--Temprature-Rainfall 1901-2016--

19F-0113 (CS), 19F-0171 (CS), 19F-0254 (CS), 19F-0931 (SE)
Talha Ahmad, M. Talha Shehroze, Muhammad Farhan, Daniyal Ahmed

Dataset has been selected from kaggle. Kaggle Data has been scrapped from Pakistan Meteorological Department archives.

Dataset contains 116 years of rainfall data in millimeters by month from 1901 to 2016. The granularity is per month average rainfall.
https://www.kaggle.com/zusmani/pakistan-temperature [1392 rows x 3 columns] Columns are as: Rainfall - (MM) | Year | Month

Dataset contains 116 years of temperature data in celsius by month from 1901 to 2016. The granularity is per month average temprature.
https://www.kaggle.com/zusmani/rainfall-in-pakistan [1392 rows x 3 columns] Columns are as: Temperature - (Celsius) | Year | Month

➔ **frontend.py**

```
from tkinter import *
from backend import *
from PIL import ImageTk,Image
import tkinter.font as font

root = Tk()
root.title("Pakistan's Rain-Temp Data")

myFont = font.Font(family='Montserrat', size=10)

def tempBarButtonClick():
    avgTMBarG()

def rainBarButtonClick():
    avgRMBarG()

def multiBarButtonClick():
    tempRainMultiBarChart()

def scatterTempButtonClick():
    scatterTempGraphFunc()

def scatterTempDecadeButtonClick():
    scatterTempGraphFuncDecade()

def scatterRainButtonClick():
    scatterRainGraphFunc()

def scatterRainDecadeButtonClick():
    scatterRainGraphFuncDecade()

def scatterMultiButtonClick():
    scatterMultiGraphFunc()

def scatterMultiDecadeButtonClick():
    scatterMultiGraphFuncDecade()

def boxPlotButtonClick():
    boxPlotTempRain()

def boxPlotDecadeButtonClick():
    boxPlotTempRainDecade()

def LRButtonClick():
    linearReg()
```

```
def LRButton2Click():
   linearReg2()

def textbuttonClick():

   def openFile():
     tf = open("dataset/statstext.txt", 'r')
     data = tf.read()
     txtarea.insert(END, data)
     tf.close()

   ws = Tk()
   ws.title("Statistics")
   ws.geometry("600x450")
   ws['bg']='#fb0'

   txtarea = Text(ws, width=70, height=22)
   txtarea.pack(pady=20)

   Button(ws,text="Calculate & Show Stats",command=openFile).pack(side=RIGHT, expand=True, fill=X, padx=20)
   ws.mainloop()

def OnHoverScatter(event):
   scatterButton.config(bg='black', fg='white')

def OnLeaveScatter(event):
   scatterButton.config(bg='green', fg='black')

def OnHoverTempScatter(event):
   scatterTempButton.config(bg='black', fg='white')

def OnLeaveTempScatter(event):
   scatterTempButton.config(bg='green', fg='black')

def OnHoverRainScatter(event):
   scatterRainButton.config(bg='black', fg='white')

def OnLeaveRainScatter(event):
  scatterRainButton.config(bg='green', fg='black')

def OnHoverScatterDecade(event):
   scatterButtonDecade.config(bg='black', fg='white')

def OnLeaveScatterDecade(event):
   scatterButtonDecade.config(bg='green', fg='black')

def OnHoverTempScatterDecade(event):
   scatterTempButtonDecade.config(bg='black', fg='white')

def OnLeaveTempScatterDecade(event):
   scatterTempButtonDecade.config(bg='green', fg='black')

def OnHoverRainScatterDecade(event):
   scatterRainButtonDecade.config(bg='black', fg='white')

def OnLeaveRainScatterDecade(event):
  scatterRainButtonDecade.config(bg='green', fg='black')

def OnHoverBarTemp(event):
   rainBarButton.config(bg='black', fg='white')

def OnLeaveBarTemp(event):
   rainBarButton.config(bg='green', fg='black')
```

```
def OnHoverBarRain(event):
   tempBarButton.config(bg='black', fg='white')

def OnLeaveBarRain(event):
   tempBarButton.config(bg='green', fg='black')

def OnHoverMultiBar(event):
   multiBarButton.config(bg='black', fg='white')

def OnLeaveMultiBar(event):
   multiBarButton.config(bg='green', fg='black')

def OnHoverBoxPlot(event):
   boxPlotButton.config(bg='black', fg='white')

def OnLeaveBoxPlot(event):
   boxPlotButton.config(bg='green', fg='black')

def OnLeaveBoxPlotDecade(event):
   boxPlotDecadeButton.config(bg='green', fg='black')

def OnHoverBoxPlotDecade(event):
   boxPlotDecadeButton.config(bg='black', fg='white')

def OnHoverText(event):
   TextButton.config(bg='black', fg='white')

def OnLeaveText(event):
   TextButton.config(bg='green', fg='black')

def OnHoverLR(event):
   LRButton.config(bg='black', fg='white')

def OnLeaveLR(event):
   LRButton.config(bg='green', fg='black')

def OnHoverLR2(event):
   LRButton2.config(bg='black', fg='white')

def OnLeaveLR2(event):
   LRButton2.config(bg='green', fg='black')

backgroundImage = Image.open("images/Background.jpg")
resizedBackground = backgroundImage.resize((1920,1080),Image.ANTIALIAS)
newBackground = ImageTk.PhotoImage(resizedBackground)
backgroundLabel = Label( root, image =newBackground)
backgroundLabel.place(x = 0, y = 0)

multiBarButton = Button(root,text="Multi Bar Graph",width=42,height=2,command=multiBarButtonClick, bg='green',
relief='groove')
multiBarButton.bind('<Enter>', OnHoverMultiBar)
multiBarButton.bind('<Leave>', OnLeaveMultiBar)
multiBarButton['font'] = myFont
multiBarButton.place(x=620, y= 260)

tempBarButton = Button(root,text="Temp Bar Graph",width=42,height=2,command=tempBarButtonClick, bg='green',
relief='groove')
tempBarButton.bind('<Enter>', OnHoverBarRain)
tempBarButton.bind('<Leave>', OnLeaveBarRain)
tempBarButton['font'] = myFont
tempBarButton.place(x=420, y= 320)
```

```
rainBarButton = Button(root,text="Rain Bar Graph",width=42,height=2,command=rainBarButtonClick, bg='green',
relief='groove')
rainBarButton.bind('<Leave>', OnLeaveBarTemp)
rainBarButton.bind('<Enter>', OnHoverBarTemp)
rainBarButton['font'] = myFont
rainBarButton.place(x=820, y= 320)

scatterTempButton = Button(root,text="Temp Line Plot by Month",width=42,height=2,command=scatterTempButtonClick,
bg='green', relief='groove')
scatterTempButton.bind('<Enter>', OnHoverTempScatter)
scatterTempButton.bind('<Leave>', OnLeaveTempScatter)
scatterTempButton['font'] = myFont
scatterTempButton.place(x=420, y= 380)

scatterRainButton = Button(root,text="Rain Line Plot by Month",width=42,height=2,command=scatterRainButtonClick,
bg='green', relief='groove')
scatterRainButton.bind('<Enter>', OnHoverRainScatter)
scatterRainButton.bind('<Leave>', OnLeaveRainScatter)
scatterRainButton['font'] = myFont
scatterRainButton.place(x=420, y= 440)

scatterButton = Button(root,text="Scatter Plot by Month",width=42,height=2,command=scatterMultiButtonClick,
bg='green', relief='groove')
scatterButton.bind('<Enter>', OnHoverScatter)
scatterButton.bind('<Leave>', OnLeaveScatter)
scatterButton['font'] = myFont
scatterButton.place(x=420, y= 500)

scatterTempButtonDecade = Button(root,text="Temp Line Plot by
Decade",width=42,height=2,command=scatterTempDecadeButtonClick, bg='green', relief='groove')
scatterTempButtonDecade.bind('<Enter>', OnHoverTempScatterDecade)
scatterTempButtonDecade.bind('<Leave>', OnLeaveTempScatterDecade)
scatterTempButtonDecade['font'] = myFont
scatterTempButtonDecade.place(x=820, y= 380)

scatterRainButtonDecade = Button(root,text="Rain Line Plot by
Decade",width=42,height=2,command=scatterRainDecadeButtonClick, bg='green', relief='groove')
scatterRainButtonDecade.bind('<Enter>', OnHoverRainScatterDecade)
scatterRainButtonDecade.bind('<Leave>', OnLeaveRainScatterDecade)
scatterRainButtonDecade['font'] = myFont
scatterRainButtonDecade.place(x=820, y= 440)

scatterButtonDecade = Button(root,text="Scatter Plot by
Decade",width=42,height=2,command=scatterMultiDecadeButtonClick, bg='green', relief='groove')
scatterButtonDecade.bind('<Enter>', OnHoverScatterDecade)
scatterButtonDecade.bind('<Leave>', OnLeaveScatterDecade)
scatterButtonDecade['font'] = myFont
scatterButtonDecade.place(x=820, y= 500)

boxPlotButton = Button(root,text="Box Plot by Month",width=42,height=2,command=boxPlotButtonClick, bg='green',
relief='groove')
boxPlotButton.bind('<Enter>', OnHoverBoxPlot)
boxPlotButton.bind('<Leave>', OnLeaveBoxPlot)
boxPlotButton['font'] = myFont
boxPlotButton.place(x=420, y= 560)

boxPlotDecadeButton = Button(root,text="Box Plot by Decade",width=42,height=2,command=boxPlotDecadeButtonClick,
bg='green', relief='groove')
boxPlotDecadeButton.bind('<Enter>', OnHoverBoxPlotDecade)
boxPlotDecadeButton.bind('<Leave>', OnLeaveBoxPlotDecade)
boxPlotDecadeButton['font'] = myFont
boxPlotDecadeButton.place(x=820, y= 560)
```

```
LRButton = Button(root,text="Linear Regression",width=42,height=2,command=LRButtonClick, bg='green', relief='groove')
LRButton.bind('<Enter>', OnHoverLR)
LRButton.bind('<Leave>', OnLeaveLR)
LRButton['font'] = myFont
LRButton.place(x=420, y= 620)

LRButton = Button(root,text="Linear Regression T o R",width=42,height=2,command=LRButtonClick, bg='green',
relief='groove')
LRButton.bind('<Enter>', OnHoverLR)
LRButton.bind('<Leave>', OnLeaveLR)
LRButton['font'] = myFont
LRButton.place(x=420, y= 620)

LRButton2 = Button(root,text="Linear Regression R o T",width=42,height=2,command=LRButton2Click, bg='green',
relief='groove')
LRButton2.bind('<Enter>', OnHoverLR2)
LRButton2.bind('<Leave>', OnLeaveLR2)
LRButton2['font'] = myFont
LRButton2.place(x=820, y= 620)

TextButton = Button(root,text="Quantitative Stats",width=42,height=2,command=textbuttonClick, bg='green',
relief='groove')
TextButton.bind('<Enter>', OnHoverText)
TextButton.bind('<Leave>', OnLeaveText)
TextButton['font'] = myFont
TextButton.place(x=620, y= 680)

root.state('zoomed')
root.mainloop()
```

