Internship Project Report

TIME SERIES-BASED ELECTRICITY CONSUMPTION

A Project Report Submitted to the Partial fulfillment of the Requirements for the Award of the degree of Master of Science in Data Science

Submitted by

HATLIN JOHEIT J A

(22PDS807)

Under the guidance of

Dr. V. ARUL KUMAR, M.Sc., M.Phil., Ph.D., SET

DEPARTMENT OF DATA SCIENCE

ST. JOSEPH'S COLLEGE (AUTONOMOUS)

Accredited at "A++" Grade (4th Cycle) by NAAC

College with Potential for Excellence by UGC

Tiruchirappalli – 620 002.

JUNE - 2023

DEPARTMENT OF DATA SCIENCE

ST. JOSEPH'S COLLEGE (AUTONOMOUS)
TIRUCHIRAPPALLI - 620 002

CERTIFICATE

This is to certify that the **INTERNSHIP PROJECT REPORT** submitted by **HATLIN JOHEIT J A, 22PDS807,** is a record of original training undergone by him/her during the period from 15th May 2023 to 15th June 2023, in partial fulfillment of the requirements for the award of the degree of **MASTER OF SCIENCE in DATA SCIENCE.**

Internal Guide **Head of the Department**

Viva-voce examination is conducted on ______________________________

Internal Examiner **External Examiner**

Date: Date:

DECLARATION

I hereby declare that the Summer Internship project report entitled "**Time series-based electricity consumption**" is an authentic record of original training undergone by me during the period from 15th May 2023 to 15th June 2023 under the supervision and guidance of **Dr. V. ARUL KUMAR**, for the award of the degree of **MASTER OF SCIENCE in DATA SCIENCE.**

I also confirm that the report is only prepared for my academic requirement, not for any other purpose.

HATLIN JOHEIT J A

(22PDS807)

Department of Data Science

St. Joseph's College (Autonomous)

Tiruchirappalli

ACCEPTANCE LETTER

Date: - May 5^{th}, 2023

Hatlin Joheit J A
St. Joseph's college (Autonomous)
22PDS807

Dear Hatlin Joheit J A,

We are excited to extend an offer to you as a Trainee Software Engineer position at **AiROBOSOFT Products and Services**, Affiliated with **AICTE** India. You are requested to report on or before **8^{th} May 2023**.

In this role, you will report directly to your assigned team leads.

During your internship with AiROBOSOFT, you may have access to trade secrets and confidential or proprietary business information belonging to AiROBOSOFT Products and Services, by accepting this offer, you acknowledge that this information must remain confidential and agree to refrain from using it for your own purposes or disclosing it to anyone outside of AiROBOSOFT Products and Services.

We look forward to having you begin your career at AiROBOSOFT Products and Services and wish a successful internship, Welcome to our team!

PRODUCTS AND SERVICES LLP
LLPIN : AAS-7147
CORPORATE
www.airobosoft.com

Our Vision, Your Future.

Regards,
CEO & Chief Ai Engineer at AiROBOSOFT.

I accept the offer with the company on the terms and conditions set out in the letter.

Hatlin Joheit J A

AiROBOSOFT Products and Services LLP

No - 4, 3rd Floor, 5th A Main Rd, adjacent to Bangalore Baptist Hospital, Hebbal, Bengaluru - 560024.

airobosoft.com

hr@airobosoft.com

99644 83 843
88843 99 089

INTERNSHIP COMPLETION CERTIFICATE

Reg. No: AAS7147

AiRobosoft

Our Vision, Your Future.

Internship Certification

This is to certify that

Hatlin Joheit J A

Has completed internship at ***AIROBOSOFT PRODUCTS AND SERVICES LLP***

On

Artificial Intelligence and Machine Learning

May 15th 2023 – June 15th 2023

Her / His performance was Very Good.

(Scan to Authenticate)

Managing Director

ACKNOWLEDGEMENT

The internship opportunity I had with **AIROBOSOFT Product and Services** was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individual as I was provided with an opportunity to be a part of it. I am also grateful for having a chance to meetso many wonderful people and professionals who led me though this internship period.

