Build pairwise correlation and regression analysis skills and create econometric models.

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ABSTRACT

In this article, the author presents a step-by-step process of creating and analyzing double-factor econometric models. In creating econometric models, students were first divided into groups and given tasks. In this way, students will develop the skills of calculating the correlation coefficient and analyzing the relationship between factors. A system of normal equations was formed to create a regression equation using the "method of least squares". Skills for performing econometric analysis based on the created model are also provided.

Keywords: factor, endogenous, exogenous, correlation, linear and non-linear relationship, regression, method of least squares, econometric model

It can be done using several steps to build students' skills to perform bivariate econometric analysis. Specifically:

Stage 1. Selection of factors.

They learn to compile statistical data and work with economic factors. Statistical analysis means the processing of the collected data from the point of view of the goals and objectives of the scientific investigation. Statistical observation One of the common methods of data processing and analysis is grouping. In statistics, grouping refers to the study of the units of the collection by dividing them into the same groups and subgroups according to their most important characteristics.

Stage 2. Working with factors.

The data obtained as a result of statistical observations for the purpose of studying economic processes are signs representing a certain side (edge) of the process, and they are divided into the resulting and influencing factors in the change of processes. If, as a result of the change of one sign, the second sign also changes, the first sign is called the factor sign, and the second sign is called the resulting sign, and this shows the interdependence of the factors and is expressed as follows:

$$y = f(x_1, x_2, \dots x_n).$$

Here, y is the resultant symbol, and xi is the factor symbol.

Variables are divided into dependent and independent variables. Whether they are related or not is determined based on the results of correlational analysis.

Factors have their qualitative and quantitative aspects. Signs expressed by numbers are called quantitative signs, signs that are not expressed by numbers, that is, factor and result signs expressed by words, are called attributive signs. Factors must be quantifiable. If the factors consist of qualitative indicators that cannot be measured quantitatively, it is necessary to clarify them quantitatively (for example, the resulting indicator - the quality of the soil that affects productivity - the factor is not in the form of a sign, score, but in the form of a value should be converted to).

Factors studied in the study of economic processes are divided into endogenous and exogenous factors. In the economic processes represented by the system of equations, the resulting signs are called endogenous factors, that is, dependent variables. Exogenous variables are predetermined variables that

affect but are independent of endogenous variables, usually denoted as x.

3rd stage. Correlative connection.

Concepts of correlation bond types, shape, density are presented with the participation of 3 students.

Interconnection of factors is divided into 2 types: functional connection and correlational connection.

Depending on the direction of change, connections are divided into two types: direct connections and reverse connections.

Depending on the form of analytical expressions, connections are divided into two types: linear and non-linear connections.

In functional relationships, each value of one variable corresponds to exactly one value of another variable.

The degree of bond density is usually interpreted as follows. If up to $0,2$ weak connection;

$0,2 \div 0,4$ – binding weaker than the average density;

$0,4 \div 0,6$ – average connection;

$0,6 \div 0,8$ – tighter than average binding;

$0,8 \div 0,99$ – close connection.

Steps to organize teacher-student relationship.

4th stage. Correlation assignment.

Students, divided into two groups, are given tasks related to direct and inverse correlation. Based on the distributed tasks, they are distributed and analyzed according to the density of connections. Through this provided assignment, the groups complete the tasks.

Table 1.

	1	2.	3	4	5	6	7
Y	1,6	3,2	5,5	8,6	11,4	14,9	22,0
X	5,4	7,9	17,4	23,9	38,8	60,3	91,5

Task 1: $r_{xy} = \dfrac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$ they determine the first group correlation coefficient by the linear correlation coefficient calculation formula.

Task 2: The second group also determines the nonlinear correlation coefficient based on Table 1.

Stage 5. Regression task.

Based on Table 1, students create a regression equation using the normal equation using the Least Squares method.

$\sum_{i=1}^{n} (y_i - \hat{y}_{x_i})^2 \to \min$ Least squares method

system of normal equations:

$$\begin{cases} n \cdot a + b \cdot \sum_{i=1}^{n} x_i = \sum_{i=1}^{n} y_i, \\ a \cdot \sum_{i=1}^{n} x_i + b \sum_{i=1}^{n} x_i^2 = \sum_{i=1}^{n} x_i \cdot y_i. \end{cases}$$

From this system of equations, a and b can be found.

$$b = \frac{n \cdot (\sum x_i y_i) - (\sum x_i) \cdot (\sum y_i)}{n(\sum x_i^2) - (\sum x_i)^2}.$$

A regression equation is created based on the calculated values.

$$y = a + bx + e$$

Econometric analysis. The analysis of the double factor regression equation leads to an increase of the x-exogenous (influencing) factor by one unit, and an increase of the y-endogenous (resulting factor) by one unit. If there is no x factor influencing the y-resultant factor, the

resultant factor will be equal to a (free term). Therefore, the obtained correlation and regression coefficients are analyzed economically. After the economic analysis, students' knowledge is evaluated. The values calculated by the students are checked in the Excel program with the active participation of the students. The skills of students who calculate the correlation coefficient and construct linear pairwise regression equations are evaluated.

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