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Forecasting production of energy in Algeria based on Arima model

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Abstract:

Production Energy forecasting is a strategy to predict and forecast future energy must attain demand and offer equilibrium. The aim of this study is to forecast industrial production of energy in Algeria, the data were obtained from 2010 to 2019. Based on the results of estimated parameters of the ARIMA model following the ARIMA model (2,2,1). Observed years during the forecast period were precisely predicted and were put within the forecast intervals generated by the selected model. This study shows that ARIMA models with optimally selected covariates are useful tools for monitoring and predicting trends industrial production of energy in Algeria .

Our research results show an increase in energy production in the forecast period.

Keywords: *Production energy, ARIMA model, Forecast, Algeria*

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I. INTRODUCTION

In its energy policy, Algeria has opted, since its independence, for the development of electricity and gas infrastructure, and access of the population to electricity and natural gas; these two vectors constitute a priority which aims to improve the quality of life of the citizen on the one hand, and the economic situation of the country on the other hand.

Aware of this issue, the sector has made it a priority to develop all the areas that will guarantee long-term coverage of the country's electricity and gas needs, in particular through the diversification of energy sources, the development of electricity production park and gas transport and distribution infrastructure.

Sonelgaz as a public company and a tool of the State, assumes the public service mission in the field of electricity and gas distribution.

In recent years, the demand for electricity has undergone significant changes, particularly in the summer, reaching significant peaks in consumption. This sharp increase in demand is a direct consequence of the change in consumer habits and the improvement in their quality of life, as well as the impetus given to the economic and industrial sector.

1.1Discussed Problems:

Energy forecasting methods contains co-integration and error correction method, scenario analysis, input output method, time series analysis et al. The prediction method of time series analysis primarily analyzes variation trend of energy production and establish a time series mode of the energy production in Algeria during 2010 -2019. We suggest the model ARIMA who has high precision, stable predictions and suitable for predicting production energy. In this paper, ARIMA model is used to forecast Algeria's production energy in future between 2020 and 2025.

1.2The target of the research: is forecasting at long term energy concentrates on investment profitability analysis and planning, such as determining the future sites or fuel sources of power plants in Algeria.

1.3National Production Park of electricity :

The imperatives of preserving the environment have imposed the use of natural gas as primary energy for the production of electricity, and also require the development of other so-called clean and renewable energies such as solar and wind energy, including deposits are available and abundant throughout the country.

Also, to meet the ever-increasing need for electricity, an ambitious program has been initiated to duplicate conventional production capacities. The strategy for executing this conventional electricity production program consists above all in developing a national industry capable of ensuring the supply of equipment for the electric power sector.

The ten-year indicative programs for electricity production means, drawn up by the CREG every two years and approved by the Minister of Energy, provide for the production capacities to be put in place over a ten-year period per region (East , West, Center and South) and by sector according to two scenarios of changes in demand (medium and high). .

The national production park is made up of the power plants of the Algerian Electricity Production Company (SPE), and of ShariketKahraba and Moutadjadida (SKTM), which are a subsidiary of Sonelgaz, as well as companies in partnership with Sonelgaz, to know:(Ministere de l enrgie et des mines, 2021)

-KahramaArzew entered service in 2005;
-ShariketKahrabaSkikda "SKS" entered service in 2006;
-ShariketKahrabaBerrouaghia "SKB" (Médéa) which entered service in 2007;
-ShariketKahrabaHadjretEnnouss "SKH" entered service in 2009;
-SPP1 entered service in 2010;
-ShariketKahraba Terga "SKT" entered service in 2012;
-ShariketKahraba of KoudietEdraouch "SKD" which entered service in 2013.