➔ **backend.py**

```
import csv
import math
from os import sep
import statistics
from scipy import stats
import numpy as np
import pandas as pd
from matplotlib import colors
from collections import Counter
import matplotlib.pyplot as plt
from matplotlib.ticker import PercentFormatter

#                --Temprature-Rainfall 1901-2016--
#   19F-0113 (CS),   19F-0171 (CS),      19F-0254 (CS),      19F-0931 (SE)
#   Talha Ahmad,     M. Talha Shehroze,     Muhammad Farhan,     Daniyal Ahmed

# Reading Data from CSV.
dataset1 = pd.read_csv(r'dataset\19012016.csv')

# Taking Mean of Monthly Temprature and Rainfall from 1901-2016
def meanTempRainFunc():
   tempMean=dataset1['Temperature (Celsius)'].mean().round(3)
   strTempMean=str(tempMean)
   temp="->Average Monthly Temprature (Celsius) from 1901-2016 was: "
   file.write(temp)
   file.write(strTempMean)
   file.write(" °C\n")

   rainMean=dataset1['Rainfall (MM)'].mean().round(3)
   strrainMean=str(rainMean)
   temp0="->Average Monthly Rainfall (MM) from 1901-2016 was: "
   file.write(temp0)
```

```
    file.write(strrainMean)
    file.write(" mm\n\n")

# Taking Median of Monthly Temprature and Rainfall from 1901-2016
def medianTempRainFunc():
    tempMedian=dataset1['Temperature (Celsius)'].median()
    strTempMedian=str(tempMedian)
    temp="->Median Monthly Temprature (Celsius) from 1901-2016 was: "
    file.write(temp)
    file.write(strTempMedian)
    file.write(" °C\n")

    rainMedian=dataset1['Rainfall (MM)'].median()
    strRainMedian=str(rainMedian)
    temp0="->Median Monthly Rainfall (MM) from 1901-2016 was: "
    file.write(temp0)
    file.write(strRainMedian)
    file.write(" mm\n\n")

# Descriptive Statistics of Dataset of Temprature and Rainfall from 1901-2016
def dataDescript():
    describeData1=dataset1[['Temperature (Celsius)']].describe().round()
    print(describeData1)
    describeData2=dataset1[['Rainfall (MM)']].describe().round()
    print(describeData2)

# Taking Minimum and Maximum of Monthly Temprature from 1901-2016
tempMin=dataset1['Temperature (Celsius)'].min()
tempMax=dataset1['Temperature (Celsius)'].max()

# Taking Minimum and Maximum Value of Monthly Rainfall from 1901-2016
rainMin=dataset1['Rainfall (MM)'].min()
rainMax=dataset1['Rainfall (MM)'].max()

# Taking Minimum and Maximum Row of Monthly Temprature from 1901-2016
def minMaxTempratureRow():
    tempMinRow = dataset1.loc[dataset1['Temperature (Celsius)'] == tempMin]
    temp="->Minimum Monthly Temprature (Celsius) from 1901-2016 was in:"
    file.write(temp+'\n')
    temp1=tempMinRow.to_string(index=False)
    file.write(temp1+'\n\n')
    tempMaxRow = dataset1.loc[dataset1['Temperature (Celsius)'] == tempMax]
    temp0="->Maximum Monthly Temprature (Celsius) from 1901-2016 was in:"
    file.write(temp0+'\n')
    temp2=tempMaxRow.to_string(index=False)
    file.write(temp2+'\n\n')

# Taking Minimum and Maximum Row of Monthly Rainfall from 1901-2016
def minMaxRainfallRow():
    rainMinRow = dataset1.loc[dataset1['Rainfall (MM)'] == rainMin]
    temp="->Minimum Monthly Rainfall (MM) from 1901-2016 was in:"
    file.write(temp+'\n')
    temp1=rainMinRow.to_string(index=False)
    file.write(temp1+'\n\n')
    rainMaxRow = dataset1.loc[dataset1['Rainfall (MM)'] == rainMax]
    temp0 ="->Maximum Monthly Rainfall (MM) from 1901-2016 was in:"
    file.write(temp0+'\n')
    temp2=rainMaxRow.to_string(index=False)
    file.write(temp2+'\n\n')

# Reading Data from CSV by Month.
janDataset = dataset1.loc[dataset1['Month'] == 'January']
febDataset = dataset1.loc[dataset1['Month'] == 'February']
```

```
marDataset = dataset1.loc[dataset1['Month'] == 'March']
aprDataset = dataset1.loc[dataset1['Month'] == 'April']
mayDataset = dataset1.loc[dataset1['Month'] == 'May']
junDataset = dataset1.loc[dataset1['Month'] == 'June']
julDataset = dataset1.loc[dataset1['Month'] == 'July']
augDataset = dataset1.loc[dataset1['Month'] == 'August']
sepDataset = dataset1.loc[dataset1['Month'] == 'September']
octDataset = dataset1.loc[dataset1['Month'] == 'October']
novDataset = dataset1.loc[dataset1['Month'] == 'November']
decDataset = dataset1.loc[dataset1['Month'] == 'December']

# Calculating Mean Temprature and Rain by Month.
janTempMean=janDataset['Temperature (Celsius)'].mean();   janRainMean=janDataset['Rainfall (MM)'].mean()
febTempMean=febDataset['Temperature (Celsius)'].mean();   febRainMean=febDataset['Rainfall (MM)'].mean()
marTempMean=marDataset['Temperature (Celsius)'].mean();   marRainMean=marDataset['Rainfall (MM)'].mean()
aprTempMean=aprDataset['Temperature (Celsius)'].mean();   aprRainMean=aprDataset['Rainfall (MM)'].mean()
mayTempMean=mayDataset['Temperature (Celsius)'].mean();   mayRainMean=mayDataset['Rainfall (MM)'].mean()
junTempMean=junDataset['Temperature (Celsius)'].mean();   junRainMean=junDataset['Rainfall (MM)'].mean()
julTempMean=julDataset['Temperature (Celsius)'].mean();   julRainMean=julDataset['Rainfall (MM)'].mean()
augTempMean=augDataset['Temperature (Celsius)'].mean();   augRainMean=augDataset['Rainfall (MM)'].mean()
sepTempMean=sepDataset['Temperature (Celsius)'].mean();   sepRainMean=sepDataset['Rainfall (MM)'].mean()
octTempMean=octDataset['Temperature (Celsius)'].mean();   octRainMean=octDataset['Rainfall (MM)'].mean()
novTempMean=novDataset['Temperature (Celsius)'].mean();   novRainMean=novDataset['Rainfall (MM)'].mean()
decTempMean=decDataset['Temperature (Celsius)'].mean();   decRainMean=decDataset['Rainfall (MM)'].mean()


# Reading Data from CSV by Decades.
dataset1903 = dataset1.loc[dataset1['Year'] == 1901]
dataset1913 = dataset1.loc[dataset1['Year'] == 1911]
dataset1923 = dataset1.loc[dataset1['Year'] == 1921]
dataset1933 = dataset1.loc[dataset1['Year'] == 1931]
dataset1943 = dataset1.loc[dataset1['Year'] == 1941]
dataset1953 = dataset1.loc[dataset1['Year'] == 1951]
dataset1963 = dataset1.loc[dataset1['Year'] == 1961]
dataset1973 = dataset1.loc[dataset1['Year'] == 1972]
dataset1983 = dataset1.loc[dataset1['Year'] == 1983]
dataset1993 = dataset1.loc[dataset1['Year'] == 1994]
dataset2003 = dataset1.loc[dataset1['Year'] == 2005]
dataset2013 = dataset1.loc[dataset1['Year'] == 2016]

# Calculating Mean Temprature and Rain by Decades.
TempMean1903=dataset1903['Temperature (Celsius)'].mean();   RainMean1903=dataset1903['Rainfall (MM)'].mean()
TempMean1913=dataset1913['Temperature (Celsius)'].mean();   RainMean1913=dataset1913['Rainfall (MM)'].mean()
TempMean1923=dataset1923['Temperature (Celsius)'].mean();   RainMean1923=dataset1923['Rainfall (MM)'].mean()
TempMean1933=dataset1933['Temperature (Celsius)'].mean();   RainMean1933=dataset1933['Rainfall (MM)'].mean()
TempMean1943=dataset1943['Temperature (Celsius)'].mean();   RainMean1943=dataset1943['Rainfall (MM)'].mean()
TempMean1953=dataset1953['Temperature (Celsius)'].mean();   RainMean1953=dataset1953['Rainfall (MM)'].mean()
TempMean1963=dataset1963['Temperature (Celsius)'].mean();   RainMean1963=dataset1963['Rainfall (MM)'].mean()
TempMean1973=dataset1973['Temperature (Celsius)'].mean();   RainMean1973=dataset1973['Rainfall (MM)'].mean()
TempMean1983=dataset1983['Temperature (Celsius)'].mean();   RainMean1983=dataset1983['Rainfall (MM)'].mean()
TempMean1993=dataset1993['Temperature (Celsius)'].mean();   RainMean1993=dataset1993['Rainfall (MM)'].mean()
TempMean2003=dataset2003['Temperature (Celsius)'].mean();   RainMean2003=dataset2003['Rainfall (MM)'].mean()
TempMean2013=dataset2013['Temperature (Celsius)'].mean();   RainMean2013=dataset2013['Rainfall (MM)'].mean()

months = ['January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November',
'December']
monthsN = [1,2,3,4,5,6,7,8,9,10,11,12]
avgTemp =
[janTempMean,febTempMean,marTempMean,aprTempMean,mayTempMean,junTempMean,julTempMean,augTempMea
n,sepTempMean,octTempMean,novTempMean,decTempMean]
avgRain =
[janRainMean,febRainMean,marRainMean,aprRainMean,mayRainMean,junRainMean,julRainMean,augRainMean,sepRain
Mean,octRainMean,novRainMean,decRainMean]
```

```
yearsN = [1903,1913,1923,1933,1943,1953,1963,1973,1983,1993,2003,2013]
avgTempDecade =
[TempMean1903,TempMean1913,TempMean1923,TempMean1933,TempMean1943,TempMean1953,TempMean1963,Te
mpMean1973,TempMean1983,TempMean1993,TempMean2003,TempMean2013]
avgRainDecade =
[RainMean1903,RainMean1913,RainMean1923,RainMean1933,RainMean1943,RainMean1953,RainMean1963,RainMean1
973,RainMean1983,RainMean1993,RainMean2003,RainMean2013]

avgTRdata = [avgTemp,avgRain]
avgTRdataDecade = [avgTempDecade,avgRainDecade]

months2 = [ 'November','December', 'January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September',
'October']
avgRain2 =
[novRainMean,decRainMean,janRainMean,febRainMean,marRainMean,aprRainMean,mayRainMean,junRainMean,julRain
Mean,augRainMean,sepRainMean,octRainMean]

# Bar Graph of Pakistan's Average Temprature/Month from 1901-2016
def avgTMBarG():
    fig = plt.figure()
    ax = fig.add_axes([0.1,0.1,0.8,0.8])
    ax.bar(months,avgTemp,color='red')
    plt.xlabel("x - Month")
    plt.ylabel("y - Temprature (°C)")
    plt.title("Pakistan's Average Temprature/Month from 1901-2016")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

# Bar Graph of Pakistan's Average Rainfall/Month from 1901-2016
def avgRMBarG():
    fig1 = plt.figure()
    ax = fig1.add_axes([0.1,0.1,0.8,0.8])
    ax.bar(months2,avgRain2,color='green')
    plt.xlabel("x - Month")
    plt.ylabel("y - Rainfall (mm)")
    plt.title("Pakistan's Average Rainfall/Month from 1901-2016")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

def tempRainMultiBarChart():
    fig2 = plt.figure()
    ax = fig2.add_axes([0.1,0.1,0.8,0.8])
    X_axis = np.arange(len(months))
    plt.bar(X_axis - 0.2, avgTemp, 0.4, label = 'Temp (°C)', color='red')
    plt.bar(X_axis + 0.2, avgRain, 0.4, label = 'Rain (mm)', color='green')
    plt.xticks(X_axis, months)
    plt.xlabel("Months")
    plt.ylabel("Temp (°C), Rain (mm)")
    plt.title("Pakistan's Temprature/Month in each Month")
    plt.legend()
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

# Scatter Plot of Pakistan's Average Temprature/Month from 1901-2016 (Showing Relation)
def scatterTempGraphFunc():
    fig3 = plt.figure()
    a1 = fig3.add_axes([0.1,0.1,0.8,0.8])
    a1.plot(monthsN, avgTemp, 'r-')
    a1.set_xlabel('Months')
```

```
    a1.set_ylabel('Temp (°C)')

    #fig3.legend(labels = ('Temp (°C)'),loc='upper center')
    plt.title("Pakistan's Temprature in each Month")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

def scatterTempGraphFuncDecade():
    fig10 = plt.figure()
    a1 = fig10.add_axes([0.1,0.1,0.8,0.8])
    a1.plot(yearsN, avgTempDecade, 'r-')
    a1.set_xlabel('Years')
    a1.set_ylabel('Temp (°C)')

    #fig3.legend(labels = ('Temp (°C)'),loc='upper center')
    plt.title("Pakistan's Temprature in each Decade from 1900-2010")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

# Scatter Plot of Pakistan's Average Temprature/Month from 1901-2016 (Showing Relation)
def scatterRainGraphFunc():
    fig5 = plt.figure()
    a1 = fig5.add_axes([0.1,0.1,0.8,0.8])

    a1.plot(monthsN, avgRain, 'g-')
    a1.set_xlabel('Months')
    a1.set_ylabel('Rain (mm)')

    #fig5.legend(labels = ('Rain (mm)'),loc='upper center')
    plt.title("Pakistan's Rainfall in each Month")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

def scatterRainGraphFuncDecade():
    fig15 = plt.figure()
    a1 = fig15.add_axes([0.1,0.1,0.8,0.8])

    a1.plot(yearsN, avgRainDecade, 'g-')
    a1.set_xlabel('Years')
    a1.set_ylabel('Rain (mm)')

    #fig5.legend(labels = ('Rain (mm)'),loc='upper center')
    plt.title("Pakistan's Rainfall in each Decade from 1900-2010")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

# Scatter Plot of Pakistan's Average Rainfall-Temprature/Month from 1901-2016 (Showing Relation)
def scatterMultiGraphFunc():
    fig6 = plt.figure()
    a1 = fig6.add_axes([0.1,0.1,0.8,0.8])
    a1.plot(monthsN, avgTemp, 'ro-')
    a1.set_xlabel('Months')
    a1.set_ylabel('Temp (°C)')

    a2 = a1.twinx()
    a2.plot(monthsN, avgRain, 'go-')
    a2.set_ylabel('Rain (mm)')

    fig6.legend(labels = ('Temp (°C)','Rain (mm)'),loc='upper center')
```

