DASHBOARD THROUGH R SHINY:

A REPORT

Data on State/UTs-wise Automatic Weather Stations (AWS) and Automatic Rain Gauges (ARG) (Source:data.gov.in)

Under the guidance of

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Submitted by -

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Acknowledgement

I would like to express my sincere gratitude to Professor Mitra for their invaluable guidance and exceptional teaching throughout the regression and statistical modeling course in R programming. The clarity and depth with which the professor conveyed complex statistical concepts, such as linear regression and modeling techniques, significantly enriched our understanding of data analysis. Their commitment to fostering a collaborative and engaging learning environment has been instrumental in enhancing our proficiency in R programming and statistical methodologies. Furthermore, I extend my appreciation for the insightful guidance provided during the course project, where we applied these principles to real-world datasets. This hands-on experience has not only strengthened our technical skills but has also instilled confidence in our ability to tackle complex data challenges. I am truly grateful for the professor's dedication to our academic growth and for equipping us with the knowledge and tools essential for meaningful contributions in the field of statistical modeling.

Introduction

The development of an R Shiny dashboard focused on State/UTs-wise Automatic Weather Stations (AWS) and Automatic Rain Gauges (ARG) in India brings statistical modeling to the forefront, offering a structured and insightful lens through which to explore and understand the intricacies of meteorological data. Statistical modeling is particularly relevant in this context due to the inherent complexity of weather patterns and the diverse array of variables influencing climatic conditions across different regions. By employing statistical techniques such as regression analysis, hypothesis testing, and spatial modeling, the dashboard aims to unravel meaningful relationships within the data, facilitating a deeper comprehension of weather phenomena. Through the lens of statistical modeling, the dashboard not only provides a comprehensive overview of meteorological trends but also enables users to make informed predictions, extrapolate patterns, and derive actionable insights crucial for decision-making in sectors like agriculture, disaster management, and environmental planning. The integration of statistical modeling within the R Shiny framework enhances the dashboard's ability to transform raw meteorological data into accessible, interactive visualizations, fostering a data-driven approach to understanding and addressing the complex dynamics of weather patterns at the State and UT levels in India.

Statistical Modeling and Regression through R

Descriptive statistics and regression analysis are fundamental components of statistical analysis in R, providing key insights into the characteristics and relationships within datasets. Let's explore each concept:

Descriptive Statistics:

Mean:

The mean, or average, is a measure of central tendency that represents the sum of all values divided by the number of observations. In R, you can calculate the mean using the **mean()** function.

```
# Calculate mean
mean_value <- mean(data_vector)
```

Median:

The median is the middle value of a dataset when it is sorted in ascending order. It is less sensitive to extreme values than the mean. In R, you can find the median using the **median()** function.

```
# Calculate median
median_value <- median(data_vector)
```

Min and Max:

The minimum (min) and maximum (max) values provide information about the range of the dataset. In R, you can obtain these values using the **min()** and **max()** functions, respectively.

```
# Calculate min and max
min_value <- min(data_vector) max_value <- max(data_vector)
```

Histogram:

A histogram is a graphical representation of the distribution of a dataset. It displays the frequencies of different intervals or bins. In R, you can create a histogram using the **hist()** function.

```
# Create a histogram
hist(data_vector, main = "Histogram", xlab = "Variable")
```

Regression Analysis:

Regression analysis is employed to model the relationship between one or more independent variables and a dependent variable. In R, the **lm()** function is commonly used for linear regression.

```
# Perform linear regression
```

```
lm_model <- lm(dependent_variable ~ independent_variable, data
= dataset)
```

The summary of the linear regression model provides insights into coefficients, significance levels, and goodness-of-fit statistics.

View regression model

```
summary summary(lm_model)
```

These statistical concepts form the backbone of data analysis in R, allowing researchers and analysts to summarize, visualize, and model data for a comprehensive understanding of underlying patterns and relationships. The versatility of R's statistical functionalities makes it a powerful tool for exploratory data analysis and hypothesis testing across various domains.

Background about topic

India's Diverse Weather Landscape

India is characterized by its diverse climate and weather patterns, owing to its vast geographical expanse and topographical variations. From the snow-capped Himalayan ranges in the north to the tropical climate in the south, the country experiences a wide range of climatic conditions. The monsoon, a crucial weather phenomenon, plays a pivotal role in shaping India's agriculture and ecosystems.

Importance of Weather Monitoring

Understanding and monitoring weather conditions are paramount for a country as agrarian and geographically diverse as India. Accurate weather information is essential for informed decision-making in agriculture, disaster management, and various sectors that are directly influenced by meteorological conditions.

