

$$A = x_{max} - x_{min} \qquad (5)$$

• The dispersion expresses the degree of scattering of the values of the variable in relation to the mean and is calculated as the arithmetic mean of the squ ares of the individual deviations from the mean. Dispersion of a population, σ^2:

$$\sigma^2 = \frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N} \qquad (6)$$

• The dispersion of a sample, not moved, s^2:

$$s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1} \tag{7}$$

• The dispersion in the case of the random variable, D_x:

$$D_x = M[(x - M(x))^2] \tag{8}$$

• The mean square deviation or standard deviation results from the extraction of the square root from the dispersion:

$$\sigma = \sqrt{\sigma^2} \tag{9}$$

The quadratic mean deviation indicator is recommended because it is expressed in the unit of measurement of the data series average, it is used to characterize the theoretical distributions, it is calculated based on a simple relation. The quadratic mean deviation is used to calculate the normal distribution, also called the normal distribution law.

The normal Gaussian distribution, $N(\mu,\sigma^2)$, is of continuous type and has the following function of distribution density:

$$\varphi(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \tag{10}$$

where:

μ= average of the variable x;

σ= mean square deviation.

The graphical representation of the normal distribution is symmetrical, bell-shaped, with parameters μ and σ. The probability that the normally distributed variable x, with parameters μ and σ to be in the range x_1, x_2 is represented by the area between x_1, x_2 and the distribution function and is given by the expression:

$$P(x_1 < x < x_2) = \int_{x1}^{x2} \varphi(x)dx \tag{11}$$

The Laplace standardized normal distribution, N(0,1), is obtained by defining the variable Z, which corresponds to the normal standard distribution function $\varphi(z)$:

$$z_i = \frac{x_i - \mu}{\sigma} \tag{12}$$

$$\varphi(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}} \tag{13}$$

The t-Student distribution is used to compare the average of the sample with the average of the population from which it comes or to compare the averages of two samples. The variable t is defined similarly to the variable Z for which the mean is the mean of the sample and the dispersion is the dispersion of the sample:

$$t_i = \frac{x_i - \bar{x}}{\frac{s}{\sqrt{n}}} \tag{14}$$

where:

$\bar{x}$= Average of the sample;

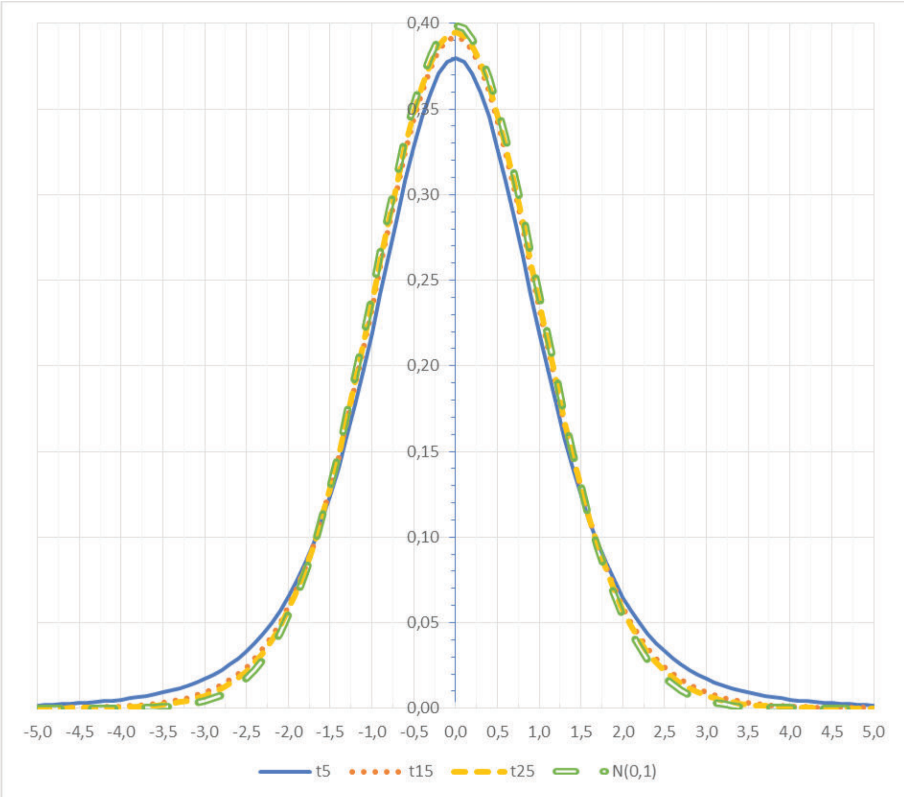
s= Quadratic mean deviation of the sample;

n= Sample size, number of degrees of freedom.

