USE OF THE SIXTH DEGREE POLYNOMIAL REGERRATION EQUATION IN FORECASTING THE GROSS OF THE REPUBLIC OF UZBEKISTAN FOR 2020

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REPUBLIC OF UZBEKISTAN

In the Republic of Uzbekistan, well-thought-out economic reforms and macroeconomic stabilization policies have been bearing fruit for many years. The growth of gross domestic product in the economy of the Republic of Uzbekistan is associated with the development and prosperity of all economic sectors, as it includes the share of each sector. In this regard, it is important to know that key macroeconomic indicators of economic development will change in the future. In particular, it is necessary to forecast the country’s GDP in the coming years; as such indicators play a key role in shaping the country’s socio-economic development programs and assessing the well-being of the population.

In view of this, it is important to know that the main macroeconomic indicators of economic development will change in the future.

Gross Domestic Product (GDP) is a reduction in total acceptance and a macroeconomic indicator that is the market value (i.e., directly for consumption) that directly reflects the final goods and services of each year. In addition, GDP is a report on annual consumption in all sectors of the economy, and fixed export funds, which use the factors of production of national equipment [1-5].

GDP is also an indicator that describes the overall results of a country’s economic activity over a period of time (month, quarter, year). The market value of goods and services produced by all enterprises in the country (including foreign and joint ventures) with the total factors of production is calculated on the basis of the system of national accounts [6-9]. It is used to describe and analyze the development of the country's economy at the macro level.

In practice, the functional, statistical, and correlation relationships between two variables $x$ and $y$ can be observed. There are variables in life that are interrelated, but the value of one is not matched by the exact value of the other, and some sets of values are matched.

**Definition 1.** Such a relationship is called a statistical relationship if a change in one of the quantities leads to a change in the distribution of the other. In particular, the statistical correlation is that the change in one of the quantities is expressed in the average value of the other. In this case, the statistical relationship is called a correlation.

**Definition 2.** The arithmetic mean of the values of $y$ corresponding to $x = x$ is called the conditional mean and is denoted by $\bar{y}_x$. 
It is known that if each $x$ corresponds to one value of the conditional mean, then the mean is a function of $x$.

**Definition 3.** The functional dependence of the conditional mean $y_x$ on $x$ is called the correlation on $y$ and

\[ y_x = f(x) \]  

(1)

determined by Equation (1) is called the regression equation of $y$ to $x$, and its graph is called the regression line of $y$ to $x$.

The conditional mean $x_y$ and the correlation between $x$ and $y$ are determined similarly. In this case the regression equation appears. Equation (2) is called the regression equation of $x$ to $y$.

\[ x_y = \varphi(y) \]  

(2)

The first problem of correlation theory is to determine the form of correlation, that is, to find the form of the regression equation (linear, quadratic, exponential, etc.). In equations (1) and (2) if both $f(x)$ and $\varphi(y)$ are linear, the correlation is called linear, otherwise it is called curvilinear.

The second problem of correlation theory is to determine the density of the correlation. The density of the correlation dependence of $y$ on $x$ is estimated by the magnitude of the scattering of $y$ values around the conditional mean $y$. A large scatter indicates that $y$ is weakly bound to $x$. The lower the scattering, the stronger the correlation. In this case, $x$ and $y$ are even functionally related, but under the influence of other random factors, this relationship is weakened, and as a result, at a single value of $x$, $y$ can take different values [2-13].

In this study, on the basis of statistical data on the volume of gross domestic product of the Republic of Uzbekistan for 2000-2019 (see Table 1), the regression equation of changes in quantities over the years was formed. The constructed equation is a curvilinear regression equation and is a 6-degree polynomial equation. The smallest squares method was used to find it.

**Table 1**

<table>
<thead>
<tr>
<th>Years</th>
<th>GDP $Y$ mldr. In sums</th>
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<th>Years</th>
<th>GDP $Y$ mldr. In sums</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>3 255,6</td>
<td>2005</td>
<td>15 923,4</td>
<td>2010</td>
<td>74 042,0</td>
<td>2015</td>
<td>210 183,1</td>
</tr>
<tr>
<td>2001</td>
<td>4 925,3</td>
<td>2006</td>
<td>21 124,9</td>
<td>2011</td>
<td>96 949,6</td>
<td>2016</td>
<td>242 495,5</td>
</tr>
<tr>
<td>2002</td>
<td>7 450,2</td>
<td>2007</td>
<td>28 190,0</td>
<td>2012</td>
<td>120 242,0</td>
<td>2017</td>
<td>302 536,8</td>
</tr>
<tr>
<td>2003</td>
<td>9 844,0</td>
<td>2008</td>
<td>38 969,8</td>
<td>2013</td>
<td>144 548,3</td>
<td>2018</td>
<td>406 648,5</td>
</tr>
<tr>
<td>2004</td>
<td>12 261,0</td>
<td>2009</td>
<td>49 375,6</td>
<td>2014</td>
<td>177 153,9</td>
<td>2019</td>
<td>511 838,1</td>
</tr>
</tbody>
</table>

It is known that the general form of n-order polynomial (or n-degree) function [4] is as follows.