II. Methods and Materials: Outline of the proposed method ARIMA MODELS:

A time series is a sequential set of data points, measured typically over successive times. Itis mathematically defined as a set of vectors x(t),t = 0,1,2,... where t represents the timeelapsed [21, 23, 31]. The variable xt is treated as a random variable. The measurements taken during an event in a time series are arranged in a proper chronological order.(Adhikari, 2021)

The ARIMA procedure analyzes and forecasts equally spaced univariate time series data,

transfer function data, and intervention data using the AutoRegressiveIntegrated Moving-Average (ARIMA) or autoregressive moving-average (ARMA)model. An ARIMA model predicts a value in a response time series as a linear combination of its own past values, past errors (also called shocks or innovations), andcurrent and past values of other time series. (doc, 2021)

The ARIMA model, first introduced by Box and Jenkins in 1970, has the fundamental presumption that the previous improvement of a specific time series likewise proceeds into what's to come. Here, the variable's improvement over the long haul is viewed as a stochastic cycle subject to irregular impacts. Equation 1 portrays a portrayal of an Autoregressive Moving Normal ARMA (p,q) measure.(bonner, 2009)

$$Yt = \delta + \sum \alpha iyt - I + Ɛt + \sum ßiƐt\text{-}I(1)$$

An ARMA(p,q) measure comprises of two segments: the autoregressive cycle (AR(p)) and the moving normal interaction (MA(q)). The AR interaction, which is portrayed by the initial segment of equation, decides the anticipated worth of Yt as the weighted amount of its own slacked values. Furthermore, irregular occasions can impact the time series. Past irregular occasions are carried out by the MA measures displayed in the second part of the condition. The request for the interaction shows the number of prior perceptions of the variable exhibit effect on the anticipated worth and subsequently, the number of components must be joined into the model. As a general rule, AR(p) and MA(q) cycles can establish determining models all alone. Other than ARIMA(p,d,q) models, the observational piece of this work additionally applies the single cycles for specific urban communities and time periods .

The seasonal part of an ARIMA model is summarized by three additional numbers:(duke, 2020)

P = of seasonal autoregressive terms

D = of seasonal differences

Q = of seasonal moving-average terms

AR: Stands for autoregression, which is nothing more than applying a linear regression algorithm using one observation and its own lagged observations as training data.(Taieb, 2021)

2.1Fitting the ARIMA model : There is three Stages of ARIMA Modeling:

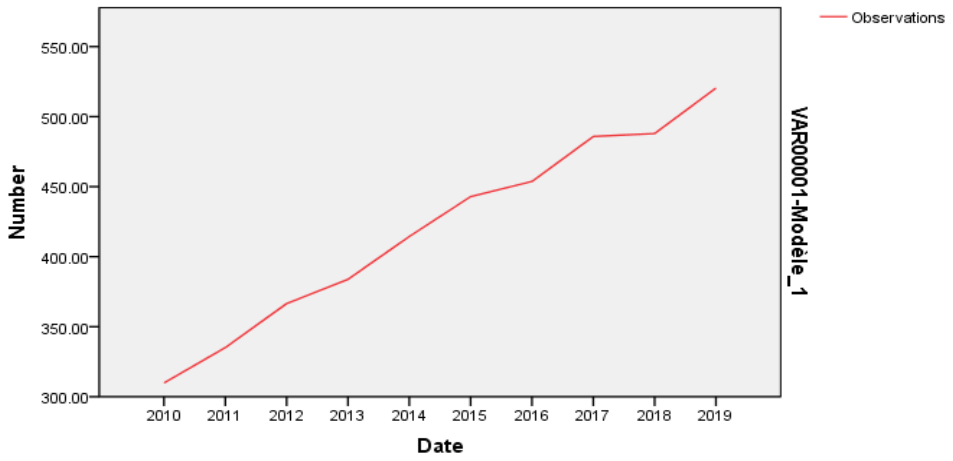
2.1.1The identification stage: The first step consists of identifying the possible ARIMA model that the series follows, which requires: (1) deciding what transformations to apply in order to convert the observed series into a stationary one; (2) determining an ARIMA model for the stationary series.

