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Modeling the trend of Iraqi GDP for 1970-2020

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ABSTRACT

The study of economic growth indicators is of fundamental importance in estimating the effectiveness of economic development plans, as well as the great role it plays in determining appropriate economic policies in order to optimally use the factors that lead to the dynamics of growth in Iraq, especially during a certain period of time. The gross domestic product (GDP) at current prices), which is considered a part of the national accounts, which is considered as an integrated dynamic of statistics that produces in front of policy makers the possibility of determining whether the economy is witnessing a state of expansion or evaluating economic activity and its efficiency in order to reach the size of the overall economy.

The research aims to determine the best and most efficient statistical model to be used in forecasting the GDP in Iraq based on time series data for the period from (1970-2020) years. Where the general trend models (Linear trend, Quadratic trend and Exponential Trend) were applied, and the three models were compared to choose the best model using some statistical criteria, including the Akiaki Information Standard (AIC) and Schwartz Standard (SBS). The results showed that the appropriate model is the Quadratic trend model, were predicting and forecasting values are close to the real values of the GDP series.

Keywords: Gross domestic product (GDP), trend models, forecasting.

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1. Introduction

The use of time series in measuring phenomena is one of the important scientific economic measures that deal with measuring and interpreting the behavior of phenomena over a specific time period. Forecasting is one of the important examples of the application of time series analysis and its accompanying series. Simply, forecasting is the process of anticipating the events that will take place in the future based on the information and input available from historical information and readings related to those events after studying their behavior in the past and present, leading to prediction of what their results will lead to in the future.

One of the time series, which is more effective and related to the economic indicators and adopted in this research due to its fundamental importance in estimating the effectiveness of economic development plans, (GDP) is the series of the gross domestic product at current prices being part of the national accounts and is considered an integral dynamic of statistics. Our study included two aspects, the first is the theoretical side which includes the study of some time series methods in forecasting, including the general linear trend model, the squared trend model, the exponential trend model, and some statistical criteria to obtain the most efficient model and use it in forecasting. As for the second, it is the practical aspect, where the previously mentioned methods were applied in the theoretical aspect (the first), relying on the Iraqi GDP series for the period from 1970 to 2020 as a sample for the study. After that, the time series data was analyzed, and the most important conclusions and recommendations were reached.

2. Theoretical aspect

Through the prediction provided by time series, which constitutes an important milestone in the decision-making process, and helps to provide us with a future vision of the results in an estimated and expected manner via the data and variables that come to us during the follow-up of the time series and its outputs according to the inputs and their calculations during the specified time period and finding a model ,the general trend is one of the important methods by which future values can be predicted. Thus, we can say that the general trend model is one of the main components of the time series, and some of these important models will be addressed in this research.

3. Components of the time series

The time series consists of the following components [3, 5]:

- *Secular Trend*

The characteristic of the general trend in the time series is summarized as the extension in a consistent manner at the level of the time period under study, or it is the amount of increase, decrease or stability that occurs in the values of a phenomenon during a specific period of time known, and thus the general trend is the resulting element that is formed from the regular movement The series over a relatively long period of time, and often a single element depends on it in building expectations, and the general trend of the time series is positive if the trend is increasing over time, and the general trend of the series is negative if the series tends to decrease over time, and the trend may be positive in part The first and negative in the second part.

- *Seasonal changes*

They are the changes whose occurrence is monitored on a regular basis during time periods (weeks, months, season of the year, season) and it is stipulated that seasonal changes should not exceed one year in length.

- *Periodic changes*

They are changes that occur regularly or irregularly and increase over a period of a year and include four stages and repeat themselves over time; these stages can be summarized as follows: (initial rise, decline stage, stagnation stage, and final rise stage).

- *Random changes*

It is one of the variables that cannot be predicted because these changes are sudden and accidental and occur randomly, and despite their occurrence in the general trend, we cannot consider them among the periodic or seasonal variables.

