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Autoregressive Integrate Mean Average as Approaches for Modeling Energy Production in the Electricity Network by Seasons of the Electric Energy Company in Lomé, Togo

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Abstract: The work accumulated in this article presents the results of modeling the tduction of electrical energy for the CEET network in Lomé, Togo, taking into account the seasons of the area. The objective is to evaluate the forecasts over the periods in relation to the seasons of the year. Four seasons are detected, namely: Long dry season, long rainy season, short dry season, and short rainy season. The data used comes from the operating values of the aforementioned network during the year 2021. Following a monthly characterization of the data structured in season, ARIMA is used as an algorithm to create models. The latter is subject to performance evaluation metrics such as RMSE, MAE, MSE, and R^2. The results of the characterization show that in the rainy season, production remains higher than consumption and we have the opposite phenomenon in the dry season. Certain contrary special cases have been observed. Regarding modeling, several results were explored; given the effect that the order of the moving average *q* had on the matrix, [p d q], of ARIMA. All things considered, the results of the models obtained are very interesting, due to their coefficient of determination, which is greater than 73%. This being said, we have: R^2 = 89.73%; MSE = 55.35; RMSE = 7.54%; MAE = 4.20, for the long rainy season and: R^2 = 89.10%; RMSE = 7.55%; MAE = 4.59 and MSE = 56.94, for the two cumulative rainy seasons. Results higher than that of the year which is: R^2 = 88.06%; MSE = 94.88; RMSE = 9.74%; MAE = 5.4. On the other hand, for the dry seasons, we find results lower than those of the year giving: MAE = 6.06; RMSE = 14.20%; MSE = 201.57; R^2 = 86.11% for the long dry season; MAE = 6.00; MSE = 159.87; RMSE = 12.64% and R^2 = 86.55% for the two dry seasons combined. Isolated cases of the models, contrary to the remarks of the characterization, are also observed for the short rainy season with the results: MAE = 6.00; MSE = 159.87; RMSE = 12.64%, and R^2 = 86.55%. We deduce that this comes from the fairly short period whose data is not consistent for the ARIMA algorithm, confirmed by the results of the two rainy seasons which are: MAE = 4.59; MSE = 56.94; RMSE = 7.55% and R^2 = 89.10%. To this end, we find the need to extend the data collection period, without forgetting the climatic anomalies which are prevalent all over the world.

Keywords: ARIMA, Consumption, Modeling, Moving Average, Production, Season

Introduction

The proliferation of electrical equipment has become ubiquitous in our modern world, with devices such as telephones, motorcycles, cars, and laptops relying on stored electrical current to operate. While this autonomy may suggest that these devices are independent of electrical energy requirements, the reality is that they still

need to be recharged by connecting to an electrical network. The electricity supplied by these networks is generated by various types of power plants, including nuclear thermal power plants (Alobaid *et al*., 2017; Powell and Edgar, 2012), flame-fired thermal power plants (Smith and Bollinger, 2022; Ağralı *et al*., 2018;) and geothermal power plants (Djemaa *et al*., 2016). Flame-fired thermal power plants, in particular, utilize fossil primary energy sources such as coal, oil, and natural gas (Liu, 2023). The latter pollute the atmosphere through their combustion and their release of greenhouse gases (Ramanathan and Feng, 2011; Latake and Pawar, 2015); which has contributed to the development of policies promoting the use of renewable energy sources such as solar photovoltaic (Liu, 2023; Phillips, 2013), wind (Ahilan *et al*., 2012) and geothermal power. Apart from that, we distinguish between base-load power plants which always provide their full energy capacity, and peak power plants which usually make it possible to manage energy peaks (Bharat *et al*., 2020; Wildi and Sybille, 2005).

From the above aforementioned, the problem lies with the power demand which fluctuates and varies from one community to another (Li and Allinson, 2018; Gaur *et al*., 2016; Adjamagbo *et al*., 2011), from one municipality to another and even worse over the time (Kondi-Akara *et al*., 2023). In most networks, particularly in our sub-region and in Togo, the solution used until now is load monitoring. This strategy generates two scenarios. The first is overproduction creating undistributed energy which leads to the waste of primary energy and financial sources. The second is the discontent of populations, companies, and/or industries because of load shedding or unexpected outages.

To remedy these problems, we propose, through this document, the forecast of production to adapt it to consumption. To achieve this, we drew inspiration from work carried out in the literature. We found that artificial intelligence algorithms help to provide solutions when the phenomena are random and the data is numerous. Thus, we can cite as algorithms: Convolutional neural networks, (Bibi *et al*., 2024), Variational AutoEncoders (Skribtsov and Surikov, 2016), residual neural networks, recurrent neural networks, (Mamadou *et al*., 2023), Linear regression (Kpomonè *et al*., 2024), Logistic regression (Rakhimovich *et al*., 2024), random forests (Iftikhar *et al*., 2021), Linear discriminant analysis (Laflèche, 1996). Also: Regression models (Federico *et al*., 2024; Mohammad-Alikhani *et al*., 2024), statistical methods (Zeng *et al*., 2010), stochastic methods (Sabath and Garbe, 2013), empirical methods (Barker *et al*., 2013), etc., have been explored to find very interesting solutions to problems related to the forecasting of electricity production in electrical networks. When carrying out the work, there was no particular emphasis on the influence of the seasons on consumption to predict production. However, in our countries, when the season changes, some devices come into play, and others are abandoned. For example, in the dry season, where the temperature is usually very high, there is excessive use of air conditioning and ventilation. This is not the case for the rainy season when the period is relatively cool.

From there, we realize that the seasons have significant impacts on the electricity needs of our communities. In this study, we aim to characterize production and consumption and then use Autoregressive Integrate Mean Average (ARIMA), on seasonal data from CEET in Lomé, Togo, to predict energy production. Electricity from consumption. Indeed, Togo is a country in West Africa. In Lomé, its capital, we have four seasons, namely: The long rainy season, the long dry season, the short rainy season, and the short dry season. The goal is to make a monthly characterization, then grouped into seasons, of the CEET data and after predicting production, submit the results of the models to certain performance evaluation criteria in order to judge them. Among these performance evaluation criteria, we retain: Mean Square Error (MSE), Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and coefficient of determination (R^2).

The results will allow the Electric Energy Company of Togo (CEET) to plan with precision found if it is good, the optimal production of energy in order to free itself from load monitoring.

Materials and Methods

In Togo, the Electric Community of Benin (CEB) is responsible for transporting electrical energy, and the Togo Electric Energy Company (CEET) is responsible for its distribution. The majority of electricity is imported by the country. There are a few production points there. Table (1) gives the list of small production centers which are only peaking plants. The available electrical power of 205.9 MW is mainly managed by the CEB which shares it between Togo and Benin. The adequacy of production and consumption is managed through agreements that exist with the networks of border countries and then the West African sub-region. Figure (1) presents the Companies in the value chain of electricity sold in Togo.

Table (1) shows that the total energy production available to Togo instantly amounts to 205.9 MW. However, demand usually remains higher. Also, the Nangbéto hydraulic power plant does not provide its full capacity at all times because it is a peak power plant to meet the peak of the country's consumption. That being said, there is an international network passing through Togo and connecting Nigeria to Côte d'Ivoire. The electricity suppliers of said network are grouped together in the production section of Fig. (1). We can easily notice the Société Nigérienne d'Electricité (NIGELEC), the Transmission Company of Nigeria (TCN), the Compagnie Ivoirienne d'Electricité (CIE) and the Volta

River Authority (VRA); added to the production plants in Table (1), some of which also appear in Fig. (1); allowing CEET to obtain electricity through the CEB.

CEET operating data (production and consumption) are often recorded using an Excel spreadsheet, the appearance of which is shown in Fig. (2). In this study, we use data from the year 2021. Registration is carried out from January 1 to December 31 at an interval of 1 h. To carry out this study, we extracted the data following the months for the seasons concerned. We had November, December, and January for the long dry season. February, March, April, May, and June for the main summer season. We have, for the short rainy season: A small part of August, September, and October. Finally, most of August and July are in the short dry season (Adewi *et al*., 2010; Badameli, 1998; Gregori and Leybourne, 2020). Figure (2) shows the data arrangement sheets by season. In this figure, we have the Long Rainy Season (LRS); the Great Dry Season (GDS); the Short Rainy Season (SRS), the Short Dry Season (SDS), the cumulative rainy seasons (CRS), the cumulative dry seasons (CDS) and the year.

In order to properly carry out this work, we carried out a statistical analysis of production and consumption data per month. This allowed us to carry out the classification well and facilitated the arrangement of the data. This analysis took into account parameters such as Mode, median, mean, standard deviation, skewness, kurtosis, minimum, and maximum, (Rénée, 2006; Saporta, 2006). Following the characterization, we used Autoregressive Integrate Mean Average (ARIMA) to perform the prediction. The fight for production-consumption adequacy led us to incorporate all the data into the study.

Table 1: Production fleet for the CEB network (Kpomonè *et al*., 2024)

Type of plants	Instantaneous installed power in MW	Production power available in MW
Lomé Thermal Power Plant Headquarters (SULZER)	16	12
Lomé B thermal power plant (CTLB)	12	11.9
Kara thermal power plant	16	4
Sokodé Thermal Power Plant	4	1,5
Kpimé Hydraulic Power plant	1,6	1,5
Nangbéto Hydraulic Power plant	75	75
Contour global thermal power plant	99,6	100

Fig. 1: Companies in the value chain of electricity sold in Togo (Ntagungira, 2015)

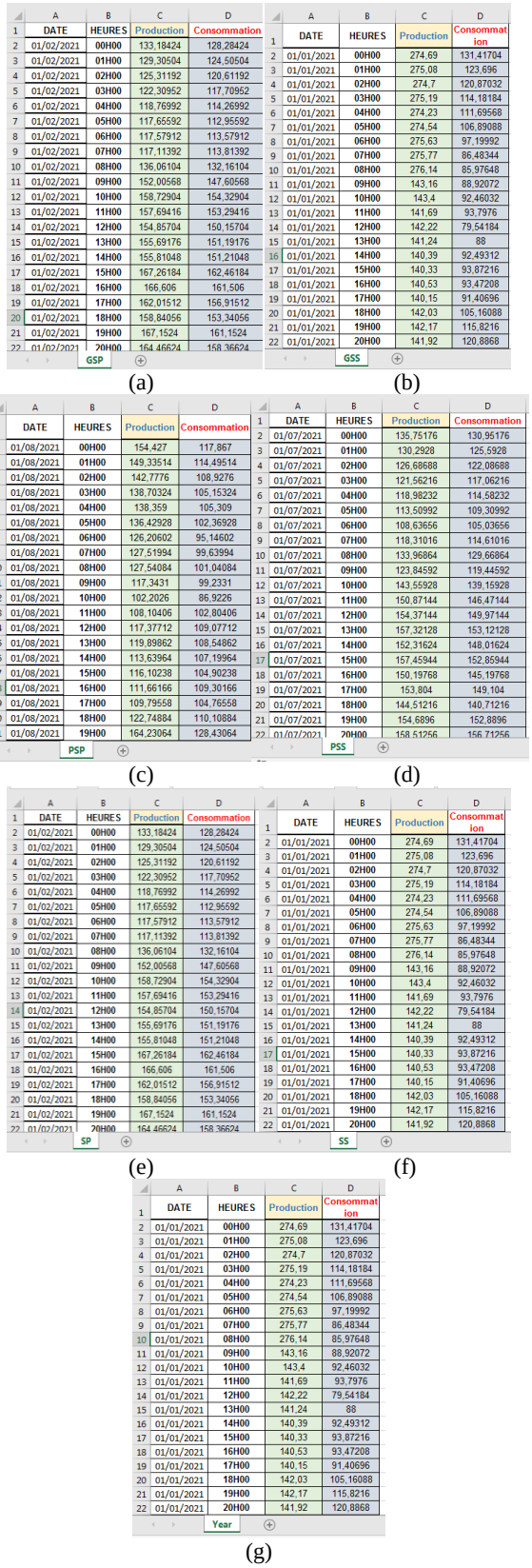


Fig. 2: Excel data arrangement sheets; (a): LRS; (b): GDS; (c): SRS; (d): SDS; (e): CRS; (f): CDS; (g): Year

Autoregressive Integrate Mean Average (Arima)

The category of ARIMA models, introduced by Box and Jenkins in 1976, aims to model the behavior of processes subjected to random shocks over time. When we observe a time series, each period between two successive measurements is influenced by a random event, called a disturbance, which alters the temporal behavior of the process and therefore the values of the observed series. ARIMA models are designed to merge three types of temporal processes: Autoregressive processes (AR), integrated processes (I), and moving averages (MA). In general, an ARIMA model combines these three processes, with each type contributing in a specific way, as specified by the ARIMA notation (*p, d, q*), where *p* represents the order of the autoregressive process, *d* is the degree of integration of the process and *q* designates the order of the moving average (Pierre *et al*., 2023; Ayoub, 2022).

The ARIMA modeling methodology for time series generally follows several well-defined steps, namely:

- ✓ Data collection and exploration
- ✓ Data preprocessing
- ✓ Identification of ARIMA parameters
- ✓ Adjustment of the ARIMA model

The identification of the ARIMA parameters aims to determine the orders *p*, *d*, and *q* of the ARIMA model. These orders correspond respectively to the autoregressive terms, the differentiation terms, and the moving average terms. To identify these parameters, a commonly used approach is to analyze graphs of the autocorrelation and partial autocorrelation of the data. In these graphs, significant peaks may suggest orders *p* and *q*. Additionally, the degree of differentiation needed can be determined by evaluating the level of stationarity of the data after different transformations. This process of identifying ARIMA parameters is often repetitive, involving extensive data exploration and analysis to select optimal model parameters. By combining visual data analysis with statistical testing, this step aims to ensure that the chosen ARIMA model is able to effectively capture the trends and patterns present in the time series being studied. The elements *p*, *d*, and *q*, by modifying them, we notice that the performances vary. However, the variation of *p* and *d* does not have too much influence on the quality of the model. Which is not the case for *q*. On this, when implementing the results, we took into account several values of the moving average q at random steps taking into account the effect on the result, but the minimum is 1 and the maximum is 100 passing through 10, 30, 50, and 80. We present in Fig. (3) the operating flowchart of ARIMA.

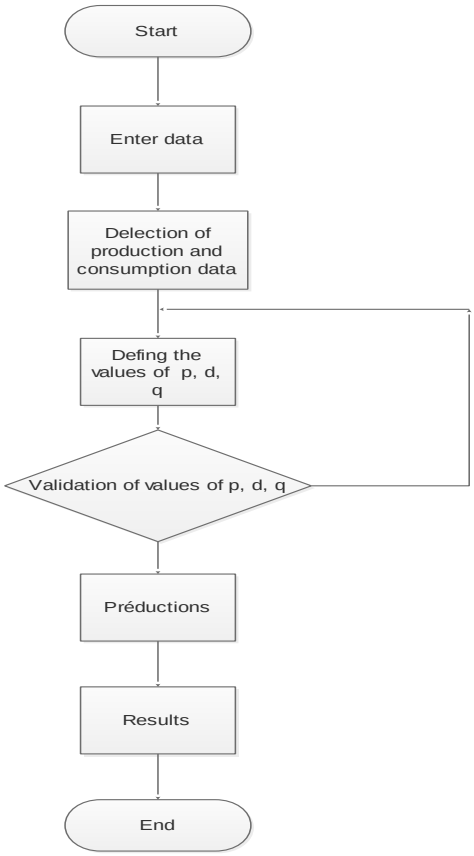


Fig. 3: ARIMA operating chart

Metrics for Evaluating Model Performance

In the world of forecasting, accuracy is a crucial factor that determines the success of any model. To measure the accuracy of a forecast, precision measurements play a vital role. One of these measures is the Mean Absolute Error (MAE) calculated by relation (1). MAE is a commonly used metric to measure forecast accuracy. It provides a simple and intuitive way to evaluate the average magnitude of errors between predicted and actual values. By understanding the MAE and its interpretation, forecasters can gain valuable information about the accuracy of their forecasts and make informed decisions based on this information. We then have the Mean Square Error (MSE) expressed by relation (2), which provides a quantitative measure of the mean square difference between the predicted and actual values. The MSE is a cost function widely used in regression tasks. The closer the value obtained for this criterion is to 0, the better the fit of the model to the observed values. A value that indicates acceptable simulation should be less than 0.2. This criterion can be interpreted as the percentage of the standard deviation not explained by the model. An MSE of 0.2 would mean that we do not explain at least 20% of the variance in the values observed with the model tested.