I am profoundly grateful to **Rev. Dr. K. AMAL SJ**, our secretary St. Joseph's college (Autonomous), Tiruchirappalli 620 002 for giving me this opportunity. I proudly grateful to **Rev.Dr. M. AROCKIASAMY XAVIER,** S.J. Principal, St. Joseph's college, Tiruchirappalli, for having given me an opportunity to pursue my study and use the facilities available in this institution. I extend my gratitude to **Dr. P. RAJENDRAN**, Deputy principal, St. Joseph's college, Tiruchirappalli, for giving me this opportunity.

I extend my sincere gratitude to **Dr. L. AROCKIAM**, Head, Department of Data Science, for his guidance and suggestions during this project work.

I thank **Dr. V. ARUL KUMAR**, **M.Sc, M.Phil., Ph.D., SET Assistant Professor**, St. Joseph's college (Autonomous) Tiruchirappalli for taking part in useful decision & giving necessary advices and guidance and arranged all facilities to make life easier. I choose this moment to acknowledge his contribution gratefully.

It is my radiant sentiment to place on record my best regards, deep sense of gratitude to **Dr.KRIUSHANTH**, Assistant professor, **Dr. PRIYA STELLA MARY**, Assistant professor, **Dr.BEATRICE DOROTHY**, Assistant professor, St. Joseph's college (Autonomous), Founder & Managing Director, Data Science Products & Research, precious guidance which were extremely valuable for my study both theoretically and practically.

I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

HATLIN JOHEIT J A

22PDS807

ABSTRACT

Electricity usage is an integral aspect of everyday life, and its demand has been steadily increasing alongside economic growth. In light of this, precise prediction of electricity consumption plays a crucial role in effectively managing and making informed decisions regarding the power system. This study introduces a methodology that utilizes time series techniques to forecast future patterns in electricity usage.

The dataset employed in this investigation comprises 4993 recorded instances of electricity consumption. The mean value of the target variable (megawatt) is 17741.7825, with a moderate level of variation indicated by the standard deviation of 4672.601868. The range of values fluctuates between 9590 and 25692, with 25% of the observations having megawatt values below 13680. The ARIMA model utilized in this study exhibited a mean absolute error (MAE) of 4142.1, denoting an average absolute discrepancy of 4142.1 between the actual and projected values.

The Prophet model, on the other hand, yielded a slightly higher MAE value of 4144.1, indicating an average deviation of approximately 4144.1 units from the actual values. A lower MAE value signifies a better fit of the model to the data. Overall, this proposed approach has the potential to be a valuable tool for forecasting electricity consumption and facilitating decision-making within the power-system.

COMPANY PROFILE

AIROBOSOFT PRODUCT AND SERVICES is a Bangalore based IT firm leading a team of Data Scientist, Robotics & Electronics Engineers, experts in Machine Learning and more, collaborated together to work on fascinating futuristic technologies.

- Website : http://www.airobosoft.com
- Industry : IT Services and IT Consulting
- Company size : 51-200 employees

  Includes members with current employer listed as AIROBOSOFT Products and Services,including part-time roles.
- Headquarters : Bangalore, Karnataka
- Specialties : Robotics, Artificial intelligence, Machine Learning, IOT, and Software development
- LinkedIn Profile link : https://www.linkedin.com/company/airobosoft-products-and-services/about/

TABLE OF CONTENT

TABLE OF FIGURES

CHAPTER- 1

INTRODUCTION

1.1. Electricity consumption

The demand for electricity has experienced a substantial increase in tandem with economic growth, establishing it as a vital component of daily life. Effectively managing surplus power production poses a complex challenge, as storing excess electricity proves difficult and arduous. Hence, the development of a precise power demand prediction system becomes imperative to mitigate the need for excessive electricity generation and storage.

Such a system holds the potential to optimize power generation and utilization, resulting in reduced costs for individual households through improved production scheduling and proactive power procurement. In the modern era, the software industry is undergoing a transformation towards machine intelligence. Machine learning and artificial intelligence have become indispensable across all sectors, enabling the creation of intelligent robots and facilitating informed decision-making through data analysis and knowledge extraction.

