MATHEMATICAL MODELING OF LABOR PRODUCTIVITY OF TEACHERS

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Annotation

The study of dependencies and relationships between objectively existing phenomena and processes plays an important role in economics. It makes it possible to better understand the complex mechanism of cause-and-effect relationships between phenomena. To study the intensity, type and form of dependencies, correlation-regression analysis is widely used, which is a methodological tool for solving problems of forecasting, planning and analyzing the economic activity of enterprises.

Keywords: education, teachers, labor efficiency, factors, object of study, modeling, correlation-regression analysis, analysis of variance, variance, single-factor analysis of variance, two-way analysis of variance.

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Economic and statistical models describe and reproduce real socio-economic systems in a formalized form, simulating their behavior in a changing environment. At the same time, the model itself is a system that transforms a certain set of factors (factorial attributes) at the input into output results (effective attributes).

The quality of models, their adequacy to real processes are determined not only by the set of input values, but also by the chosen form of connection. It is practically impossible to display the whole variety of conditions, factors and relationships of a real phenomenon, therefore, in the process of economic and statistical modeling, the most significant of them are considered [1].

When studying and analyzing the socio-economic factors that affect the efficiency of teachers' work, one of the most important points is to identify the significance of the influence of certain factors in their totality on the performance indicator. In practice,

this is very difficult. The task is facilitated if here you can use the method of analysis of variance, which is one of the branches of mathematical statistics.

The task of the analysis of variance is to isolate from the general variability of the trait:

- variability due to the action of each of the studied independent variables;
- variability due to the interaction of the studied features;
- random variability due to all other unknown variables.

Models with more than one factor make it possible to investigate the impact on the result not only of individual controlled factors (main influences), but also their overlap (interactions). According to the method of organizing the initial data, among the ANOVA models, there are complete and incomplete t-factor designs, complete and incomplete block plans, and randomized (random) block plans [1].

The object of study of dispersion analysis is stochastic relationships between the response (reaction) and factors, when the latter are not quantitative, but qualitative [2]. The main idea of the analysis of variance is to compare the “factorial variance” generated by the influence of a factor and the “residual variance” due to random causes [3]. If the difference between these variances is significant, then the factor has a significant impact on X; in this case, the mean values of the observed values at each level (group means) also differ significantly. If it has already been established that the factor significantly affects X, and it is required to find out which of the levels has the greatest impact, then the averages are additionally compared in pairs. There are two models of analysis of variance:

- with fixed levels of factors,
- with random factors.

Depending on the number of factors that determine the variation of the resulting feature, analysis of variance is divided into single-factor and multi-factor.

The main schemes for organizing initial data with two or more factors are:

- cross-classification, which is typical for models with fixed levels of factors.
- hierarchical (nested) classification, typical for models with random factors.

Disadvantage: it is impossible to select those samples that differ from others. For this purpose, it is necessary to use the Scheffe method or to conduct pairwise comparisons of samples. Multivariate analysis of variance, in addition to the functions of single-factor analysis of variance, evaluates interfactorial interaction [4].

In practice, it often becomes necessary to check the significance of the difference between the sample means of m populations ($m > 2$). For example, it is required to evaluate the influence of various factors on the efficiency of teachers' work, increasing

the cognitive activity of students on indicators of the quality of education, improving the mechanisms of the social management system on the indicators being studied, etc. To effectively solve such a problem, a new approach is needed, which is implemented in the analysis of variance.

Two-factor analysis of variance is used in cases where the simultaneous effect of two factors on different samples of objects is studied, i.e. when different samples are influenced by different combinations of two factors. It may happen that one variable has a significant effect on the trait under study only at certain values of another variable. The essence of the method remains the same as in the one-factor model, but in the two-factor analysis of variance, more hypotheses can be tested [5].

The solution to the problem of two-factor analysis of variance depends on the number of observations made for each combination of factor levels, if, in other words, in each cell of the two-factor complex.

Analysis of variance is designed to assess the influence of various, but controllable factors on the result of an experiment. Let the result of the experiment be some random variable Y, also called the response. The values of the random variable Y are affected by the X factor, which consists of n-levels. Depending on the number of factors included in the analysis, one-factor, two-factor and multifactor analysis of variance are distinguished.

Analysis of variance is possible if the measurement results are independent random variables obeying the normal distribution law with the same variances. In a one-factor analysis of variance, the degree of influence of one factor X on the mathematical expectation of the response M(Y) is revealed. The factor can be quantitative or qualitative. During the experiment, factor X is maintained at n-levels. At each level of the factor, m duplicate experiments are carried out. The value of m can be the same or different for each of the levels. The results of all measurements are presented in the form of a table, which is called the observation matrix. First, for each series of duplicate experiments, calculate the arithmetic mean μ_i, which are estimates of M(Yi) and the reproducibility variance S_vi^2

Thus, the general scheme of analysis of variance with a one-factor complex can be represented as sequential operations:

1) groupings;
2) definitions of averages for groups and general average;
3) calculation of the sum of squared deviations of the group means from the total mean;
4) the same - all observed values from the total average;

5) the same - within groups as the difference between the total sum of squares and the sum of squares between groups;
6) finding the number of degrees of freedom of variation in groups and within groups;
7) determination of inter- and intra-group variance (taking into account the number of degrees of freedom) and the ratio of a larger variance to a smaller one;
8) selection of F values according to tables with a given probability;
9) comparison of the calculated value with the table and conclusion about the reliability or unreliability of the influence of the studied factors.

Thus, analysis of variance makes it possible to establish the influence of a number of factors on the main socio-economic indicators of universities.

Summing up, we can say that the purpose of analysis of variance is to test the statistical significance of the difference between the means (for groups or variables). This check is carried out by splitting the sum of squares into components, i.e. by splitting the total variance (variation) into parts, one of which is due to random error (i.e., intragroup variability), and the second is associated with the difference in mean values. The last component of the variance is then used to analyze the statistical significance of the difference between the means. If this difference is significant, the null hypothesis is rejected and the alternative hypothesis that there is a difference between the means is accepted.

List of used Literature

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