We also have the Root Mean Squared Error (RMSE)

presented by relation (3). The root mean square error is also one of the main performance indicators for a regression model. It measures the average difference between the values predicted by a model and the actual values. It provides an estimate of how well the model is able to predict the target value (accuracy). The lower the RMSE value, the more accurate the model. A perfect model (a hypothetical model that would always predict the exact expected value) would have a value equal to 0. The RMSE value is expressed in the same unit as the target value.

Finally, we calculated the coefficient of determination (R^2). This coefficient is expressed on a scale of 0-1, where an R^2 of 1 indicates that the regression model fully explains the variance of the dependent variable, signifying a perfect fit. Relation (4) gives its calculation formula. The coefficient of determination is equal to the correlation coefficient (R^2) squared. The correlation coefficient measures the strength of the relationship between two variables: the dependent variable and the predictor variable. This force is between -1 and 1. Thus, by having *r*, it is possible to calculate R^2. On the other hand, this calculation does not make it possible to determine the effect that led to the adequacy or otherwise of the data with linear regression. The limitation of the coefficient of determination lies in adding variables to a linear regression. When you add too many of them, it tends to increase the value of R^2, unjustifiably. In this case, it is useful to refer to the "adjusted R^2" which will determine the reliability of the correlation. Generally speaking, the coefficient of determination is a good tool for estimating the link between linear regression and variables; but its use remains limited since it only partially measures the usefulness of a linear regression and the adjustment of the points with the regression model, (Kpomonè *et al*., 2024; Pierre *et al*., 2023; Ayoub, 2022; Komla, 2020).

$$MAE = \frac{1}{N}\sum_{j=1}^{N}\left|P_{j,p} - P_{j,r}\right| \quad (1)$$

$$MSE = \frac{1}{N}\sum_{j=1}^{N}\left(P_{j,p} - P_{j,r}\right)^2 \quad (2)$$

$$RMSE = \sqrt{\frac{1}{N}\sum_{j=1}^{N}\left(P_{j,p} - P_{j,r}\right)^2} \quad (3)$$

$$R^2 = \frac{\sum_{j=1}^{N}\left(P_{j,P} - P_{p,avg}\right)*\left(P_{j,r} - P_{j,avg}\right)}{\sqrt{\left[\sum_{j=1}^{N}\left(P_{j,p} - P_{p,avg}\right)^2\right]*\left[\sum_{j=1}^{N}\left(P_{j,r} - P_{r,avg}\right)^2\right]}} \quad (4)$$

where:

- ✓ $P_{j,p}$ represents the estimated or predicted values
- ✓ $P_{j,r}$ are measured values
- ✓ $P_{p,avg}$ being the predicted mean values
- ✓ $P_{j,avg}$ is the average measured value
- ✓ N is the number of points sampled

Results

The statistical analysis is carried out taking into account all days of all months of the year that is to say from January to December. Almost all basic parameters of inferential statistics are calculated, but the shape characteristics will not be used for data analysis. The dispersion characteristics, particularly the maximum, and others, will be useful to us. Production is characterized separately, as is consumption. Their results are accumulated in Tables (2-25). The values stored in these tables are expressed in MW, except for the skewness and kurtosis coefficients.

Table 2: Statistical analysis of January production

	Statistical parameter							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-01-01	130,970	142,355	191,287	66,365	0,513	-1,731	130,970	276,140
2021-01-02	95,740	97,375	114,136	21,308	0,419	-1,748	95,740	142,520
2021-01-03	96,360	111,935	111,539	17,986	0,906	-0,612	95,810	144,560
2021-01-04	120,110	129,384	132,924	8,962	0,318	-1,352	120,110	145,560
2021-01-05	125,820	143,075	154,563	47,516	2,143	2,839	125,820	276,400
2021-01-06	143,440	142,700	140,390	6,359	-1,725	1,103	125,980	145,200
2021-01-07	127,860	144,740	139,189	8,077	-0,519	-1,677	127,860	146,640
2021-01-08	262,390	269,115	271,742	7,755	0,094	-1,824	262,390	281,490
2021-01-09	243,670	246,195	258,265	15,697	0,412	-1,663	243,670	279,490
2021-01-10	136,400	244,500	225,452	45,115	-0,895	-0,824	136,400	277,740
2021-01-11	261,082	69,620	149,607	99,344	0,343	-1,873	65,480	277,762
2021-01-12	167,580	247,285	227,263	48,051	-0,353	-1,676	167,580	279,840
2021-01-13	118,480	262,016	229,147	58,091	-0,791	-1,141	118,480	277,520
2021-01-14	109,082	138,247	133,873	14,606	-0,113	-0,907	109,082	155,152
2021-01-15	123,132	153,592	144,652	13,453	-0,687	-1,240	123,132	157,022
2021-01-16	20,710	50,525	49,222	14,539	-0,265	-0,713	20,710	69,150
2021-01-17	19,100	36,765	42,039	17,824	0,306	-1,242	19,100	67,973
2021-01-18	134,310	136,810	142,118	9,991	1,259	0,441	134,310	166,370

2021-01-19	134,790	150,475	148,961	13,092	0,402	-1,326	134,790	169,480
2021-01-20	137,002	137,582	141,395	9,186	0,326	-0,508	124,242	156,562
2021-01-21	122,522	136,802	133,434	7,869	0,021	-0,427	122,522	152,452
2021-01-22	122,962	122,512	124,077	10,466	0,033	-0,623	105,852	139,982
2021-01-23	106,492	115,312	115,530	8,442	0,014	-1,963	106,492	125,692
2021-01-24	107,262	123,987	124,498	10,789	0,322	-0,123	107,262	149,272
2021-01-25	121,862	136,767	137,004	13,045	0,133	-1,562	121,862	154,092
2021-01-26	60,672	124,961	123,677	25,521	-1,364	1,233	60,672	156,332
2021-01-27	137,882	152,322	147,719	7,672	-0,273	-1,808	137,882	156,672
2021-01-28	94,625	135,438	134,804	19,531	-0,392	-1,201	94,625	154,302
2021-01-29	69,220	139,630	133,561	36,227	-0,644	0,091	69,220	211,520
2021-01-30	133,460	150,300	152,040	11,768	-0,148	-1,132	133,460	167,920
2021-01-31	131,380	147,840	148,220	12,867	0,161	-1,491	131,380	165,500

Table 3: Statistical analysis of January consumption

	Statistical parameter							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-01-01	79,542	101,180	104,439	15,799	0,185	-1,426	79,542	131,417
2021-01-02	72,318	98,768	102,266	14,402	0,307	-0,208	72,318	128,803
2021-01-03	85,070	98,326	103,036	14,310	0,581	-0,902	85,070	130,168
2021-01-04	96,742	140,951	132,322	19,472	-0,517	-1,232	96,742	156,964
2021-01-05	109,474	152,651	144,531	16,859	-0,702	-0,905	109,474	165,227
2021-01-06	119,323	155,431	148,401	13,548	-0,771	-0,711	119,323	164,813
2021-01-07	119,333	150,021	144,603	13,372	-0,678	-0,946	119,333	161,252
2021-01-08	116,742	143,336	141,626	10,863	-0,606	-0,472	116,742	156,003
2021-01-09	148,417	124,149	127,140	13,529	0,207	-1,082	103,932	148,417
2021-01-10	107,614	118,537	122,072	11,634	0,536	-1,039	107,614	143,724
2021-01-11	115,111	147,368	141,104	16,131	-0,475	-1,307	115,111	162,306
2021-01-12	115,053	143,878	141,528	12,757	-0,429	-0,883	115,053	159,817
2021-01-13	120,949	147,368	144,833	11,902	-0,586	-0,710	120,949	160,424
2021-01-14	117,246	145,113	141,468	11,464	-0,450	-0,761	117,246	159,615
2021-01-15	122,295	149,101	144,415	12,762	-0,562	-1,147	122,295	160,027
2021-01-16	109,842	128,251	129,183	9,380	0,208	-0,201	109,842	147,840
2021-01-17	100,760	113,586	118,100	13,536	0,478	-1,186	100,760	141,812
2021-01-18	110,598	143,810	138,222	16,205	-0,357	-1,279	110,598	160,124
2021-01-19	119,758	152,180	145,950	13,984	-0,677	-1,050	119,758	161,476
2021-01-20	117,607	148,946	143,939	13,823	-0,708	-0,817	117,607	160,169
2021-01-21	119,402	146,848	142,686	11,863	-0,667	-0,874	119,402	157,425
2021-01-22	119,156	144,077	141,178	11,428	-0,551	-0,829	119,156	156,410
2021-01-23	105,939	121,366	123,820	11,063	0,282	-1,000	105,939	142,345
2021-01-24	93,630	107,868	111,989	14,310	0,614	-0,826	93,630	139,224
2021-01-25	117,391	149,889	143,818	16,060	-0,594	-1,259	117,391	163,531
2021-01-26	115,009	148,766	142,881	14,110	-0,658	-0,972	115,009	158,966
2021-01-27	109,151	142,936	135,784	16,419	-0,459	-1,337	109,151	158,375
2021-01-28	119,700	147,626	145,243	12,936	-0,369	-1,143	119,700	163,060
2021-01-29	119,816	149,488	145,993	12,604	-0,495	-0,900	119,816	165,341
2021-01-30	106,370	127,046	128,139	10,090	-0,119	-0,265	106,370	145,392
2021-01-31	97,826	108,342	115,192	14,331	0,658	-1,024	97,826	142,480

Table 4: Statistical analysis of February production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-02-01	117,114	155,751	146,954	18,956	-0,529	-1,393	117,114	167,262
2021-02-02	117,568	159,987	154,803	15,722	-0,884	-0,374	117,568	172,001
2021-02-03	128,791	161,838	155,431	15,293	-0,443	-1,327	128,791	175,350
2021-02-04	127,568	156,843	154,440	13,082	-0,740	-0,822	127,568	169,248
2021-02-05	126,147	154,639	151,278	9,211	-1,251	0,887	126,147	160,903
2021-02-06	119,139	131,427	134,765	9,881	0,530	-0,579	119,139	156,836
2021-02-07	111,298	127,399	130,384	13,444	0,529	-0,854	111,298	155,243
2021-02-08	110,958	148,450	143,889	17,711	-0,399	-1,111	110,958	166,336
2021-02-09	118,944	159,510	151,222	15,482	-0,617	-1,059	118,944	171,236
2021-02-10	125,149	158,956	153,594	13,828	-0,611	-0,942	125,149	170,864

2021-02-11	124,514	152,445	152,373	12,611	-0,180	-0,736	124,514	174,724
2021-02-12	127,593	148,968	149,562	9,401	-0,285	-0,174	127,593	165,461
2021-02-13	108,660	128,689	133,312	13,843	0,205	-1,065	108,660	155,013
2021-02-14	104,763	121,776	125,936	15,788	0,378	-1,235	104,763	151,191
2021-02-15	117,628	154,269	146,966	15,608	-0,430	-1,318	117,628	166,255
2021-02-16	129,037	150,496	151,532	11,540	-0,240	-1,132	129,037	167,232
2021-02-17	107,768	144,176	142,258	16,964	-0,310	-1,017	107,768	165,136
2021-02-18	123,430	152,981	149,623	11,185	-0,574	-0,662	123,430	163,566
2021-02-19	122,526	149,102	146,713	10,760	-0,685	-0,569	122,526	159,894
2021-02-20	109,905	131,226	129,927	9,382	-0,474	-0,010	109,905	146,029
2021-02-21	111,963	125,063	128,243	11,425	0,691	-0,454	111,963	153,115
2021-02-22	123,551	155,673	148,028	14,684	-0,607	-1,216	123,551	165,050
2021-02-23	122,984	151,110	149,851	11,530	-0,688	-0,454	122,984	164,734
2021-02-24	126,942	156,705	153,446	11,996	-0,677	-0,707	126,942	168,232
2021-02-25	110,721	136,418	137,528	12,501	-0,341	-0,295	110,721	160,408
2021-02-26	117,853	153,154	150,195	12,835	-1,081	0,484	117,853	166,757
2021-02-27	121,056	152,471	150,326	10,796	-1,014	0,750	121,056	164,994
2021-02-28	107,574	124,778	128,018	13,710	0,497	-0,896	107,574	152,706

Table 5: Statistical analysis of February consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-02-01	112,956	151,201	142,117	18,531	-0,542	-1,399	112,956	162,462
2021-02-02	112,768	154,385	149,911	15,390	-0,895	-0,314	112,768	167,101
2021-02-03	125,491	157,305	150,856	14,887	-0,455	-1,323	125,491	170,950
2021-02-04	124,268	151,943	149,515	12,719	-0,733	-0,882	124,268	163,048
2021-02-05	122,347	149,162	146,269	8,906	-1,303	0,868	122,347	154,920
2021-02-06	115,739	126,577	129,832	9,535	0,576	-0,541	115,739	151,436
2021-02-07	106,498	123,270	125,667	12,876	0,482	-0,902	106,498	148,943
2021-02-08	107,658	143,636	139,581	17,075	-0,458	-1,086	107,658	160,136
2021-02-09	115,140	154,931	146,489	15,151	-0,631	-1,049	115,140	166,140
2021-02-10	121,849	154,306	148,848	13,472	-0,606	-0,989	121,849	165,464
2021-02-11	120,414	147,595	147,286	12,160	-0,208	-0,747	120,414	168,824
2021-02-12	124,793	144,182	144,641	8,631	-0,293	-0,206	124,793	159,461
2021-02-13	104,360	124,139	128,633	13,206	0,137	-1,021	104,360	148,913
2021-02-14	100,822	116,926	120,926	15,147	0,378	-1,243	100,822	145,540
2021-02-15	114,228	149,119	141,932	15,259	-0,423	-1,370	114,228	160,955
2021-02-16	125,637	145,846	146,619	11,511	-0,137	-1,244	125,637	162,718
2021-02-17	106,068	138,976	137,287	16,699	-0,279	-1,191	106,068	158,915
2021-02-18	119,130	147,631	144,427	10,801	-0,602	-0,669	119,130	157,466
2021-02-19	119,126	144,452	142,121	10,581	-0,673	-0,676	119,126	154,994
2021-02-20	104,705	126,598	125,215	9,250	-0,567	0,039	104,705	140,529
2021-02-21	108,663	121,340	123,897	10,672	0,688	-0,429	108,663	147,415
2021-02-22	118,368	150,673	142,799	14,513	-0,610	-1,209	118,368	159,550
2021-02-23	119,684	146,410	145,080	11,177	-0,699	-0,538	119,684	158,734
2021-02-24	123,742	152,505	148,508	11,573	-0,648	-0,805	123,742	162,546
2021-02-25	106,121	131,560	132,528	11,939	-0,391	-0,153	106,121	154,908
2021-02-26	113,253	148,604	145,254	12,409	-1,122	0,557	113,253	160,857
2021-02-27	117,856	147,671	145,572	10,187	-1,079	0,759	117,856	158,794
2021-02-28	104,174	120,078	123,122	13,201	0,503	-0,904	104,174	147,006

Table 6: Statistical analysis of Mars production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-03-01	115,584	149,768	145,121	14,669	-0,482	-1,041	115,584	163,415
2021-03-02	129,184	155,154	153,401	11,855	-0,343	-0,912	129,184	171,355
2021-03-03	123,905	156,743	154,251	11,890	-0,880	0,462	123,905	172,020
2021-03-04	127,340	155,319	153,936	9,870	-0,826	0,620	127,340	168,887
2021-03-05	131,105	159,760	155,452	12,445	-0,742	-0,853	131,105	168,583
2021-03-06	120,879	140,063	143,550	11,814	0,149	-0,871	120,879	162,043
2021-03-07	8,900	117,688	116,558	37,135	-1,487	1,788	8,900	156,096