The normal distribution N (0,1) and the distribution t-Student are shown in graph (1). The graph was made with the NORM.DIST and T.DIST functions from excel. The distribution t with 5 degrees of freedom was denoted by t5, the one with 15 degrees of freedom t15 and the one with 25 degrees of freedom t25. For a sample larger than 30, the normal N (0,1) distribution is used instead of the t-Student distribution.

Normal distribution N (0,1) and distribution t-Student

Graph 1



The coefficient of variation, V, as a derived statistical quantity, is calculated by reporting the standard mean deviation to the mean of the distribution series in order to verify the representativeness of the mean. If the value of the coefficient of variation is less than 30%, the average is considered to be a measure representative of the central trend of the distribution series. The coefficient of variation is also used to compare the distribution series in relation to the homogeneity criterion, the hierarchy of coefficients of variation of the distribution series establishing the order of homogeneity of the series. The calculation formula is:

$$V = \frac{s}{\bar{x}} \quad (15)$$

The existence of causal relationships in the economy is determined by the sensitivity of one variable to the change of another variable, which determines that in the case of bivariate series to calculate the following indicators:

• The covariance, COV, expresses the simultaneous scattering of the variables x and y in relation to their averages. The calculation relation for the case of the random variables y and x is:

$$\mathrm{COV}_{yx} = M[y - M(y)][x - M(x)] \tag{16}$$

• Pearson's covariance is:

$$\mathrm{cov}_{xy} = \frac{\sum_{i=1}^{n}(y_i - \bar{y})(x_i - \bar{x})}{n} \tag{17}$$

• Pearson linear correlation coefficient, r_{xy}, is:

$$r_{xy} = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{n s_x s_y} = \frac{\mathrm{cov}_{xy}}{s_x s_y} \in [-1,1] \tag{18}$$

The correlation coefficient represents the numerical expression of the degree of association of the changes of the two variables in relation to their averages. If the size of the coefficient is close to 1, the existence of a directly proportional link between the two variables is considered, and if the size of the coefficient is close to -1, the existence of an inversely proportional link between the two variables is considered.

The autocorrelation coefficient highlights the existence of the correlation between the dynamics of the variable y in period t and the dynamics of the same variable in period t-k:

$$r_{yt,yt+k} = \frac{\sum_{t=1}^{n}(y_{t+k} - \bar{y})(y_t - \bar{y})}{\sum_{t=1}^{n}(y_t - \bar{y}_t)^2} \tag{19}$$

The coefficient of determination, R^2, is an expression of the proportion of changes in the effect variable y explained by the explanatory variable x. The calculation relationship is:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2} \tag{20}$$

where:

$\bar{y}$= Average value of the variable;

$\hat{y}_i$= Estimated value of the variable in point i;

n= Number of observations.

If R approaches 1, the confidence increases that the variable y depends on the variable or explanatory / causal variables considered.

The coefficient of elasticity, E, expresses the proportion in which the effect of y changes with respect to the change of the factor x and is calculated by the formula:

$$E = \frac{y_1 - y_0}{y_0} : \frac{x_1 - x_0}{x_0} \quad (21)$$

If:

$|E| > 1$ The variable y is elastic / sensitive to changes in the variable x;

$|E| = 1$ The variable y changes at the same rate as the variable x;

$|E| < 1$ The variable y is inelastic / insensitive to changes in the variable x.

Conclusions

From this article we can deduce a series of conclusions, both theoretical and practical. Thus, a first conclusion that emerges from the study is that it has highlighted a number of issues regarding the indicators that can be used to substantiate the financial and economic decisions that an economic entity can take in order to obtain more and more results. good and consequently high profitability.

Another conclusion is that the study highlighted all the possibilities to use statistical indicators, which would be able to emphasize the economic efficiency at the microeconomic level at a given time and based on them, to be able to make an estimate, of course probabilistic, but with a high degree of confidence in order to be able to anticipate the results that will be reached by making decisions in accordance with reality.

Also, another conclusion is that the algorithm established for such analyzes and the indicators used are valid for any economic and social entity, regardless of the object of activity.

Last but not least, it is clear that statistics, econometrics and why not applied mathematics in economics offer a wide range of possibilities to analyze and interpret the results at a given time, as well as estimating the evolution prospects of the results of economic entities.

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