MULTIDIMENTIONAL COMPARATIVE ANALYSIS OF INNOVATIVE ACTIVITY OF TERRITORIAL UNITS

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Abstract

The author has analyzed the innovation activity of industrial organizations by testing the hypothesis of equality of the mean vector and constant vector, testing the hypothesis of equality of the two mean vectors, testing the hypothesis of equality of the covariance matrices for different regions of the Republic of Belarus for 2010-2011.

1 Introduction

International and national experts in the field of economics more often say about correlation of economic development and scientific and technological progress. Advances in science and technology are a key factor in the growth of labor productivity, increasing competitiveness of organizations and the state in general, which, eventually, leads to improved quality of life. Analysis of innovation activity is conjugate with a lot of statistics . Objects of accounting are characterized by the many signs simultaneously. The correct display of essence of the objects, reflected in the many features, possible in case of use of the most important characteristics. Solution of a such problem can be found by using multivariate statistical analysis.

2 International standards for statistics of science and innovation

Development of scientific and technical knowledge was the incentive for the development of statistics, science and innovation, both in scientific knowledge and practice. Systematization methodological foundations of science and statistics of innovation was presented in the publications: Frascati Manual, Oslo Manual, UNESCO Manual on Statistics of scientific and technological activities and technical document UNESCO Institute for Statistics to measure the scientific and technological activities [1].

On the basis forms of state statistical reporting 1-nt (Science) "Report on the execution of research and development statistics agencies of placecountry-regionBelarus provide information for the concerned persons about the scientific activity. The form of the state statistical reporting 1-nt (innovation) "Report about innovation activity organizations" provides information about the costs of innovation, sources of funding, the amount of shipped innovative products (services), organizational and marketing innovations, etc.

3 Analysis of innovative activity by multidimensional methods of statistics

One of the areas of multivariate statistical analysis of innovation sphere is statistical hypothesis testing. It presupposes an availability of the sample of data, which is parametrically compare with general set or other sample of data.

Macroeconomic analysis of innovation activity can be carried out taking into account the hypothesis of equality of mean vector and constant vector. Analysis is performed by comparing the average level of innovation activity of individual regions with an average level across the country, or compare the average level of innovation activity of the state with an average level of other countries.

The mean vector of level of innovative activity $\overline{X} = (\overline{X}_1, \overline{X}_2, ..., \overline{X}_m)$ should be compared with the constant vector $\mu = (\mu_1, \mu_2, ..., \mu_m)$. The null hypothesis: $H_0 : \overline{X} = \mu$, the alternative hypothesis: $H_1 : \overline{X} \neq \mu$. Hotelling's criterion allows to check the hypothesis of equality of the mean vector and constant vector [2]:

$$T_p^2 = n \cdot (\overline{X} - \mu)^T \cdot \Sigma^{-1}(\overline{X} - \mu),$$

where Σ - covariance matrix; X- matrix with centered values of the trait.

The critical value for given level of significance (α) and degrees of freedom $\upsilon_1 = m$(number of variables) and $\upsilon_2 = n - m$is calculated by formula [2]:

$$T^2_{\alpha,m,n-m} = \frac{m(n-1)}{n-m} \cdot F_{\alpha,m,n-m},$$

where $F_{\alpha,m,n-m}$ - the table value Fisher criterion.

If $T^2_{\alpha,m,n-m} > T_p^2$, the hypothesis $H_0 : \overline{X} = \mu$ is valid. When $T^2_{\alpha,m,n-m} < T_p^2$ the alternative hypothesis is accepted $H_1 : \overline{X} \neq \mu$.The deviation of hypothesis $H_0 : \overline{X} = \mu$ allows us to conclude that the organizations of the region for this period have the level of innovative activity, which is significantly different from the national level or planning level.

For the multidimensional analysis of innovation activity we can use the test of the hypothesis of equality of two vectors of averages. This hypothesis allows to reveal the differences indicators of innovation activity in the regions during the analysis.

The null hypothesis $H_0 : \overline{X}_1 = \overline{X}_2$ is mean the insignificant influence of different functioning conditions regional organizations on their innovative activity. An alternative hypothesis $H_1 : \overline{X}_1 \neq \overline{X}_2$.

To test this hypothesis applies a multidimensional T^2-test, which is calculated by the formula [2]:

$$T_p^2 = \frac{n_1 \cdot n_2}{n_1 + n_2} \cdot (\overline{X}_1 - \overline{X}_2)^T \cdot \Sigma_*^{-1}(\overline{X}_1 - \overline{X}_2),$$

where $\overline{X}_1$ and $\overline{X}_2$ - the mean vectors of innovation activity in the different regions;

Σ_*^{-1} - the inverse matrix calculated for the joint covariance matrix of the various regions.

The critical value of a multidimensional T^2-test is given by [2]:

$$T_{cr}^2 = \frac{(n_1 + n_2 - 2)m}{n_1 + n_2 - m - 2} \cdot F_{\alpha, m, n_1+n_2-m-2}.$$

In the multivariate statistical analysis the test of the hypothesis of equality of covariance matrices is also used. Accounting for covariances in the study of innovation and equality check covariance matrices significantly reduces the chance of error in the findings. The hypothesis of equality of mean vector can be confirmed, but the study of covariance matrices can more accurately assess whether significant the differences between the variation and covariation in the studied samples.

4 Concluding remarks

The use of multivariate statistical analysis to study the process of innovation activity of organizations allows deeply examine large number of features, diverse in nature. The results obtained by different methods are not contradictory. Emergence of contradictions points to the breach of logic analysis of innovation activity and becomes a source of erroneous conclusions.

References

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