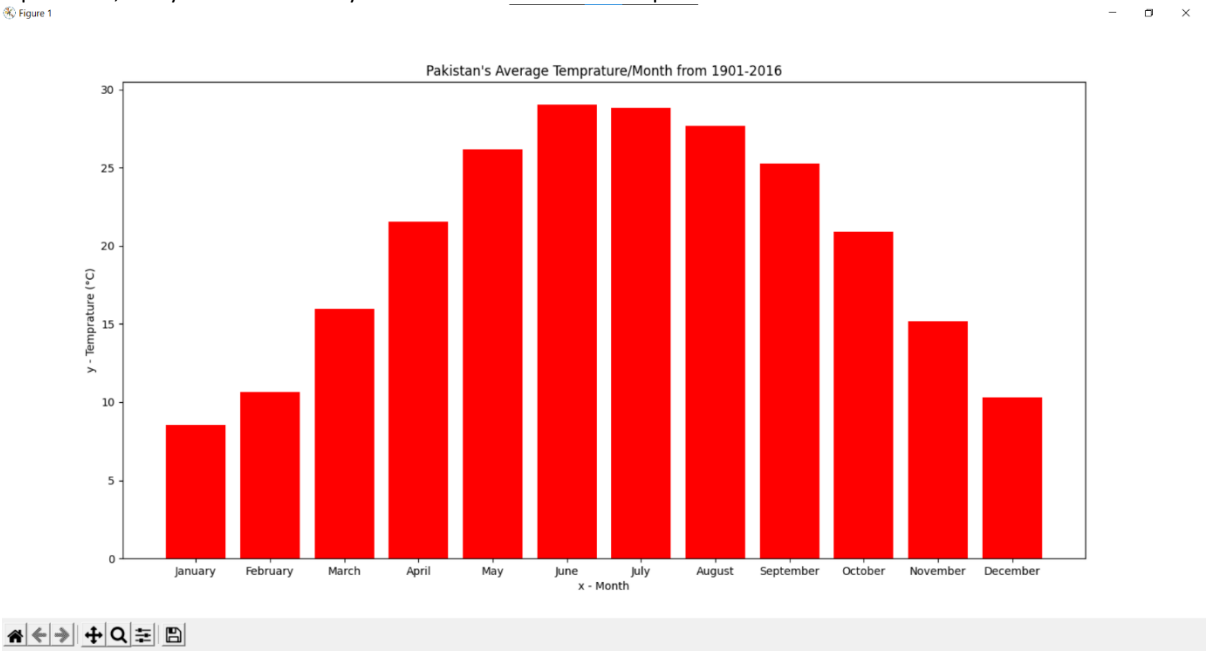
```
    plt.title("Relationship b/w Pakistan's Rainfall/Temprature in each Month")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

# Scatter Plot of Pakistan's Average Rainfall-Temprature/Month from 1901-2016 (Showing Relation)
def scatterMultiGraphFuncDecade():
    fig16 = plt.figure()
    a1 = fig16.add_axes([0.1,0.1,0.8,0.8])
    a1.plot(yearsN, avgTempDecade, 'ro-')
    a1.set_xlabel('Years')
    a1.set_ylabel('Temp (°C)')

    a2 = a1.twinx()
    a2.plot(yearsN, avgRainDecade, 'go-')
    a2.set_ylabel('Rain (mm)')

    fig16.legend(labels = ('Temp (°C)','Rain (mm)'),loc='upper center')
    plt.title("Relationship b/w Pakistan's Rainfall/Temprature in each Decade from 1900-2010")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

def boxPlotTempRain():
    fig4 = plt.figure()
    ax = fig4.add_axes([0.1,0.1,0.8,0.8])
    ax.set_xticklabels(['Temprature', 'Rain']) # warning for fixed labels.
    bp = ax.boxplot(avgTRdata)
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

def boxPlotTempRainDecade():
    fig14 = plt.figure()
    ax = fig14.add_axes([0.1,0.1,0.8,0.8])
    ax.set_xticklabels(['Temprature', 'Rain']) # warning for fixed labels.
    bp = ax.boxplot(avgTRdataDecade)
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

def linearReg():

    slope, intercept, r, p, std_err = stats.linregress(avgTemp, avgRain)

    def myfunc(avgTemp):
      return slope * avgTemp + intercept

    mymodel = list(map(myfunc, avgTemp))

    fig24 = plt.figure()
    ax = fig24.add_axes([0.1,0.1,0.8,0.8])
    ax.set_xlabel('Temp (°C)')
    ax.set_ylabel('Rain (mm)')

    plt.scatter(avgTemp, avgRain)
    plt.plot(avgTemp, mymodel)
    plt.title("Regression Model b/w Pakistan's Temprature on Rainfall by each Month")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

def linearReg2():
```

```
    slope, intercept, r, p, std_err = stats.linregress(avgRain, avgTemp)

    def myfunc(avgRainDecade):
      return slope * avgRainDecade + intercept

    mymodel = list(map(myfunc, avgRain))

    fig34 = plt.figure()
    ax = fig34.add_axes([0.1,0.1,0.8,0.8])
    ax.set_xlabel('Rain (mm)')
    ax.set_ylabel('Temp (°C)')

    plt.scatter(avgRain, avgTemp)
    plt.plot(avgRain, mymodel)
    plt.title("Regression Model b/w Pakistan's Rainfall on Temprature by each Month")
    wm = plt.get_current_fig_manager()
    wm.window.state('zoomed')
    plt.show()

#####     FunctionCalls()

file = open("dataset/statstext.txt","w")

meanTempRainFunc()
medianTempRainFunc()
#    dataDescript()
minMaxTempratureRow()
minMaxRainfallRow()

file.close()

#    avgTMBarG()
#    avgTMBarGDecade()
#    scatterTempGraphFuncDecade()
#    scatterRainGraphFuncDecade()
#    scatterMultiGraphFuncDecade()
#    avgRMBarG()
#    tempRainMultiBarChart()
#    boxPlotTempRain()
#    scatterTempGraphFunc()
#    scatterRainGraphFunc()
#    scatterMultiGraphFunc()
#    boxPlotTempRain()
#    boxPlotTempRainDecade()
#    linearReg()
#    linearReg2()

#____________________E____N____D________O__F________P___R___O___G___R___A___M_____________________
```

