academic publishers
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE (ISSN: 2692-5206)
Volume 04, Issue 02, 2024
Published Date: - 25-04-2024

# REGRESSIVE ANALYSIS OF RETAIL TRADE TURNOVER IN A SAMPLE OF NAMANGAN CITY

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**Abstract**
In this work, an regressive model is selected, which shows the most optimal volume of retail trade turnover in the city of Namangan using the least squares method and, according to it, the volume of trade turnover is predicted for the next five-year.

**Key words**
Least squares method, linear trend equation, exponential trend equation, second order parabolic trend equation.

A time series is a system made up of random variables x observed in certain time sequences $t_1, t_2, ..., t_n$. More completely, it consists of a set of values that are collected, recorded or observed over a certain period of time. Therefore, time series is a sequence of statistical values describing the change of these events over time, which can be described as follows:

$$x(t_1), x(t_2), \ldots, x(t_n)$$

Components of a Time Series:
• trend;
• seasonal variation;
• cyclical variation;
• irregular variation.

It can be seen that trend equations serve as the main component in predicting time series. The least squares method is the best approximation method for the trend equation in time series. Based on the given information, the trend equation can be determined in the form of a straight-line, exponential function, and second-order parabolic forms. The linear trend equation is defined as follows:

$$Y = a_0 + a_1 t$$

Parameters $a_0$ and $a_1$ of the sought straight line (unknown terms of the equation) are determined by creating a system of normal equations using the least square method and solving this system:

$$\begin{cases} Na_0 + a_1 \sum t = \sum Y \\ a_0 \sum t + a_1 \sum t^2 = \sum Yt \end{cases}$$

where: Y is the values of the given series, N is their number, t is the ordinal number of the period (or moment of time).

Among the widespread processes in the economy, there are often those in which the values of the series change from time to time with relative pictures or in a way close to them. So, in this case, the change

of events takes place in the form of geometric progression or close to it. To smooth such lines, the trend equation is constructed as an exponential function. If we express it by $\hat{Y}_t = a_0 \cdot a_1 10^t$ , then this expression can be logarithmized and changed to a linear equation:

$$lg\hat{Y}_t = lga_0 + tlga_1$$

So, by replacing the degrees of the series with their logarithms, parameters $a_0$ and $a_1$ can be determined by their logarithms. In this case, the system of normal equations according to the method of least squares has the following form:

$$\begin{cases} Nlga_0 + lga_1 \sum t = \sum lgy \\ lga_0 \sum t + lga_1 \sum t^2 = \sum tlgy \end{cases}$$

If the second-order differences between the series values, that is, the second differences calculated from the first levels, are almost the same or close to it, then there is a theoretical basis for interpreting them in the form of a second-order parabola with respect to time. In this case, the series levels initially increase rapidly, and after a certain period of time, the growth rate decreases, and in the last periods, it may even decrease completely. Under these conditions, the trend equation is represented by the formula $\hat{Y}_t = a_0 + a_1 t + a_2 t^2$ and its unknown values $a_0$, $a_1$ and $a_2$ according to the method of least squares

$$\begin{cases} Na_0 + a_1 \sum t + a_2 \sum t^2 = \sum y \\ a_0 \sum t + a_1 \sum t^2 + a_2 \sum t^3 = \sum yt \\ a_0 \sum t^2 + a_1 \sum t^3 + a_2 \sum t^4 = \sum yt^2 \end{cases}$$

**An example**. Based on the given data, find the type of trend equation that best describes the volume of retail trade turnover of Namangan city.

| Years | Conditional sign of time | Volume of retail trade turnover (billion soums) | Years | Conditional sign of time | Volume of retail trade turnover (billion soums) |
|---|---|---|---|---|---|
| 2010 | 1 | 463.3 | 2017 | 8 | 2481.0 |
| 2011 | 2 | 698.3 | 2018 | 9 | 2991.7 |
| 2012 | 3 | 762.0 | 2019 | 10 | 3861.8 |
| 2013 | 4 | 1058.0 | 2020 | 11 | 5074.7 |
| 2014 | 5 | 1236.3 | 2021 | 12 | 6086.6 |
| 2015 | 6 | 1575.0 | 2022 | 13 | 6275.8 |
| 2016 | 7 | 2025.3 | | | |

1. Straight line trend equation:

$$y = 504.92x - 873.69$$
$$R^2 = 0.9155$$

2. . Logarithmic trend equation:

$$y = 2211.7(\ln x) - 1176$$
$$R^2 = 0.6786$$

3. Second-order parabolic trend equation:

$$y = 43.26x^2 - 100.71x + 640.4$$
$$R^2 = 0.9894$$

Here, $R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}$ is the coefficient of determination, and as its value approaches 1, the values of the trend equation approach the series values.

SSR-sum of squares regression;

SST- total sum of squares;
SSE – sum of squares error.

In this article, the volume of retail trade turnover of Namangan city is covered in the form of different trend equations, and according to it, the coefficient of determination for the second-order parabolic trend equation took the value closest to 1. In this case, it was found that the second-order parabolic equation serves as the best trend equation.

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