Table 1: Industrial production of energy sector

year	Industrial production of the energy sector
2010	**309.8**
2011	**335.1**
2012	**366.5**
2013	**383.8**
2014	**414.4**
2015	**442.9**
2016	**453.7**
2017	**485.8**
2018	**487.9**
2019	**520.4**

Source:(Conjoncture, 2021)

Figure 1: Sequential trace of Evolution of industrial production in energy sector



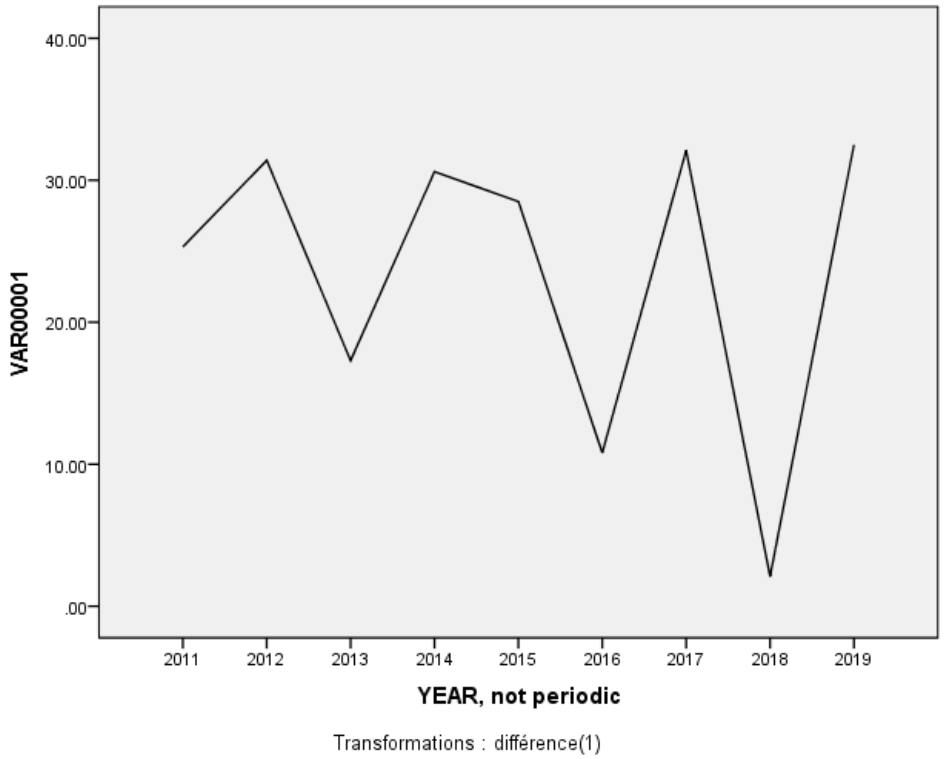
Source: Authors' calculation based on study data analysis using SPSS v22

Figure 1: after a variation observed in 2018, the Energy sector marked a clear recovery in the rate of increase, observing an increase in 2019.

2.1.2 First and second differences :

The graph of the series indicates the need for at least one regular difference for the series to be stationary.

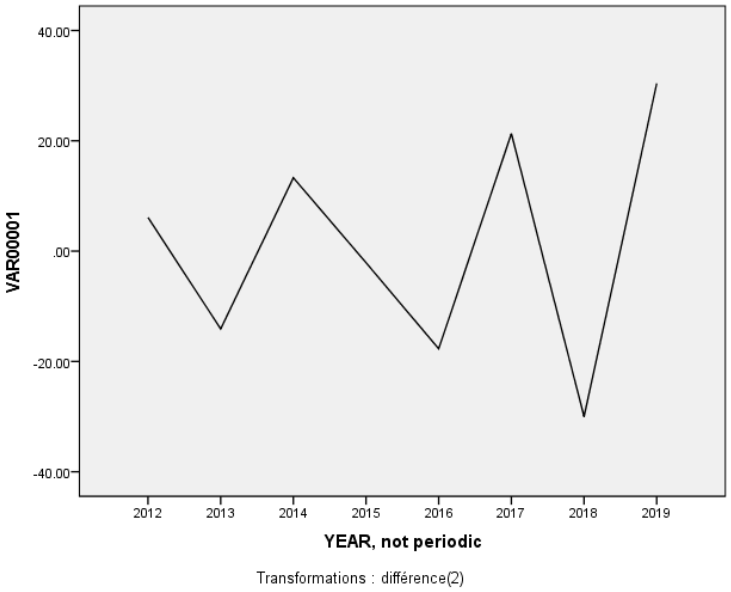
Figure 2: first difference



Source: Authors' calculation based on study data analysis using SPSS v22

Figure 2 shows the first difference of the registration series and we can see that it contains very noticeable variations year to year, up to 0.8 that is 80% of its value.