2021-03-08	123,335	157,271	152,978	16,377	-0,319	-1,149	123,335	176,132
2021-03-09	125,737	158,491	153,292	12,612	-0,484	-0,861	125,737	170,478
2021-03-10	124,616	150,555	150,694	11,074	-0,414	-0,574	124,616	166,187
2021-03-11	125,641	141,374	143,155	8,363	-0,019	-0,386	125,641	158,010
2021-03-12	125,942	155,185	151,019	12,780	-0,574	-0,954	125,942	166,787
2021-03-13	117,051	136,149	136,810	9,928	-0,265	-0,816	117,051	152,629
2021-03-14	99,876	116,665	118,435	10,387	-0,006	-0,881	99,876	136,987
2021-03-15	107,018	148,317	138,737	22,401	-0,456	-1,520	107,018	164,722
2021-03-16	124,626	154,953	152,083	13,733	-0,510	-0,828	124,626	170,760
2021-03-17	121,740	150,187	147,516	10,742	-0,720	-0,343	121,740	162,655
2021-03-18	116,960	142,611	141,002	9,509	-0,713	0,011	116,960	154,166
2021-03-19	108,209	146,657	139,066	17,263	-0,605	-1,242	108,209	157,475
2021-03-20	72,430	124,530	118,573	25,341	-0,046	-1,138	72,430	157,033
2021-03-21	73,556	121,737	114,897	25,637	-0,382	-1,382	73,556	148,387
2021-03-22	118,619	158,555	151,166	17,697	-0,593	-1,198	118,619	171,929
2021-03-23	124,230	146,817	146,314	12,742	-0,019	-1,239	124,230	165,955
2021-03-24	111,144	139,429	136,263	13,763	-0,333	-1,191	111,144	155,229
2021-03-25	116,914	137,400	138,958	11,680	0,171	-0,737	116,914	158,366
2021-03-26	120,233	155,535	148,658	13,851	-0,788	-0,876	120,233	162,127
2021-03-27	116,221	146,722	142,774	15,617	-0,154	-1,364	116,221	165,154
2021-03-28	103,430	119,292	123,307	16,098	0,192	-1,604	103,430	149,059
2021-03-29	116,695	153,415	145,898	18,843	-0,433	-1,443	116,695	168,499
2021-03-30	123,154	156,902	153,252	12,314	-0,753	-0,263	123,154	168,315
2021-03-31	127,591	160,316	155,319	12,943	-0,733	-0,803	127,591	169,559

Table 7: Statistical analysis of March consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-03-01	112,184	144,718	139,721	14,361	-0,473	-1,171	112,184	157,585
2021-03-02	125,684	150,004	148,247	11,496	-0,314	-0,991	125,684	164,855
2021-03-03	120,305	151,813	149,189	11,368	-0,963	0,484	120,305	165,720
2021-03-04	123,740	150,468	148,586	9,380	-0,839	0,467	123,740	162,587
2021-03-05	126,305	155,410	150,356	12,249	-0,759	-0,880	126,305	163,083
2021-03-06	116,979	135,463	138,371	11,047	0,086	-0,840	116,979	155,443
2021-03-07	7,600	113,793	112,312	35,581	-1,544	1,988	7,600	149,696
2021-03-08	119,309	151,510	147,490	16,361	-0,321	-1,137	119,309	170,862
2021-03-09	121,937	153,255	148,117	12,120	-0,493	-0,885	121,937	164,478
2021-03-10	120,716	145,055	145,557	10,704	-0,442	-0,638	120,716	160,287
2021-03-11	120,141	135,886	137,805	7,952	-0,143	-0,355	120,141	151,510
2021-03-12	122,042	150,879	145,803	12,577	-0,574	-1,019	122,042	161,836
2021-03-13	113,451	131,099	131,623	9,387	-0,242	-0,824	113,451	147,029
2021-03-14	95,137	112,240	113,489	10,016	-0,038	-0,785	95,137	131,487
2021-03-15	101,518	143,917	133,549	22,259	-0,489	-1,515	101,518	158,222
2021-03-16	120,826	149,203	146,699	13,473	-0,473	-0,896	120,826	165,060
2021-03-17	116,740	144,987	142,046	10,925	-0,784	-0,389	116,740	156,455
2021-03-18	113,060	137,411	135,944	9,373	-0,652	-0,215	113,060	148,866
2021-03-19	103,009	141,009	133,795	17,015	-0,619	-1,233	103,009	151,296
2021-03-20	68,630	119,620	114,377	23,705	-0,104	-1,022	68,630	150,233
2021-03-21	69,556	116,687	109,672	25,030	-0,392	-1,383	69,556	142,387
2021-03-22	114,119	153,605	145,699	17,324	-0,585	-1,230	114,119	165,929
2021-03-23	120,130	140,466	140,698	12,766	0,043	-1,294	120,130	160,755
2021-03-24	107,144	134,374	130,688	13,498	-0,340	-1,270	107,144	148,829
2021-03-25	112,914	129,619	133,154	11,422	0,287	-0,823	112,914	152,266
2021-03-26	116,233	149,609	143,362	13,715	-0,762	-0,956	116,233	157,359
2021-03-27	112,121	141,122	137,119	15,206	-0,177	-1,404	112,121	158,454
2021-03-28	99,030	114,642	118,795	15,693	0,208	-1,571	99,030	143,259
2021-03-29	112,595	148,565	140,977	18,377	-0,451	-1,463	112,595	162,299
2021-03-30	119,854	152,152	147,952	11,818	-0,749	-0,422	119,854	161,815
2021-03-31	123,791	155,016	149,981	12,633	-0,689	-0,896	123,791	164,162

Table 8: Statistical analysis of April production

	Statistical parameters							
Avril	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-04-01	159,596	197,915	191,607	16,349	-0,624	-0,893	159,596	211,335
2021-04-02	164,681	189,427	189,089	12,036	-0,236	-0,491	164,681	208,545
2021-04-03	150,622	182,553	178,672	13,776	-0,531	-0,729	150,622	196,480
2021-04-04	132,745	155,555	158,351	19,644	0,146	-1,543	132,745	186,467
2021-04-05	133,433	154,243	160,701	18,000	0,717	-0,553	133,433	195,951
2021-04-06	154,223	193,034	188,659	16,600	-0,671	-0,631	154,223	208,530
2021-04-07	160,599	197,123	193,113	17,114	-0,559	-1,068	160,599	214,542
2021-04-08	159,647	200,711	195,723	15,736	-1,012	-0,046	159,647	211,542
2021-04-09	142,422	181,267	177,140	16,951	-0,442	-0,779	142,422	199,507
2021-04-10	133,977	160,278	163,775	16,067	0,161	-1,027	133,977	189,785
2021-04-11	95,529	149,646	153,610	23,595	-0,086	-0,108	95,529	191,909
2021-04-12	56,760	197,710	182,445	34,627	-2,148	5,197	56,760	213,282
2021-04-13	159,559	200,823	195,315	15,011	-0,866	-0,324	159,559	211,469
2021-04-14	160,767	201,280	195,470	14,440	-0,921	-0,262	160,767	209,866
2021-04-15	164,644	200,887	195,394	14,640	-0,776	-0,646	164,644	211,644
2021-04-16	158,765	199,405	194,384	14,198	-1,016	0,130	158,765	209,455
2021-04-17	142,827	169,050	172,271	15,002	0,050	-1,054	142,827	195,641
2021-04-18	110,480	142,989	146,161	20,223	-0,175	-0,997	110,480	181,089
2021-04-19	130,304	188,152	173,164	28,669	-0,487	-1,506	130,304	205,265
2021-04-20	148,152	195,029	187,561	17,096	-0,834	-0,518	148,152	205,433
2021-04-21	156,434	193,850	190,658	14,602	-0,744	-0,440	156,434	209,286
2021-04-22	148,383	188,694	186,158	16,789	-0,655	-0,057	148,383	211,593
2021-04-23	158,434	194,677	191,476	13,473	-0,933	0,451	158,434	208,668
2021-04-24	134,596	172,952	171,839	12,805	-0,767	1,353	134,596	196,291
2021-04-25	126,570	146,582	150,504	18,370	0,847	-0,429	126,570	188,201
2021-04-26	146,018	190,253	183,810	20,265	-0,399	-1,062	146,018	211,705
2021-04-27	133,532	152,738	161,799	18,479	0,311	-1,378	133,532	193,564
2021-04-28	144,064	189,786	181,262	19,891	-0,724	-0,971	144,064	204,525
2021-04-29	151,485	184,224	181,387	13,786	-0,400	-0,483	151,485	206,517
2021-04-30	154,321	192,700	187,030	15,130	-0,700	-0,653	154,321	207,112

Table 9: Statistical analysis of April consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-04-01	125,056	156,729	150,695	13,991	-0,526	-1,115	125,056	168,555
2021-04-02	128,170	149,298	148,063	9,570	-0,521	-0,724	128,170	160,597
2021-04-03	125,672	153,681	149,580	12,065	-0,578	-0,912	125,672	164,438
2021-04-04	101,786	119,517	122,531	14,816	0,131	-1,455	101,786	145,127
2021-04-05	104,923	119,329	124,487	13,591	0,726	-0,555	104,923	152,101
2021-04-06	122,391	154,755	149,406	13,472	-0,717	-0,864	122,391	164,749
2021-04-07	125,949	159,129	152,714	14,308	-0,593	-1,159	125,949	169,211
2021-04-08	125,182	158,818	154,024	13,325	-0,842	-0,550	125,182	170,032
2021-04-09	116,042	146,319	141,480	12,781	-0,717	-0,882	116,042	155,004
2021-04-10	104,607	126,576	129,028	12,679	0,280	-0,597	104,607	151,675
2021-04-11	82,529	115,921	121,831	17,787	0,106	-0,598	82,529	151,249
2021-04-12	22,610	156,500	143,569	31,441	-2,537	7,157	22,610	171,892
2021-04-13	124,079	160,508	154,164	13,521	-0,815	-0,671	124,079	171,439
2021-04-14	125,807	159,056	154,746	12,723	-0,724	-0,596	125,807	170,136
2021-04-15	129,514	159,004	153,792	12,137	-0,615	-0,972	129,514	169,664
2021-04-16	123,095	158,622	153,743	13,241	-0,781	-0,512	123,095	171,085
2021-04-17	109,607	128,583	132,224	12,624	-0,003	-1,119	109,607	152,101
2021-04-18	87,040	110,934	113,285	14,180	-0,221	-0,720	87,040	138,619
2021-04-19	98,914	148,625	134,774	23,687	-0,530	-1,490	98,914	162,515
2021-04-20	113,932	153,279	146,156	14,817	-0,824	-0,729	113,932	162,143
2021-04-21	124,214	152,792	150,313	13,546	-0,587	-1,021	124,214	165,787
2021-04-22	120,293	152,899	147,902	12,756	-1,046	0,103	120,293	162,963
2021-04-23	125,724	157,481	152,489	11,557	-0,907	-0,278	125,724	165,836
2021-04-24	96,716	134,649	132,609	10,611	-1,451	3,693	96,716	151,821

2021-04-25	96,010	114,102	117,291	13,895	0,832	-0,375	96,010	145,081
2021-04-26	113,508	149,683	143,379	16,424	-0,556	-1,117	113,508	164,235
2021-04-27	104,372	117,958	126,270	14,020	0,315	-1,344	104,372	150,704
2021-04-28	110,064	149,116	142,526	16,017	-0,741	-0,901	110,064	158,905
2021-04-29	117,205	146,460	141,408	11,178	-0,716	-0,469	117,205	159,677
2021-04-30	118,131	153,501	146,606	12,719	-0,852	-0,674	118,131	158,812

Table 10: Statistical analysis of May production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-05-01	97,515	112,369	120,549	18,126	0,382	-1,453	97,515	153,340
2021-05-02	107,453	121,176	121,909	11,278	0,647	-0,381	107,453	148,288
2021-05-03	103,527	126,154	125,249	10,690	-0,028	-0,468	103,527	147,204
2021-05-04	104,126	147,510	137,591	21,826	-0,476	-1,471	104,126	163,224
2021-05-05	123,609	159,529	152,843	15,179	-0,616	-1,155	123,609	171,097
2021-05-06	122,258	158,310	151,941	13,568	-0,778	-0,737	122,258	168,369
2021-05-07	121,874	150,177	149,406	13,235	-0,454	-0,876	121,874	168,052
2021-05-08	109,618	128,041	128,815	9,227	-0,005	-0,309	109,618	144,917
2021-05-09	102,800	115,990	119,055	10,973	0,911	-0,290	102,800	141,433
2021-05-10	111,554	154,623	145,766	20,053	-0,563	-1,378	111,554	169,039
2021-05-11	126,311	159,256	154,556	12,967	-0,707	-0,580	126,311	173,452
2021-05-12	122,607	158,987	152,569	13,443	-0,780	-0,643	122,607	169,273
2021-05-13	79,486	118,731	124,827	17,156	-0,525	0,048	79,486	152,588
2021-05-14	115,282	139,378	142,843	17,263	-0,068	-1,505	115,282	165,755
2021-05-15	109,305	138,299	136,838	11,139	-0,627	0,394	109,305	154,746
2021-05-16	102,418	122,176	126,253	13,198	0,452	-0,645	102,418	150,267
2021-05-17	120,219	158,034	149,939	16,900	-0,552	-1,233	120,219	171,366
2021-05-18	126,038	152,739	150,202	10,093	-0,757	-0,198	126,038	164,255
2021-05-19	115,643	159,043	149,586	18,656	-0,579	-1,238	115,643	170,929
2021-05-20	124,337	154,333	151,504	11,991	-0,760	-0,269	124,337	167,420
2021-05-21	121,857	153,147	149,300	11,784	-0,939	0,091	121,857	165,488
2021-05-22	102,915	130,611	126,636	14,395	-0,018	-1,477	102,915	148,490
2021-05-23	92,426	108,669	113,413	17,265	0,980	-0,353	92,426	147,437
2021-05-24	103,716	122,723	125,797	14,140	0,543	-0,642	103,716	153,953
2021-05-25	119,890	164,787	154,964	19,380	-0,638	-1,151	119,890	180,476
2021-05-26	126,995	167,948	160,959	16,160	-0,701	-0,567	126,995	181,940
2021-05-27	127,060	162,401	156,911	13,775	-0,828	-0,495	127,060	172,286
2021-05-28	128,685	159,451	156,186	12,235	-0,839	-0,349	128,685	171,788
2021-05-29	119,616	137,781	139,093	10,614	-0,043	-0,739	119,616	155,832
2021-05-30	99,140	120,456	125,772	17,601	0,253	-1,267	99,140	155,110
2021-05-31	119,692	148,918	145,655	14,919	-0,146	-1,028	119,692	172,771

Table 11: Statistical analysis of May consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-05-01	92,715	106,919	115,269	17,561	0,393	-1,426	92,715	147,340
2021-05-02	103,777	116,076	117,613	11,076	0,705	-0,394	103,777	143,288
2021-05-03	100,427	121,154	121,212	10,269	0,008	-0,579	100,427	141,404
2021-05-04	102,826	145,271	135,032	20,738	-0,509	-1,454	102,826	159,194
2021-05-05	119,209	154,129	147,372	15,092	-0,595	-1,215	119,209	165,797
2021-05-06	117,958	154,085	147,533	13,898	-0,737	-0,866	117,958	163,469
2021-05-07	117,674	146,827	144,394	12,969	-0,449	-0,918	117,674	163,152
2021-05-08	105,618	123,191	124,165	9,165	0,126	-0,276	105,618	140,662
2021-05-09	99,200	111,386	114,684	10,666	0,914	-0,320	99,200	136,333
2021-05-10	107,854	149,723	140,999	19,662	-0,556	-1,394	107,854	163,739
2021-05-11	122,211	155,736	150,044	12,911	-0,739	-0,654	122,211	168,452
2021-05-12	118,707	153,947	147,923	13,141	-0,796	-0,623	118,707	164,173
2021-05-13	75,486	114,181	120,852	17,370	-0,494	-0,081	75,486	147,588
2021-05-14	111,382	133,978	137,864	17,168	-0,032	-1,556	111,382	160,355
2021-05-15	108,005	133,667	132,676	10,165	-0,455	0,213	108,005	149,646
2021-05-16	99,018	117,956	121,983	12,691	0,450	-0,660	99,018	145,067
2021-05-17	115,619	152,684	144,977	16,587	-0,539	-1,218	115,619	166,666

