Author: Shantanu Tyagi

Date: 30-01-2021

ID: 201801015

In [1]:
```
import pandas as pd
from matplotlib import pyplot as plt
import numpy as np
from scipy import stats
# Reading CSV
df = pd.read_csv('Temperature_2020.csv')
# Station Name
name = 'MOUNT LOFTY AS'
# Filtering
df = df.loc[df['STATION_NAME'] == name]
# Removing large values
df = df[df['TMAX']!=-9999]
df = df[df['TMIN']!=-9999]
print('STATION: ' + name)
# New dataframes for individual analysis
df1 = df['TMAX']
df2 = df['TMIN']
```

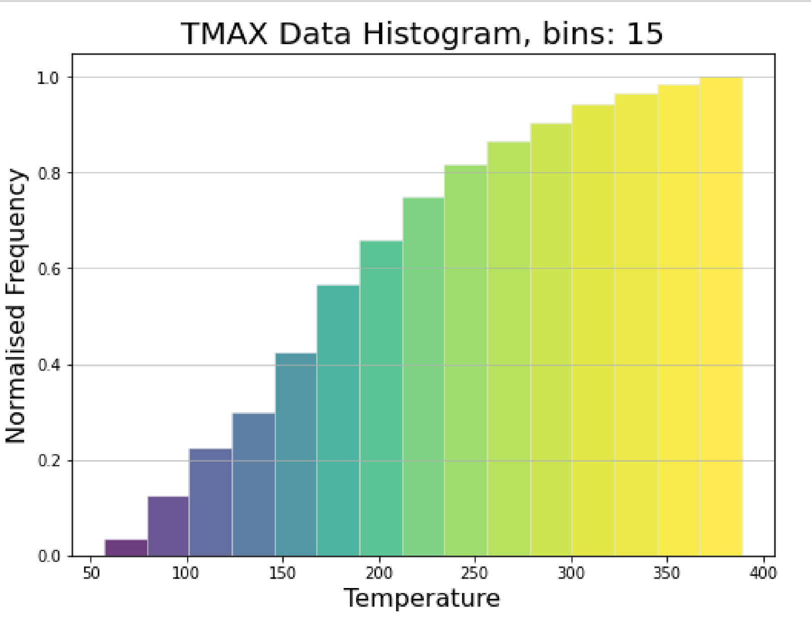
```
STATION: MOUNT LOFTY AS
```

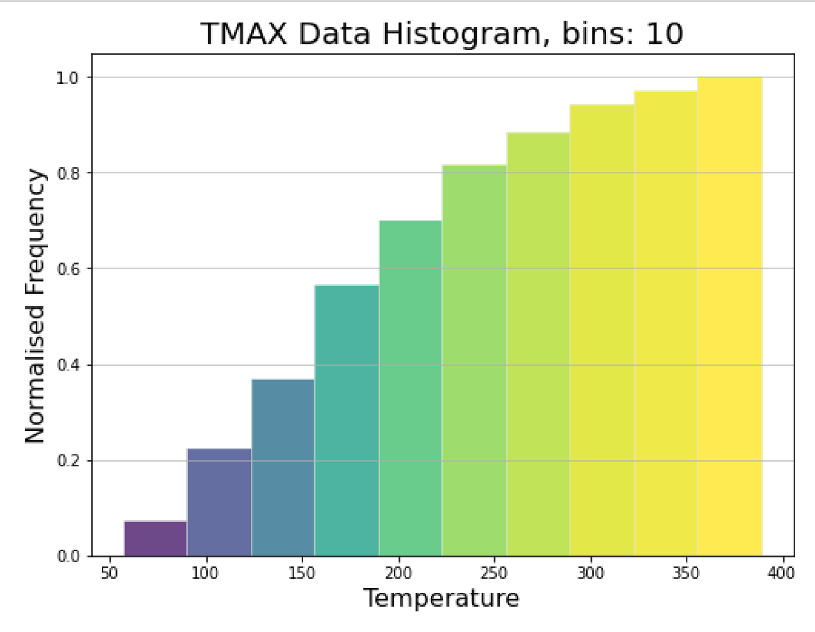
In the above code, I have first imported the CSV file in a dataframe and selected all columns from the rows having the desired station name. Then, the large values like -9999 are filtered off and finally we get two dataframes for this station, one for TMAX and other for TMAX.