1.2. Importance of electricity consumption forecasting

1.2.1. Efficient Planning:

The utilization of electricity consumption forecasting plays a pivotal role in facilitating efficient planning of power generation, transmission, and distribution systems. By accurately predicting electricity demand, utilities can ensure they possess adequate capacity to meet the demand, thus avoiding excessive or insufficient infrastructure development.

1.2.2. Cost Optimization:

Precise forecasting enables utilities to optimize costs by circumventing the need for costly emergency measures, such as purchasing electricity from other providers. Additionally, forecasting empowers utilities to strategize their energy procurement, enabling them to procure electricity during periods when prices are at their lowest.

1.2.3. Reliable Supply:

Forecasting plays a crucial role in maintaining a reliable supply of electricity by anticipating shifts in demand and taking proactive measures to uphold a stable grid. These measures include load shedding or implementing demand response programs to curtail demand during peak usage periods, as well as augmenting power production during periods of low usage.

1.2.4. Integration of Renewable Energy:

Electricity consumption forecasting holds significance in the seamless integration of renewable energy sources, such as solar and wind, into the grid. Given the variability and intermittency of these energy sources, precise forecasting is essential for balancing the supply and demand of electricity on the grid effectively.

1.2.5. Environmental Sustainability:

Accurate forecasting contributes to reducing the environmental impact associated with electricity generation. By anticipating periods of high demand, utilities can avoid activating polluting power plants and instead prioritize the use of cleaner and more sustainable energy sources.

In summary, electricity consumption forecasting is an indispensable tool for utilities to efficiently manage their operations, optimize costs, and ensure a reliable and sustainable supply of electricity to consumers. By leveraging accurate forecasting, utilities can make informed decisions that enhance their overall performance and contribute to a greener and more sustainable energy future.

1.3. Forecasting of electricity consumption

In my project, I utilize time series models to predict and forecast the usage of electrical energy.

Specifically, we employ the widely recognized ARIMA model (Auto Regressive Integrated Moving Average) to capture the historical data's patterns and trends, thereby enabling short-term forecasts.

The ARIMA model combines three key components: the autoregressive (AR) component, the integrated (I) component, and the moving average (MA) component. The AR component establishes the relationship between past and current values within the time series, while the MA component captures the connection between past and current errors. The component ensures the time series achieves stationary before modeling.

To apply the ARIMA model, we first preprocess the historical data on electricity consumption. This dataset comprises hourly electricity consumption data spanning from January 25, 2023, to March 18, 2023. Our preprocessing steps involve data cleansing, identifying missing values, and aggregating the data to a daily level.

Subsequently, we employ the ARIMA model to generate electricity consumption forecasts for the upcoming two months. The accuracy of our forecasts will be assessed using evaluation metrics such as Mean Absolute Error (MAE).

Moreover, we also employ the Prophet model to compare its performance against the ARIMA model.

Ultimately, based on the insights and recommendations derived from these forecasts, we aim to assist utilities in efficiently planning their electricity generation, transmission, and distribution systems. Our objective is to ensure a reliable and sustainable supply of electricity to consumer

CHAPTER- 2

PROBLEM STATEMENT

Through the utilization of time series analysis, governments can effectively capture the recurring patterns in electricity usage on a daily, weekly, and seasonal basis. Additionally, they can incorporate external variables such as temperature and weather events into their analysis. This comprehensive approach enables governments to enhance the accuracy of their electricity consumption predictions, resulting in fairer and more precise billing practices for consumers. Furthermore, precise forecasting of electricity consumption equips governments with the ability to plan for emergency scenarios such as pandemics, natural disasters, or unforeseen events. By implementing reliable forecasting models, governments can ensure an adequate electricity supply to meet the population's demand during these critical situations. Moreover, accurate forecasting models facilitate governments in their transition towards renewable energy sources, as they can effectively plan and optimize the utilization of these sustainable energy alternatives.