Application Homepage

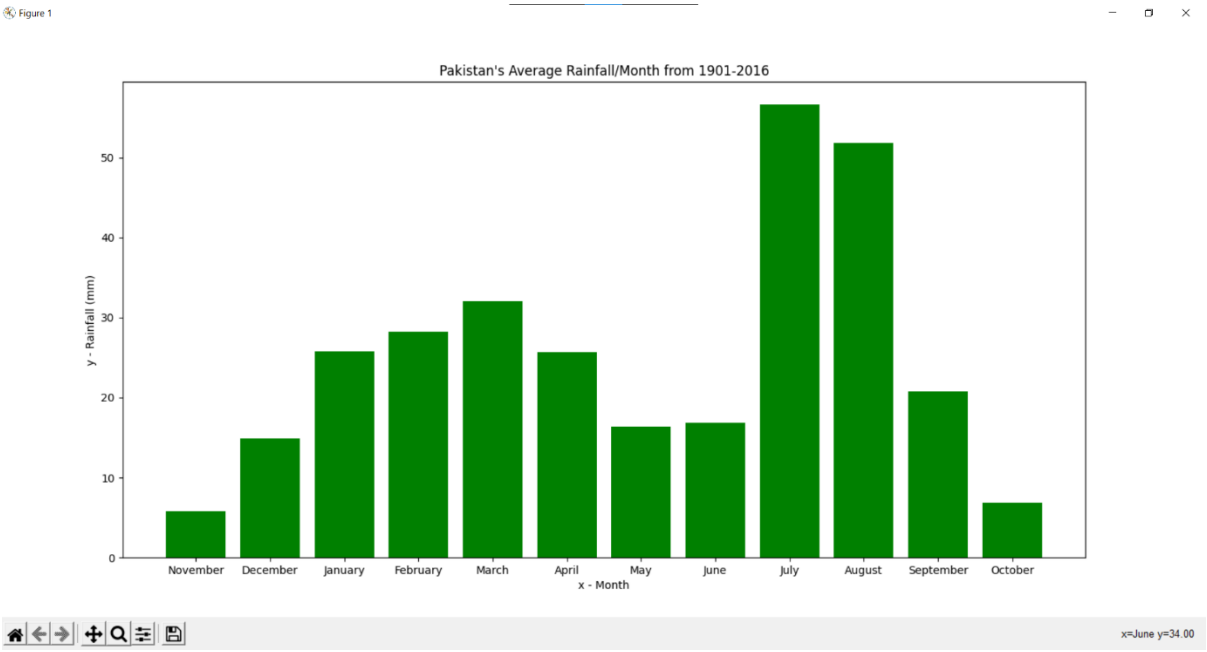
Bar Graph representing Pakistan's average Temperature in every month from 1901-2016

We can see that the data is normal, this is not the case everywhere around the world due to country's position on the equator. So, in my view we are lucky and blessed to have such temperature trend.