Figure 03: second difference

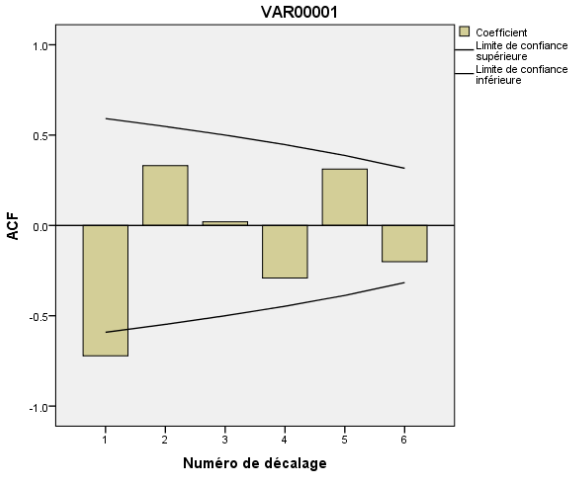


Source: Autours' calculation based on study data analysis using SPSS v22

Once we had determined the order of regular and seasonal differences, the next step is to identify the ARIMA structure.

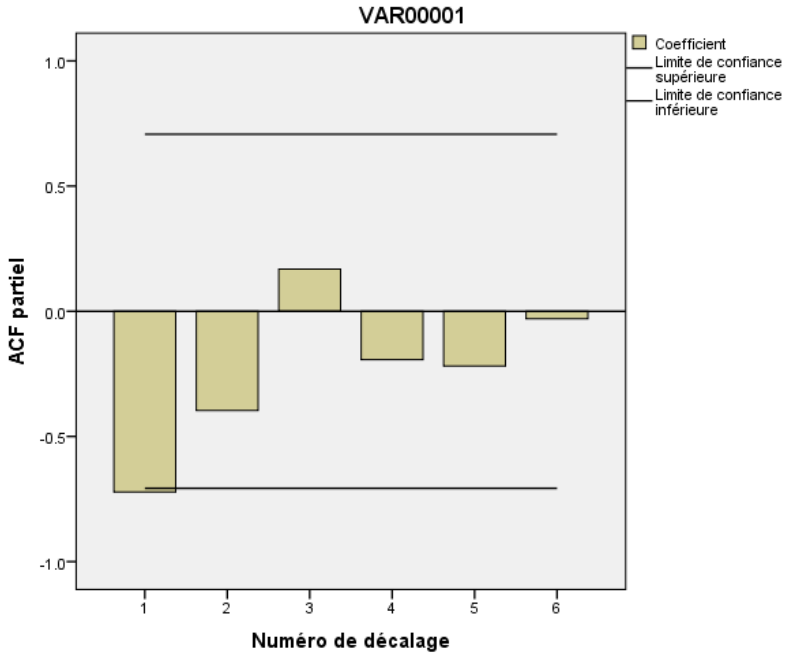
Identification of the orders of p and q is carried out by comparing the estimated partial and simple autocorrelation functions with the theoretical functions of the ARIMA process.

Figure 04: ACF plots after the second differences



Source: Autours' calculation based on study data analysis using SPSS v22

Figure 5: PACF plots after the second differences



Source: Autours' calculation based on study data analysis using SPSS v22

- The regular part suggests an AR(2) model
- The PACF of this series confirms the MA(1) structure for the regular part: a geometric decay is observed in the first lags and, by the interaction as well, which repeats after the seasonal lags
- So finally we suggests the model Arima with coefficient **(2,2,1)**

2.1.3.The estimation and diagnostic checking stage:

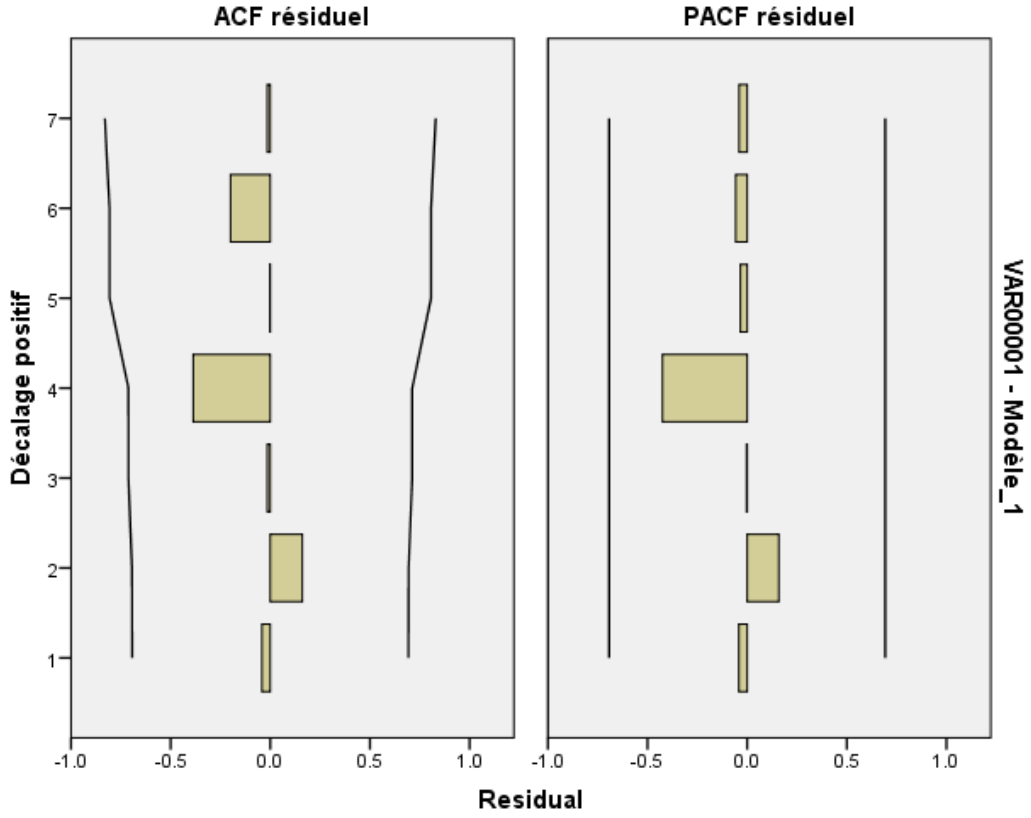
Forecasting is a set of techniques aimed at assessing the long-term economic situation. (زنادي، 2018).

Once we have provisionally chosen a model for the stationary series we move on to the second step of estimation, where the AR and MA model parameters are estimated by maximum likelihood. And we check that the residuals do not have a dependence structure and follow a white noise process.

In this study we have chosen the model**ARIMA (2, 2, 1).**

And now we check whether the model fits the data. There are several tools we may use the Residuals analysis; we calculate the residuals from the model and plot them. The autocorrelation functions, ACFs, PACFs, spectral densities, estimates, etc., and we confirm that they are consistent with white noise.