2.1. Background work

- I collected the data from Company. I referred many algorithms to get the clear idea about their usagein my work.
- To understand & learn the algorithms I followed youtube channel as well as website. I installed Anaconda Jupyter notebook for my work. It is as open- source software available in the internet for free.
- I worked for nearly four to five to completing my work. I have selected dataset from two more resource and glanced to select the particular one.
- After gathering that it was a little bit noise data so that I went to data pre-processing stage. Meanwhile doing data pre- processing work I referred a lot of website for this purpose.
- After cleaning the data, I selected the machine learning model according to my dataset and my method of prediction. I have imported many libraries in python for my work.
- I trained & tested my data. Later I validated it. After that I evaluated my model. Simultaneously while I am doing my work, I visited some website to know about the real time applications of my work in this site.
- Moreover, for my problem statement TIME SERIES-BASED ELECTRICITY CONSUMPTION. I have collected the dataset from the Company. I pre-processed my data. My dataset consists of two attributes.

CHAPTER- 3

TECHNOLOGY ADOPTED

3.1. TIME SERIES

Time series forecasting in machine learning is the use of algorithms to predict future values or patterns based on historical data ordered chronologically.

3.2. MACHINE LEARNING

Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and makedecisions with minimal human intervention.

3.3. TOOLS USED

3.3.1. PYTHON

Python is a general-purpose interpreted, interactive, object-oriented, and high level programming language

3.3.2. JUPYTER NOTEBOOK

JupyterLab is a web-based interactive development environment for Jupyter notebooks, code, and data. JupyterLab is flexible: configure and arrange the user interface to support a wide range of workflows in data science, scientific computing, and machine learning.

3.3.3. PYTHON LIBRARIES

- **Pandas** is a fast, powerful, flexible and easy to use open-source data analysis and manipulation tool, built on top of the Python programming language.

- **Scikit-learn** is a popular machine learning library in Python that provides a comprehensive set of tools for data preprocessing, model selection, training, and evaluation, offering a wide range of algorithms and functionalities for various machine learning tasks. It is widely used for classification, regression, clustering, and dimensionality reduction, making it a versatile and powerful tool for implementing machine learning algorithms.

- **Prophet** is a time series forecasting library developed by Facebook that offers intuitive and efficient forecasting models.

- **Statsmodels** is a comprehensive statistical modeling library in Python that provides a wide range of statistical models and methods for data analysis and inference.

3.4. MODEL USED

3.4.1. TIME SERIES MODELING

Choose an appropriate time series model such as ARIMA and c, and fitted it to the data.

ARIMA: (Auto Regressive Integrated Moving Average) is a statistical method for time series analysis. It models the dependencies in the data and can be used for forecasting future values. ARIMA combines three components:

1. Auto regression (AR)
2. Differencing (I)
3. Moving Average (MA)

Prophet: The prophet model is a time series forecasting model developed by Facebook. It decomposes the time series into trend, seasonality, and holiday components and uses a Bayesian approach to generate future forecasts. Prophet is designed to be user-friendly and can handle missing data, outliers, and changes in trend and seasonality.

CHAPTER- 4

SOLUTION FOR THE PROBLEM

4.1 TIME SERIES BASED ELECTRICITY CONSUMPTION

Dataset contains: 4993 records and 2 attributes. The description of the columns is given below:

- Date-time
- Megawatt

I have imported the necessary libraries required for my work. Imported the dataset using pandas library. I checked is there any noisy data in the dataset and clear all the noisy data. The input features are then used to train the different machine learning models. Each dataset is divided into training and testing set.

After training the dataset predict the dependent variable using time series modeling. Total record of the dataset is 4993. After creating the model, the prediction is been done to find the accuracy of the model. Train-test-split used for the evaluation and it is a technique for evaluating the performance of a machine learning algorithm.

