Using time series analysis to predict the number of visitors to Imam Hussein's Ar-.baeen in 2024 and 2025

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Abstract

The visit known as the Arbaeen happened forty days after Imam Hussein›s (peace be upon him) martyrdom on the tenth of Muharram in the year 61 AH. Delegations from various Iraqi cities and villages travel to Karbala, the home of Al-Hussein (peace be upon him), and they are accompanied by sizable delegations of Ahl al-Bayt school adherents from a variety of nations, including Iran, Bahrain, Kuwait, Lebanon, Pakistan, and others. In this research, we examine the estimation values for the numbers of visitors by utilizing time series analysis and A few tests are the mathematical time period needed to validate our findings. To determine whether the results are accurate by the sample number of visits from 2017 to 2023 provided by the Holy Imam Hussein Shrine's General Secretariat. Because government organizations and the Holy Shrine need to be able to provide efficient services, including a counter for food and health services and a comfortable place for visitors to sleep, it is vital to forecast the number of visitors.

Keywords: time series, ARIMA(0,1,0), SARIMA, autocorrelation

1.Introduction

Karbala is situated at longitude 44.01039 and latitude 32.60685 in the southwest of Baghdad, 105 kilometers away from it. 30 meters above sea level is where it is situated.[1]

Therefore, those who are knowledgeable and knowledgeable are really interested in statisticians

Due to the fact that it offers forms, facts, percentages, and statistics to respect any phenomenon Given the fortunate number that the fortunate forty-first visit will make up There has been a little increase in the number of tourists, both Arabs and foreigners, in almost all elements and variables of the place [2]. The degree of labor and material resources as well as the excellent service rendered prior to local, Arab, and foreign processions, volunteers, and Hussein Shrine parts [3].

The aim of this research forecasting the number of visitors to help the government for taking serves for people in Arbaeen time [4].

3.Materials and Methods

1.The Time Series [6]

time series collective views Xt happened at time t and can be expressed as the form

$X1, X2,\ldots,Xt\ s.t\ X1$It shows the importance of the timely observation $t1$ This approach works with all variables To help decision-makers make the best choice, time series data for the past era are being analyzed with the goal of predicting how many visitors will be came in the future

The ability to predict the future through time series does not require a theoretical foundation; rather, it relies on previous changes in the variable's values. This indicates that expectations for the future are not concerned with the impact of a variable's value on the other variables

One prerequisite for time series is that they must be Xt It is stable and presumes knowledge of the model's parameters. which produces the mean squared error with the lowest value, ie

(1).....

3.2: Autocorrelation (AC)

The nature of the procedures themselves is where the issue with autocorrelation in time series data first arises. There may be accumulated inaccuracies in years or decades as a result of measurement errors in this form of data collection.[5]

Autocorrelation may be caused by consecutive time points, as well as by failing to include variables in the function

(2).....

t.s

In other words, the sample's autocorrelation function has the following structure

(3).....

(4).....

***[7](MAE) Error Absolute Mean* :3.3**

The discrepancy between the predicted and actual values is calculated in absolute terms as the absolute error. The following formula can be used to determine MAE.

(5).....=MAE

3.4: Mean Absolute Percentage Error (MAPE)[8]

To compute this precision as a percentage, MAPE is computed as the average absolute percent error for every time minus real

values split by actual values. The resulting is the formula:

MAPE = ...(6)

***[9](RMSE) Error Square Mean Root* :3.5**

the approaching how or ,information the to model the of fit absolute The is ,model the by predicted values the match points information actual :formula following the by computed be can It .RMSE by symbolized

(7).....= RMSE

4. Statistical Study

4.1:time seri of visitors

One of the most significant Iraqi cities is the holy city of Karbala, which is home to numerous religious sites that are well-known throughout the country as well as artifacts, Iraqi history, and religious sites. The information in Table (1) indicates that the Holy Imam Hussein Shrine publishes statistics annually to support researchers in their research. It means that the services offered to guests through the thresholds are the best [10].where table(1) from The statistical bulletin is published by the Holy Shrine of Hussein, Karbala and Al-Wathuth Center

Table (1) number of visitors

year	Visitors
2017	15385000
2018	17000000
2019	15229955
2020	14553308
2021	16327542
2022	21198640
2023	22019146

4.2 Box-Jenkins Procedure

Time series modeling heavily relies on the Autoregressive Moving Average (ARMA) model. While they can model unknown processes with the fewest parameters when compared to autoregressive models (AR) and moving average models (MA), ARMA models offer the very effective linear models of fixed time series.