Automatic Weather Stations (AWS) : Role of Automatic Weather Stations

Automatic Weather Stations (AWS) have emerged as indispensable tools in modern meteorology. These stations are equipped with sensors and instruments that automatically collect data on various meteorological parameters, including temperature, humidity, wind speed, and precipitation. AWS provides real-time data, enabling timely and accurate weather forecasts.

Implementation Across States and Union Territories

To bolster the country's meteorological infrastructure, India has deployed AWS across different States and Union Territories. These stations contribute significantly to enhancing the precision of weather forecasts, which is critical for sectors such as agriculture, aviation, and disaster preparedness.

Automatic Rain Gauges (ARG) for Precipitation Monitoring

In addition to AWS, Automatic Rain Gauges (ARG) play a vital role in monitoring precipitation patterns. These devices automatically measure and record rainfall, aiding in flood prediction, water resource management, and ecological studies.

Recent Government Initiatives

The Indian government has undertaken initiatives to modernize and expand the meteorological infrastructure. These initiatives focus on deploying advanced technologies, including AWS and ARG, to strengthen the country's capability in weather monitoring and prediction. Such efforts align with the broader goal of building a resilient and adaptive society in the face of changing climatic conditions.

In 2024, the Government of India (GOI) and the India Meteorological Department (IMD) continue to spearhead ambitious weather monitoring schemes. The Government of India, recognizing the integral role of weather information in various sectors, has continued to invest substantially in expanding the meteorological infrastructure. Collaborative efforts between governmental agencies, research institutions, and private stakeholders have facilitated the establishment of state-of-the-art Automatic Weather Stations (AWS) and Automatic Rain Gauges (ARG) throughout the country. This comprehensive network ensures the real-time collection of meteorological data, enabling precise weather forecasting, early warning systems for natural disasters, and informed decision-making in sectors like agriculture, water resource management, and disaster preparedness.

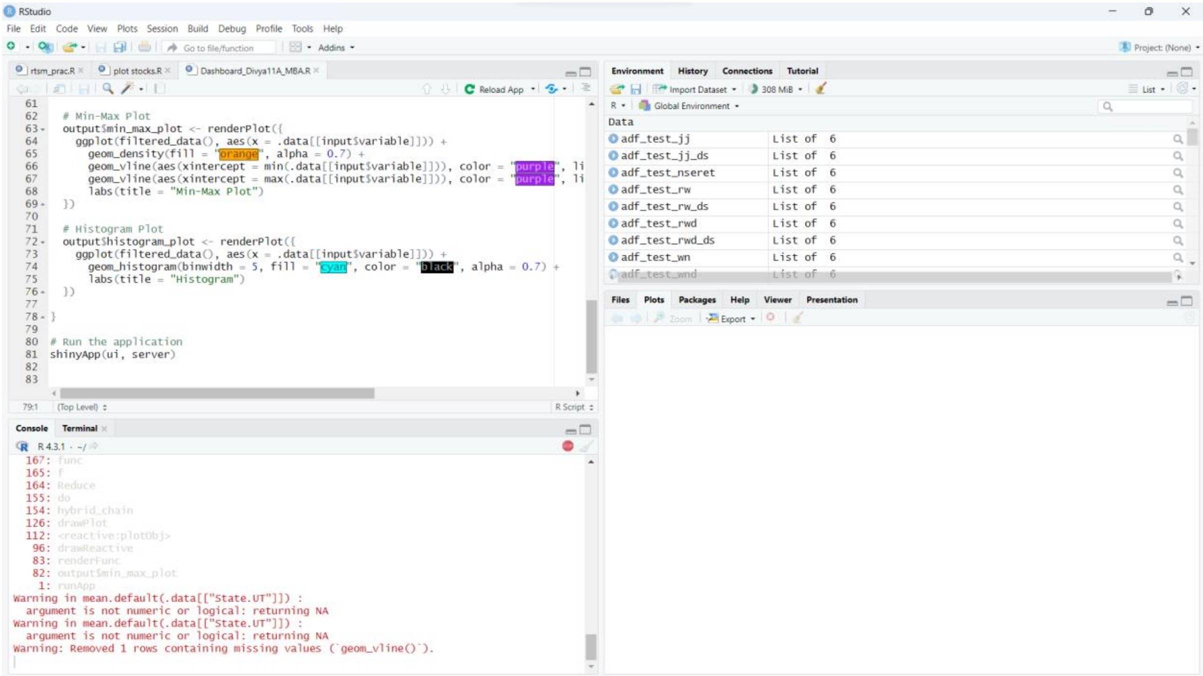
The IMD, as the primary agency responsible for weather forecasting and monitoring in India, has been at the forefront of these endeavors. Embracing advancements in technology, the IMD has integrated sophisticated tools and models for numerical weather prediction, enabling more accurate and extended-range forecasts. Additionally, the department has enhanced its observational capabilities through the deployment of state-of-the-art satellites and ground-based sensors, reinforcing India's position as a regional leader in meteorological research and services.