CHAPTER- 5

WORKFLOW

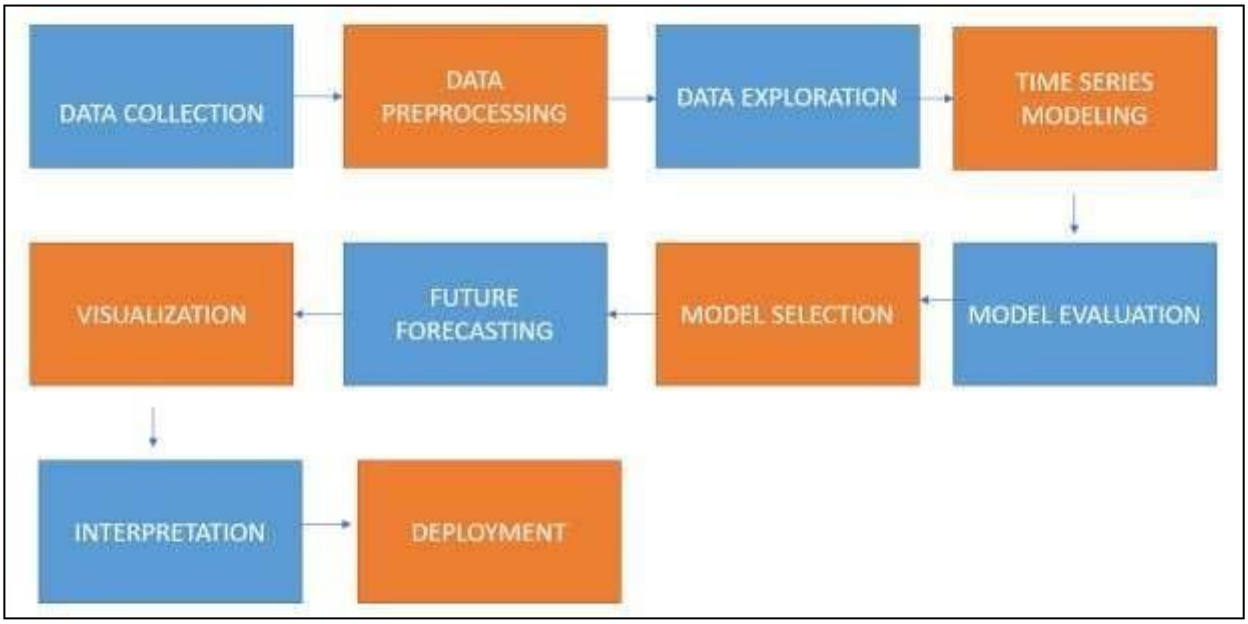

Figure 5.1 Workflow

5.1. Data collection:

Gather historical data on electricity consumption from trustworthy sources, with the potential to utilize IOT devices for data collection in this project.

The dataset consists of 2 attributes with the dimensions of **4993*2**. The Attributes areDate-time and Kilowatt.

5.2. Data preprocessing:

Clean the data by removing any outliers, missing values, or errors. Transform the data into a stationary time series if required.

To preprocess the data, the following procedures are implemented:

- **Missing data**

  Dealing with Missing Data upon examining the dataset, it was determined that there are no missing values present.

- **Converting to Suitable Data Types**

The date-time attribute was initially identified as an object variable. Therefore, it was transformed into the appropriate Date-time data type.

5.3. Data Exploration:

Analyze the data to identify any trends, seasonality, or patterns in electricity consumption.

Summary	
Count	4993
Mean	17741.7825
Std	4672.601868
Min	9590
25%	13680
50%	17741
75%	21779
Max	25692

5.4. Time series modeling:

Select an appropriate model for time series analysis, such as ARIMA and Prophet, and apply it to the data.

ARIMA, which stands for Auto Regressive Integrated Moving Average, is a statistical technique used for analyzing time series data. It captures dependencies in the data and is effective for forecasting future values. ARIMA combines three components: Auto regression (AR), Differencing (I), and Moving Average (MA), allowing it to capture various patterns in the data.

Prophet, developed by Facebook, is a time series forecasting model. It decomposes the time series into trend, seasonality, and holiday components and utilizes a Bayesian approach to generate future forecasts. Prophet is user-friendly, accommodating missing data, outliers, and changes in trend and seasonality.

5.5. Model assessment:

Assess the model's performance by employing metrics like Mean Absolute Error (MAE), Mean Squared Error (MSE), or Root Mean Squared Error (RMSE).

5.5.1. Mean Squared Error (MSE):

This metric calculates the average of the squared differences between the predicted values and the actual values. A lower MSE indicates better model performance.

5.5.2. Root Mean Squared Error (RMSE):

Derived from the MSE, this metric is the square root of the MSE. It is commonly used to evaluate ARIMA models.

5.5.3. Mean Absolute Error (MAE):

This metric determines the average of the absolute differences between the predicted values and the actual values. MAE is another commonly used evaluation metric for ARIMA models.