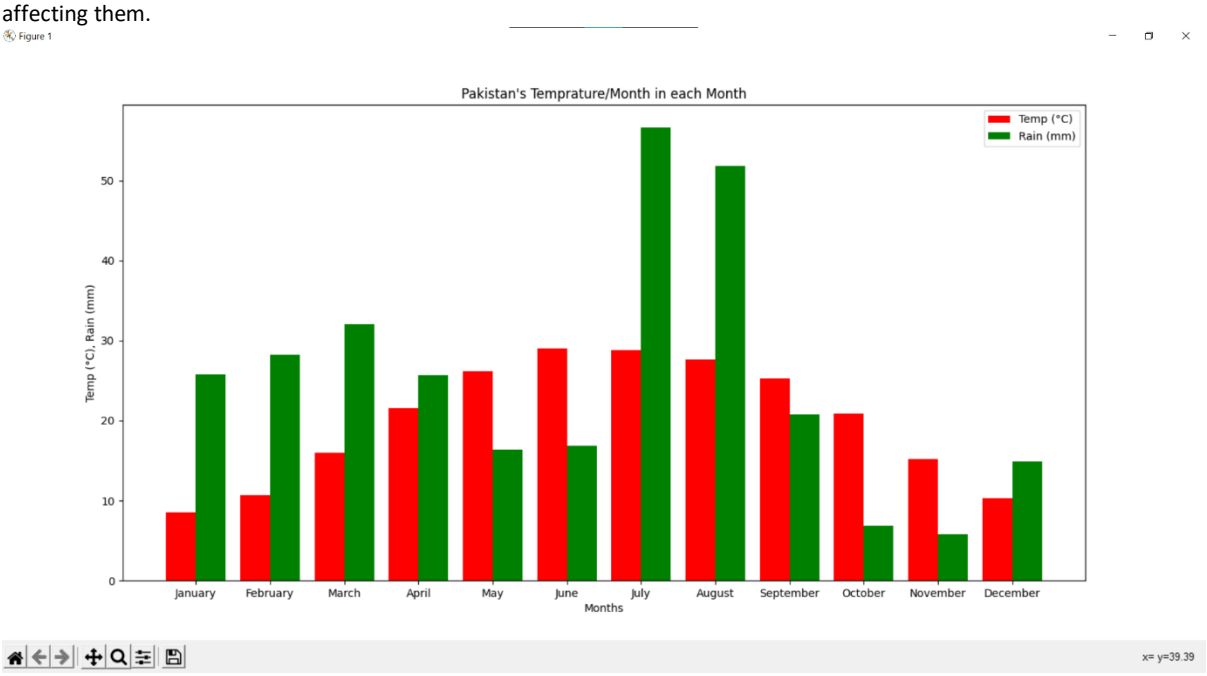


Bar Graph representing Pakistan's average Rainfall in every month from 1901-2016

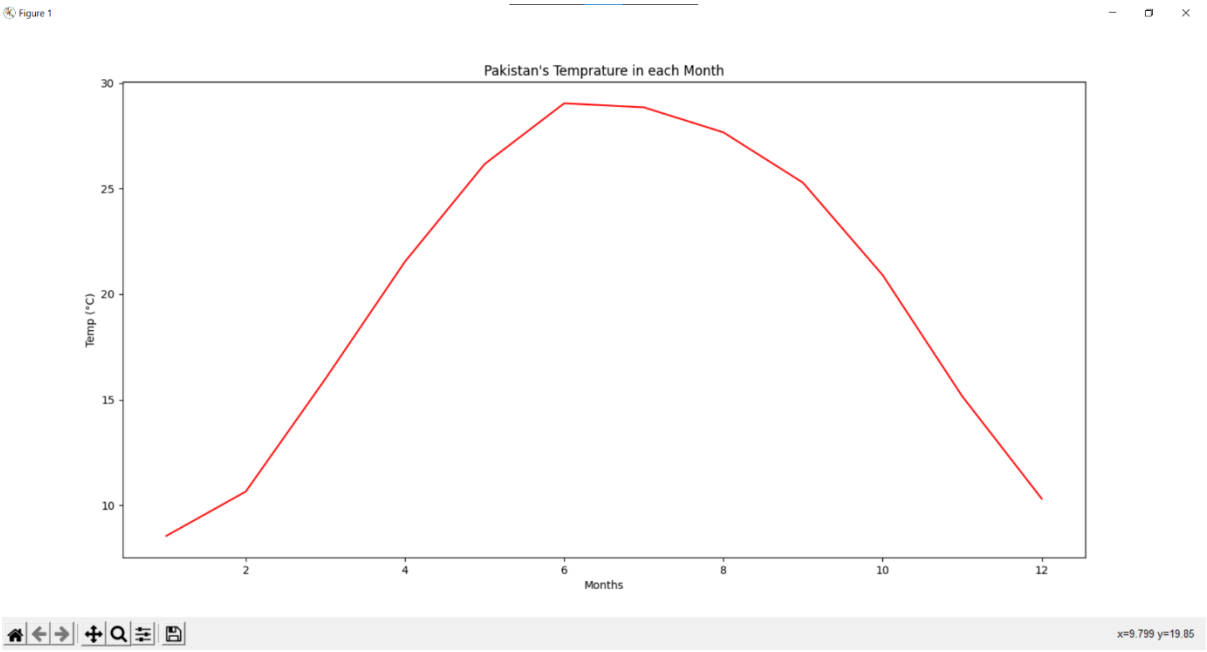
Data seems almost random at first sight, and we can see extreme months (July, August) reason being the arrival of monsoon winds. Data is 115 years, but data is surprisingly not normal and neither skewing in any direction. If we breakdown the data in interval of months. December to May data is normal. In Pakistan Monsoon season starts in July and lasts till September, explaining the huge spikes in data for July, August.



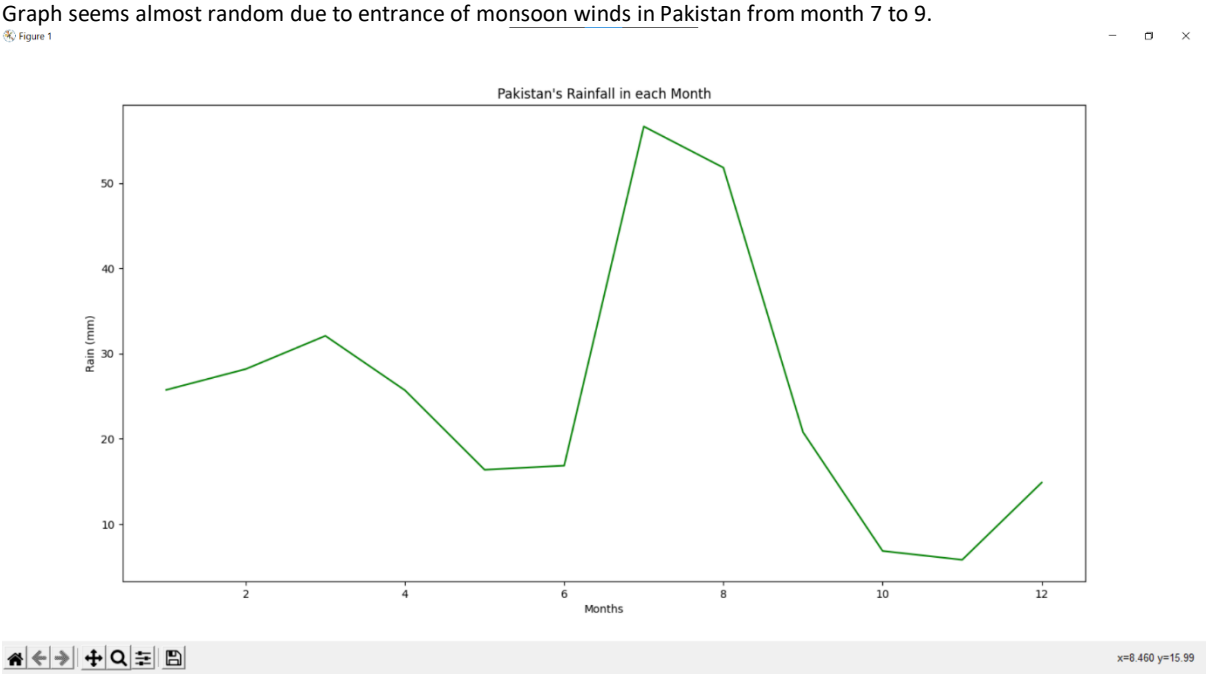
Multi Bar Graph representing Pakistan's average Temperature/Rainfall in every month from 1901-2016
Temperature/Rainfall may seem directly connected to each other, but this is not the case as there are many other factors affecting them.



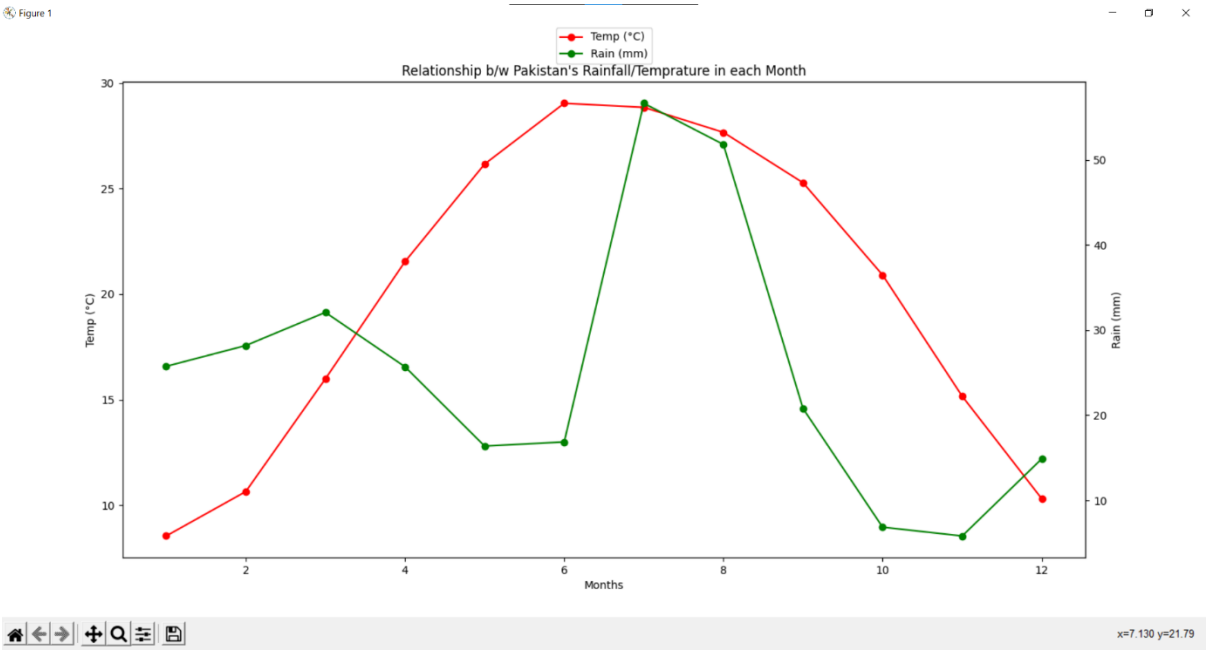
Line Graph representing Pakistan's average Monthly Temperature from 1901-2016
Temperature follows normal distribution but for a major part of year, it is above 22 degree Celsius which is not really ideal for any outside work under sun especially for a country where majority is associated with farming as profession.