Forecast of visitors are hard and challenging because of its nonlinear paradigm and wide changes in intensity [5]. Autoregressive Integrated Moving Average (ARIMA) modeling is one of the effective techniques [8]. The autoregressive moving average (ARMA) model, created by George Box and Gwilym Jenkins in the 1970s [14], is a generalization of the ARIMA model. Due to the fact that it encompasses a range of types, including season,

absence of season, and stability The ARIMA model is promoted as a thorough statistical modeling approach for time series [9].

In a study by Momani [11], the ARIMA model was employed to forecast visitors data, and it was asserted that the forecast's outcome was favorable. Ponnamperuma and Rajapakse [12] also discovered that ARIMA might be used to predict visitors over the short term.

4.3: Seasonal Autoregressive Integrated Moving Average (SARIMA)

Additional seasonal components are incorporated to create the seasonal ARIMA model. It is basically stated as SARIMA (p, d, q) (P, D, Q), where S is the seasonal interval. The non-seasonal part of the model is called lowercase notation, and the seasonal part is called uppercase notation. Similar expressions are used in the seasonal ingredient of the model as in the non-seasonal ingredient, but there is a seasonal rearward shift. The following is the equation [15]:

……(8)

With

where is the actual data; and represents AR component coefficient and MA component

coefficient respectively; c is the constant value; μ is the mean value of the series and is the random error, which also known as white noise. B represents the non-seasonal backshift operators and d is the non-seasonal differencing order. For seasonal part, is the seasonal AR

component coefficients while is the seasonal MA component coefficients. *B*- is the seasonal backshift operators and D representing the seasonal differencing order.

Test statistical

5.Result

In this section study the result of analysis for the data by statistic rules write in above sections, from analysis we found ARIMA (0,1,0) the best model to get the forecasting for visitors by following mothed

5.1: Autocorrelation (AC)for visitors

In this part take autocorrelation for visitors by ARIMA (0,1,0) we look in table (2) R Square equal (0.872) this mean the modal is best for forecasting the number of visitors and the figure (1) Probability of visitors.

Table (2) Model Summary and Parameter Estimates

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1

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1049903.750
-2103417919
.049
5
1
6.685
.872
Linear

From table (2)note that sig.<0.05 this mean model is active and we can take model to forecast

Figure (2) the probability of visitors

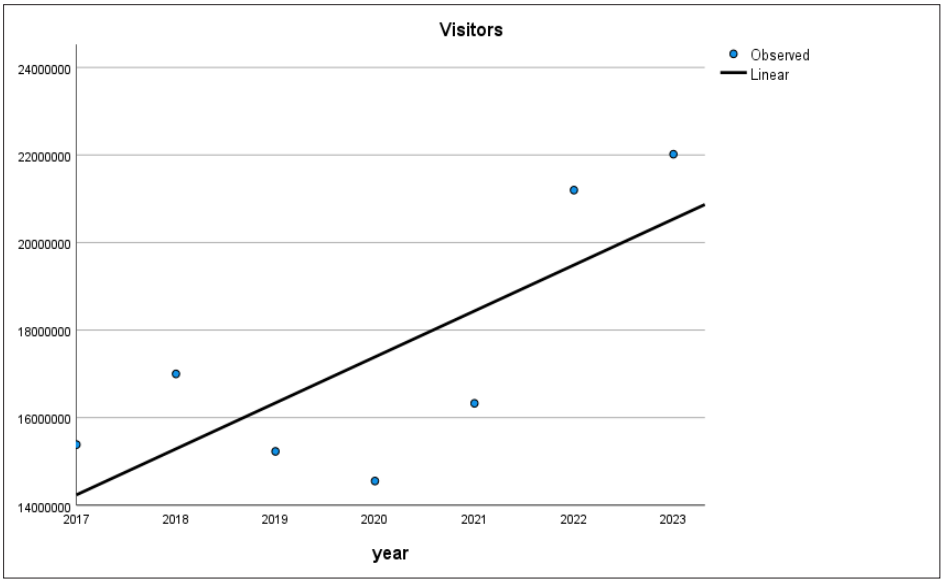


Table (3) Autocorrelations

Series: Visitors					
Lag	Autocorrelation	Std. Errora	Box-Ljung Statistic		
			Value	df	Sig.b
1	.148	.323	.211	1	.646
2	-.368	.289	1.840	2	.399
3	-.378	.250	4.124	3	.248
4	.104	.204	4.382	4	.357
a. The underlying process assumed is independence (white noise).					
b. Based on the asymptotic chi-square approximation.					

