Tech Saksham

Case study Report

Data Analytics with Power BI

"Analysis of Commercial Electricity Consumption in Indian States"

"Thiruvalluvar college"

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ABSTRACT

This paper focuses on using big data analytics to analyze the electricity consumption patterns of 500 consumers(residential) in a particular area over 24 months. The data was obtained from MESB and analyzed to understand the trends in consumption better. The analysis was used to create visualizations and graphs that helped to identify the consumption patterns of individual users as well as the overall trends in the area. Using the Power BI tool, a dashboard is created to showcase the results. The dashboard provides valuable information such as the top 10 consumers and average consumption values by user. This information can be used by utility companies to identify areas where consumption is high and to develop strategies to reduce overall electricity consumption. This study demonstrates the value of big data analytics in understanding complex patterns and identifying opportunities for energy savings.

Keywords: Consumption, Analytics, Electricity, Visualizations

CHAPTER 1

INTRODUCTION

Problem Statement

Currently, electricity is used in every home for various tasks, including watching television, charging smartphones, using an electric light bulb, and other things. Electricity has become an essential part of our daily life. It powers our homes, businesses, and industries, and has enabled us to achieve unprecedented levels of comfort, convenience, and productivity. However, this growing dependence on electricity has led to a significant increase in its consumption, placing enormous pressure on energy resources and the environment. As a result, it has become imperative to analyze and control the supply and demand of electricity, to ensure its sustainable use and reduce the impact of its production on the environment. In recent years, there has been a noticeable rise in electricity consumption, driven by the increasing use of electronic devices, appliances, and industrial machinery. This trend is expected to continue in the coming years, with the growth of emerging markets and the adoption of new technologies, such as electric vehicles and renewable energy systems. To meet the growing electricity demand, utility companies are exploring new ways to optimize energy production and distribution, while minimizing waste and reducing emissions.

Proposed Solution

To achieve this goal, big data analytics has emerged as a promising tool for analyzing electricity consumption patterns and identifying opportunities for energy savings. By analyzing large volumes of data generated by smart meters and other monitoring devices, utility companies can gain insights into the behavior of individual consumers, as well as the overall trends in consumption. This information can be used to develop targeted strategies for reducing energy use, promoting energy efficiency, and managing peak demand. The paper aims to present a study on the electricity consumption patterns of 500 residential consumers in a particular area over 24 months, using big data analytics. The data was obtained from the MSEB and analyzed to identify trends in consumer behavior.

Feature

- Real-Time Analysis: The dashboard will provide real-time analysis of electricity consumption data.
- Customer Segmentation: It will segment customers based on various parameters like dates, usage, latitude, longitude etc.
- Trend Analysis: The dashboard will identify and display trends in electricity consumption.
- Predictive Analysis: It will use historical data to predict future electricity consumption.

Advantages

- Data-Driven Decisions: Government can make informed decisions based on real-time data analysis.
- Improved Engagement: Understanding electricity consumption and trends can help govt. engage with their consumption of electricity more effectively.
- Increased Revenue: By identifying consumption rate for Wind energy and Water energy, govt. can increase their revenue.

Scope

Some studies use a top-down methodology for estimating electricity demand based on its relationship (regression equations or elasticity factors) with macroeconomic variables (Saxena, Gopal, Ramanathan, & al, 2017). However, this approach is limited with regards to addressing the transformational aspects of such relationships over a longer horizon, since electricity requirement is in effect obtained as either a second or third order effect from changes in macroeconomic factors.1 It follows that all-encompassing variables like GDP or sectoral value additions will fail to account for dynamism in new economic activities, service demands, technologies, policies, and institutional frameworks, that in turn play a more direct role in determining level, composition and growth of demand. Hence, the role of choice and innovation in the technology-policy space needs to be factored in order to translate changes in macroeconomic variables into service demands and finally into electricity demand.