2021-05-18	122,438	147,532	145,369	9,629	-0,713	-0,223	122,438	159,355
2021-05-19	110,943	154,045	144,461	18,522	-0,593	-1,231	110,943	165,529
2021-05-20	120,337	149,033	146,583	11,746	-0,719	-0,352	120,337	162,420
2021-05-21	117,957	148,547	144,500	11,374	-0,957	0,071	117,957	159,788
2021-05-22	98,415	126,011	122,111	13,941	-0,024	-1,449	98,415	143,390
2021-05-23	89,626	104,307	109,354	16,663	0,948	-0,433	89,626	141,437
2021-05-24	100,116	117,923	121,431	14,047	0,557	-0,742	100,116	148,353
2021-05-25	115,690	159,386	150,077	19,196	-0,628	-1,174	115,690	175,376
2021-05-26	122,895	162,398	156,255	15,988	-0,691	-0,599	122,895	176,540
2021-05-27	123,960	157,851	152,348	13,198	-0,819	-0,537	123,960	167,386
2021-05-28	124,585	155,151	151,457	12,026	-0,827	-0,408	124,585	166,788
2021-05-29	115,816	133,281	134,502	10,244	-0,060	-0,795	115,816	150,232
2021-05-30	97,840	116,406	121,760	16,340	0,281	-1,270	97,840	149,210
2021-05-31	115,692	146,494	141,934	15,137	-0,243	-1,108	115,692	168,071

Table 12: Statistical analysis of June production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-06-01	119,762	153,990	148,389	15,379	-0,407	-1,026	119,762	172,714
2021-06-02	108,252	155,012	149,536	17,929	-0,686	-0,579	108,252	170,623
2021-06-03	125,626	157,463	154,583	13,224	-0,708	-0,567	125,626	171,699
2021-06-04	113,996	146,795	143,227	11,451	-0,920	0,182	113,996	157,493
2021-06-05	102,467	124,283	125,245	12,709	0,170	-0,482	102,467	148,403
2021-06-06	104,374	119,546	124,170	13,846	0,733	-0,780	104,374	151,669
2021-06-07	115,563	159,808	149,018	17,368	-0,632	-1,200	115,563	168,630
2021-06-08	120,122	146,469	148,616	15,615	0,000	-0,965	120,122	174,045
2021-06-09	115,258	150,513	143,529	17,209	-0,451	-1,394	115,258	163,099
2021-06-10	118,783	148,381	143,574	13,507	-0,430	-1,063	118,783	162,030
2021-06-11	116,736	138,608	139,656	12,812	0,149	-1,116	116,736	160,144
2021-06-12	98,325	126,809	124,981	14,199	0,040	-0,703	98,325	150,800
2021-06-13	81,177	121,042	121,270	17,641	-0,145	0,180	81,177	156,099
2021-06-14	115,217	151,968	143,922	15,768	-0,693	-1,174	115,217	159,910
2021-06-15	125,320	154,824	148,871	11,665	-0,726	-0,801	125,320	162,474
2021-06-16	123,664	142,864	141,087	7,956	-0,462	-0,271	123,664	153,830
2021-06-17	113,341	150,548	143,147	16,491	-0,522	-1,299	113,341	164,671
2021-06-18	120,413	148,774	145,486	9,494	-0,782	0,154	120,413	158,454
2021-06-19	112,331	127,830	130,887	10,850	0,595	-0,624	112,331	150,825
2021-06-20	101,636	110,661	115,664	11,477	0,409	-1,414	101,636	134,162
2021-06-21	88,881	106,425	108,334	14,099	0,845	-0,184	88,881	137,795
2021-06-22	98,253	141,046	130,757	19,756	-0,617	-1,329	98,253	150,312
2021-06-23	109,581	140,330	135,148	13,464	-0,446	-1,133	109,581	153,885
2021-06-24	110,396	141,061	136,043	13,685	-0,364	-1,086	110,396	155,380
2021-06-25	111,519	137,334	133,850	13,277	-0,239	-1,228	111,519	154,046
2021-06-26	69,125	119,067	117,041	18,026	-0,935	0,694	69,125	143,750
2021-06-27	85,533	104,024	106,567	16,273	0,818	-0,376	85,533	139,250
2021-06-28	83,640	137,509	127,871	22,072	-0,440	-1,212	83,640	155,266
2021-06-29	114,152	141,557	137,889	12,001	-0,507	-0,890	114,152	155,108
2021-06-30	112,222	139,752	138,427	12,017	-0,467	-0,766	112,222	153,976

Table 13: Statistical analysis of June consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-06-01	118,462	149,427	145,047	14,062	-0,392	-0,987	118,462	167,714
2021-06-02	104,552	150,248	144,770	17,575	-0,671	-0,621	104,552	165,323
2021-06-03	121,826	153,162	150,275	12,770	-0,757	-0,444	121,826	166,799
2021-06-04	109,496	141,424	138,614	11,164	-0,948	0,284	109,496	152,193
2021-06-05	99,379	119,883	120,945	12,277	0,219	-0,576	99,379	142,803
2021-06-06	100,674	115,662	120,220	12,986	0,711	-0,737	100,674	146,169
2021-06-07	111,763	154,808	144,443	16,916	-0,636	-1,183	111,763	163,630
2021-06-08	116,522	141,769	144,075	15,449	0,047	-0,982	116,522	169,345
2021-06-09	111,658	145,463	138,837	16,878	-0,448	-1,408	111,658	157,999
2021-06-10	114,983	143,194	138,732	13,151	-0,444	-1,097	114,983	156,461

2021-06-11	115,436	134,517	135,518	12,616	0,275	-1,205	115,436	155,844
2021-06-12	94,925	122,459	120,698	13,669	0,011	-0,708	94,925	145,500
2021-06-13	77,677	116,992	117,128	16,956	-0,204	0,271	77,677	150,399
2021-06-14	111,517	147,095	139,226	15,490	-0,680	-1,214	111,517	155,010
2021-06-15	121,520	150,324	144,804	12,077	-0,591	-0,943	121,520	160,592
2021-06-16	121,732	138,064	137,220	6,937	-0,501	0,007	121,732	148,530
2021-06-17	109,841	146,991	138,759	16,099	-0,540	-1,311	109,841	159,371
2021-06-18	116,913	143,392	140,849	9,246	-0,692	0,036	116,913	153,854
2021-06-19	108,731	124,740	127,028	9,999	0,469	-0,567	108,731	145,125
2021-06-20	97,573	106,411	111,427	10,916	0,415	-1,379	97,573	129,362
2021-06-21	85,581	102,993	105,197	15,031	0,896	-0,221	85,581	136,495
2021-06-22	96,953	136,596	127,349	18,182	-0,633	-1,279	96,953	145,512
2021-06-23	106,181	135,880	131,177	13,247	-0,434	-1,116	106,181	149,062
2021-06-24	106,896	136,111	131,589	13,201	-0,382	-1,099	106,896	149,980
2021-06-25	108,519	133,245	129,800	12,829	-0,258	-1,229	108,519	149,146
2021-06-26	65,225	115,317	113,174	17,937	-0,926	0,698	65,225	139,250
2021-06-27	82,433	100,124	102,617	15,608	0,802	-0,389	82,433	133,850
2021-06-28	79,740	132,853	123,401	21,570	-0,464	-1,191	79,740	149,666
2021-06-29	111,352	137,334	133,873	11,994	-0,466	-0,988	111,352	150,608
2021-06-30	108,622	135,552	133,940	11,503	-0,488	-0,740	108,622	148,476

Table 14: Statistical analysis of July production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-07-01	108,637	147,355	140,930	16,756	-0,492	-1,211	108,637	160,794
2021-07-02	118,886	147,748	144,659	12,275	-0,462	-0,927	118,886	161,609
2021-07-03	94,626	125,029	125,406	10,300	-0,937	1,635	94,626	141,557
2021-07-04	84,527	97,920	103,316	14,319	1,019	-0,122	84,527	133,377
2021-07-05	98,634	145,820	133,470	22,726	-0,504	-1,540	98,634	159,553
2021-07-06	115,047	147,102	143,035	15,750	-0,383	-1,258	115,047	166,430
2021-07-07	112,384	144,411	141,437	15,755	-0,317	-1,135	112,384	163,507
2021-07-08	106,877	147,779	140,063	18,088	-0,656	-0,982	106,877	163,010
2021-07-09	109,173	137,805	134,990	11,427	-0,542	-0,442	109,173	153,031
2021-07-10	96,907	117,969	120,412	12,157	0,324	-0,449	96,907	143,473
2021-07-11	93,600	104,991	109,423	14,402	0,798	-0,692	93,600	137,813
2021-07-12	99,088	137,174	130,216	18,501	-0,395	-1,397	99,088	155,013
2021-07-13	107,750	140,225	134,292	13,732	-0,572	-1,019	107,750	151,730
2021-07-14	108,679	141,428	136,675	14,172	-0,529	-0,953	108,679	155,176
2021-07-15	108,229	141,482	137,223	13,032	-0,668	-0,816	108,229	151,611
2021-07-16	112,375	136,998	132,872	10,321	-0,441	-1,034	112,375	148,199
2021-07-17	98,203	115,978	117,328	11,797	0,772	-0,208	98,203	142,141
2021-07-18	83,510	104,926	107,709	13,302	0,465	-0,700	83,510	132,294
2021-07-19	99,901	132,456	125,539	15,612	-0,555	-1,398	99,901	142,873
2021-07-20	94,637	110,509	112,853	11,483	0,406	-0,713	94,637	134,931
2021-07-21	97,511	137,125	130,121	18,120	-0,379	-1,386	97,511	152,799
2021-07-22	102,953	144,812	138,774	16,559	-0,529	-0,970	102,953	160,571
2021-07-23	111,355	135,150	134,095	11,471	-0,371	-0,452	111,355	153,352
2021-07-24	105,457	121,355	123,516	10,204	0,691	-0,172	105,457	143,254
2021-07-25	97,569	109,036	111,956	11,755	0,755	-0,592	97,569	135,622
2021-07-26	98,806	140,424	133,081	18,971	-0,503	-1,302	98,806	155,854
2021-07-27	108,455	136,570	131,640	12,191	-0,408	-1,137	108,455	148,110
2021-07-28	104,408	134,792	132,768	14,510	-0,390	-1,140	104,408	151,577
2021-07-29	102,451	131,334	127,995	14,753	-0,020	-1,055	102,451	153,641
2021-07-30	114,415	140,133	136,675	14,205	-0,320	-1,448	114,415	155,312
2021-07-31	101,414	118,880	121,253	9,679	0,214	-0,158	101,414	140,035

Table 15: Statistical analysis of July consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-07-01	105,037	142,955	136,705	16,801	-0,460	-1,255	105,037	156,713
2021-07-02	115,486	143,398	140,271	11,844	-0,462	-0,938	115,486	157,109
2021-07-03	91,326	121,029	121,136	9,780	-1,042	1,881	91,326	136,257

2021-07-04	81,127	93,670	99,241	13,763	1,014	-0,120	81,127	128,777
2021-07-05	95,234	141,520	129,057	22,331	-0,504	-1,543	95,234	154,853
2021-07-06	111,647	142,313	138,852	15,570	-0,373	-1,318	111,647	160,630
2021-07-07	108,784	139,761	136,933	15,359	-0,323	-1,145	108,784	157,751
2021-07-08	102,577	143,129	135,901	18,132	-0,662	-0,984	102,577	158,410
2021-07-09	105,673	133,312	130,711	11,005	-0,580	-0,436	105,673	147,731
2021-07-10	93,607	113,569	116,216	11,637	0,281	-0,506	93,607	138,073
2021-07-11	90,100	100,941	105,252	13,703	0,790	-0,705	90,100	132,213
2021-07-12	95,588	132,824	125,695	18,001	-0,408	-1,409	95,588	149,313
2021-07-13	104,350	136,075	130,201	13,226	-0,577	-1,046	104,350	146,630
2021-07-14	105,379	139,129	133,304	14,141	-0,632	-1,025	105,379	149,376
2021-07-15	104,729	138,282	133,731	13,450	-0,606	-0,901	104,729	149,700
2021-07-16	109,075	132,448	129,047	10,154	-0,340	-1,148	109,075	143,785
2021-07-17	95,403	112,178	113,499	11,116	0,753	-0,207	95,403	136,841
2021-07-18	79,810	101,026	103,618	12,740	0,427	-0,691	79,810	126,994
2021-07-19	96,501	127,856	121,027	15,253	-0,544	-1,390	96,501	138,473
2021-07-20	91,137	106,609	108,687	10,916	0,374	-0,708	91,137	129,631
2021-07-21	94,111	132,475	125,871	17,758	-0,392	-1,383	94,111	148,499
2021-07-22	99,553	140,362	134,320	16,312	-0,523	-1,019	99,553	156,371
2021-07-23	108,055	130,900	129,816	10,977	-0,410	-0,481	108,055	147,952
2021-07-24	102,057	117,355	119,407	9,655	0,636	-0,211	102,057	137,954
2021-07-25	93,899	105,136	107,781	11,114	0,735	-0,610	93,899	130,022
2021-07-26	95,406	136,124	128,581	18,577	-0,499	-1,329	95,406	150,354
2021-07-27	107,155	132,520	127,878	11,458	-0,348	-1,295	107,155	142,810
2021-07-28	101,208	130,742	128,652	14,109	-0,399	-1,157	101,208	146,477
2021-07-29	98,651	127,184	124,062	14,461	-0,073	-1,109	98,651	148,841
2021-07-30	110,615	135,883	132,475	13,835	-0,319	-1,443	110,615	150,912
2021-07-31	98,314	115,230	117,491	9,491	0,237	-0,257	98,314	135,135

Table 16: Statistical analysis of August production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-08-01	102,203	127,530	133,980	21,728	0,431	-1,099	102,203	171,586
2021-08-02	121,171	148,387	151,792	18,808	0,257	-0,945	121,171	185,135
2021-08-03	125,989	151,056	154,734	16,874	0,409	-0,972	125,989	185,211
2021-08-04	135,645	153,031	158,352	15,341	0,548	-0,831	135,645	188,362
2021-08-05	121,151	164,528	160,716	18,817	-0,184	-0,852	121,151	189,850
2021-08-06	124,011	155,100	156,783	16,705	0,391	-0,278	124,011	189,904
2021-08-07	114,830	138,090	141,927	20,515	0,794	-0,547	114,830	182,982
2021-08-08	99,980	131,962	133,751	20,968	-0,008	-1,016	99,980	167,856
2021-08-09	119,148	141,882	145,665	22,504	0,716	-0,669	119,148	189,192
2021-08-10	117,079	148,444	148,255	16,042	0,299	0,298	117,079	187,946
2021-08-11	89,857	148,763	148,707	26,328	-0,458	0,077	89,857	191,371
2021-08-12	137,698	154,420	156,827	14,104	0,586	-0,512	137,698	187,324
2021-08-13	131,989	155,905	156,218	14,808	0,352	-0,747	131,989	182,998
2021-08-14	118,992	140,482	142,926	16,140	0,586	-0,456	118,992	174,028
2021-08-15	96,028	129,914	130,344	20,850	-0,017	-0,884	96,028	164,010
2021-08-16	121,423	156,170	154,061	22,052	-0,002	-1,406	121,423	189,653
2021-08-17	134,550	157,038	160,091	16,634	0,348	-0,975	134,550	190,392
2021-08-18	134,973	160,247	159,392	14,525	0,195	-0,953	134,973	186,930
2021-08-19	136,706	154,102	157,889	16,424	1,015	0,138	136,706	196,123
2021-08-20	126,470	147,509	152,308	19,695	0,701	-0,476	126,470	192,733
2021-08-21	120,780	145,340	147,319	15,055	0,638	-0,205	120,780	177,544
2021-08-22	82,339	126,139	127,119	23,419	0,098	-0,777	82,339	168,198
2021-08-23	125,663	149,415	153,892	23,526	0,427	-1,201	125,663	195,398
2021-08-24	134,428	152,934	160,530	18,762	0,500	-1,066	134,428	194,442
2021-08-25	138,497	163,307	166,385	15,338	0,283	-0,740	138,497	193,845
2021-08-26	139,735	157,760	165,610	19,171	0,492	-1,261	139,735	200,943
2021-08-27	135,079	156,052	162,242	18,410	0,463	-1,127	135,079	195,256
2021-08-28	120,330	155,459	154,497	18,871	0,066	-0,621	120,330	187,611
2021-08-29	107,094	141,162	140,029	24,605	0,181	-1,244	107,094	179,802