5.6. Model selection:

Select the most effective model based on the evaluation metrics.

5.6.1. AIC:

The Akaike Information Criterion (AIC) is a statistical measure utilized for model selection. It balances the goodness of fit of the model with the number of parameters employed. AIC is calculated as $2k - 2\ln(L)$, where k represents the number of parameters and L is the likelihood function.

5.6.2. BIC:

The Bayesian Information Criterion (BIC) is another statistical measure employed for model selection. It is similar to AIC but imposes a stronger penalty on models with a higher number of parameters. BIC is calculated as -2ln(L) + kln(n), where k denotes the number of parameters, L represents the likelihood function, and n is the sample size.

5.7. Future forecasting:

Future forecasting in time series refers to the practice of projecting future values of a variable based on its past behavior. Time series forecasting, a statistical method, is employed to analyze and model time series data, which comprises observations collected repeatedly over time. By identifying patterns and trends in the historical data, time series forecasting aims to utilize this knowledge to anticipate future values.

Various techniques can be used for forecasting time series data, including statistical models like ARIMA, exponential smoothing, or machine learning algorithms such as deep learning or random forests. These techniques leverage historical observations and relevant data to predict future values of the time series. The accuracy of time series forecasting is influenced by several factors, including the quality and quantity of the provided data, the chosen forecasting method, the forecast horizon, and the underlying assumptions and data conditions.

Finally, apply the selected model to forecast electricity consumption for future periods.

5.8. Visualization:

Visualizations play a crucial role in comprehending and interpreting time series data as they facilitate the identification of patterns, trends, and anomalies, providing valuable insights for decision-making purposes. Various visualization techniques are commonly employed in time series analysis, with the line chart being the most popular choice. Line charts portray the time series values over time, utilizing the x-axis for time and the y-axis for the relevant variable.
This visualization style is effective in detecting outliers or unexpected changes as it can highlight trends and patterns in the data. In this project, the forecasted values were visualized and compared with the actual data to detect any disparities or inconsistencies.

5.9. Interpretation:

To comprehend how a variable evolves over time, one must interpret time series data using the following essential methods:

1. Identify Trends: Start by detecting patterns within the time series, such as vertical, horizontal, or mixed trends. An upward trend indicates the variable is rising over time, a downward trend signifies a decrease, and a horizontal trend implies stability.
2. Analyze Seasonality: Identify predictable cycles or patterns that repeat over specific periods, such as daily, weekly, monthly, or annually. Discovering seasonality aids in recognizing recurring patterns within the defined time intervals.
3. Detect Outliers: Look for values that significantly deviate from the rest of the data. Outliers may result from unforeseen events or measurement errors. Understanding the impact of outliers on overall trends and seasonality is crucial.
4. Assess Stationary: Stationary refers to the statistical characteristics of a time series that remain consistent over time. It involves having constant autocorrelation structure, mean, and variance. Stationary enables the use of specialized statistical techniques designed for stationary data.
5. Evaluate Forecasts: Once a model has been fitted to the time series data, it's important to assess the accuracy of the forecasts. Metrics such as mean squared error (MSE) mean absolute error (MAE), and mean absolute percentage error (MAPE) can be utilized to gauge forecast precision and identify areas for improvement.

Carefully examining patterns, seasonality, outliers, and forecast accuracy is crucial when interpreting time series data. These actions provide valuable insights into the behavior of the variable over time. Finally, analyze the results and draw conclusions regarding electricity consumption patterns and trends.

5.10. Deployment:

Deploy the final model in production to generate reliable electricity consumption forecasts for decision-making purposes.

CHAPTER- 6

SUMMARY OF FINDINGS

➢ The dataset consists of 4993 observations.

➢ The target variable (kilowatt) has an average (mean) value of 17741.7825.

➢ The standard deviation of the target variable is 4672.601868, indicating a moderate level of variability in the data.

➢ The minimum value of the target variable is 9590, while the maximum value is 25692, indicating a wide range of values.

➢ The 25th percentile of the target variable is 13680, indicating that 25% of the observations have kilowatt values below this threshold.

➢ The 50th percentile (median) of the target variable is 17741, showing that half of the observations have kilowatt values below this value.