CHAPTER 2

SERVICES AND TOOLS REQUIRED

2.1 Services Used

- Data Collection and Storage Services: Electricity consumption of Indian states is collected from various industrial sectors consuming the power and the energy production resources are also collected and stored in cloud.

- Data Processing Services: Services like Azure Stream Analytics or AWS Kinesis Data Analytics can be used to process the real-time data.

- Machine Learning Services: Azure Machine Learning or AWS Sage Maker can be used to build predictive models based on historical data.

2.2 Tools and Software used

Tools:

- Power BI: The main tool for this project is Power BI, which will be used to create interactive dashboards for real-time data visualization.
- Power Query: This is a data connection technology that enables you to discover, connect, combine, and refine data across a wide variety of sources.
- Software Requirements:
- Power BI Desktop: This is a Windows application that you can use to create reports and publish them to Power BI.
- Power BI Service: This is an online SaaS (Software as a Service) service that you use to publish reports, create new dashboards, and share insights.
- Power BI Mobile: This is a mobile application that you can use to access your reports and dashboards on the go.

CHAPTER 3

PROJECT ARCHITECTURE

3.1 Architecture

Here's a high-level architecture for the project:

- Data Collection: Gather energy consumption data from various sources, such as smart meters, sensors, or utility bills. Ensure that the data is accurate and covers a suitable timeframe for analysis.
- Data Storage: Data storage is the retention of information using technology specifically developed to keep that data and have it as accessible as necessary. Data storage refers to the use of recording media to retain data using computers or other devices.
- Data Processing: It is a process of standardizing how an organization collects, stores, transforms, distributes, manages, and uses data. The end-goal of data architecture is to deliver relevant data so that stakeholders can leverage it to make strategic decisions and enhance business processes.
- Machine Learning: Predictive models are built based on processed data using Azure Machine Learning or AWS Sage Maker. These models can help in predicting customer behavior, detecting fraud, etc.
- Data Visualization: Power BI offers a wide range of interactive visualizations, including charts, graphs, maps, tables, and custom visuals. These visualizations help in presenting data in a visually appealing and meaningful way, making it easier to understand and analyze.
- Data Access: The dashboards created in Power BI can be accessed through Power BI Desktop, Power BI Service (online), and Power BI Mobile.

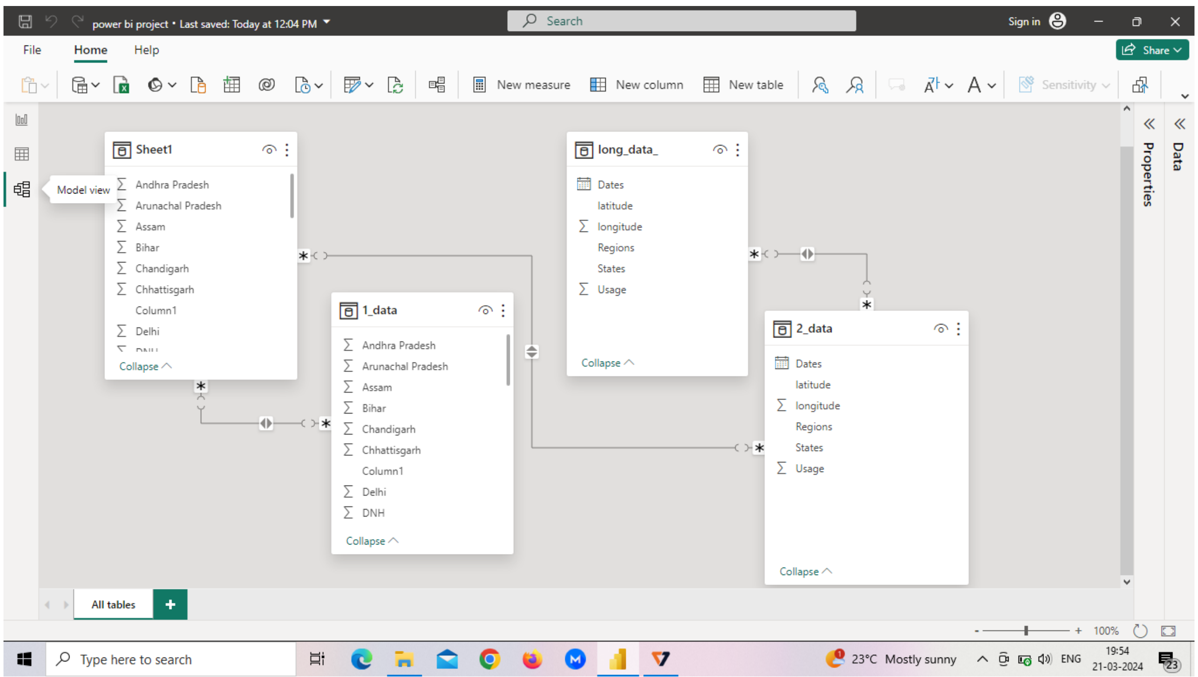
This architecture provides a comprehensive solution for real-time analysis of power consumption. However, it's important to note that the specific architecture may vary depending on the electricity's existing infrastructure, specific requirements, and budget. It's also important to ensure that all tools and services comply with relevant data privacy and security regulations