2021-08-30	131,467	163,907	162,161	21,867	0,032	-1,371	131,467	197,433
2021-08-31	141,437	161,135	165,442	17,854	0,415	-1,139	141,437	199,397

Table 17 : Analyse statistique de la consommation d'août

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-08-01	86,923	107,874	110,164	12,213	0,532	-0,430	86,923	132,626
2021-08-02	92,411	129,734	123,297	14,916	-0,661	-0,927	92,411	139,915
2021-08-03	100,322	130,568	124,792	15,570	-0,319	-1,588	100,322	142,141
2021-08-04	104,455	133,284	128,968	12,158	-0,470	-1,016	104,455	144,962
2021-08-05	94,211	133,630	129,127	16,156	-0,540	-0,943	94,211	148,484
2021-08-06	102,701	136,870	130,581	14,770	-0,550	-1,195	102,701	147,792
2021-08-07	98,260	108,339	112,800	11,863	1,140	-0,073	98,260	138,332
2021-08-08	96,669	104,947	108,453	10,670	0,784	-0,722	96,669	129,168
2021-08-09	91,828	127,750	120,477	18,696	-0,246	-1,377	91,828	146,164
2021-08-10	102,967	127,095	126,357	12,151	-0,116	-1,240	102,967	143,200
2021-08-11	104,715	129,077	127,869	13,289	-0,112	-1,303	104,715	147,661
2021-08-12	108,080	132,325	129,375	10,725	-0,396	-0,860	108,080	147,134
2021-08-13	103,679	128,951	127,064	12,073	-0,485	-1,084	103,679	141,824
2021-08-14	99,171	115,181	116,320	9,294	0,377	-0,329	99,171	133,897
2021-08-15	95,624	102,296	106,672	9,974	1,001	-0,387	95,624	127,710
2021-08-16	92,823	132,060	125,118	18,330	-0,463	-1,412	92,823	148,483
2021-08-17	107,646	133,728	130,576	13,689	-0,242	-1,250	107,646	152,943
2021-08-18	106,073	136,606	131,289	13,317	-0,478	-1,226	106,073	149,780
2021-08-19	110,236	133,803	132,416	13,480	-0,223	-1,292	110,236	151,563
2021-08-20	95,910	133,579	127,647	14,888	-0,711	-0,707	95,910	146,373
2021-08-21	94,590	113,645	115,029	10,861	0,412	-0,359	94,590	136,294
2021-08-22	92,634	104,154	106,567	10,736	0,969	-0,120	92,634	129,908
2021-08-23	96,593	135,440	127,711	18,643	-0,416	-1,415	96,593	149,890
2021-08-24	102,938	136,170	132,214	14,651	-0,454	-1,157	102,938	149,988
2021-08-25	108,467	141,576	137,304	12,761	-0,591	-0,792	108,467	152,013
2021-08-26	109,215	146,367	138,105	16,610	-0,524	-1,396	109,215	156,215
2021-08-27	106,109	138,689	134,009	14,923	-0,542	-1,210	106,109	150,975
2021-08-28	104,163	123,927	125,516	9,380	-0,039	-0,014	104,163	143,118
2021-08-29	105,700	113,201	117,366	11,238	0,890	-0,574	105,700	139,259
2021-08-30	104,023	139,650	132,233	17,460	-0,507	-1,277	104,023	152,423
2021-08-31	112,017	141,966	138,438	14,752	-0,365	-1,358	112,017	156,719

Table 18: Statistical analysis of September production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-09-01	112,382	144,281	139,149	16,386	-0,346	-1,266	112,382	162,560
2021-09-02	103,805	140,048	133,603	14,572	-0,684	-0,894	103,805	151,772
2021-09-03	107,608	134,652	132,785	12,285	-0,368	-0,757	107,608	150,720
2021-09-04	100,656	117,398	118,148	8,369	0,080	-0,549	100,656	132,896
2021-09-05	94,728	104,505	107,915	13,587	1,343	0,457	94,728	139,305
2021-09-06	102,700	140,998	133,460	21,076	-0,412	-1,423	102,700	160,289
2021-09-07	113,767	148,239	140,472	15,159	-0,384	-1,385	113,767	160,226
2021-09-08	113,497	147,105	142,003	17,617	-0,291	-1,372	113,497	166,505
2021-09-09	114,489	150,594	144,358	16,222	-0,447	-1,243	114,489	164,188
2021-09-10	113,822	139,594	137,996	11,913	-0,399	-1,048	113,822	154,423
2021-09-11	93,331	113,127	115,806	12,169	0,713	0,195	93,331	140,863
2021-09-12	90,762	103,917	107,400	14,745	0,973	-0,401	90,762	135,823
2021-09-13	105,734	132,908	130,525	14,783	-0,160	-1,247	105,734	152,864
2021-09-14	104,731	132,760	130,607	13,555	0,047	-0,832	104,731	154,952
2021-09-15	100,101	137,965	132,174	18,371	-0,390	-1,331	100,101	154,556
2021-09-16	111,077	137,065	133,816	13,261	-0,293	-1,177	111,077	153,355
2021-09-17	113,302	143,821	138,913	15,083	-0,348	-1,281	113,302	160,124
2021-09-18	99,962	126,908	124,391	12,843	-0,043	-0,566	99,962	146,236
2021-09-19	99,860	114,398	118,754	13,982	0,859	-0,387	99,860	147,589
2021-09-20	108,280	145,058	138,257	17,019	-0,408	-1,384	108,280	157,775
2021-09-21	110,416	150,263	143,404	17,044	-0,558	-1,194	110,416	162,986

2021-09-22	113,725	138,695	138,540	12,510	-0,267	-0,787	113,725	159,789
2021-09-23	107,353	152,866	142,125	19,807	-0,545	-1,381	107,353	162,076
2021-09-24	116,570	146,039	142,711	13,220	-0,541	-1,049	116,570	159,476
2021-09-25	110,546	126,988	125,649	8,926	0,254	0,009	110,546	148,235
2021-09-26	94,437	108,211	112,157	13,340	1,048	0,214	94,437	141,800
2021-09-27	100,371	132,792	127,449	16,394	-0,190	-1,299	100,371	151,852
2021-09-28	101,195	144,805	139,272	18,069	-0,464	-1,037	101,195	162,928
2021-09-29	117,372	147,356	142,280	15,957	-0,329	-1,321	117,372	165,385

Table 19: Statistical analysis of September consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-09-01	109,182	139,981	134,732	15,801	-0,364	-1,283	109,182	157,060
2021-09-02	102,505	135,834	129,990	13,585	-0,707	-0,861	102,505	146,772
2021-09-03	104,408	130,452	128,630	11,726	-0,396	-0,749	104,408	145,420
2021-09-04	97,556	113,317	113,964	7,946	0,057	-0,602	97,556	127,796
2021-09-05	91,528	100,705	104,035	12,978	1,367	0,499	91,528	134,105
2021-09-06	99,100	136,898	129,256	20,516	-0,423	-1,429	99,100	155,089
2021-09-07	110,467	143,789	136,443	15,031	-0,349	-1,405	110,467	156,557
2021-09-08	110,297	142,955	137,787	17,231	-0,287	-1,398	110,297	161,405
2021-09-09	111,289	146,696	140,170	15,719	-0,459	-1,238	111,289	159,788
2021-09-10	110,522	135,594	133,816	11,675	-0,375	-1,073	110,522	149,823
2021-09-11	90,131	109,077	111,685	11,610	0,691	0,169	90,131	135,563
2021-09-12	87,743	100,082	103,617	14,000	0,992	-0,367	87,743	130,723
2021-09-13	102,534	128,643	126,212	14,112	-0,151	-1,221	102,534	147,764
2021-09-14	103,431	129,785	126,907	13,038	0,035	-0,966	103,431	149,952
2021-09-15	96,601	134,215	128,082	17,857	-0,404	-1,324	96,601	149,560
2021-09-16	107,877	132,696	129,532	12,796	-0,315	-1,199	107,877	148,055
2021-09-17	110,102	139,521	135,038	14,229	-0,343	-1,311	110,102	154,824
2021-09-18	96,762	122,758	120,270	12,083	-0,033	-0,576	96,762	140,936
2021-09-19	96,660	110,348	114,558	13,317	0,865	-0,394	96,660	141,989
2021-09-20	104,830	140,543	133,641	16,505	-0,407	-1,395	104,830	152,175
2021-09-21	107,216	145,810	139,166	16,391	-0,569	-1,184	107,216	157,406
2021-09-22	110,395	134,345	134,350	12,149	-0,289	-0,843	110,395	154,489
2021-09-23	104,153	148,166	137,762	19,243	-0,545	-1,385	104,153	157,376
2021-09-24	113,170	141,489	138,344	13,023	-0,510	-1,090	113,170	154,976
2021-09-25	106,761	122,710	121,273	8,796	0,154	-0,163	106,761	142,735
2021-09-26	91,037	103,901	107,736	12,770	1,074	0,246	91,037	136,300
2021-09-27	96,871	127,942	122,916	15,909	-0,214	-1,333	96,871	146,152
2021-09-28	96,295	139,860	134,573	17,811	-0,492	-1,003	96,295	157,948
2021-09-29	113,172	142,715	137,568	15,572	-0,349	-1,328	113,172	159,685
2021-09-30	113,346	140,184	137,178	13,112	-0,454	-1,159	113,346	153,301

Table 20 : Analyse statistique de la production D'Octobre

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-10-01	116,027	136,516	137,904	11,306	0,092	-0,683	116,027	160,161
2021-10-02	105,986	121,100	126,216	13,574	0,668	-0,880	105,986	149,935
2021-10-03	99,273	121,333	122,553	13,515	0,382	-0,288	99,273	149,167
2021-10-04	115,558	150,251	143,243	17,295	-0,427	-1,399	115,558	164,022
2021-10-05	118,892	152,471	148,714	14,537	-0,572	-0,766	118,892	166,854
2021-10-06	97,831	138,346	137,490	13,978	-0,714	0,817	97,831	158,228
2021-10-07	109,863	143,119	137,030	18,631	-0,359	-1,504	109,863	159,766
2021-10-08	123,437	145,822	141,795	11,408	-0,380	-1,236	123,437	157,609
2021-10-09	110,038	131,628	133,364	11,910	0,061	-0,712	110,038	153,776
2021-10-10	104,795	119,272	121,683	11,721	0,333	-1,123	104,795	142,644
2021-10-11	105,052	145,952	137,292	20,070	-0,432	-1,486	105,052	161,067
2021-10-12	109,729	143,238	138,853	17,007	-0,474	-1,208	109,729	161,570
2021-10-13	119,463	145,353	142,286	12,985	-0,190	-1,129	119,463	163,308
2021-10-14	116,101	146,410	143,274	13,752	-0,388	-1,070	116,101	163,021
2021-10-15	108,550	156,103	149,594	15,497	-1,085	0,158	108,550	163,686
2021-10-16	117,846	139,144	139,104	12,268	-0,235	-0,895	117,846	157,703

2021-10-17	107,106	124,732	128,906	14,934	0,457	-1,094	107,106	154,220
2021-10-18	120,905	141,299	139,948	11,529	-0,068	-1,359	120,905	157,116
2021-10-19	111,511	146,097	140,169	18,340	-0,322	-1,470	111,511	163,077
2021-10-20	124,237	154,209	147,591	14,057	-0,551	-1,228	124,237	166,224
2021-10-21	122,046	145,366	141,988	9,995	-0,601	-1,033	122,046	152,583
2021-10-22	115,967	148,730	141,818	16,625	-0,276	-1,563	115,967	166,072
2021-10-23	110,553	125,725	126,528	9,677	0,325	-0,530	110,553	144,910
2021-10-24	97,820	116,474	118,160	11,183	0,259	-0,667	97,820	138,417
2021-10-25	106,811	148,514	139,368	21,381	-0,366	-1,429	106,811	169,034
2021-10-26	118,185	140,236	139,311	11,152	0,038	-0,714	118,185	159,996
2021-10-27	112,259	145,495	139,162	17,188	-0,251	-1,453	112,259	162,087
2021-10-28	118,187	155,343	148,916	15,030	-0,564	-0,958	118,187	169,889
2021-10-29	123,551	155,953	150,837	14,689	-0,416	-1,034	123,551	170,073
2021-10-30	117,875	137,072	137,177	12,290	0,128	-0,975	117,875	158,633
2021-10-31	99,488	122,425	125,997	14,929	0,152	-1,034	99,488	149,945

Table 21: Statistical analysis of October consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-10-01	112,727	131,916	133,487	10,866	0,110	-0,684	112,727	155,361
2021-10-02	102,546	117,050	121,902	12,933	0,638	-0,914	102,546	144,425
2021-10-03	95,573	116,957	118,119	12,918	0,365	-0,298	95,573	143,487
2021-10-04	111,248	145,449	138,704	16,994	-0,462	-1,403	111,248	158,322
2021-10-05	115,192	148,066	144,451	14,315	-0,544	-0,787	115,192	163,654
2021-10-06	92,731	133,246	132,819	13,984	-0,708	0,950	92,731	153,928
2021-10-07	105,663	138,664	132,996	18,466	-0,367	-1,507	105,663	154,966
2021-10-08	119,637	142,123	137,485	11,067	-0,490	-1,276	119,637	151,509
2021-10-09	106,238	127,078	128,652	11,293	0,059	-0,683	106,238	148,076
2021-10-10	101,295	114,772	117,229	11,090	0,328	-1,124	101,295	137,044
2021-10-11	101,252	141,402	132,454	19,612	-0,444	-1,494	101,252	155,367
2021-10-12	105,129	138,088	134,036	16,598	-0,513	-1,193	105,129	156,270
2021-10-13	115,863	140,703	137,424	12,545	-0,168	-1,149	115,863	157,908
2021-10-14	148,860	141,806	138,453	13,437	-0,391	-1,151	112,501	157,221
2021-10-15	104,450	151,103	144,844	15,159	-1,086	0,182	104,450	158,586
2021-10-16	113,446	134,694	134,546	11,820	-0,296	-0,891	113,446	152,203
2021-10-17	103,606	120,250	124,326	14,303	0,460	-1,105	103,606	148,520
2021-10-18	117,205	136,449	135,631	11,268	-0,062	-1,381	117,205	152,516
2021-10-19	107,811	141,547	135,774	17,716	-0,349	-1,468	107,811	157,424
2021-10-20	120,661	149,528	143,016	13,640	-0,548	-1,250	120,661	160,824
2021-10-21	118,346	140,816	137,351	9,661	-0,571	-1,092	118,346	148,083
2021-10-22	112,367	144,230	137,176	16,330	-0,276	-1,580	112,367	160,972
2021-10-23	106,853	121,475	122,178	9,202	0,299	-0,559	106,853	139,610
2021-10-24	94,320	112,195	113,898	10,645	0,219	-0,689	94,320	132,917
2021-10-25	103,211	144,014	134,689	20,859	-0,367	-1,434	103,211	163,834
2021-10-26	114,585	135,486	134,648	10,813	0,038	-0,802	114,585	154,296
2021-10-27	108,159	141,095	134,370	16,745	-0,275	-1,461	108,159	156,587
2021-10-28	114,287	150,493	144,233	14,602	-0,579	-0,966	114,287	164,389
2021-10-29	119,751	150,903	146,053	14,135	-0,432	-1,041	119,751	164,373
2021-10-30	113,175	132,496	132,577	11,854	0,101	-0,976	113,175	153,033