Line Graph representing Pakistan's average monthly rainfall from 1901-2016
Graph seems almost random due to entrance of monsoon winds in Pakistan from month 7 to 9.

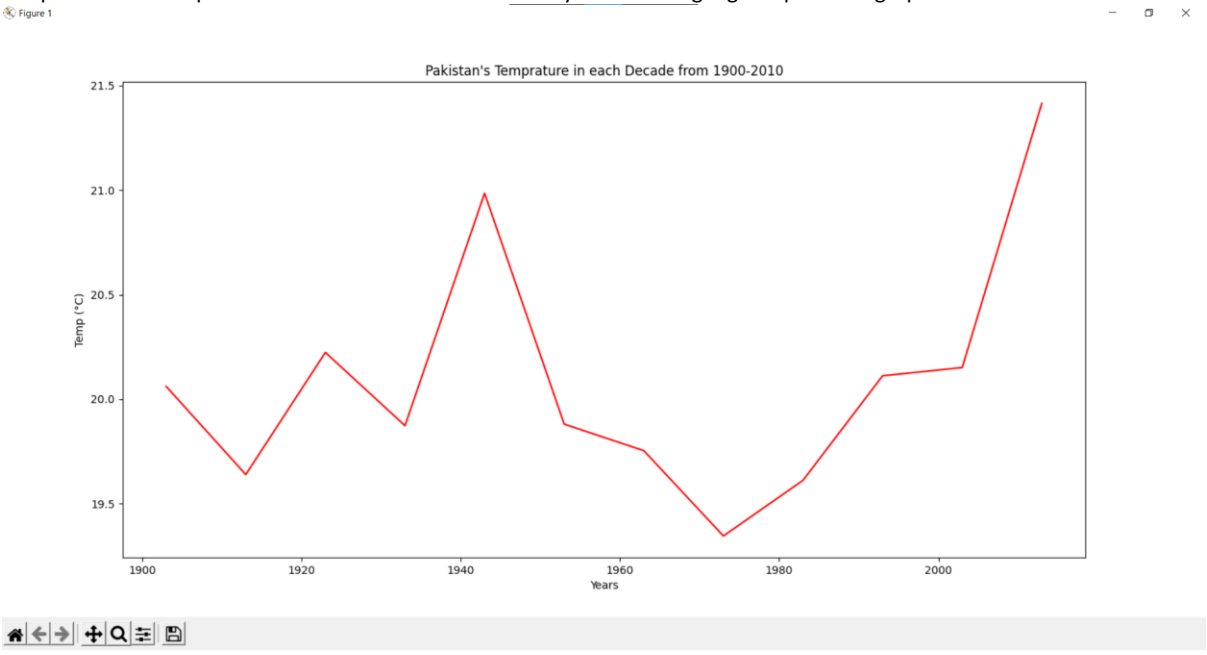


Scatter Plot showing the relation/comparison between average monthly temperature and rainfall data from 1901-2016
One interesting observation is that historically the peak temperature and rainfall is at the same time of year.



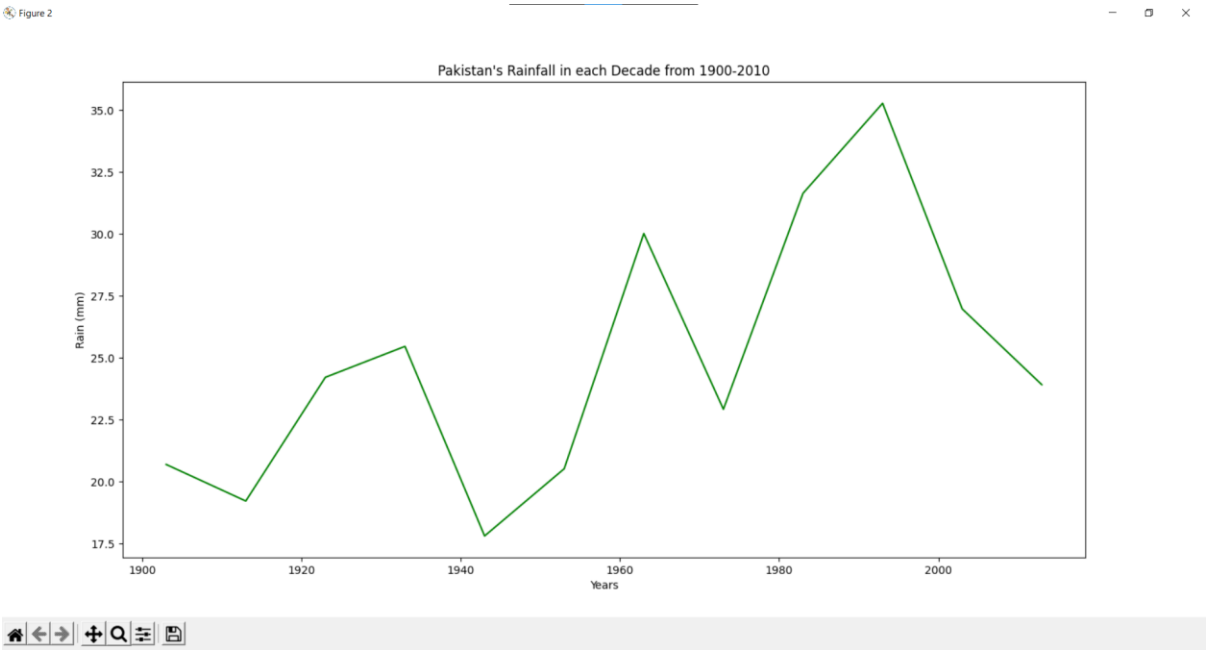
Line Graph representing Pakistan's average Temperature from 1901-2016 by Decade

Temperature is relatively rising every decade from 1900s bar 70s and 80s. This current decade is having by far the highest temperature out of past 12 decades as can be observed by the alarming high slope in the graph.

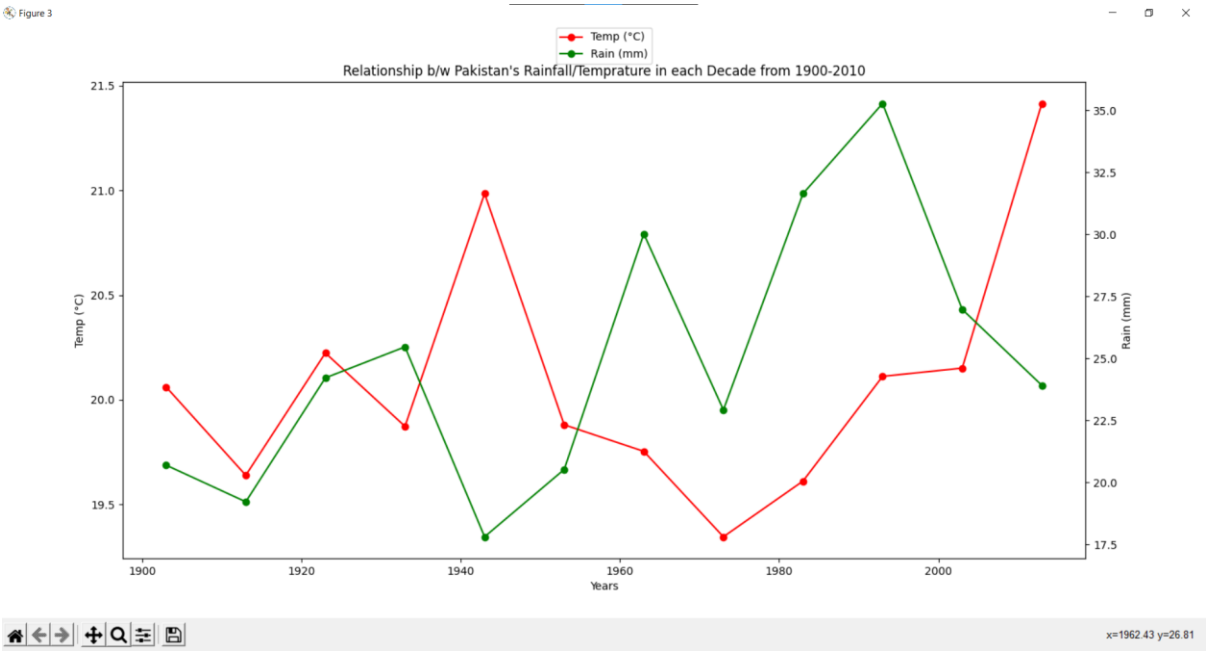


Line Graph representing Pakistan's average Rainfall from 1901-2016 by Decade

Rainfall follows different patterns every few decades, sometimes going up, sometimes going down but since the last few decades rainfall is going down as can be observed by alarming down slope in the graph.