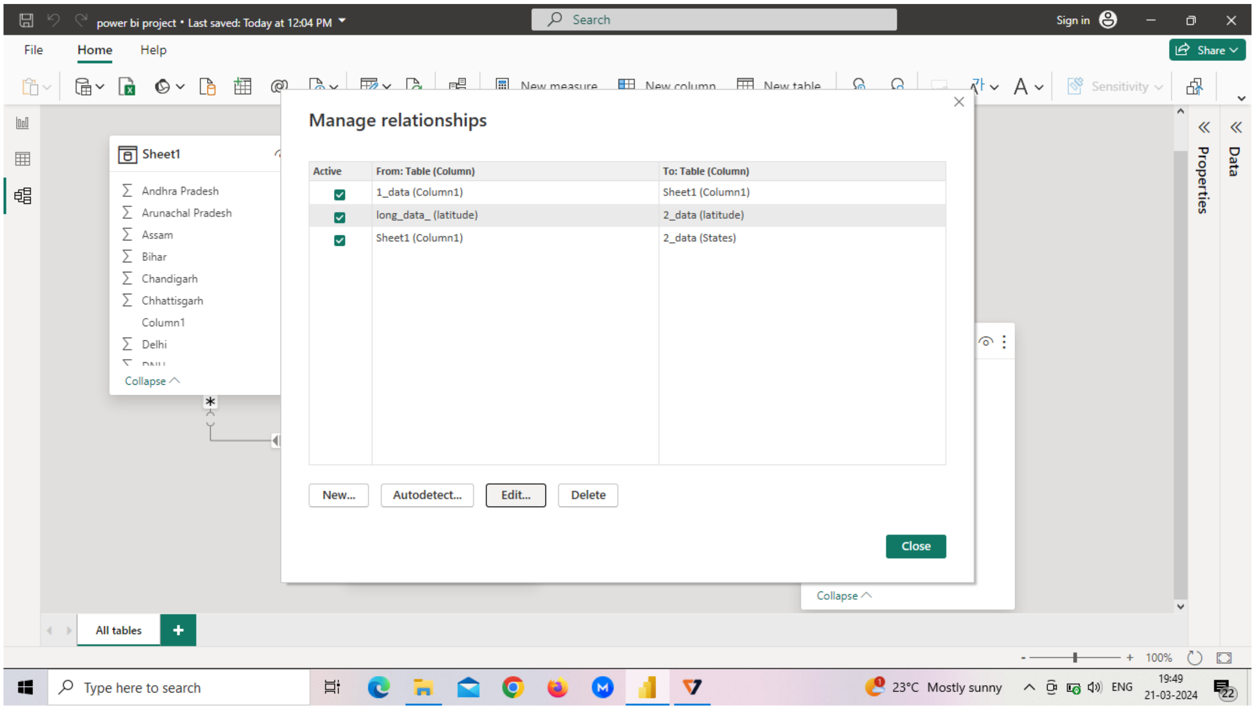
CHAPTER 4

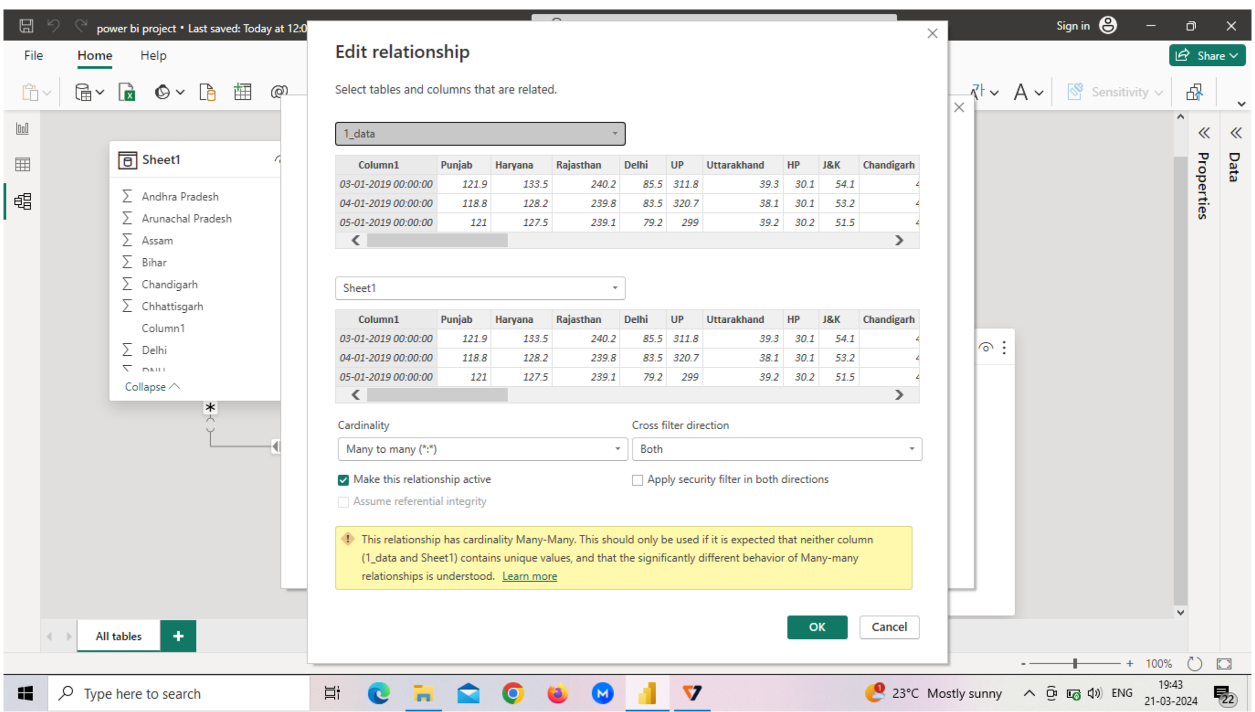
MODELING AND RESULT

Manage relationship

The "1_data" file will be used as the main connector as it contains most key identifier (Column 1) which can be use to relates the 4 data files together. The "long_data" file is use to link the client profile geographically with "Dates".