Table 22: Statistical analysis of November production

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-11-01	102,363	118,231	124,192	14,019	0,431	-1,027	102,363	149,627
2021-11-02	100,101	136,532	133,504	16,038	-0,541	-0,679	100,101	155,121
2021-11-03	102,816	150,543	144,118	21,370	-0,530	-1,135	102,816	174,742
2021-11-04	124,399	155,498	149,712	14,672	-0,554	-1,159	124,399	168,381
2021-11-05	119,617	136,288	137,127	9,707	0,126	-0,900	119,617	155,144
2021-01-06	104,537	126,562	126,437	13,483	0,314	-0,823	104,537	150,620
2021-11-07	101,508	113,550	117,361	13,436	0,588	-1,206	101,508	139,693
2021-11-08	112,141	151,052	141,535	20,206	-0,258	-1,429	112,141	173,571
2021-11-09	116,131	157,638	151,291	16,588	-0,631	-0,842	116,131	173,467

2021-11-10	124,076	156,917	153,675	14,029	-0,635	-0,735	124,076	171,612
2021-11-11	124,210	151,733	153,064	15,471	-0,301	-1,153	124,210	173,506
2021-11-12	119,100	151,802	145,653	14,878	-0,381	-1,296	119,100	166,777
2021-11-13	115,587	138,326	138,309	11,407	-0,480	-0,580	115,587	154,960
2021-11-14	102,053	129,866	130,642	12,599	-0,237	-0,241	102,053	152,617
2021-11-15	123,155	155,494	150,954	16,368	-0,291	-1,364	123,155	171,701
2021-11-16	123,443	153,336	150,934	13,300	-0,567	-0,722	123,443	169,458
2021-11-17	129,535	155,566	150,520	11,944	-0,614	-1,093	129,535	164,322
2021-11-18	130,072	163,780	156,732	15,573	-0,465	-1,208	130,072	180,276
2021-11-19	125,549	164,696	157,714	16,991	-0,674	-0,922	125,549	179,427
2021-11-20	118,420	146,058	144,929	11,279	-0,428	-0,297	118,420	163,056
2021-11-21	115,393	128,380	130,676	12,630	0,778	-0,399	115,393	157,765
2021-11-22	123,242	163,183	153,548	17,433	-0,662	-1,098	123,242	175,794
2021-11-23	125,704	167,865	159,879	16,796	-0,755	-0,778	125,704	181,215
2021-11-24	127,490	166,436	160,161	16,838	-0,606	-0,817	127,490	183,372
2021-11-25	131,260	159,287	155,486	11,669	-0,492	-0,925	131,260	172,899
2021-11-26	95,826	139,030	141,875	23,802	-0,171	-0,845	95,826	177,650
2021-11-27	112,375	136,428	138,644	12,453	-0,247	-0,421	112,375	157,865
2021-11-28	101,328	126,583	126,324	15,666	0,201	-1,203	101,328	152,890
2021-11-29	29,900	140,999	133,764	29,036	-2,429	5,694	29,900	157,891
2021-11-30	112,476	145,898	144,829	14,546	-0,286	-0,556	112,476	168,042

Table 23: Statistical analysis of November consumption

	Statistical parameters							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-11-01	98,563	114,959	120,734	14,762	0,508	-0,966	98,563	147,927
2021-11-02	98,801	135,232	132,104	15,943	-0,553	-0,674	98,801	153,421
2021-11-03	101,516	148,675	140,401	20,148	-0,579	-1,087	101,516	168,942
2021-11-04	120,000	150,798	144,641	14,462	-0,539	-1,173	120,000	163,180
2021-11-05	115,520	132,956	132,748	9,866	0,084	-1,032	115,520	150,144
2021-11-06	100,737	122,112	121,900	13,162	0,304	-0,852	100,737	145,320
2021-11-07	97,508	109,250	113,053	12,962	0,594	-1,197	97,508	134,493
2021-11-08	108,141	146,527	137,460	20,231	-0,311	-1,461	108,141	167,971
2021-11-09	114,831	153,718	147,845	15,056	-0,668	-0,697	114,831	168,267
2021-11-10	122,776	151,767	148,884	13,472	-0,552	-0,902	122,776	166,266
2021-11-11	120,210	146,733	148,347	15,271	-0,281	-1,219	120,210	168,206
2021-11-12	115,400	146,902	140,853	14,453	-0,376	-1,303	115,400	161,477
2021-11-13	111,987	134,076	133,797	10,944	-0,522	-0,591	111,987	149,268
2021-11-14	97,853	125,216	126,046	12,150	-0,300	-0,177	97,853	146,817
2021-11-15	119,455	152,494	146,100	15,992	-0,294	-1,402	119,455	166,901
2021-11-16	119,743	148,650	147,026	13,217	-0,639	-0,745	119,743	163,558
2021-11-17	125,535	150,566	145,675	11,527	-0,629	-1,097	125,535	158,733
2021-11-18	126,272	158,803	151,880	14,966	-0,483	-1,209	126,272	174,476
2021-11-19	121,749	159,396	152,818	16,458	-0,681	-0,926	121,749	173,727
2021-11-20	114,720	140,808	139,880	10,554	-0,461	-0,264	114,720	156,526
2021-11-21	111,393	123,220	125,929	11,853	0,828	-0,351	111,393	151,665
2021-11-22	118,742	157,230	148,139	16,886	-0,661	-1,097	118,742	169,874
2021-11-23	121,204	162,265	154,639	16,215	-0,768	-0,720	121,204	175,245
2021-11-24	123,590	161,036	154,956	16,495	-0,561	-0,907	123,590	177,472
2021-11-25	126,360	153,987	151,303	11,937	-0,462	-0,882	126,360	168,730
2021-11-26	90,666	134,180	136,821	24,042	-0,168	-0,846	90,666	173,550
2021-11-27	108,975	131,228	133,444	11,819	-0,201	-0,480	108,975	151,595
2021-11-28	97,528	121,583	121,220	14,922	0,208	-1,219	97,528	146,690
2021-11-29	23,600	136,249	128,506	29,200	-2,474	5,863	23,600	151,727
2021-11-30	109,546	141,078	140,048	14,051	-0,315	-0,629	109,546	161,842

Table 24: Statistical analysis of December production

	Statistical							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-12-01	112,527	143,637	136,989	13,664	-0,568	-1,160	112,527	154,696
2021-12-02	108,875	142,729	135,281	13,227	-0,701	-0,840	108,875	149,756
2021-12-03	105,141	133,873	131,726	14,195	-0,509	-1,038	105,141	149,815

2021-12-04	106,317	130,644	128,189	8,691	-0,996	0,042	106,317	139,306
2021-12-05	108,155	120,510	120,850	7,119	0,089	-1,114	108,155	133,126
2021-12-06	112,905	146,061	141,222	16,358	-0,481	-1,247	112,905	161,220
2021-12-07	113,663	143,071	141,286	15,840	-0,261	-1,314	113,663	161,978
2021-12-08	119,743	144,666	141,437	14,599	-0,436	-1,458	119,743	156,838
2021-12-09	109,232	136,484	136,261	13,424	-0,536	-0,864	109,232	153,020
2021-12-10	110,902	140,621	135,642	13,075	-0,603	-1,068	110,902	150,998
2021-12-11	98,486	121,317	119,662	9,800	-0,475	-0,419	98,486	133,809
2021-12-12	81,790	113,047	111,060	13,316	-0,914	-0,022	81,790	127,638
2021-12-13	99,360	143,829	132,498	18,939	-0,545	-1,391	99,360	154,615
2021-12-14	111,678	142,309	137,896	13,314	-0,528	-1,085	111,678	156,167
2021-12-15	110,141	142,247	137,953	15,407	-0,475	-1,223	110,141	157,199
2021-12-16	110,961	141,646	138,683	15,043	-0,366	-1,105	110,961	159,040
2021-12-17	108,462	143,430	137,330	15,285	-0,554	-1,027	108,462	157,247
2021-12-18	103,449	122,268	120,765	7,152	-0,866	0,511	103,449	132,266
2021-12-19	82,585	96,843	101,461	12,229	0,353	-1,219	82,585	121,649
2021-12-20	88,697	122,539	117,163	16,234	-0,525	-1,202	88,697	136,775
2021-12-21	97,498	125,844	121,317	13,820	-0,455	-1,162	97,498	138,602
2021-12-22	97,998	129,987	123,237	14,371	-0,497	-1,374	97,998	141,417
2021-12-23	102,134	129,915	124,551	13,779	-0,391	-1,303	102,134	144,812
2021-12-24	94,610	125,356	123,056	14,813	-0,307	-1,096	94,610	145,642
2021-12-25	87,607	103,923	104,722	9,183	0,145	-0,827	87,607	120,663
2021-12-26	84,605	102,121	103,479	9,841	0,172	-0,676	84,605	121,354
2021-12-27	92,502	137,412	126,444	21,041	-0,479	-1,548	92,502	148,887
2021-12-28	98,860	134,723	129,322	14,124	-0,657	-0,842	98,860	147,052
2021-12-29	104,598	136,966	134,184	14,150	-0,288	-0,724	104,598	161,598
2021-12-30	102,606	135,400	130,057	13,364	-0,629	-0,834	102,606	148,263
2021-12-31	91,114	116,617	116,391	12,326	-0,242	-0,369	91,114	137,199

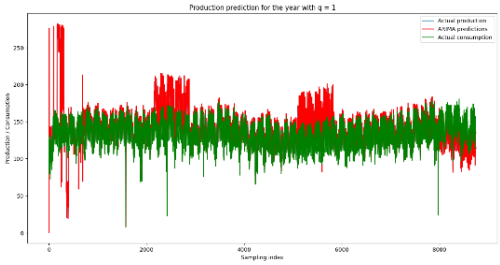
Table 25: Statistical analysis of December consumption

	Statistical parameter							
Date	Mode	Median	Mean	Std	Skewness	Kurtosis	Min	Max
2021-12-01	124,418	158,553	151,749	13,693	-0,736	-0,895	124,418	166,042
2021-12-02	124,135	157,476	153,357	13,440	-0,697	-0,615	124,135	170,301
2021-01-03	121,301	147,771	147,353	13,223	-0,304	-1,109	121,301	164,462
2021-12-04	110,817	143,477	142,334	12,304	-0,672	0,312	110,817	161,256
2021-12-05	116,195	129,114	131,158	9,946	0,429	-0,970	116,195	148,966
2021-12-06	123,255	160,624	152,770	16,611	-0,619	-1,197	123,255	173,236
2021-01-07	131,883	159,816	156,130	14,117	-0,286	-1,462	131,883	175,588
2021-12-08	126,008	164,642	158,639	13,711	-0,831	-0,589	126,008	171,827
2021-12-09	132,692	164,224	158,315	12,853	-0,758	-0,707	132,692	172,006
2021-12-10	132,509	164,467	158,388	12,425	-0,659	-0,891	132,509	172,064
2021-12-11	112,926	141,011	138,967	14,737	-0,024	-1,051	112,926	161,639
2021-12-12	97,290	134,832	133,137	17,459	-0,546	-0,515	97,290	158,048
2021-12-13	125,280	162,924	153,688	16,292	-0,601	-1,303	125,280	172,300
2021-12-14	130,168	162,453	158,025	12,719	-0,777	-0,704	130,168	171,877
2021-12-15	128,751	164,165	156,932	14,748	-0,590	-1,151	128,751	176,929
2021-12-16	122,512	156,366	153,862	14,090	-0,688	-0,548	122,512	172,593
2021-12-17	136,412	162,817	159,932	12,951	-0,547	-0,867	136,412	180,507
2021-12-18	118,386	138,835	139,633	10,184	-0,457	0,011	118,386	156,176
2021-12-19	97,265	116,999	122,230	15,282	0,314	-1,060	97,265	147,899
2021-01-20	104,977	140,494	136,480	16,039	-0,468	-1,067	104,977	158,131
2021-12-21	114,440	147,643	143,498	16,949	-0,406	-1,073	114,440	166,168
2021-12-22	120,428	149,121	144,204	13,966	-0,477	-1,337	120,428	161,637
2021-12-23	125,263	152,280	147,734	13,656	-0,482	-1,229	125,263	166,312
2021-12-24	118,190	148,391	145,520	14,493	-0,236	-1,109	118,190	169,692
2021-12-25	111,357	125,711	126,324	9,128	0,129	-0,990	111,357	142,258
2021-12-26	106,295	120,647	124,196	11,307	0,427	-0,984	106,295	144,414
2021-12-27	110,562	158,362	146,175	21,291	-0,547	-1,455	110,562	167,207
2021-12-28	117,320	154,139	149,544	14,161	-0,684	-0,579	117,320	168,912
2021-12-29	125,758	154,325	152,628	13,551	-0,303	-1,113	125,758	173,868
2021-12-30	120,796	153,523	148,778	13,298	-0,738	-0,471	120,796	168,043
2021-12-31	113,524	137,382	137,768	12,349	-0,113	-0,613	113,524	157,384

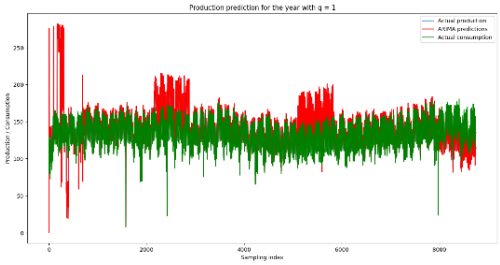
Cumulative Graphical Results and Performance Metrics

Now regarding the results of the modeling, following characterization by statistical analysis, Fig. (4) Shows the performance evolutions of the models explored over the entire year with all the data collected. Figure (5) shows the main rainy season and those for the main dry season are presented in Fig. (6). At the level of Fig. (7) we have the short rainy season; Fig. (8) shows graphical views of the results of the short dry season. Knowing that Fig. (9) presents the graphical views of the results of the two rainy seasons combined, Fig. (10) shows those of the two dry seasons combined. These graphical views immediately expose the configurations of the matrices with: $p = 0$, $d = 1$, and q varying as follows: (a): $q = 1$; (b): $q = 10$; (c): $q = 30$; (d): $q = 50$; (e): $q = 80$; (f): $q = 100$.

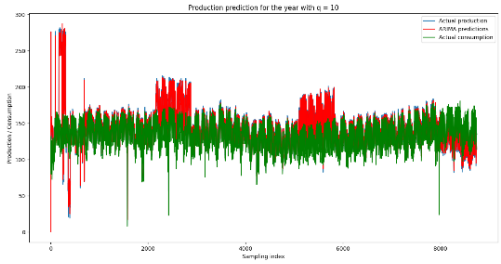
Furthermore, the matrices p, d, and d are detailed on each line, in Table (26), we cumulate the results of the performance evaluation metrics for the year. Table (27) those of the long rainy season, Table (28); for the long dry season; Table (29) contains those of the short rainy season; Table (30), there is some for the short dry season; Table (31) brings together those of the cumulative rainy seasons and Table (32) is reserved for the cumulative dry seasons.