Figure 6: ACF and PACF residual



Source: Autours' calculation based on study data analysis using SPSS v22

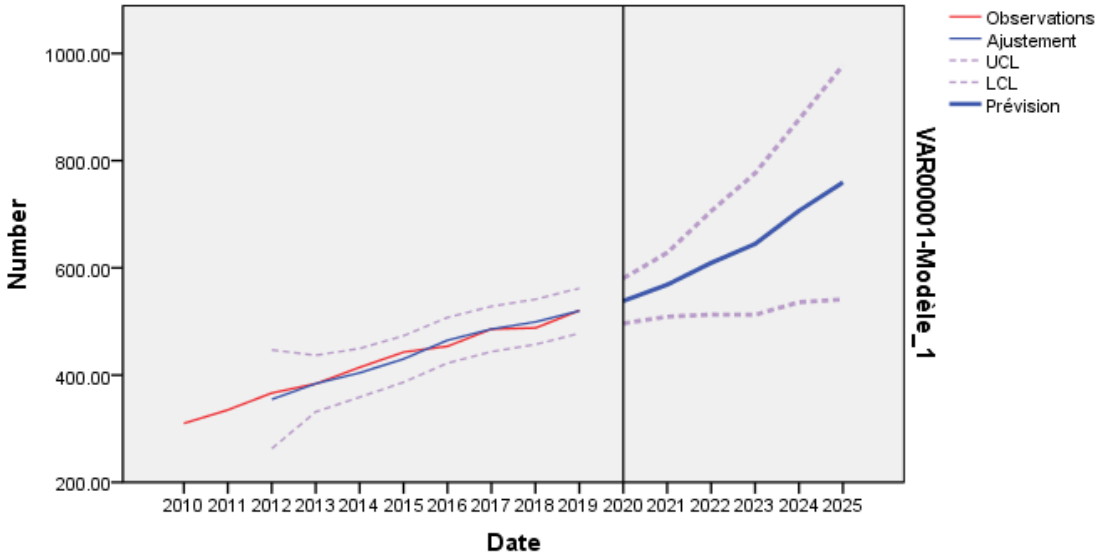
Figure 6: We look that the the residual corrélogram indicates that it is a process without memory, so we can forcast with this model.

III. Results: The forecasting stage :

we use the forecast statement to forecast future values of the time series and to generate confidence intervals for these forecasts from the ARIMA model produced by the preceding estimate statement.

We are going to generate predictions for industrial production of energy in Algeria for six years from 2020 to 2025.

Figure 07: industrial production of energy in Algeria forecast from 2020 to 2025



Source: Autours' calculation based on study data analysis using SPSS v22

Figure 07: in the diagram the chronological series of original value is between 2010 and 2019, and the period from 2020 to 2025 is the forecasting is the forecasting of the production energy in Algeria, we note that the production will increase and it rises at a faster rate than the original series.

Table 2: industrial production of energy in Algeria forecast from 2020 to 2025

year	Forecasts	Min forecast	Max forecast
2020	538.46	496.44	580.48
2021	568.58	508.96	628.20
2022	609.37	512.83	705.91
2023	644.50	512.53	776.47
2024	706.51	536.02	877.00
2025	759.42	541.19	977.64

Source: Autours' calculation based on study data analysis using SPSS v22

Table 2: this table contain the values of forecasting and the minimum forecast and the maximum forecasts witch are increasing until 2025.

IV. Discussion :

In this paper, we proposed a method to increase the performance of the ARIMA model using the clustering technique and forecasting the industrial production of energy in Algeria, the most efficient model for our series is ARIMA (2, 2,1) and it is used for improving the accuracy of the forecasting result and to automate the forecasting of industrial production of energy in Algeria. The increase in energy forecast in Algeria in the coming years needs more station of production and storage.

V. Conclusion:

Electricity is a fundamental necessary factor in our daily life. The energy source becomes a core component for social and economic development and the central source of its usage of a country. Electric power storage is quite impractical and the demand of it can change dramatically in space and time related to different sectors. The forecasting of electricity production is an essential issue for utility owners, power system operators, energy planners and system managers. The methods for prediction are chosen by considering different factors including size of the time series, prediction interval, and prediction period .During the last several decade various methods are being used for production of electricity to predict the future consumption accurately.

The methods for prediction are chosen by considering different factors including size of the time series, prediction interval, and prediction period. During the last several decade various methods are being used for consumption of electricity to predict the future consumption accurately. ARIMA is a core forecasting technique to predict the future electric power production which meets the future energy demand. The prediction figure helps to determine the budget and how much electricity should be produced in various sectors including agricultural, transportation, residential, commercial. Forecasting is used to predict the future information by considering previous and present data and analyzed the trends of them. Forecasting electricity production using different ARIMA models on real dataset and comparing them to determine the best model gives highly accurate and stable prediction. Electricity forecasting is a challenging task, it can't be predicted 100% accurately. Because forecasting depends on some factors which varies on different sectors, areas, industries etc. Considering electricity production of any sector, there are so many attributes that can be chosen for detecting and predicting the production of any area.

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