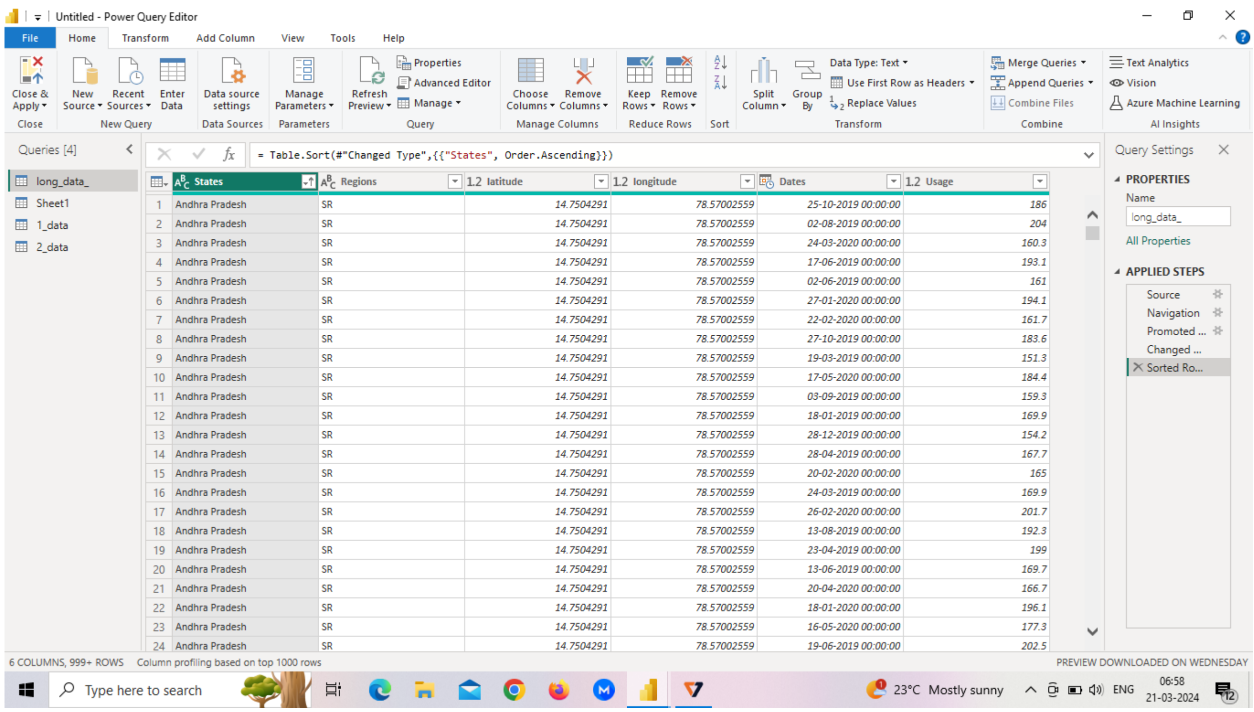



power bi project • Last saved: Today at 12:04 PM
Search
Sign in
File
Home
Help
New measure
New column
New table
Sensitivity
Share
Manage relationships
Active
From: Table (Column)
To: Table (Column)
1_data (Column1)
Sheet1 (Column1)
long_data_ (latitude)
2_data (latitude)
Sheet1 (Column1)
2_data (States)
New...
Autodetect...
Edit...
Delete
Close
Sheet1
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Column1
Delhi
Collapse
Properties
Data
All tables
Type here to search
23°C Mostly sunny
ENG
19:49
21-03-2024