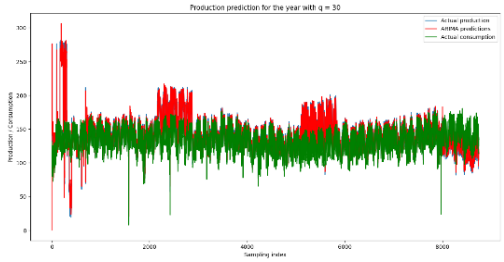
(a)



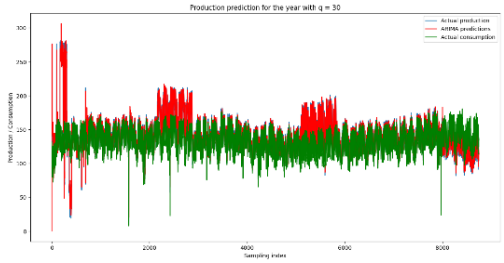
(b)



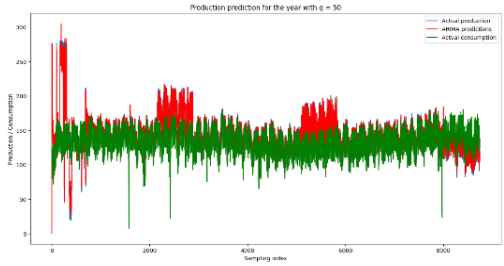
(c)



(d)

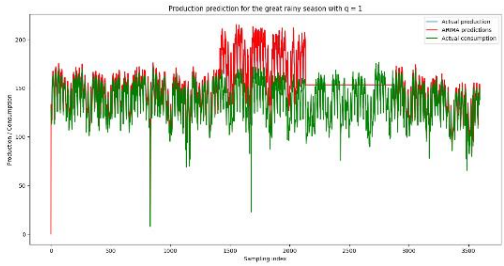


(e)

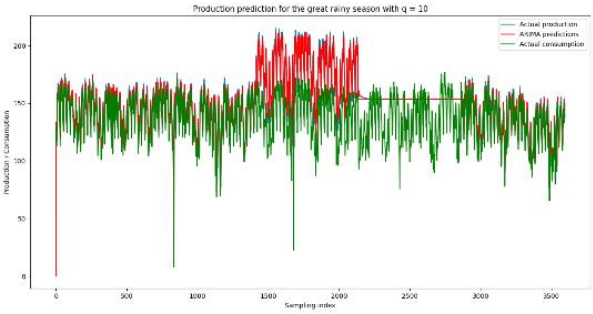


(f)

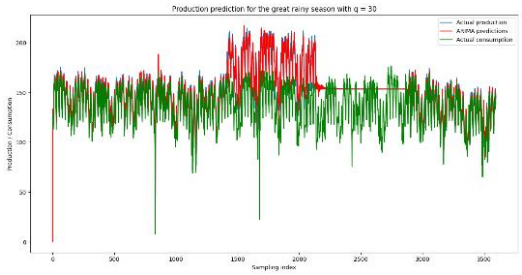
Fig. 4: Graphical view of the results of the year with: p = 0, d = 1, and q varying as follows: (a): q = 1; (b): q = 10; (c): q = 30; (d): q = 50; (e): q = 80; (f): q = 100



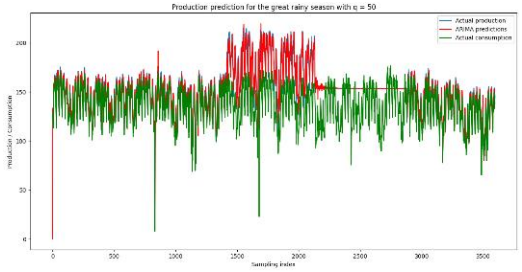
(a)



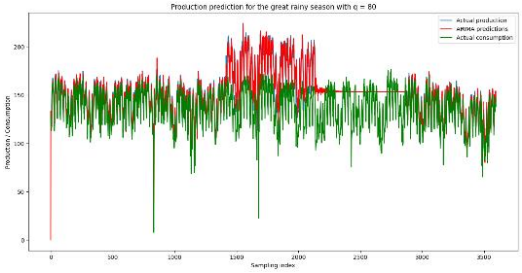
(b)



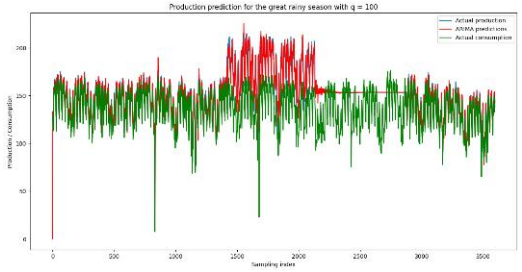
(c)



(d)

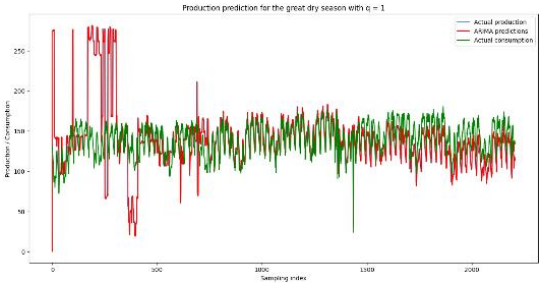


(e)



(f)

Fig. 5: Graphical view of the results of the long rainy season with: p = 0, d = 1, and q varying as follows: (a): q = 1; (b): q = 10; (c): q = 30; (d): q = 50; (e): q = 80; (f): q = 100



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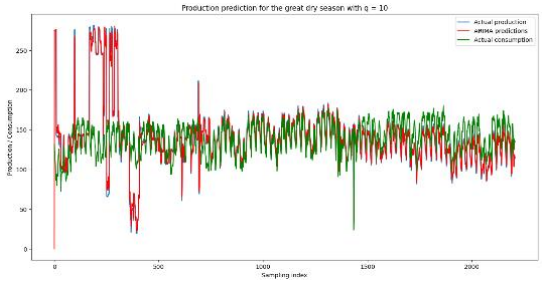
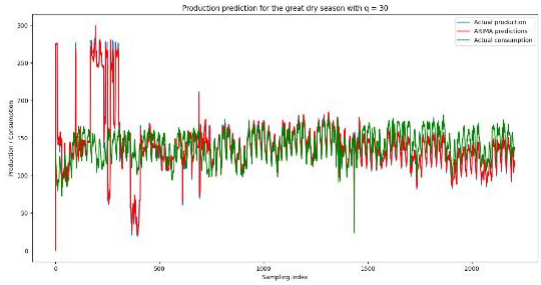
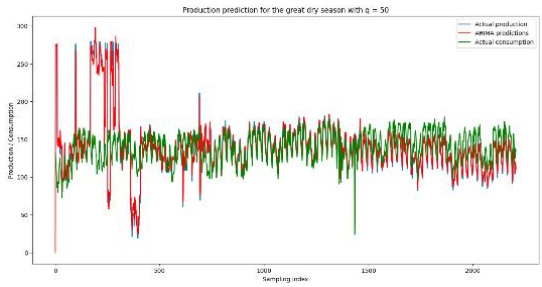


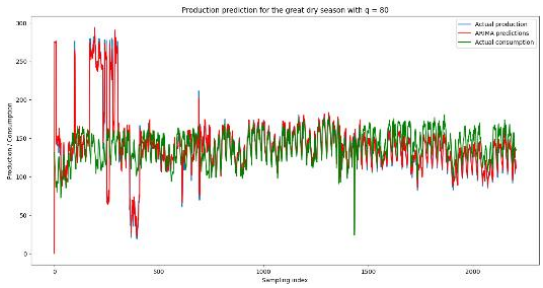
(b)



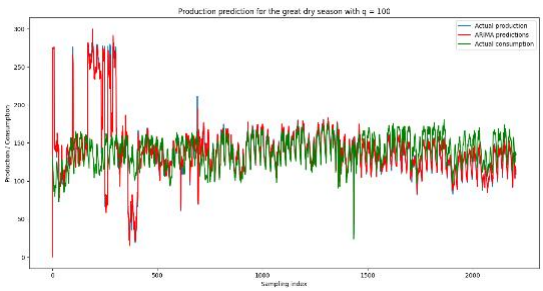
(c)



(d)

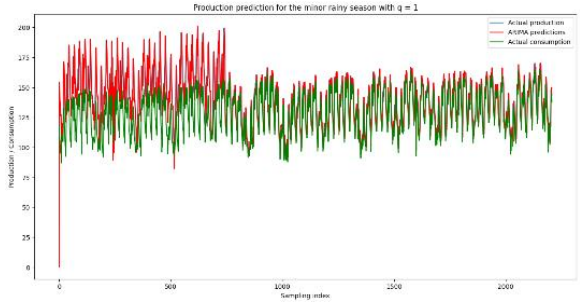


(e)

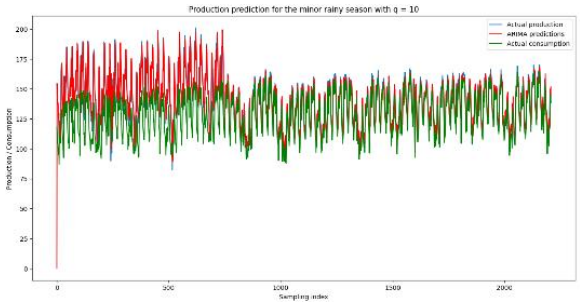


(f)

Fig. 6: Graphical view of the results of the long dry season with: p = 0, d = 1, and q varying as follows: (a): q = 1; (b): q = 10; (c): q = 30; (d): q = 50; (e): q = 80; (f): q = 100



(a)



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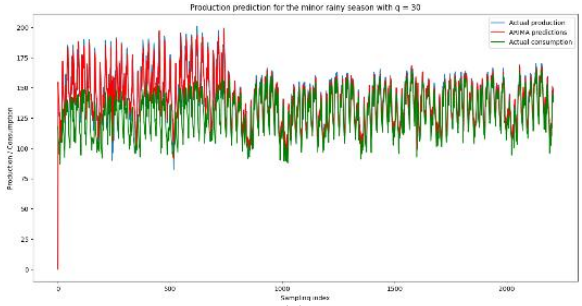

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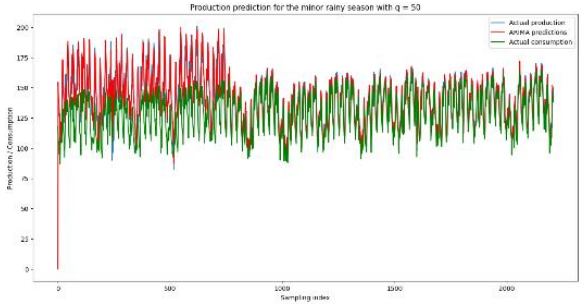
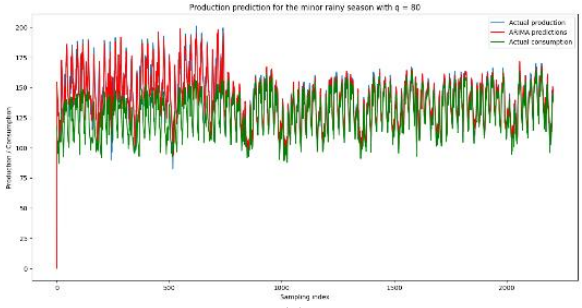


(d)



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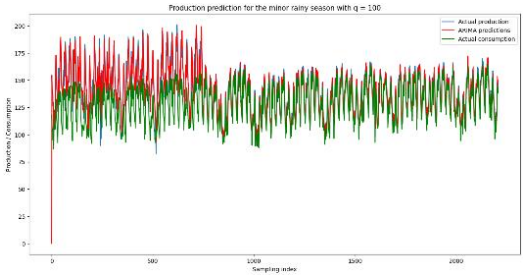
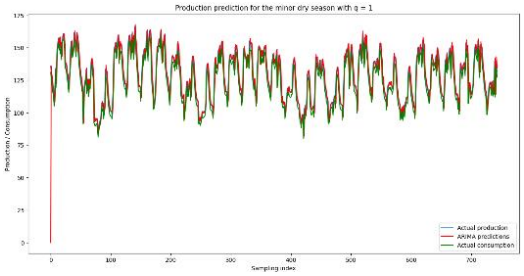
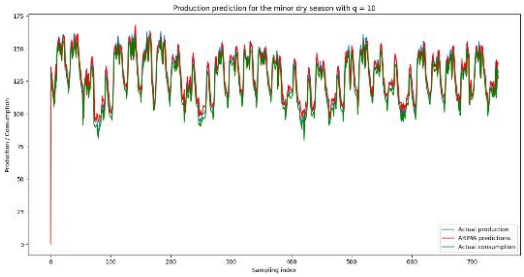


(f)

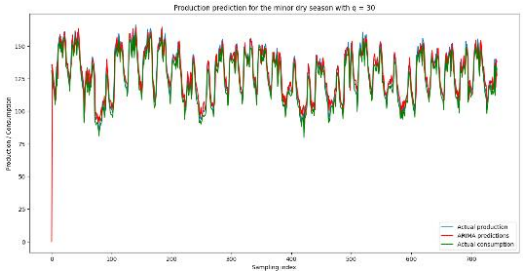
Fig. 7: Graphical view of the results of the short rainy season with: p = 0, d = 1, and q varying as follows: (a): q = 1; (b): q = 10; (c): q = 30; (d): q = 50; (e): q = 80; (f): q = 100



(a)



(b)



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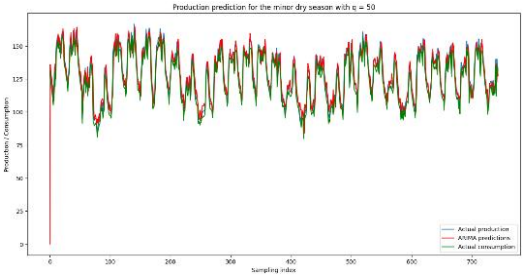

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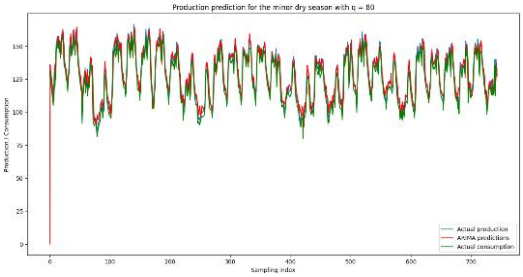

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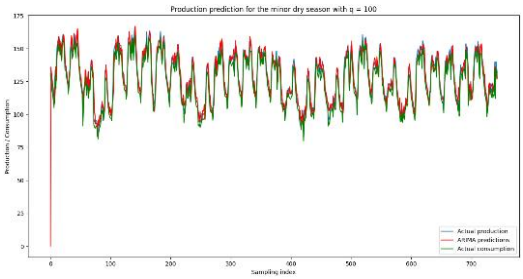
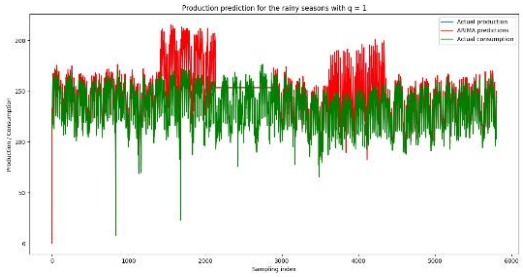
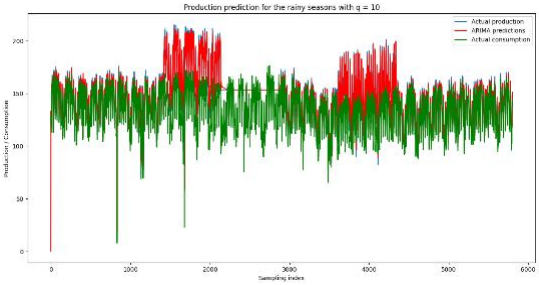


(f)

Fig. 8: Graphical view of the results of the short dry season with: p = 0, d = 1, and q varying as follows: (a): q = 1; (b): q = 10; (c): q = 30; (d): q = 50; (e): q = 80; (f): q = 100



(a)



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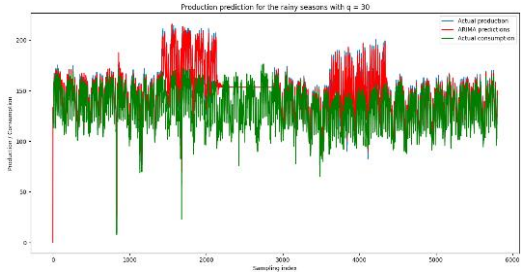

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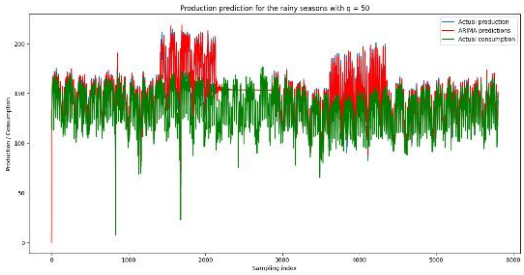