➢ The 75th percentile of the target variable is 21779, meaning that 75% of the observations have kilowatt values below this threshold.

➢ In this project, the ARIMA model achieved an MAE value of 4142.1, indicating that, on average, its predictions deviate from the actual values by approximately 4142.1 units. A lower MAE value signifies a better fit of the model to the data.

➢ The Prophet model, on the other hand, produced an MAE value of 4144.1, meaning that its predictions, on average, deviate from the actual values by about 4144.1 units. Similarly, a lower MAE value indicates a better fit of the model to the data.

CHAPTER- 7
CONCLUSION

In conclusion the application of time series based electricity consumption; the model applied is ARIMA model to analyze time series data on electricity consumption and generated predictions for future electricity usage. The following process involves:

1. Importing the necessary libraries and loading the data.
2. Conducting data cleaning tasks such as converting the index to date-time, checking for missing values, and resampling the data to a 15-minute interval.
3. Splitting the data into training and testing sets and fitting the ARIMA model to the training data.

After the model was fitted, the following actions done

1. Making predictions on the testing data and evaluating the model's performance using metrics like mean absolute error (MAE), mean squared error (MSE), and root mean squared error (RMSE). The obtained MAE value of 4142.1 indicated the average absolute difference between the predicted and actual values.
2. Assessing the model's overall performance, which was deemed satisfactory as the MAE was lower than the standard deviation of the data.

Thus, the ARIMA model proved to be a suitable approach for predicting future electricity consumption, offering valuable insights for energy companies to plan ahead, anticipate demand, and adjust their operations accordingly.

REFERENCES

1. https://towardsdatascience.com/time-series-forecasting-with-machine-learning b3072a5b44ba?gi=97f5661f25cd

2. https://www.analyticsvidhya.com/blog/2021/10/a-comprehensive-guide-to-time-series-analysis/

3. https://docs.aws.amazon.com/forecast/latest/dg/aws-forecast-recipe-prophet.html

4. https://neptune.ai/blog/arima-vs-prophet-vs-lstm

ANNEXURE

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

from statsmodels.tsa.arima.model import ARIMA

from sklearn.metrics import mean_absolute_error, mean_squared_error



# Load the dataset

dataset = pd.read_excel("data_electricity.xlsx", parse_dates=['datetime'],
index_col='datetime')
dataset.head()

dataset = dataset.sort_values('datetime')



# split into train and test
cutoff_date = '2023-03-01'
train = dataset[dataset.index < cutoff_date] test =
dataset[dataset.index >= cutoff_date]print(train)
print(test)



# Train the ARIMA model

model = ARIMA(train, order=(2, 1, 2)) # (p,d,q) = (2,1,2)model_fit
= model.fit()


# Make predictions on the testing data

 predictions = model_fit.predict(start=test.index[0], end=test.index[-1],dynamic=False)
```

```
# Print the predicted values
print(predictions)
test = test.drop('kilowatt',axis=1)


# Make predictions on the testing set

predictions = model_fit.forecast(steps=len(test))[1]
print(predictions)

# Evaluate the performance of the model using MAE, MSE, and RMSEmae =
mean_absolute_error(test, predictions)
mse = mean_squared_error(test, predictions)rmse =
np.sqrt(mse)
print("MAE: ", mae)

print("MSE: ", mse)

print("RMSE: ", rmse)
n_steps = 10
forecast = model_fit.forecast(steps=n_steps)


# Print the predicted values

print("Predicted values for the next {} steps: {}".format(n_steps, forecast[0]))


# Forecast future values
forecast = model_fit.forecast(steps=50)[0]


# Convert to DataFrame

forecast_df = pd.DataFrame(forecast, index=pd.date_range(start='2023-03-2500:00:00',
periods=25, freq='24H'), columns=['forecasted_kilowatt'])
```

```
# Print the forecasted values
print(forecast_df)

#Prophet Model

from fbprophet import Prophet
model = Prophet()
model.fit(dataset)
model.component_modes
future_dates = model.make_future_dataframe(periods=60)
future_dates
prediction = model.predict(future_dates)
model.predict_trend
model.plot(prediction)
```