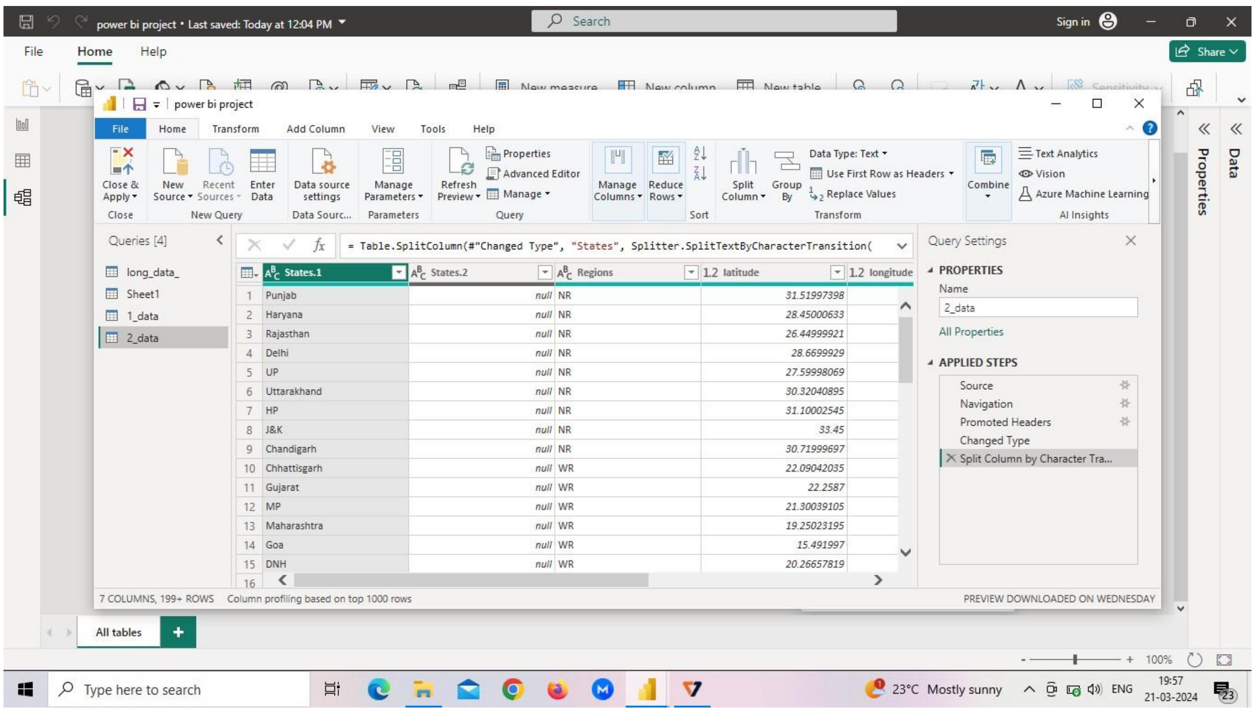

Edit relationship
Select tables and columns that are related.
1_data
Column1 Punjab Haryana Rajasthan Delhi UP Uttarakhand HP J&K Chandigarh
03-01-2019 00:00:00 121.9 133.5 240.2 85.5 311.8 39.3 30.1 54.1
04-01-2019 00:00:00 118.8 128.2 239.8 83.5 320.7 38.1 30.1 53.2
05-01-2019 00:00:00 121 127.5 239.1 79.2 299 39.2 30.2 51.5
Sheet1
Column1 Punjab Haryana Rajasthan Delhi UP Uttarakhand HP J&K Chandigarh
03-01-2019 00:00:00 121.9 133.5 240.2 85.5 311.8 39.3 30.1 54.1
04-01-2019 00:00:00 118.8 128.2 239.8 83.5 320.7 38.1 30.1 53.2
05-01-2019 00:00:00 121 127.5 239.1 79.2 299 39.2 30.2 51.5
Cardinality
Many to many (*:*)
Cross filter direction
Both
Make this relationship active
Apply security filter in both directions
Assume referential integrity
This relationship has cardinality Many-Many. This should only be used if it is expected that neither column (1_data and Sheet1) contains unique values, and that the significantly different behavior of Many-many relationships is understood. Learn more
OK
Cancel
Type here to search
23°C Mostly sunny
ENG
19:43
21-03-2024

Modeling for Date and consumption data

Notice that the Dates and usage of the consumption of electricity are there in the datasets by not sorted, so by using the ascending command, it is been sorted in ascending order.T he states are sorted in ascending order to find the highest consumption state and the usage of it.