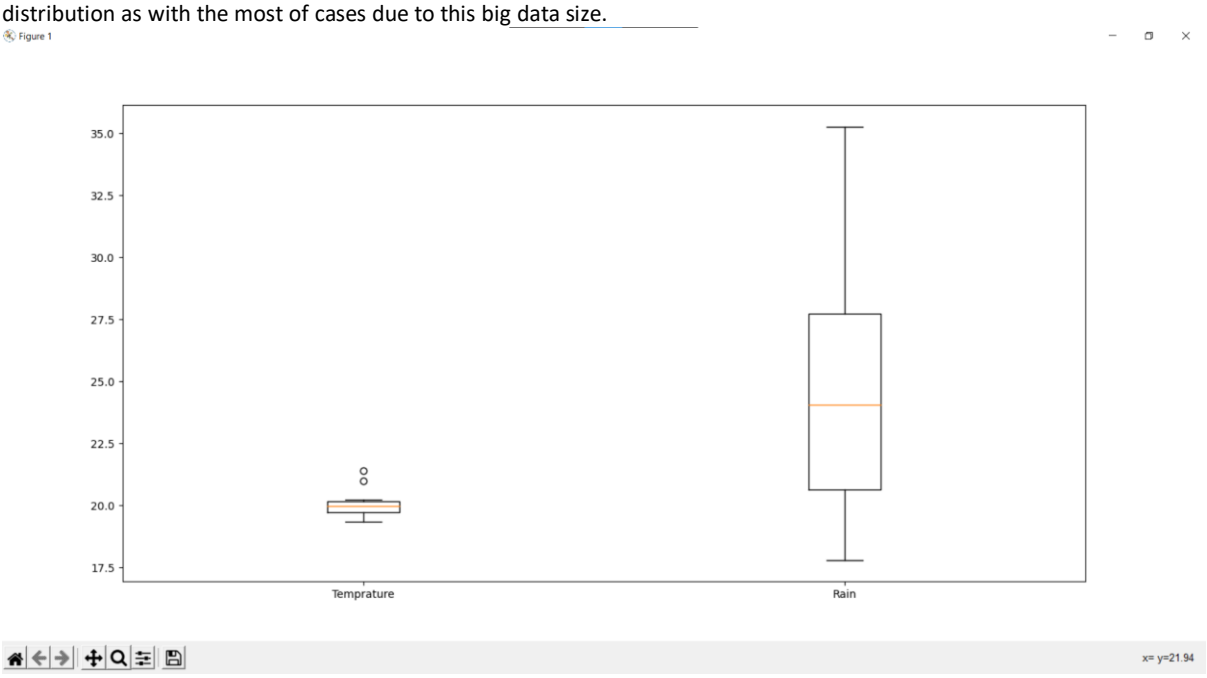
Scatter Plot showing the relation/comparison between average temperature and rainfall data from 2901-2016 by decade



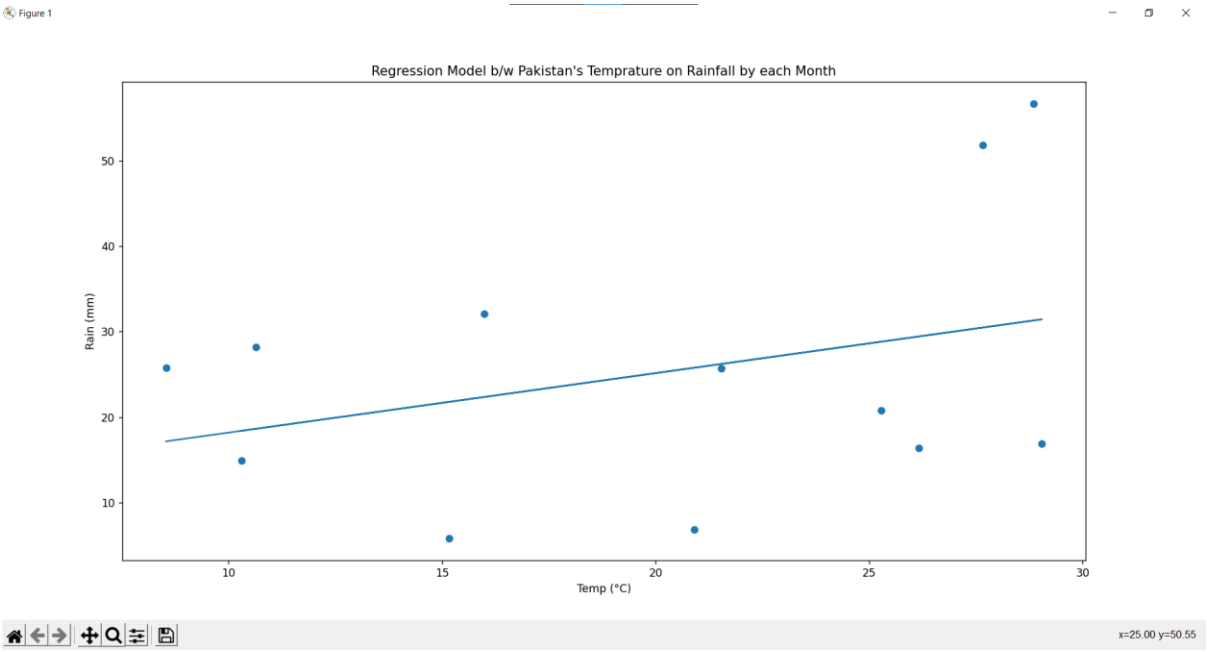
Box Plot representing the average monthly Temperature and Rainfall data from 1901-2016

Below graph represents the minimum, maximum, lower and upper quartile as well as median for both Temperature and Rainfall, 2 months having monsoon winds are the outliers here in the observations. Both the Plots looks to be following normal distribution as with the most of cases due to this big data size.

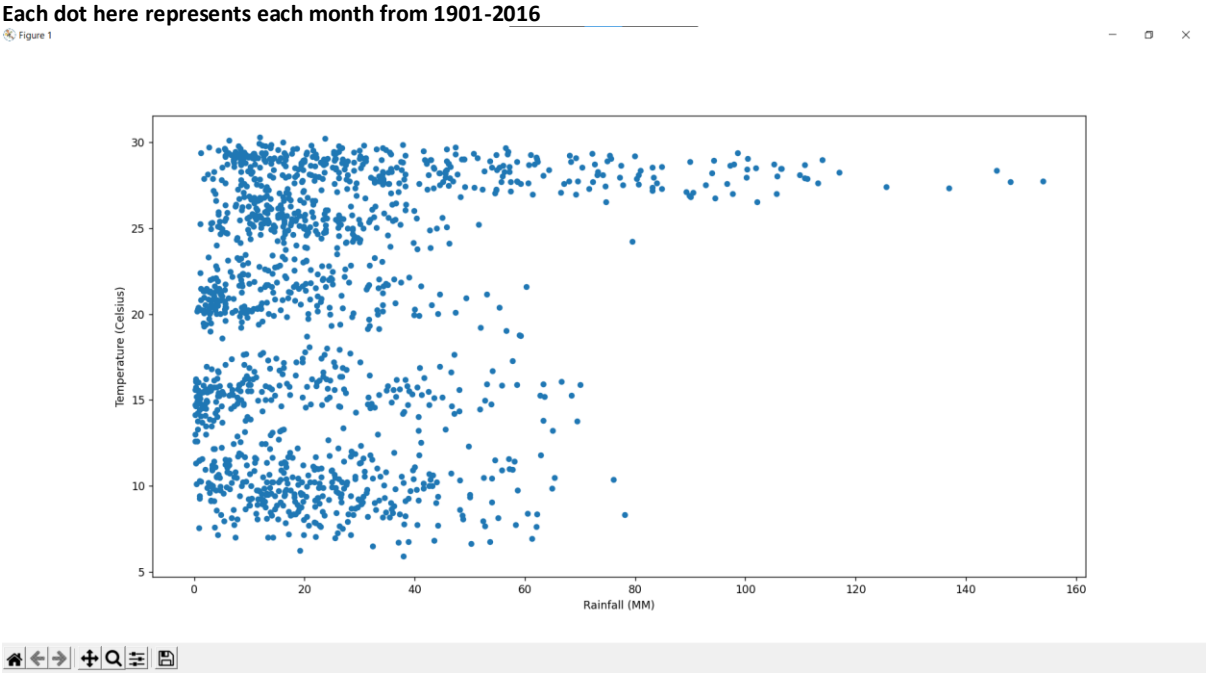
Box Plot representing the average Temperature and Rainfall data from 1901-2016 by Decade
Below graph represents the minimum, maximum, lower and upper quartile as well as median for both Temperature and Rainfall, 2 decades (70s,80s) are the outliers here in the observations. Both the Plots looks to be following normal distribution as with the most of cases due to this big data size.