Furthermore, the weather monitoring schemes in 2024 underscore the commitment to bolstering climate resilience and adaptive capacity. ***The integration of machine learning, artificial intelligence, and data analytics in meteorological modeling enhances the precision of predictions, especially in the face of changing climatic conditions***. These initiatives align with the broader national agenda of sustainable development, disaster risk reduction, and building a resilient society capable of navigating the complexities of a dynamic climate.

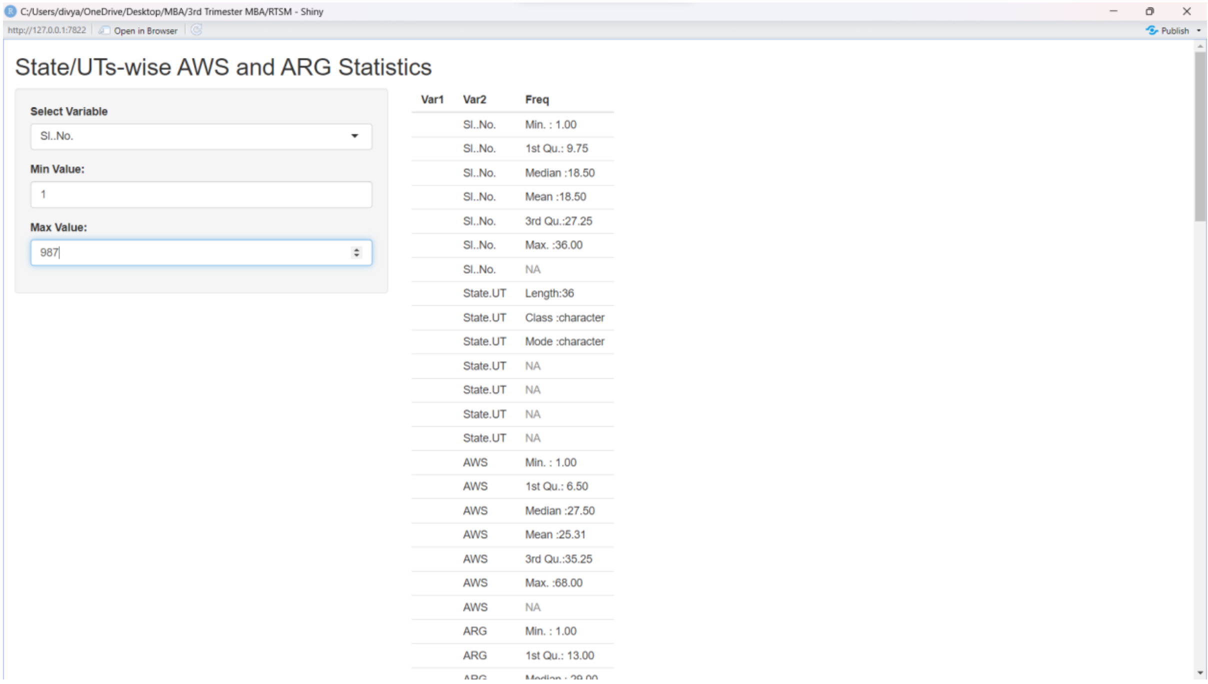
As India continues to experience the impacts of climate change, the GOI and IMD's forward-looking approach to weather monitoring reaffirms their dedication to leveraging the latest technologies to safeguard lives, livelihoods, and the environment. Through collaborative efforts and a holistic vision for meteorological advancements, these schemes stand as testament to India's proactive stance in addressing the challenges and opportunities posed by its diverse and ever-changing weather patterns.