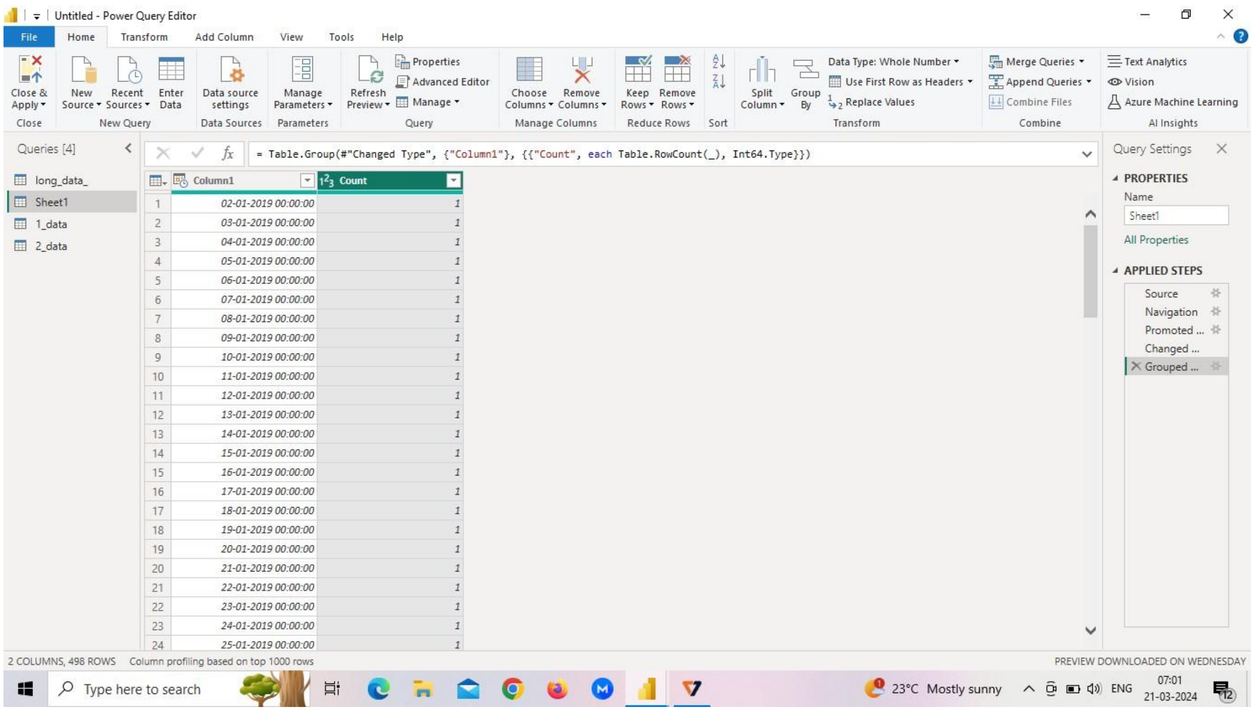


Then split column by dates and states. Refer to applied steps for details.

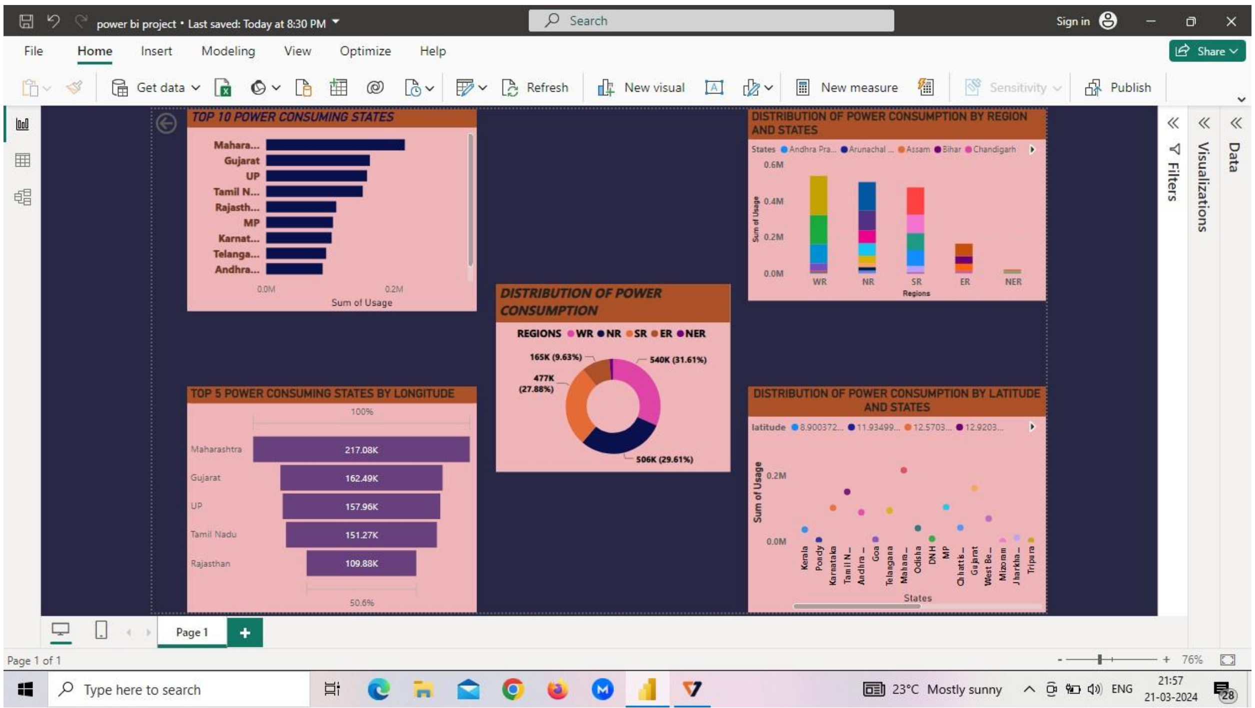


Grouping of age by ranges

As the States ranges from 0 to 29 , we shall group them into different state range for easier profiling, we will group the states with the value of median**.**



DASHBOARD



power bi project • Last saved: Today at 8:30 PM
TOP 10 POWER CONSUMING STATES
DISTRIBUTION OF POWER CONSUMPTION
DISTRIBUTION OF POWER CONSUMPTION BY REGION AND STATES
TOP 5 POWER CONSUMING STATES BY LONGITUDE
DISTRIBUTION OF POWER CONSUMPTION BY LATITUDE AND STATES

CONCLUSION

In conclusion, our research paper has successfully developed a consumption and prediction model that can be utilized to forecast electricity consumption for the next few months. The model, developed using the Prophet algorithm, has shown reasonable forecasting accuracy, which can be used to draw inferences about the demand-side increase and to help bolster the supply side of the equation. We have also developed a dashboard using the Power BI tool that can provide insights into the electricity consumption patterns, such as the top 10 consumers, the top 5 values and counts of months by year and users, and the average values by user. These insights can be leveraged to strategize policies and optimize energy usage in homes. Although the current model has been developed using a limited dataset, we have shown that it can perform even better with more data. Overall, our research provides a strong foundation for future studies on electricity consumption prediction and optimization.

FUTURE SCOPE

Future scenarios of sectoral value-added and overall and per capita GDP, are used to determine service demands in certain sectors, that in turn determine the employment of various appliances and equipment to convert electricity into end-use services(such as water pumped, steel produced, lighting and air conditioning, etc.). The government over successive years has prioritised the manufacturing sector to draw surplus labor from primary activities and enhance growth, productivity and meaningful employment. This has reflected in the National Manufacturing Policy (NMP) as well as the more recently launched Make in India (MII) campaign. Among key priorities has been increasing the share of manufacturing from 16-17 percent at present to 25 percent of GDP (Bhattacharjee, 2015). If this is achieved by 2030, then industry will need to grow at 1.5 percentage points higher than overall GDP, assuming services retains its current 60 percent share.

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