Table(3) take autocorrelation for four lag for bax-ljung

Figure (2) Autocorrelations

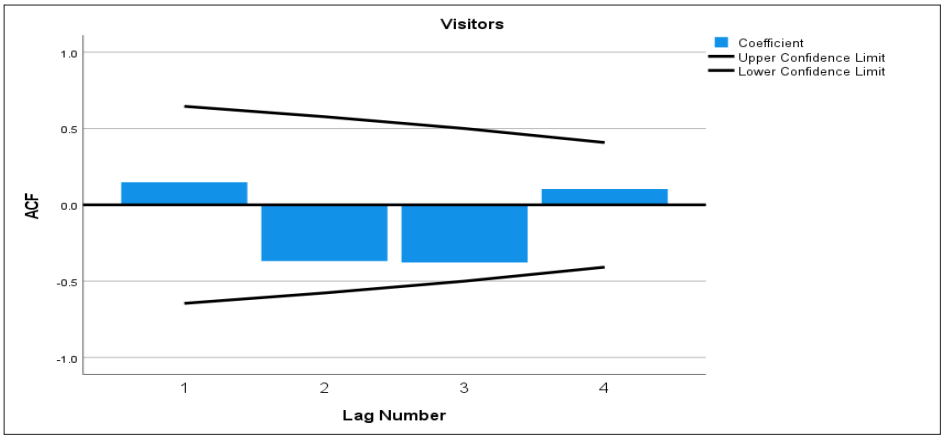
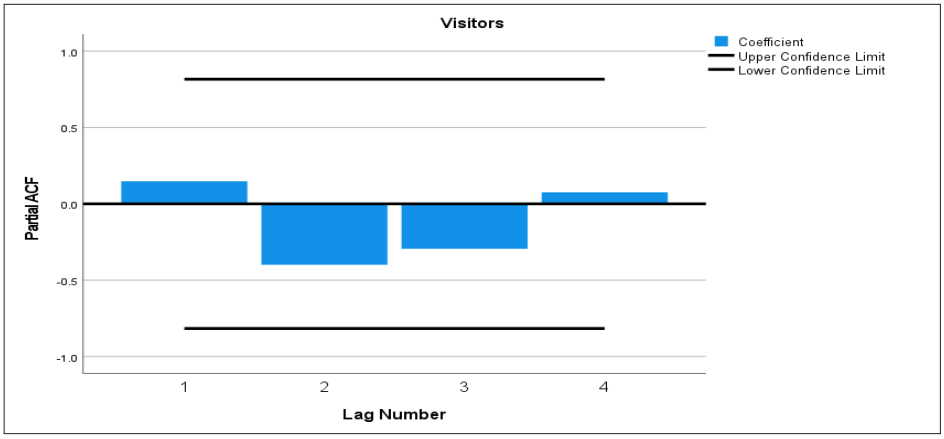


Table (4) Partial Autocorrelations

Series: Visitors		
Lag	Partial Autocorrelation	Std. Error
1	.148	.408
2	-.399	.408
3	-.295	.408
4	.075	.408

Figure (3) partial Autocorrelations



According to the ACF plot and PACF plot of the residuals in Figures (3) (4), none of the spikes are significant and are therefore not autocorrelated because they are all inside the boundaries. All four of these graphs for the residuals support the notion that the variance is constant and the mean of the residuals is zero. As a result, the remainders data almost follows a normal distribution. Consequently, it can be said that this model is suitable for use, and the expected value is shown in the center red line of the time series plot

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Figure (4) compare between ARIMA (0,0,0) and ARIMA (0,1,0)

From figure (4) Note that ARIMA (0.,0,0) model is not better model because the result for sample interval very far from fit Unlike the other model, the results were very close to fit

Table (5) forecasting of visitors

year	Forecasting the visitors
2024	22587270
2025	22937174

After applying the statistical laws, it was found that the prediction rate is according to the table (), as this indicates a stable and controllable increase in the provision of services (health, roads, and other services), as the service that is available to this large number of people needs a lot of attention from the holy shrines. To confirm the results obtained, we use error criteria to determine whether the models used in prediction are appropriate as in the table (6)

Table (6) The Comparison of The Performance of Prediction Models

	ARIMA (0,0,0)	ARIMA (**0**,**1**,0)
RMSE	19005432	22985310
MAPE	23876543	22976543
MAE	20987654	22912345

6.Conclusion

We discovered that the number of visits is (22587270) for the year 2024 and (22937174) for the year 2025, and that the numbers are increasing steadily and are under the control of the institutions after carefully investigating mathematical and statistical approaches. Serving the Arba'een visit is a duty for all state ministries since it expands the nation's economic opportunities, particularly the globe is currently shifting away from the use of oil sources, which are still recognized as official sources in our nation's economy, and toward the use of clean energy. The Arbaeen visit portrays a strong economic facade in this way, and everyone in the must pledge to work hard to uphold the noble reputation of the country .

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