4. General trend analysis

The general trend is the main component of the time series components, through which we can predict future values. The general trend depends on its movement within the time series for a long period, either the movement of a straight line or a curve, and the general trend of any phenomenon is analyzed in several ways, [2,4]. The most important of these methods of analysis is the method of least squares used in this research. This method is the method of least squares which enables us to estimate the general trend by using time as an independent variable X and the values of the series Y as a dependent variable, and the simple linear regression equation can be used to predict future values for this series and this method is One of several types of general trend equations, including:

4.1. Linear Trend Model

If the increase and decrease in the phenomenon occurs by a fixed amount for each period of time, then the equation of the general trend is in the form of a straight line, and it is also called the simple linear skew model according to the following formula [6, 7]:

$$Y_t = B_0 + B_1 X_t + e_t \quad \dots \quad (1)$$

Where:

Y_t: Dependent variable (the value of the phenomenon)
B_0: Cut-off part of the vertical axis
B_1: Slope of the general trend line
X_t: Independent variable (representing time)
e_t: Random error that is normally distributed with a mean of zero, a variance of σ_e^2 and an autovariance of zero.

4.2. Quadratic trend model

The general form of a quadratic trend model is:

$$Y_t = B_0 + B_1 X_t + B_2 X_t^2 + e_t \quad \dots \quad (2)$$

4.3. Exponential trend model

$$Y_t = \exp\left(B_0 + B_1 \mathrm{X}_t\right) + e_t \quad \dots \quad (3)$$

5. Criteria for choosing the best model

The statistician Akaike created a criterion in 1973 AD to choose the most efficient model from among more than one [6, 7].

$$AIC = n \ln \sigma_e^2 + 2K \dots (4)$$

where,

K : The rank of the model is the number of parameters.

σ_e^2: Estimation of error variance

Akeake information is calculated for each of the three models selected, and the model whose AIC value is the lowest is chosen as the best model.

Schwartz Bayesian Information Criterion

This standard was proposed by Schwartz in 1978, similar to the BIC standard and symbolized by the symbol SBS, calculated by the following formula:

$$SBS = n \ln(SSR) + k \ln(n) \dots (5)$$

SBS :Sum of error squares

n :Sample volume

k = p+d+q

The Schwartz criterion is calculated for each of the three models selected, and the model whose value of the SBS criterion is the lowest is chosen as the best model.

6. The practical side

The research data represented a time series of the gross domestic product in Iraq at current prices in million Iraqis for the period from 1970-2020. The data was obtained from the Central Bureau of Statistics with the number of observations (53) shown in the following table.

Table 1. Gross domestic product (in current prices in millions) in Iraq for the years (1970-2020)

year	Gross domestic product	year	Gross domestic product	year	Gross domestic product	year	Gross domestic product	year	Gross domestic product
1970	1257.1	1981	11143.6	1992	107754.1	2003	20562256.7	2014	24160672.1
1971	1456.5	1982	12777.0	1993	305608.1	2004	38058543.0	2015	232204463.4
1972	1455.7	1983	13255.7	1994	1570702.9	2005	53386428.5	2016	183275254.8
1973	1631.3	1984	14922.4	1995	6384213.3	2006	80459422.4	2017	186542703.4
1974	3431.2	1985	15493.8	1996	6323871.5	2007	93981672.4	2018	24160672.1
1975	4090.5	1986	15063.0	1997	9804751.5	2008	129852309.4	2018	249574.3
1976	5365.7	1987	17900.0	1998	13772379.1	2009	110679662.0	2019	256171
1977	6042.1	1988	20032.5	1999	29253129.5	2010	137051309.8	2020	188112.3
1978	7224.9	1989	21025.8	2000	40470980.2	2011	191652911.5		
1979	11390.9	1990	56375.0	2001	34108514.4	2012	216813332.1		
1980	15948.4	1991	41078.0	2002	34123696.2	2013	24160672.1		

Table 2. Metadata of the Iraqi Gross domestic product series

	N	Minimum	Maximum	Mean	Std. Deviation
Gross domestic product	47	1257	232204463	39897976.67	66745061.180

We note from Table No. 2 that the average gross domestic product amounted to (3989796.67), with a standard deviation of (66745061.180), and the largest values were (232204463) in 2015 and the lowest value (1257) in 1970. In order to identify the descriptive features of the data from 1970-2020, the time period was represented on the horizontal axis and the Gross domestic product data on the vertical axis as shown in the following figure:

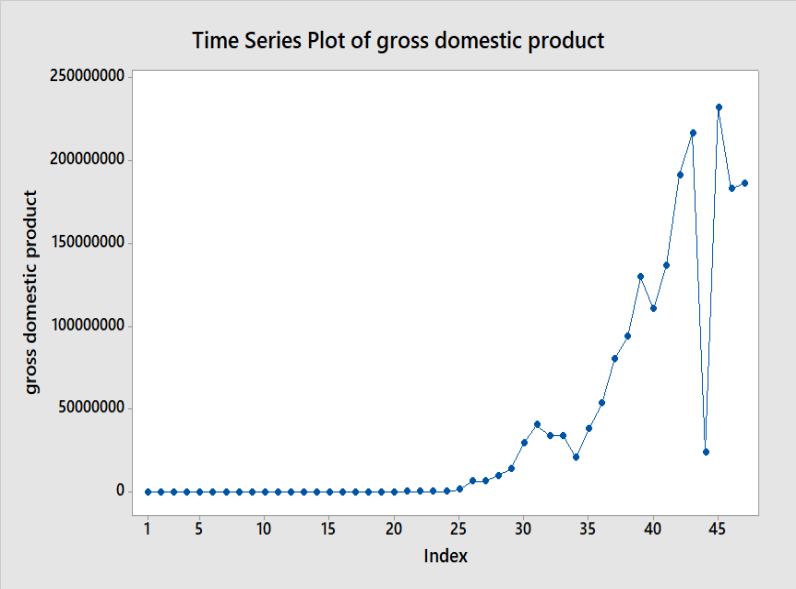

Figure 1. Gross domestic product data series at current prices for the years (1970-2020)

From Figure 1, we notice that the time series follows a general positive trend that increases over time, as the highest value is (232204463) in the year (2015), and the lowest value is (1257) in the year (1970).
To accurately determine the most efficient model, a number of models have been reconciled, including (the linear trend model, the quadratic trend model and the exponential trend model) and the selection of the best model according to the differentiation criteria that were mentioned in the theoretical side that achieves the lowest value.
The equation for the linear direction that has been reconciled is:

$$y_t = \text{-7.35878E9 + 3.71233E6 t}$$

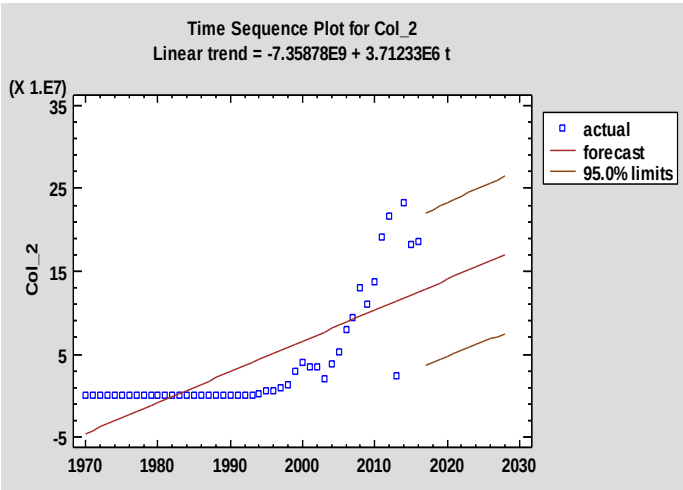

Figure 2. Linear trend model of gross domestic product data

Table 3. Matchmaking accuracy metrics

(MAPE)	(MPE)	MAE	SBIC	HQC	AIC	RMSE
312104.	281111.	3.45648E7	35.14	35.14	35.14	4.27123E7

The quadratic trend equation that has been reconciled is: y_t =7.64042E11 + -7.70434E8 t + 194216. t^2

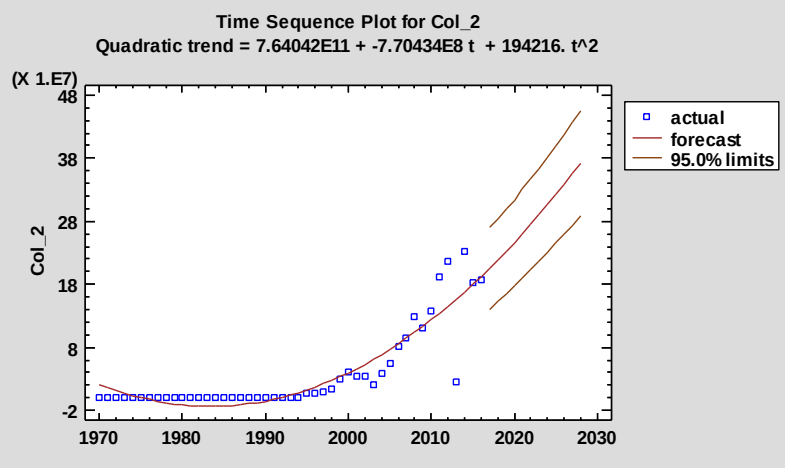

Figure 3. Quadratic trend model of gross domestic product data

Table 4. Matchmaking accuracy metrics

MAPE	MPE	MAE	SBIC	HQC	AIC	RMSE
114631.	-65916.3	1.65902E7	34.3207	34.3207	34.3207	2.83565E7

The equation of the general exponential trend that has been reconciled:

$$y_t = \exp(-602.25 + 0.308887\ t)$$

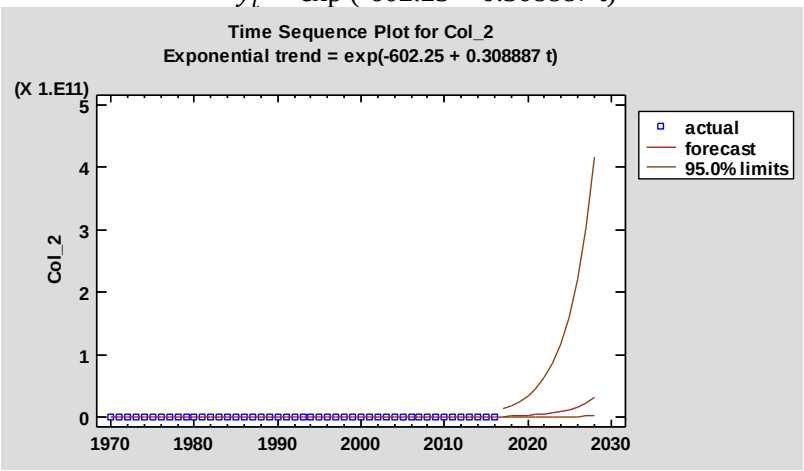

Figure 4. Exponential trend model gross domestic product data

Table 5. Matchmaking accuracy metrics

(MAPE)	(MPE)	MAE	SBIC	HQC	AIC	RMSE
160.144	-100.915	3.96203E7	37.1212	37.1212	37.1212	1.1502E8

The following table shows the values of the AIC standard and the SBS standard for the general linear trend model, the squared trend model and the exponential trend model for gross domestic product data in Iraq for the period from 1970-2020.

Table 6. Criteria for choosing the best model

Model	AIC	HQC	SBIC
Linear Trend model	35.14	35.14	35.14
Quadratic Trend model	34.3207	34.3207	34.3207
Trend Exponential model	37.1212	37.1212	37.1212

We note from the above table that the model that has the least (AIC), (SBS) is the quadratic model and thus is the best model for predicting the future values of gross domestic product.
The forecast was made using the squared trend model of the gross domestic product in Iraq for the years from 2021 to 2028 as shown in the following table:

Table 7. Predicted values of the Iraqi gross domestic product for (2021-2028)

year	Forecasting	Lower 95% Limit	Upper 95% Limit
2021	2.60373E8	1.90608E8	3.30138E8
2022	2.75156E8	2.03834E8	3.46477E8
2023	2.90327E8	2.17301E8	3.63353E8
2024	3.05886E8	2.31004E8	3.80769E8
2025	3.21834E8	2.44943E8	3.98726E8
2026	3.38171E8	2.59115E8	4.17227E8
2027	3.54896E8	2.7352E8	4.36271E8
2028	3.72009E8	2.88158E8	4.5586E8

7. Conclusions

Through the history of our research, the following results were reached:

- After studying the data of the Iraqi GDP, it has been found that the series is unstable and that there is a general positive trend, and the stability of the data has been achieved.
- Using the differentiation criteria (SBIC, HQC, HQC) between the three models (linear, quadratic and exponential) it has been found that the general quadratic trend model is the best suitable models for time series data according to the y_t =7.64042E11+ -7.70434E8 t+194216 t^2. The size of the Iraqi GDP was predicted for the years (from 2021-2028) using the best model, which is the quadratic model, and the predictive values showed consistency with the original values of the series and the gross domestic product is growing exponentially.

8. Recommendations

- It has been observed through the predictive values of the gross domestic product that there is a clear increase, and this means that the higher the rate of gross domestic product, the greater the size of the overall economy, and thus the size of the total income, and in the end it is offset by the increase in the income obtained by the individual, This provides information to those responsible for the gross domestic product because it represents the course of the macro economy during the study period, and specialists can benefit from this information by developing future plans and policies that ensure the improvement of the country's economic situation.
- Using the squared model that was reached to predict the size of the Iraqi gross domestic product by the competent authorities and adopting the predictions given by the model to develop appropriate future plans is recommended.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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