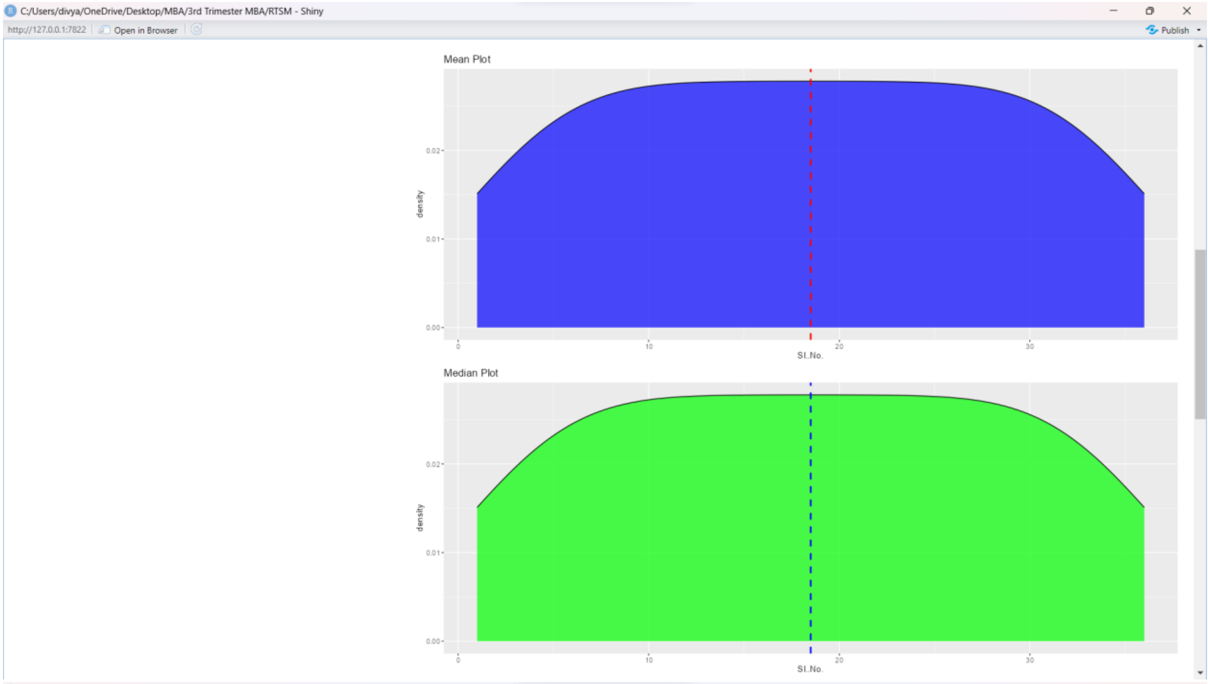
Code outputs

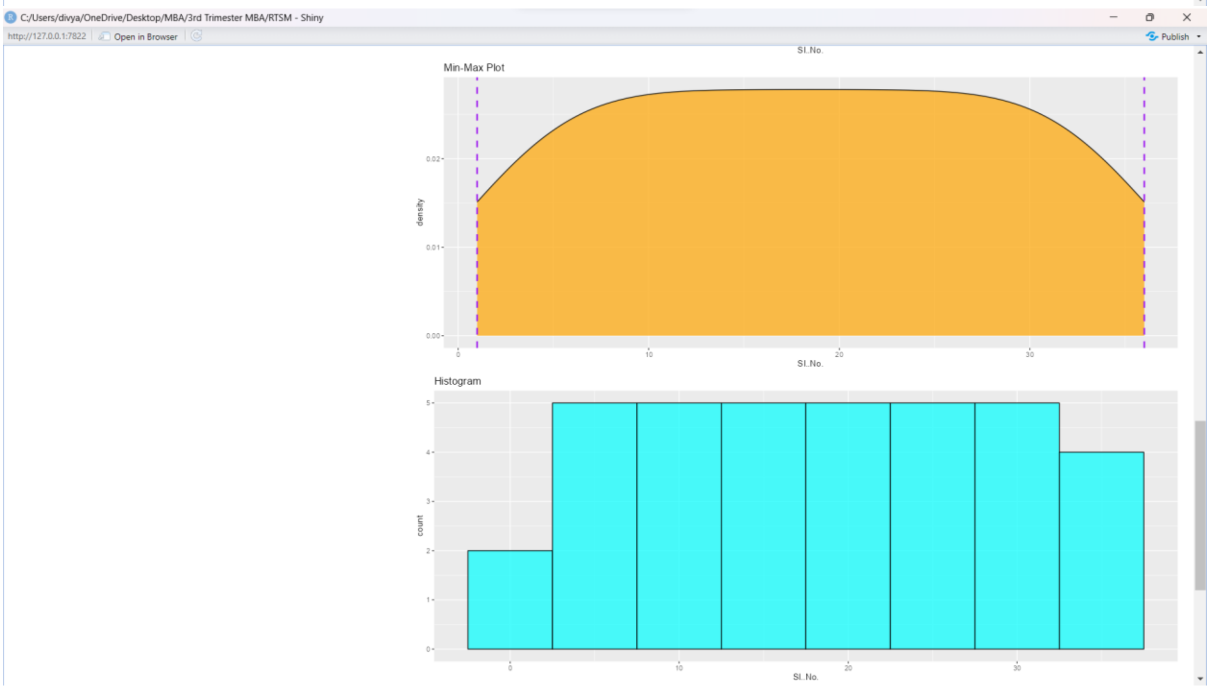
The code was executed on RStudio in the R language. Some snippets of the code in the environment:-



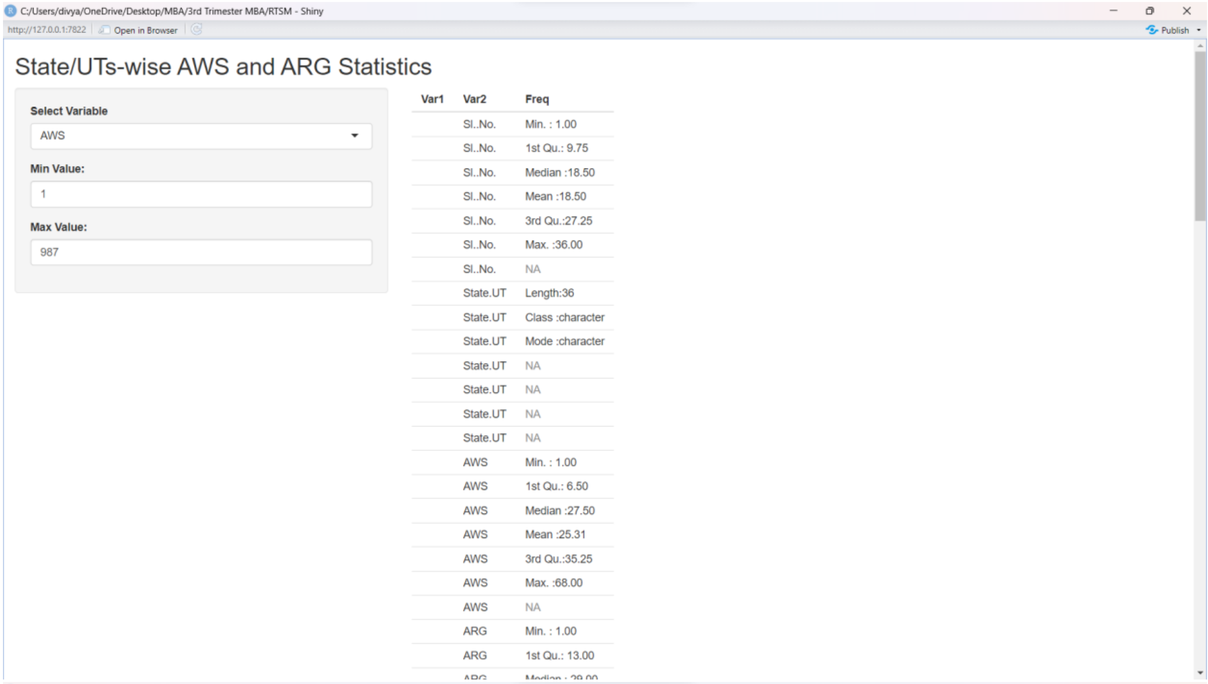
1. App UI



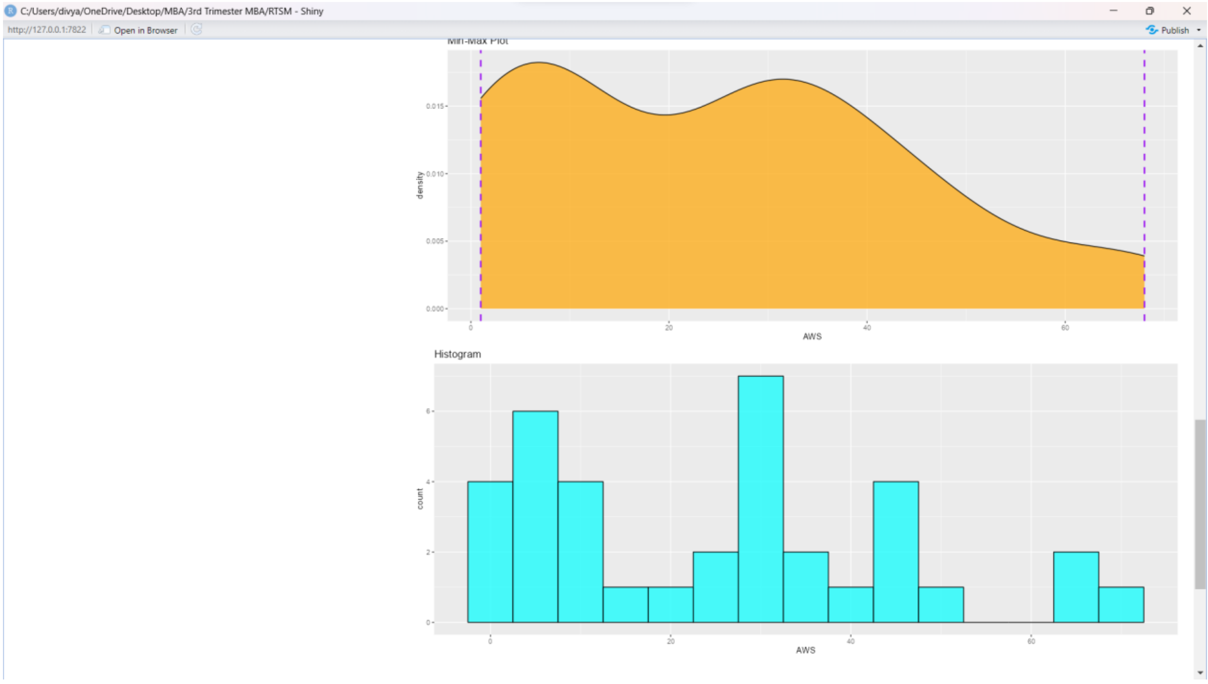

C:/Users/divya/OneDrive/Desktop/MBA/3rd Trimester MBA/RTSM - Shiny
http://127.0.0.1:7822
Open in Browser
Publish
Mean Plot
density
Sl..No.
Median Plot
density
Sl..No.


C:/Users/divya/OneDrive/Desktop/MBA/3rd Trimester MBA/RTSM - Shiny
http://127.0.0.1:7822
Open in Browser
Publish
Min-Max Plot
density
Sl..No.
Histogram
count
Sl..No.

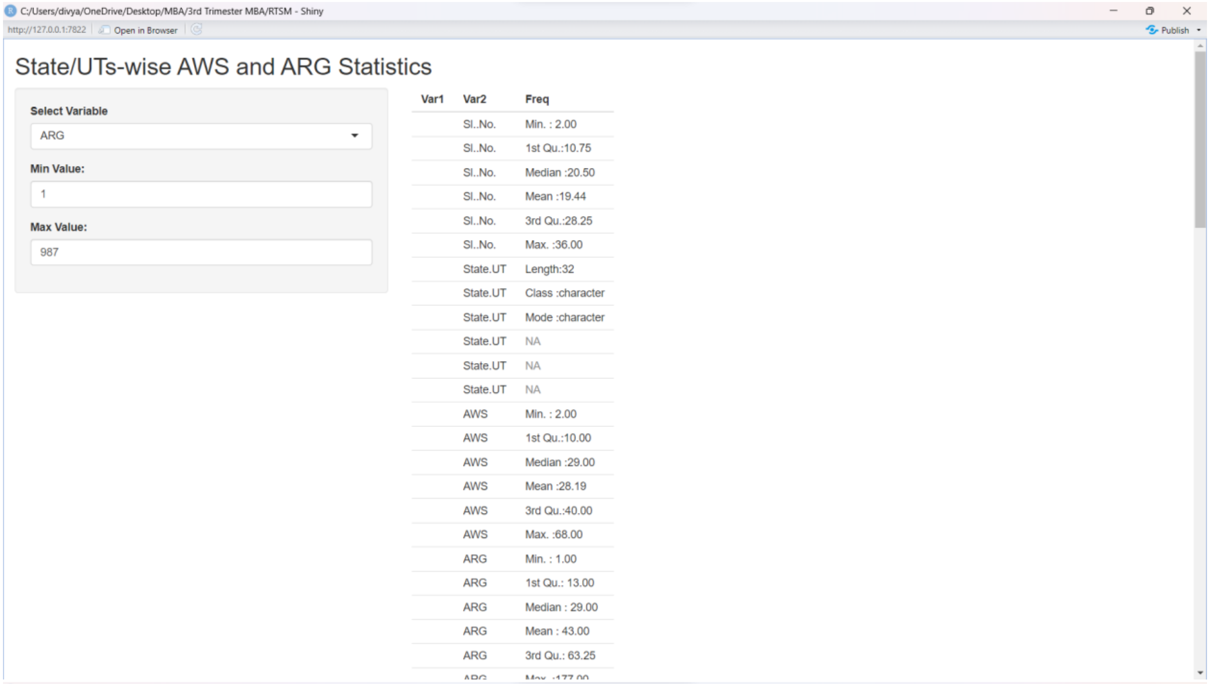
2. For AWS variable range selected 1 – 987

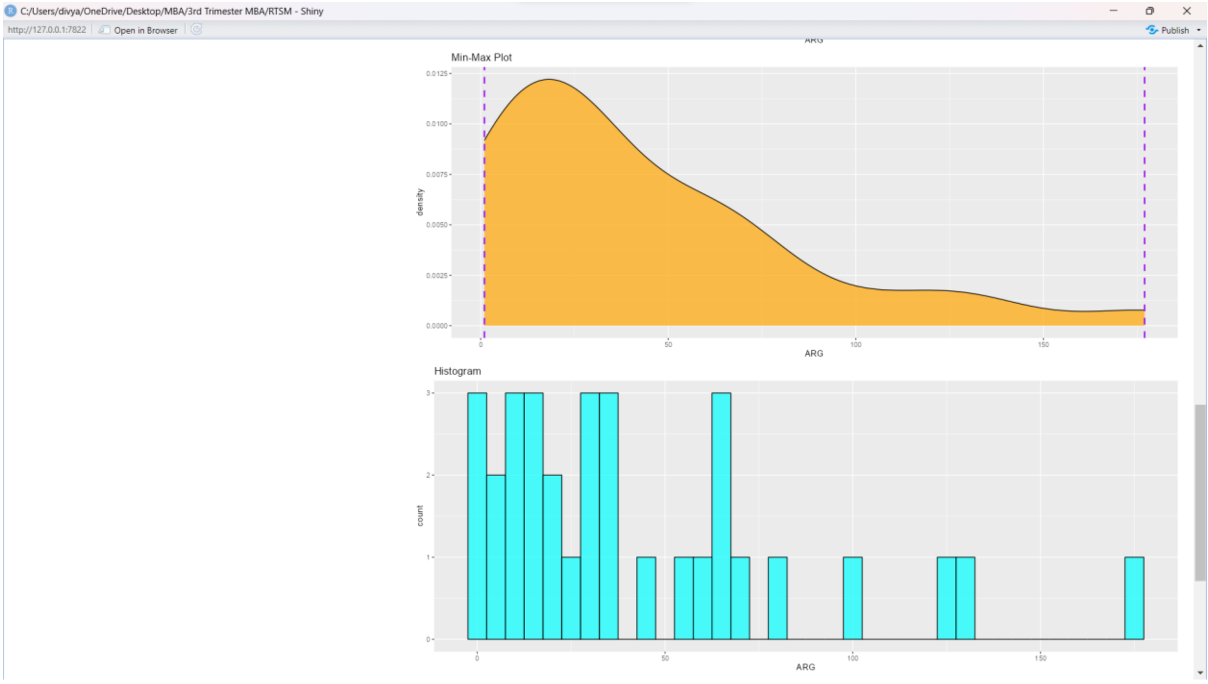


Var1	Var2	Freq
	Sl..No.	Min. : 1.00
	Sl..No.	1st Qu.: 9.75
	Sl..No.	Median :18.50
	Sl..No.	Mean :18.50
	Sl..No.	3rd Qu.:27.25
	Sl..No.	Max. :36.00
	Sl..No.	NA
	State.UT	Length:36
	State.UT	Class :character
	State.UT	Mode :character
	State.UT	NA
	State.UT	NA
	State.UT	NA
	State.UT	NA
	AWS	Min. : 1.00
	AWS	1st Qu.: 6.50
	AWS	Median :27.50
	AWS	Mean :25.31
	AWS	3rd Qu.:35.25
	AWS	Max. :68.00
	AWS	NA
	ARG	Min. : 1.00
	ARG	1st Qu.: 13.00



3. For ARG variable range selected 6 – 90



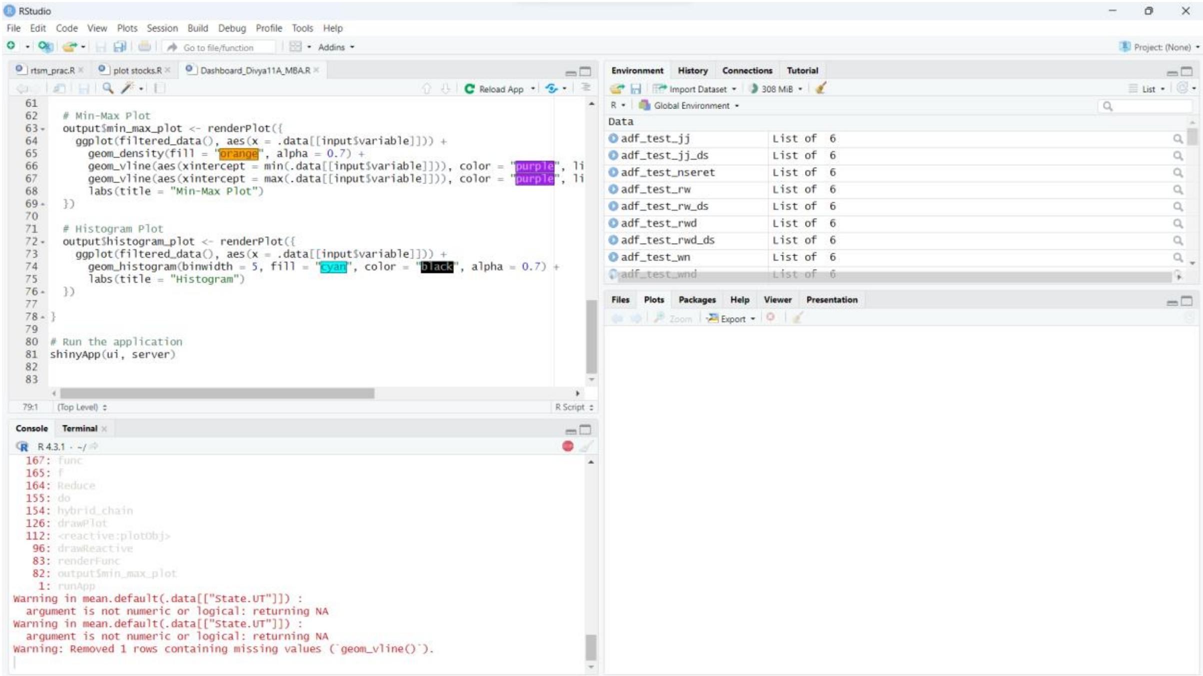


Bibliography

1. https://data.gov.in/resource/stateuts-wise-automatic-weather-stations-aws-and-automatic-rain-gauges-arg-reply-unstarred#api

Appendix A

Code (RStudio)



library(shiny)

library(ggplot2)

Load the CSV data

csv_data <- read.csv("C:/Users/divya/OneDrive/Desktop/MBA/3rd Trimester MBA/RTSM/RS_Session_255_AU_2113_1.csv")

UI

ui <- fluidPage(

titlePanel("State/UTs-wise AWS and ARG Statistics"),

sidebarLayout(

sidebarPanel(

selectInput("variable", "Select Variable", choices = names(csv_data)),

numericInput("min_value", "Min Value:", value = min(csv_data$variable), min = min(csv_data$variable), max = max(csv_data$variable)),

numericInput("max_value", "Max Value:", value = max(csv_data$variable), min = min(csv_data$variable), max = max(csv_data$variable)),

```
    ),
    mainPanel(
      tableOutput("summary_table"),
      plotOutput("mean_plot"),
      plotOutput("median_plot"),
      plotOutput("min_max_plot"),
      plotOutput("histogram_plot"),
      plotOutput("regression_plot")
    )
  )
)

# Server
server <- function(input, output) {

  # Filter data based on user input
  filtered_data <- reactive({
    variable <- input$variable
    min_value <- input$min_value
    max_value <- input$max_value

    filtered_data <- subset(csv_data, csv_data[[variable]] >= min_value & csv_data[[variable]]
<= max_value)
    return(filtered_data)
  })

  # Display descriptive statistics table
  output$summary_table <- renderTable({
    summary_stats <- summary(filtered_data())
    return(summary_stats)
```

```
  })

  # Mean Plot
  output$mean_plot <- renderPlot({
    ggplot(filtered_data(), aes(x = .data[[input$variable]])) +
      geom_density(fill = "blue", alpha = 0.7) +
      geom_vline(aes(xintercept = mean(.data[[input$variable]])), color = "red", linetype =
"dashed", size = 1) +
      labs(title = "Mean Plot")
  })

  # Median Plot
  output$median_plot <- renderPlot({
    ggplot(filtered_data(), aes(x = .data[[input$variable]])) +
      geom_density(fill = "green", alpha = 0.7) +
      geom_vline(aes(xintercept = median(.data[[input$variable]])), color = "blue", linetype =
"dashed", size = 1) +
      labs(title = "Median Plot")
  })

  # Min-Max Plot
  output$min_max_plot <- renderPlot({
    ggplot(filtered_data(), aes(x = .data[[input$variable]])) +
      geom_density(fill = "orange", alpha = 0.7) +
      geom_vline(aes(xintercept = min(.data[[input$variable]])), color = "purple", linetype =
"dashed", size = 1) +
      geom_vline(aes(xintercept = max(.data[[input$variable]])), color = "purple", linetype =
"dashed", size = 1) +
      labs(title = "Min-Max Plot")
  })
```

```
  # Histogram Plot
  output$histogram_plot <- renderPlot({
    ggplot(filtered_data(), aes(x = .data[[input$variable]])) +
      geom_histogram(binwidth = 5, fill = "cyan", color = "black", alpha = 0.7) +
      labs(title = "Histogram")
  })

}

# Run the application
shinyApp(ui, server)
```