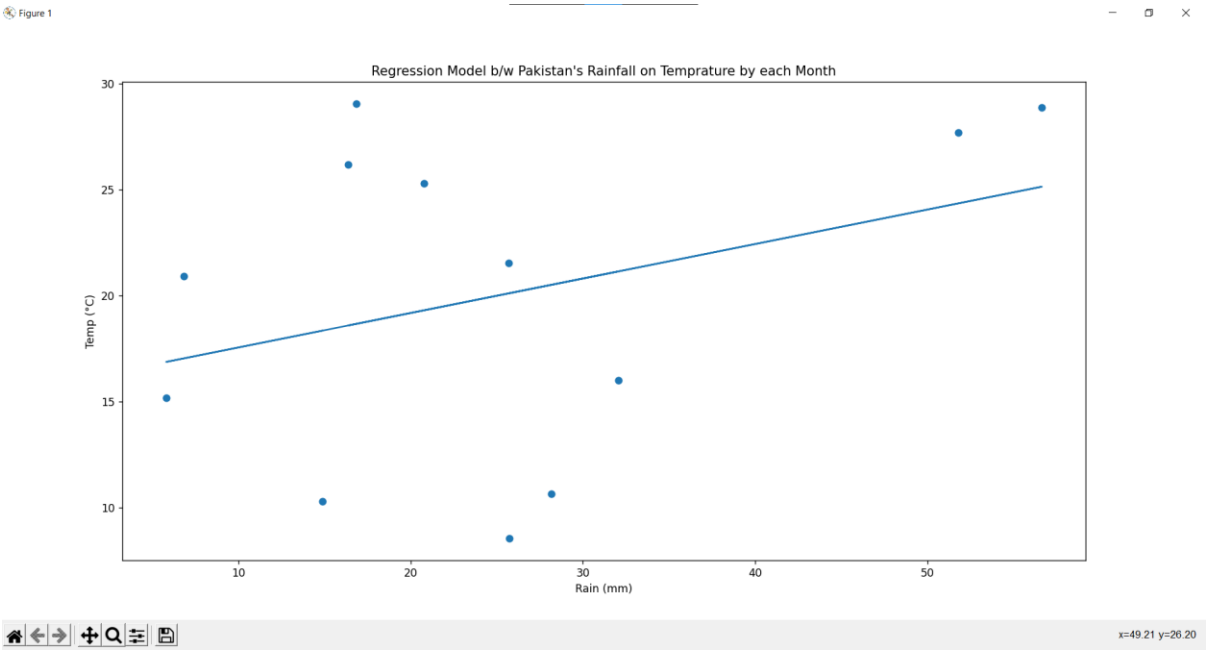
Linear Regression on average monthly Temperature (x) and Rainfall (y) data from 1901-2016
We cannot really control temperature or Rainfall directly but for the sake of observation, Rainfall is taken as Dependent variable here.



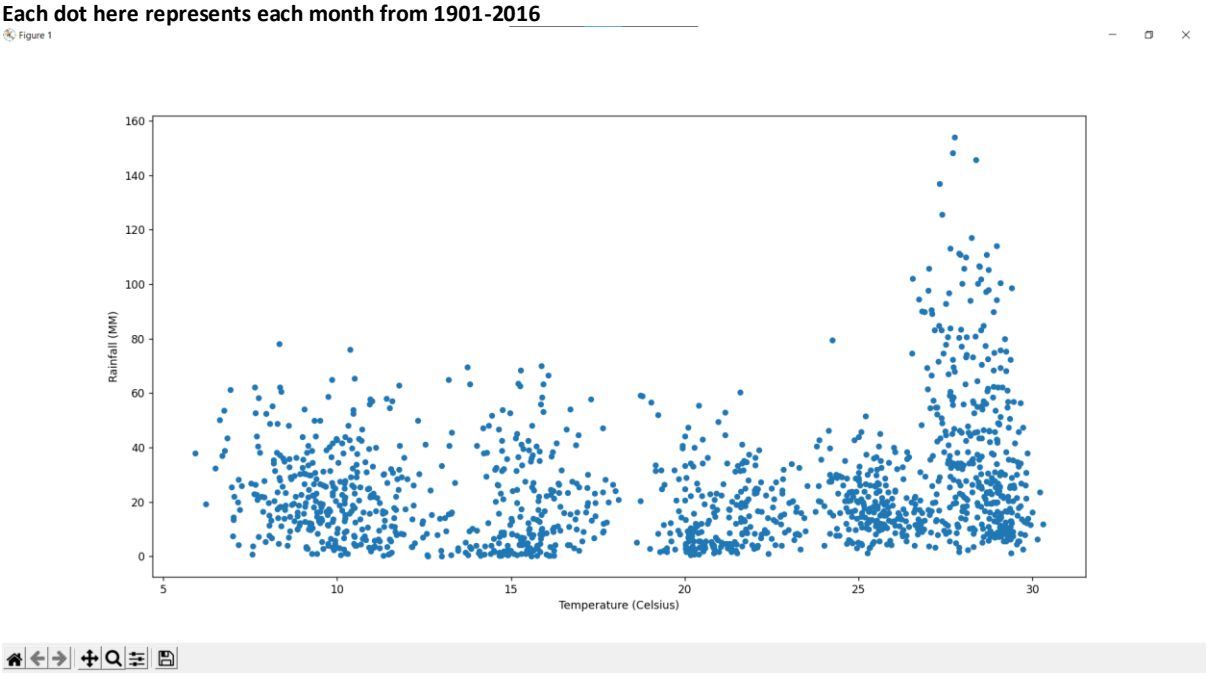
Each dot here represents each month from 1901-2016



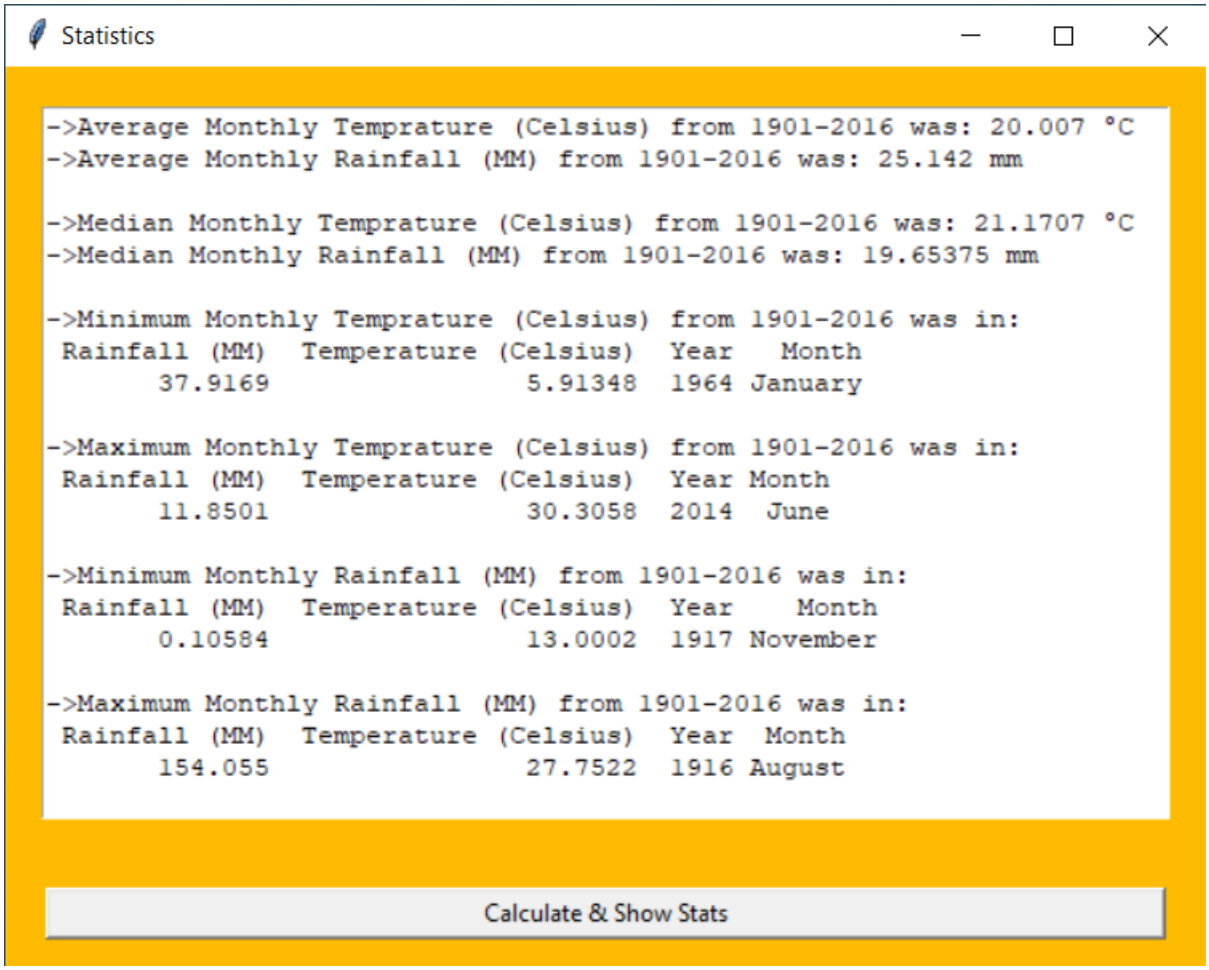
Linear Regression on average monthly Rainfall (x) and Temperature (y) data from 1901-2016
We cannot really control temperature or Rainfall directly but for the sake of observation, Temperature is taken as Dependent variable here.



Each dot here represents each month from 1901-2016



Analysis of Mean, Median, Minimum, Maximum Temperature and Rainfall from 1901-2016



The purpose of this analysis was to observe and try to identify the patterns in the Temperature/Rainfall to help understand and predict them for the fight against Climate Change as well as for some statistical analysis for farmers which is the source of income for the majority of Pakistani's. We tried our best despite the lack of experience with these statistical tools. We believe the above analysis and data can be helpful for farmers in identifying which crop to yield and when to yield it. Also, by the predictions we did use the LR method, they can avoid risks identifying the factors statistically. The data can also be helpful for someone with the knowledge to make strategies in order to tackle and Climate change effectively.

Thank you.