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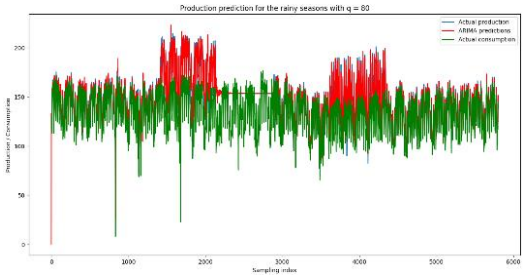

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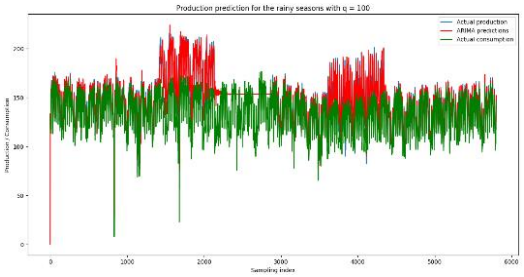
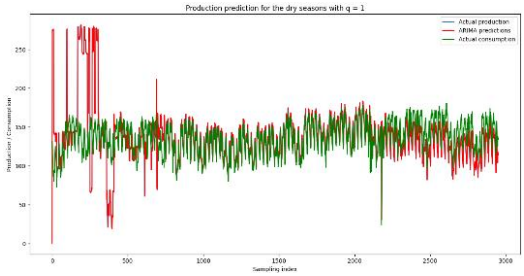
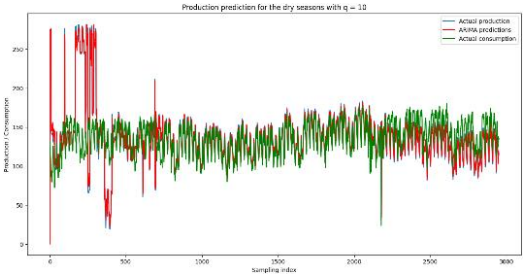


(f)

Fig. 9: Graphical view of the results of the two cumulative rainy seasons, with: p = 0, d = 1, and q varying as follows: (a): q = 1; (b): q = 10; (c): q = 30; (d): q = 50; (e): q = 80; (f): q = 100



(a)



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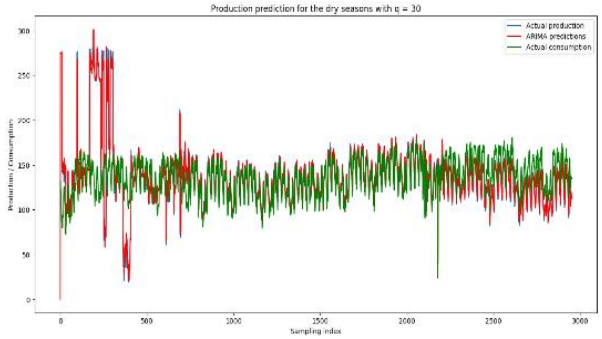

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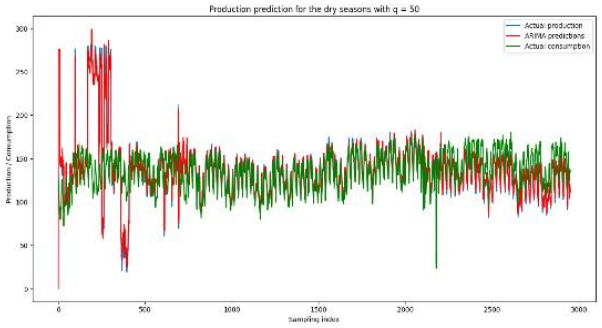

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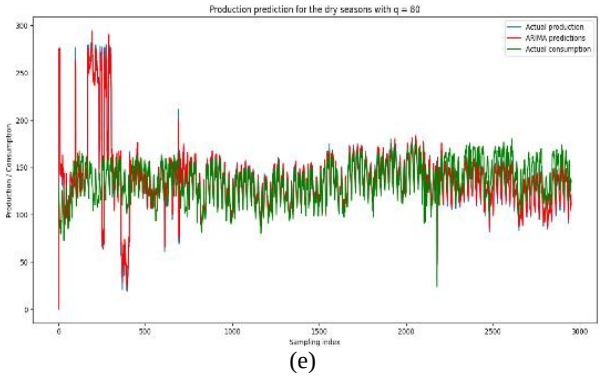

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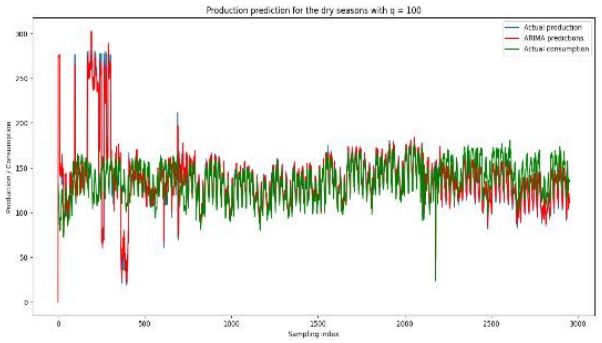

(f)

Fig. 10: Graphical view of the results of the cumulative dry seasons with: p = 0, d = 1, and q varying as follows: (a): q = 1; (b): q = 10; (c): q = 30; (d): q = 50; (e): q = 80; (f): q = 100

Table 26: Results obtained by performance for the year

ARIMA parameters matrix			Performance evaluation metrics			
p	*d*	*q*	RMSE (%)	MAE	MSE	R^2 (%)
0	1	1	10,88	6,18	118,45	85,09
0	1	10	10,61	6,08	112,48	85,84
0	1	30	10,17	5,76	103,34	86,99
0	1	50	9,96	5,60	99,22	87,51
0	1	80	9,80	5,45	95,99	87,92
0	1	100	9,74	5,40	94,88	88,06

Table 27: Performance results obtained for the long rainy season

ARIMA parameters matrix			Performance evaluation metrics			
p	*d*	*q*	RMSE (%)	MAE	MSE	R^2 (%)
0	1	1	8,79	5,04	77,33	85,65
0	1	10	8,49	4,85	72,08	86,63
0	1	30	7,96	4,56	63,34	88,25
0	1	50	7,73	4,38	59,72	88,92
0	1	80	7,54	4,26	56,92	89,44
0	1	100	7,44	4,20	55,35	89,73

Table 28: Performance results obtained for the long dry season

ARIMA parameters matrix			Performance evaluation metrics			
p	*d*	*q*	RMSE (%)	MAE	MSE	R^2(%)
0	1	1	15,11	6,67	228,30	84,27
0	1	10	14,89	6,55	221,83	84,71
0	1	30	14,55	6,52	211,81	85,40
0	1	50	14,37	6,41	206,50	85,77
0	1	80	14,24	6,25	202,65	86,03
0	1	100	14,20	6,06	201,57	86,11

Table 29: Performance results obtained for the short rainy season

ARIMA parameters matrix			Performance evaluation metrics			
p	*d*	*q*	RMSE (%)	MAE	MSE	R^2 (%)
0	1	1	6,64	9,88	97,68	77,12
0	1	10	6,24	9,36	87,60	79,48
0	1	30	5,78	8,72	75,98	82,20
0	1	50	5,45	8,46	71,53	83,25
0	1	80	5,34	8,22	67,63	84,16
0	1	100	5,25	8,11	65,82	84,58

Table 30: Performance results obtained for the short dry season

ARIMA parameters matrix			Performance evaluation metrics			
p	*d*	*q*	RMSE (%)	MAE	MSE	R^2 (%)
0	1	1	9,25	5,90	85,50	73,19
0	1	10	8,88	5,51	78,82	75,29
0	1	30	8,31	5,10	69,11	78,33
0	1	50	7,96	4,81	63,34	80,14
0	1	80	7,68	4,53	58,91	81,53
0	1	100	7,65	4,49	58,51	81,66

Table 31: Performance results obtained for cumulative rainy seasons

ARIMA parameters matrix			Performance evaluation metrics			
			RMSE			R^2
p	*d*	*q*	(%)	MAE	MSE	(%)
0	1	1	9,00	5,62	80,98	84,49
0	1	10	8,61	5,37	74,22	85,79
0	1	30	8,06	5,03	65,00	87,55
0	1	50	7,83	4,81	61,24	88,27
0	1	80	7,64	4,67	58,31	88,83
0	1	100	7,55	4,59	56,94	89,10

Table 32: Performance results obtained for cumulative dry seasons

ARIMA parameters matrix			Performance evaluation metrics			
			RMSE			R^2
p	*d*	*q*	(%)	MAE	MSE	(%)
0	1	1	13,65	6,27	186,40	84,32
0	1	10	13,43	6,15	180,33	84,83
0	1	30	13,08	6,13	171,14	85,60
0	1	50	12,90	6,10	166,47	85,99
0	1	80	12,68	6,5	160,88	86,46
0	1	100	12,64	6,00	159,87	86,55

Discussion

The production of electrical energy begins to be the first concern of all leaders around the world. Without delay than last time, the Blitta solar power plant in Togo has just been inaugurated (Musikingala and Plaza, 2021). The only problem is the mastery of nature. Rivers are often fed by rain. The sun is only really available in the absence of clouds and in abundance, at certain hours of the day; etc. It is then time to think about producing electricity (Ntagungira, 2015); to serve the ever-growing populations with uncontrollable demographics in our regions, associated with the occupation of areas with variable seasons. Seeing the classification made in this article, everything seems to reveal reality. The seasons influence the use of electricity. In the dry season, the cases become more complicated but in the rainy season, the observations are clear. Consumption peaks are observable in December; one month of the dry season. For example, in Table (24) and the 1st, for a production of 154.696 MW recorded, we observe consumption of 166.042 MW on the same date, (Table 25). Also, in the same context, on January 21, we observed a production of 152.452 MW (Table 2), while the consumption recorded on the same date in Table (3) amounts to 157.425 MW. It can also be observed on the 16 and 17th of January (Table 2). During these periods, the production maxima are 69,150 MW and 67,973 MW then consumption rises to 147,840 MW on the 16th and 141,812 MW on the 17th (Table 3) these are always dates included in the great dry season. The phenomenon becomes contrary when the short rainy season already passes. For example, throughout the month of August, the maximum values of all production (Table 16) are well above the maximum values of all consumption (Table 17). Observation is greater during the long rainy season. On February 1, for example, the power produced is 172.001 MW (Table 4) while the power consumed drops to 167.101 MW (Table 5). In Table (6), on March 3 we have a production of 172,020 MW against a consumption of 165,720 MW (Table 7). On April 15, maximum production amounted to 211.644 MW (Table 8), for consumption of 169.644 MW (Table 9). It is the same in May, which is always a month of the main rainy season because on the 25th, we have a production of 180.476 MW (Table 10) and consumption is 175.376 MW (Table 11). Finally, June is not spared. On the 1st, production reached 172.714 MW for consumption of 167.714 MW (Tables 12-13). Everything suggests that in the rainy season, the rivers are well fed and the reservoirs do not suffer in storage. This facilitates production but at the same time the shortage of this primary energy source creates an insufficiency during the dry season, hence the imbalance. The solution to providing electricity to populations is managed by foreign partners who are connected to the networks of the Electric Community of Benin (CEB).

Apart from these observations, let us come to the results of the prediction. The variation of the order of the moving average (q) had positive effects on the quality of the results. Which pushed us to vary them in order to monitor their extent. This is not the case for p, the autoregressive process, and d, the degree of integration. That being said, the prediction results are clear and confirm the basic idea of this study. It is enough to observe them starting from those of the year to the isolated seasons passing by the grouping of the seasons. Firstly, for the whole year, we find 88.06% as the coefficient of determination for an RMSE of 9.74%, this being the best result. Which rises to R^2 = 89.73%; and RMSE = 7.44% for the long dry season. As this is not finished, we also find R^2 = 89.10% and RMSE = 7.55% for the two rainy seasons combined. On the other hand, the results are not promising in terms of dry seasons. We find R^2 = 86.55% and RMSE = 12.64% for the two dry seasons combined, therefore a low result compared to that of the whole year combined. Also, we find for the long dry season: R^2 = 85.99% and RMSE = 12.50%; for the short dry season, we have: R^2 = 81.66% and RMSE = 7.65%. We see that the performance of these models is lower than that of the whole year. This identical situation for the short rainy season where we find: R^2 = 84.58% and RMSE = 5.25%; hence the need to extend the data collection period to allow ARIMA to process the quantity necessary for its modeling quality, otherwise, use another algorithm altogether to resume the study. However, it is important to point out that the characterization does not confirm the observations of these models. This can be explained by the quantity of data used because these seasons have shorter durations than the seasons which validates the

observations which led to the realization of this study.

Two results can be deduced from this study. Firstly, the first confirms that the seasons have an influence on the consumption of electrical energy automatically affecting its consumption (production-consumption adequacy) in the study area because of the performance of the models obtained with ARIMA, also validated by the results of the characterization. Then, the second result which shows that the characterization responds confirms the phenomenon while the models obtained do not confirm the results by their performances; but we found that this may be due to the quantity of data processed with the algorithm used. Also, the point not to lose sight of is the climate disruption that is occurring during the data collection period and in the study area.

Conclusion

In this study, we have accumulated the results related to the forecast of electricity production per season from consumption for the CEET network in Lomé in Togo. We used the values collected during the year 2021 in said network. To achieve this, a monthly characterization is carried out. Then their grouping by seasons in the study area was added. The Auto-Regressive Integrate Mean Average (ARIMA) algorithm allowed us to design the models. These are subject to performance evaluation metrics such as Mean Square Error (MSE); Mean Absolute Error (MAE): Root Mean Square Error (RMSE) and the coefficient of determination (R^2).

The results of the characterization show that the phenomenon is clear. The long and short rainy seasons show in almost all cases an overproduction compared to consumption. On the contrary, the short and long dry seasons show that consumption is in most cases higher than production.

Concerning the modeling, all the models studied give determination coefficients greater than 80%. When creating the models, varying the p and d values had no effect on the results. On the other hand, by varying q, the performances improved up to almost 90% in certain cases and we stopped at q = 100. Thus, the results of the best performances are as follows: For the long dry season, we have: MAE = 6.06; MSE = 201.57; RMSE = 14.20%; R^2 = 86.11%. The short dry season: Gives MAE = 4.49; MSE = 58.51; RMSE = 7.65%; R^2 = 81.66%. Concerning the long rainy season, we have MAE = 4.20; MSE = 55.35; RMSE = 7.44%; and R^2 = 89.73%. In addition: MAE = 65.82, MSE = 8.11, RMSE = 5.25%; R^2= 84.58% for the short rainy season. Combining the two dry seasons gives: MAE = 6.00; MSE = 159.87; RMSE = 12.64; R^2 = 86.55%. Then we find: MAE = 4.59; MSE = 56.94; RMSE = 7.55; R^2 = 89.10% for the grouping of the two rainy seasons. Finally, for all the values of the year grouped together, we have MAE = 5.40; MSE = 94.88; RMSE = 9.74%, and R^2 = 88.06%.

We then confirm that separating the forecast by season gives better performance with ARIMA modeling and we find 89.73% for the main rainy season compared to 88.06% for the whole year. Likewise, for the grouping of the two rainy seasons, the coefficient of determination of the forecast compared to the actual data also remains better and is 89.10%. On the other hand, when the data used by ARIMA are not dense enough, in the case of dry seasons, the results are slightly lower than for the entire year. Even the remarkable effect that at q in the matrices [p d q] on the results the simulations will continue until the determination of the optimal matrix.

This being said, we will have to move away from old forecasting methods (hourly, weekly, monthly, and annual), to explore the work, by grouping them by seasons and through other algorithms. However, it will also be necessary to resume the work by increasing the data collection period to include a view on climate change.

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Author's Contributions

Apaloo Bara Komla Kpomonè: Did the statistical analysis, wrote the codes, and wrote the article.

Bokovi Yao: Made considerable contributions to the conception, design, and acquisition of data and analysis and interpretation of data. He contributed to drafting the article reviewed it critically for significant intellectual content and gave the final approval of the version to be submitted and any revised version.

Ghafi Kondi-Akara Victoire: Evaluated the content and form of the article then made suggestions for improving the article.

Moro Ouma Cecil Naphtaly: Judged the article and made his contribution through his reading and organization of the results.

Ethics

The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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