\[ y_i = \beta_0 + \beta_1 x_i + \beta_2 x_i^2 + \ldots + \beta_n x_i^n + \varepsilon_i \]  

(3)

We find the unknown coefficients of the regression equation using the least squares method, that is, we minimize the function $f$.

\[ F = \sum_{i=1}^{n} (y_i - \bar{y}_i)^2 = \sum_{i=1}^{n} (y_i - \bar{\beta}_0 - \bar{\beta}_1 x_i - \bar{\beta}_2 x_i^2 - \ldots - \bar{\beta}_n x_i^n)^2 \rightarrow \min \]  

(4)
Using (4) we create the following system and solve it to find the coefficients of equation (3)

\[
\begin{align*}
\sum y_i &= \bar{\beta}_0 \cdot N + \bar{\beta}_1 \sum x_i + \bar{\beta}_2 \sum x_i^2 + \ldots + \bar{\beta}_n \sum x_i^n, \\
\sum y_i \cdot x_i &= \bar{\beta}_0 \sum x_i + \bar{\beta}_1 \sum x_i^2 + \bar{\beta}_2 \sum x_i^3 + \ldots + \bar{\beta}_n \sum x_i^{n+1}, \\
&\quad \ldots \\
\sum y_i \cdot x_i^{n-1} &= \bar{\beta}_0 \sum x_i^{n-1} + \bar{\beta}_1 \sum x_i^n + \bar{\beta}_2 \sum x_i^{n+1} + \ldots + \bar{\beta}_n \sum x_i^{2n-1}, \\
\sum y_i \cdot x_i^n &= \bar{\beta}_0 \sum x_i^n + \bar{\beta}_1 \sum x_i^{n+1} + \bar{\beta}_2 \sum x_i^{n+2} + \ldots + \bar{\beta}_n \sum x_i^{2n}.
\end{align*}
\]  
(5)

Here, \(N\) is the number of observations.

Substituting 6 instead of \(n\) in equation (3) gives a polynomial regression equation of degree 6.

\[y_i = \beta_0 + \beta_1 x_i + \beta_2 x_i^2 + \ldots + \beta_6 x_i^6.\]  
(6)

We find the unknown coefficients in equation (6) by substituting 6 instead of \(n\) in the system (5) (\(N = 20\), as Table 1 gives 20 years of data.)

\[
\begin{align*}
\sum y_i &= 20 \bar{\beta}_0 + \bar{\beta}_1 \sum x_i + \bar{\beta}_2 \sum x_i^2 + \ldots + \bar{\beta}_6 \sum x_i^6, \\
\sum y_i \cdot x_i &= \bar{\beta}_0 \sum x_i + \bar{\beta}_1 \sum x_i^2 + \bar{\beta}_2 \sum x_i^3 + \ldots + \bar{\beta}_6 \sum x_i^7, \\
&\quad \ldots \\
\sum y_i \cdot x_i^5 &= \bar{\beta}_0 \sum x_i^5 + \bar{\beta}_1 \sum x_i^6 + \bar{\beta}_2 \sum x_i^7 + \ldots + \bar{\beta}_6 \sum x_i^{11}, \\
\sum y_i \cdot x_i^6 &= \bar{\beta}_0 \sum x_i^6 + \bar{\beta}_1 \sum x_i^7 + \bar{\beta}_2 \sum x_i^8 + \ldots + \bar{\beta}_8 \sum x_i^{12}.
\end{align*}
\]  
(7)

The coefficient of reliability is used to determine the degree of dependence of the quantities \(X\) and \(Y\).

\[R^2 = 1 - \frac{\sum_{i=1}^{N}(Y_i - \bar{Y}^2)}{\sum_{i=1}^{N}(Y_i - \bar{Y})^2}.\]  
(8)

Here, the value of the observation in step \(Y_i - \bar{Y}\) the acceptable value of equation (6) in step \(Y_i - \bar{Y}\), the average value of the observation in \(\bar{Y} - Y\), i.e.

\[\bar{Y} = \frac{\sum_{i=1}^{N}Y_i}{N}.\]  
(9)

(7) After performing the calculations in the system, the regression equation looks like this:

\[y = 0.126 x^6 - 5.94 x^5 + 99.44 x^4 - 625.9 x^3 + 1309.4 x^2 + 2475.1 x - 736.55.\]

In finding the above equation, the years in Table 1 were calculated by substituting the numbers from 1 to 20. This change has almost no effect on accounting.

Using the reliability coefficients (8) and (9), we find \(R = 99.91\%\). This coefficient indicates the degree of dependence of the quantities \(X\) and \(Y\).
Using the found polynomial regression equation of degree 6, it is possible to forecast the gross domestic product of the Republic of Uzbekistan for 2020. To do this, we replace the unknown $x$ in the equation by 21 (which in turn corresponds to 2020). As a result, $t$ can be predicted that in 2020 the gross domestic product of the Republic of Uzbekistan will reach 699052.77 billion UZS. This forecast has a reliability coefficient of 99.91%. However, this forecast will be significantly affected by the fact that in 2020, as well as in the world, Uzbekistan has also had a COVID-19 pandemic.

References:


