DATA VISUALIZATION

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ABSTRACT
Climate change

Students

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1. Introduction

Climate change is one of the most pressing global issues of our time, characterized by long-term shifts in temperatures and weather patterns. These changes, largely driven by human activities such as the burning of fossil fuels, deforestation, and industrial processes, have profound impacts on natural ecosystems, human health, and economic activities. Understanding and addressing climate change requires comprehensive data analysis and visualization to identify trends, make informed decisions, and implement effective mitigation strategies.

In our project for the Data Visualization course, we focused on analyzing climate data from two distinct regions: the United States and Jordan. By examining weather patterns in these geographically and climatically diverse regions, we aimed to gain insights into how climate change manifests in different parts of the world.

2. Data Overview

2.1. Weather data in United Sates

The first dataset comprises weather data from various locations across the United States. The dataset includes weather data from 2016 to 2017 with 16744 records and 14 features. See table below.

US dataset

Key	Data Type
Data.Precipitation	Float
Date.Full	String
Date.Month	Integer
Date.Week of	Integer
Date.Year	Integer
Station.City	String
Station.Code	String
Station.Location	String
Station.State	String
Data.Temperature.Avg Temp	Integer
Data.Temperature.Max Temp	Integer
Data.Temperature.Min Temp	Integer
Data.Wind.Direction	Integer
Data.Wind.Speed	Float

Table I: Dataset description (US)

2.2. Weather data in Jordan

The second dataset comprises weather observations collected from three major cities in Jordan: Amman, Irbid, and Aqaba. The dataset provides comprehensive information on various meteorological parameters recorded over the period from 2008 to 2020, offering insights into the climatic conditions experienced in each city during this timeframe. See table below.

Jordan dataset

Key	Data Type
loc_id	String
date	String
maxtempC	Integer
mintempC	Integer
avgtempC	Integer
totalprecipMM	Integer
windspeedKmph	Integer
sunhour	Float
winddirdegree	Integer
weatherDesc	String
humidity	Integer
visibilityKm	Integer
HeatIndexC	Integer
DewPointC	Integer
WindChillC	Integer
WindGustKmph	Integer
FeelsLikeC	Integer
uvIndex	Integer
sunrise	String
sunset	String
moonrise	String
moonset	String
moon_phase	String
moon_illumination	Float

Table II:Dataset description (JO)

3. Data Visualization

We have represented the data in several ways in order to understand the pattern of the data and make it clearer using Shiny Web App and to make it more interactive for the user so that he can specify the city and year to obtain higher accuracy.

3.1. United states

3.1.1. Bubble Plot

The bubble plot displays the relationship between wind speed and minimum temperature across New York state. Each point represents New York data for the first week. The size of the points indicates the state, and the color represents the year. See picture 1.

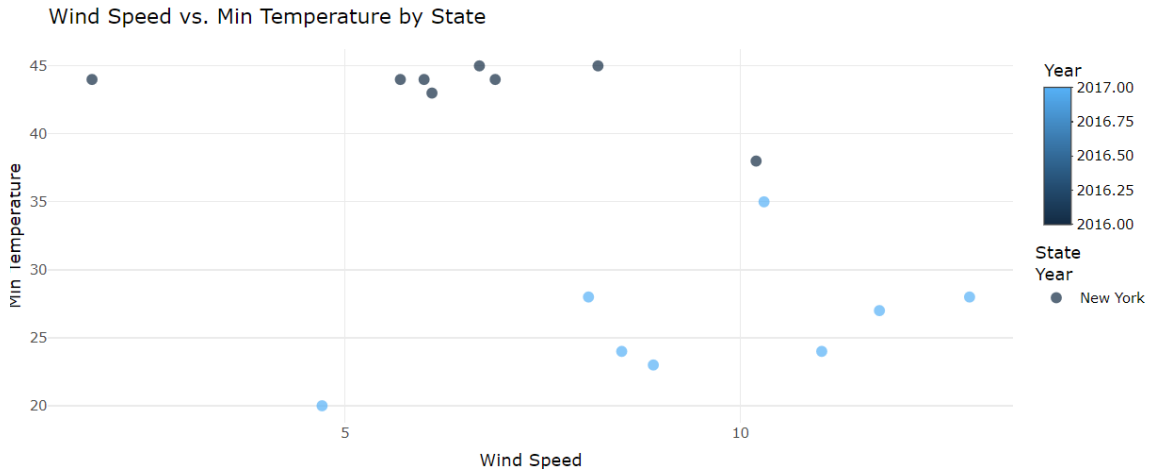

Figure 1 :Bubble Plot

3.1.2. Density Plot

The density plot shows the distribution of maximum temperatures by month and state of New York. The x-axis represents the month, and the y-axis represents the density of maximum temperatures. See figure 2 below.

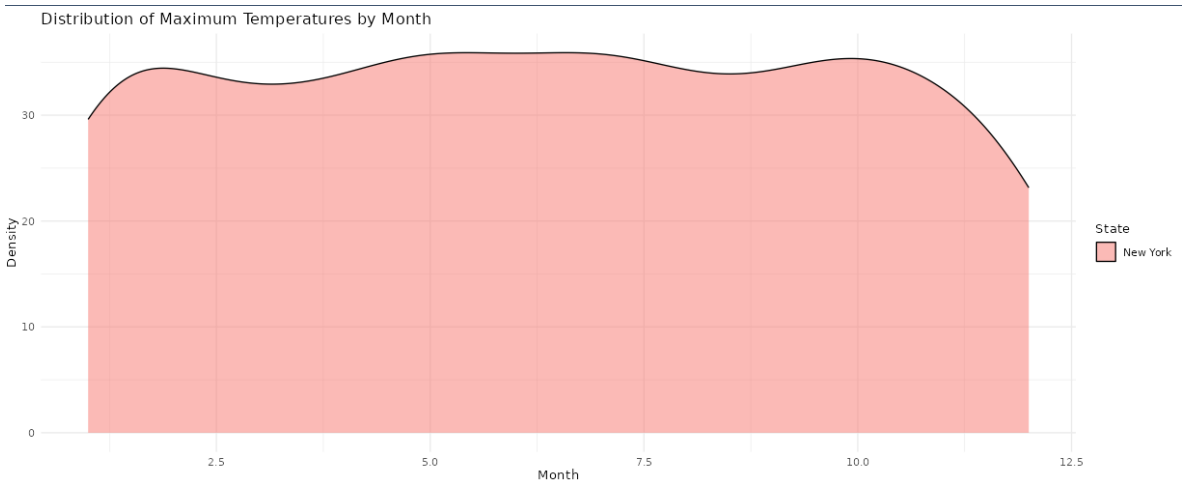

Figure 2:Density Plot

3.1.3. Correlation plot

This plot shows the correlation between wind speed and average temperature for New York location in the New York state. Each point represents a data point, and the dashed line represents the linear regression model. See the figure below.

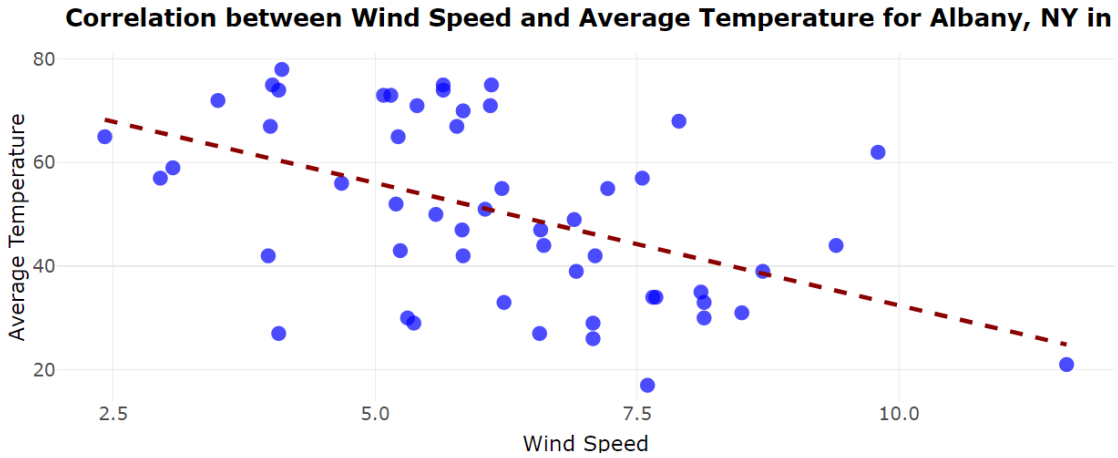

Figure 3:Correlation Plot

3.1.4. Monthly Temperature Plot

The plot showcases the monthly temperature trends across an entire state. It displays the maximum, minimum, and average temperatures recorded each month throughout the year. The horizontal axis denotes the months, while the vertical axis represents temperature values. The maximum temperature for each month is depicted by an upper line, the minimum temperature by a lower line, and the average temperature by a central line. By visualizing these data points, this plot offers insights into the overall temperature variations experienced across different seasons within the state. see figure below.

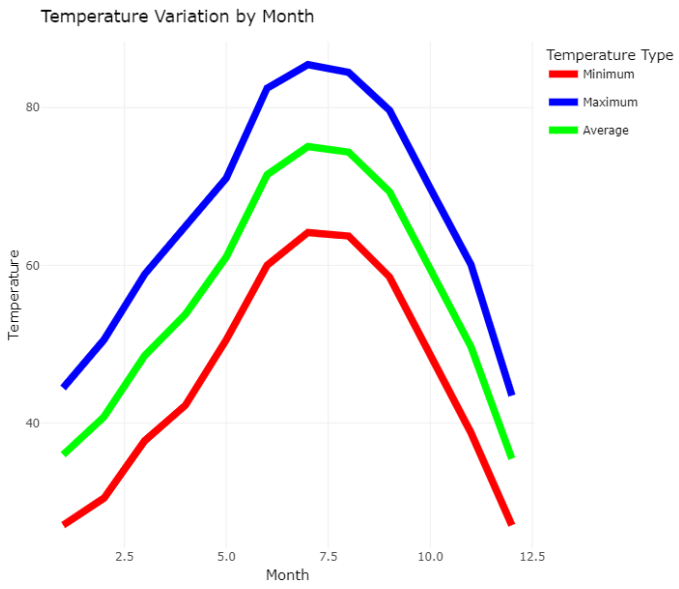

Figure 4: Monthly temperature plot.

3.1.5. Heat Map

The heat map represents the average monthly temperatures across 10 states in the United States. The x-axis displays the 12 months of the year, while each state is represented by a column on the y-axis. The intensity of shading within each cell corresponds to the average temperature recorded in that state during the respective month, with darker shades indicating higher temperatures and lighter shades indicating lower temperatures. By examining this visualization, viewers can discern the seasonal temperature variations experienced across these diverse geographical regions throughout the year. See the figure below.

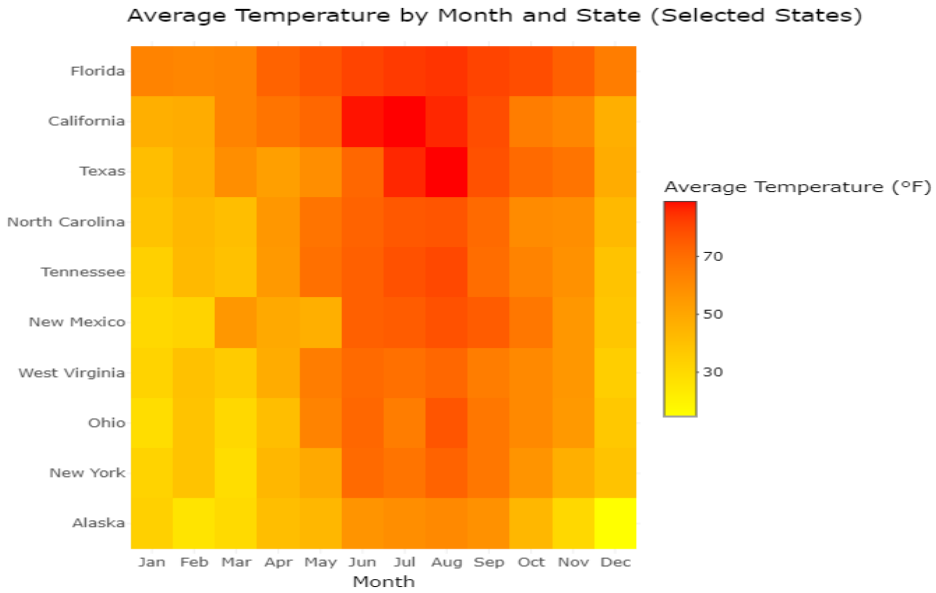

Figure 5:Heat Map

3.1.6. Monthly Average Temperature for Selected State

The monthly average temperature for California depicts the typical temperature variations experienced throughout the year in the state. This data provides insights into the seasonal climate patterns, with each month's average temperature reflecting the prevailing weather conditions. By analyzing this information, researchers and stakeholders can understand the annual temperature trends, helping in various applications such as agriculture, tourism, and urban planning. See figure on the next pag.

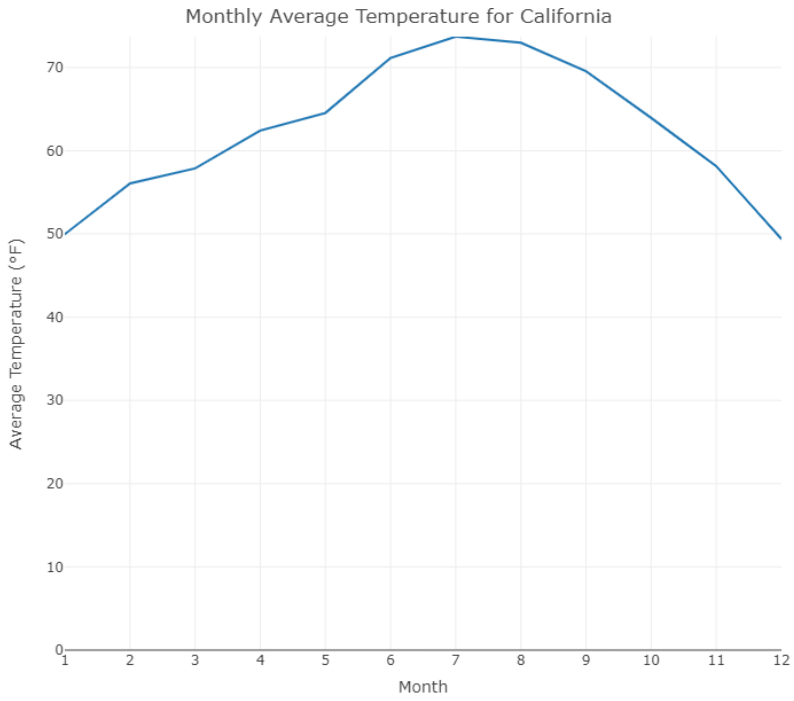

Figure 6:Monthly average temperature.

3.1.7. Seasonal Temperature trend for Selected State.

The analysis of between-season temperature fluctuations and average temperatures in California provides insights into the state's dynamic climate. This examination highlights the transitional periods between seasons, shedding light on the nuanced temperature variations throughout the year. Understanding these fluctuations is crucial for discerning California's diverse microclimates and their impacts on various sectors. See figure below.

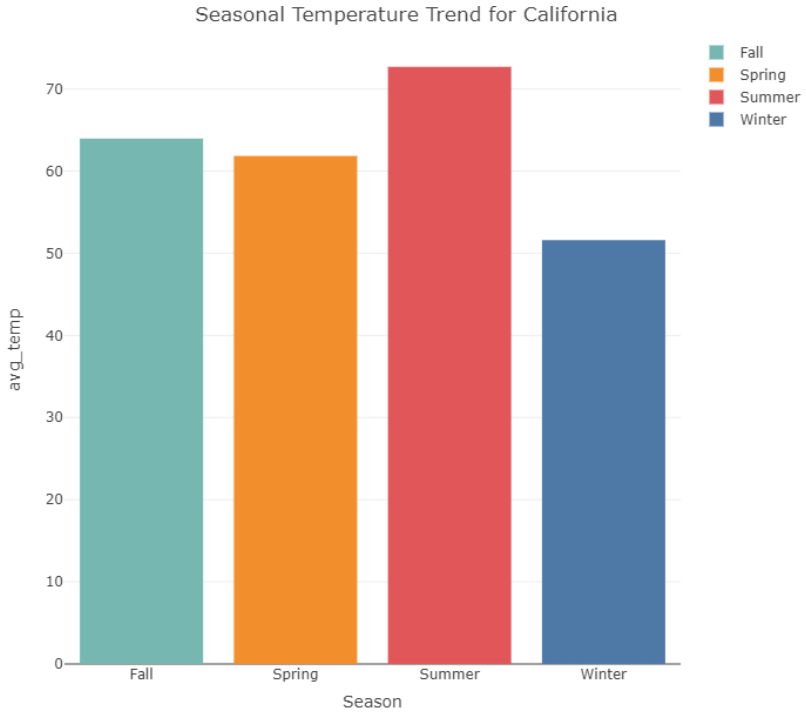

Figure 7:Season temperature trend foe selected state

3.2. Jordan

3.2.1. Temperature Plot

The maximum temperature plot for Amman, Jordan, in the year 2020 illustrates the highest recorded temperatures monthly. Each data point on the plot represents the maximum temperature reached during a specific month. The x-axis represents the months of the year, while the y-axis displays the temperature values. This plot provides a concise overview of the peak temperatures experienced in Amman each month throughout the year, facilitating the identification of seasonal temperature trends and variations. See figure below.

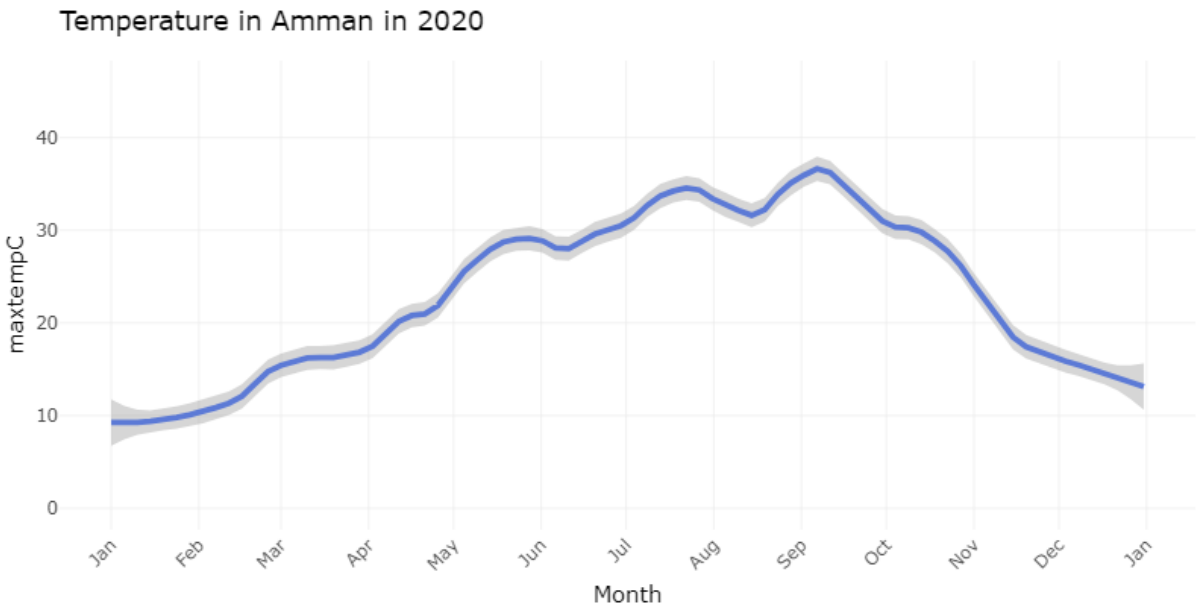

Figure 8:Temperature Plot

3.2.2. Ridgeline Plot

The Ridgeline Plot visualizes the relationship between temperature and months in Amman. Months are represented on the y-axis, creating distinct layers for each month, while temperature values are displayed along the x-axis. The plot showcases the distribution of temperature values for each month, allowing for a comparison of temperature patterns throughout the year. By observing the ridges formed by the overlapping distributions, viewers can discern seasonal trends and variations in temperature experienced in Amman over the course of the year. See figure on the next page.

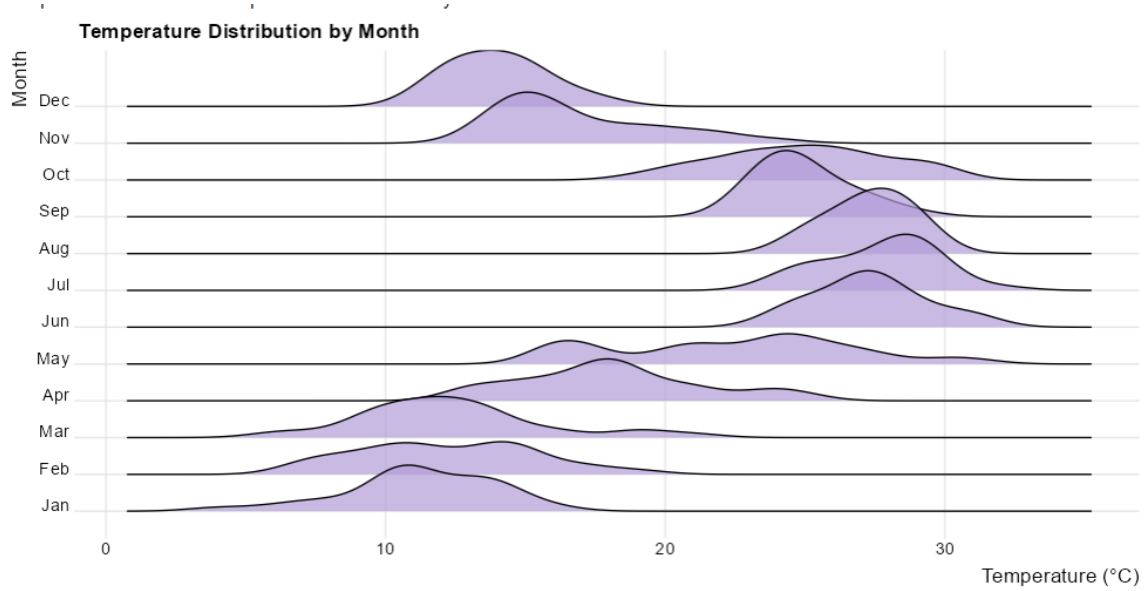

Figure 9:Ridgeline Plot

3.2.3. Stacked Bar Plot

The stacked bar plot illustrates the variation in UV degrees for three cities: Amman, Irbid, and Aqaba. The x-axis represents binned sunrise times, categorizing the day into time intervals, while the y-axis displays UV degrees. Each bar is divided into three segments, with each segment representing the UV degree recorded in a specific city during the corresponding time interval. By examining the height and distribution of the stacked bars, viewers can compare the UV exposure levels across different times of the day and cities, providing insights into regional variations in sun exposure. See figure below.

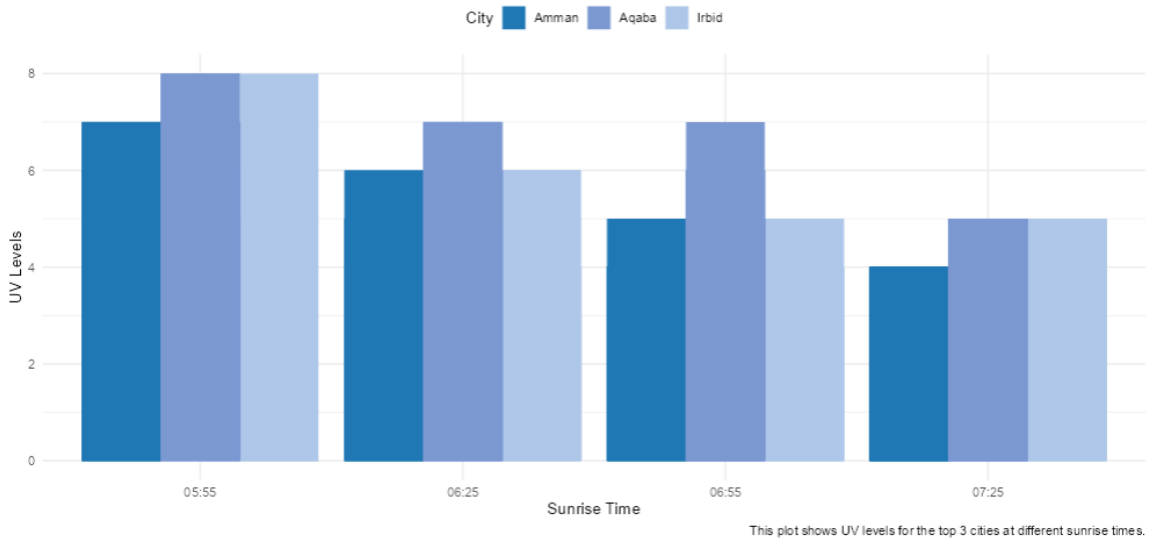

Figure 10:Stacked Bar Plot

3.2.4. Pie Chart

The pie chart represents the distribution of moon phases in Amman over a given period. Each segment of the pie corresponds to a specific moon phase, such as full moon, new moon, waxing crescent, waning gibbous, etc. The size of each segment reflects the proportion of time that phase occurred during the observation period. This visualization allows viewers to easily grasp the frequency and occurrence of different moon phases in Amman, providing insights into lunar cycles and their potential influence on various activities and phenomena. See figure 11 below.

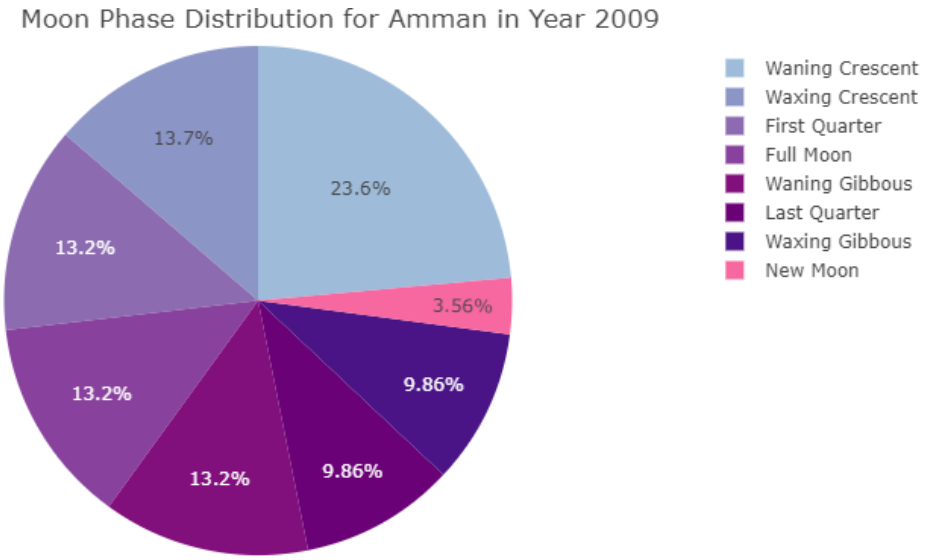

Figure 11:Pie Chart

3.2.5. Violin Plot

The violin plot depicts the distribution of mean daily temperatures by month in Amman. Each 'violin' represents a month, with the width of the violin indicating the frequency or density of temperature values. The central white dot within each violin denotes the median temperature for that month. By observing the shape and spread of the violins, viewers can discern the variability and distribution of temperatures across different months in Amman. This visualization offers insights into seasonal temperature patterns and potential anomalies throughout the year. See figure below.

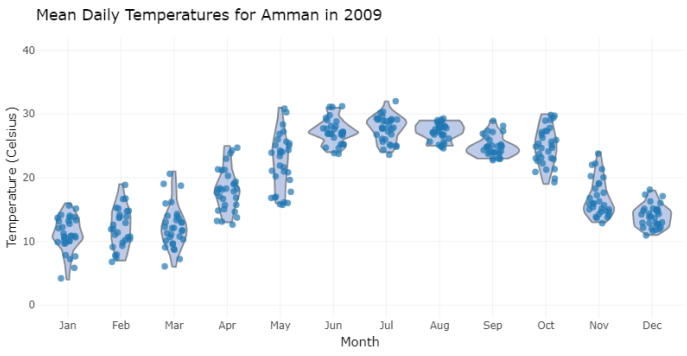

Figure 12:Violin Plot