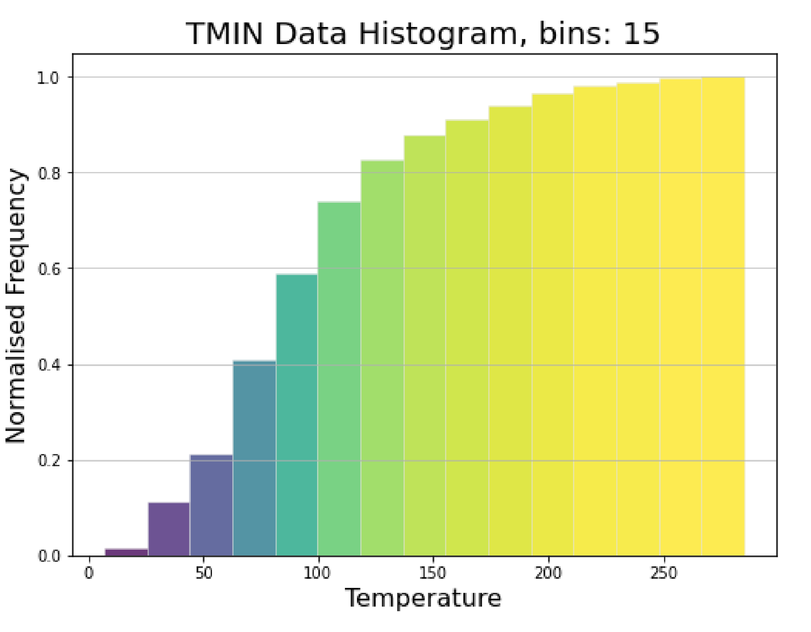
In [2]:
```
# Histogram function (data array, number of bins, subplot number, normalised?, cumulative?)
def plotHistogram(data, bins, i, norm, cumu):
    # Sub plot
    plt.subplot(1, 2, i)
    # assign weights if normalisation has to take place
    if norm:
        size = len(data)
    else: # else weights = 1
        size = 1
    # Hist function gives heights, bin intervals and patches with weight array to normalise heights
    n, bins, patches = plt.hist(data, bins=bins, facecolor='#2ab0ff', edgecolor='#e0e0e0', linewidth=0.5, alpha=0.8,
cumulative=cumu, weights = np.ones_like(data)*1./size)
    nn = max(n)
    # patches are used to change color of the bars in histogram
    for i in range(len(patches)):
        patches[i].set_facecolor(plt.cm.viridis((n[i]/nn)))
    # plotting starts here
    plt.title(data.name + ' Data Histogram, bins: '+str(i+1), fontsize=20)
    plt.xlabel('Temperature', fontsize=16)
    if norm:
        plt.ylabel('Normalised Frequency', fontsize=16)
    else:
        plt.ylabel('Frequency', fontsize=16)
    plt.grid(axis='y', alpha=0.75)
```

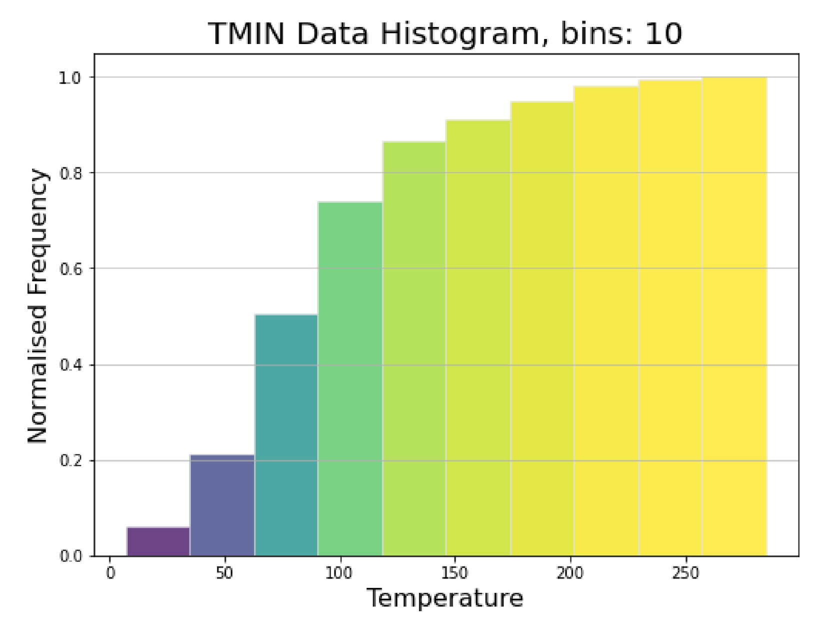
In the above code, I have defined a function that plots histogram based on the parameters that are given to the function. It takes the data array, the number of bins we want in the histogram, the sub plot number since 2 plots are to be plotted side by side and lastly if we want the simple histogram or a normalised histogram such that sum of heights of individual bars equals to 1.

In [3]:
```
# plot histograms  by calling the function
plt.figure(figsize=(18, 6))
# TMAX histogram
plotHistogram(df1,15, 1, True, True) # 15 bins
plotHistogram(df1,10, 2, True, True) # 10 bins
plt.show()
plt.figure(figsize=(18, 6))
# TMIN histogram
plotHistogram(df2,15, 1, True, True) # 15 bins
plotHistogram(df2,10, 2, True, True) # 10 bins
plt.show()
```









4 normalised and cumulative distribution histograms have been plotted, 2 each for TMAX and TMIN respectively with two values of bin size, i.e. 15 and 10 respectively.

The Pearson correlation coefficient measures the linear association between variables. Its value can be interpreted like so:

+1 - Complete positive correlation

+0.8 - Strong positive correlation

+0.6 - Moderate positive correlation

0 - no correlation whatsoever

-0.6 - Moderate negative correlation

-0.8 - Strong negative correlation

-1 - Complete negative correlation

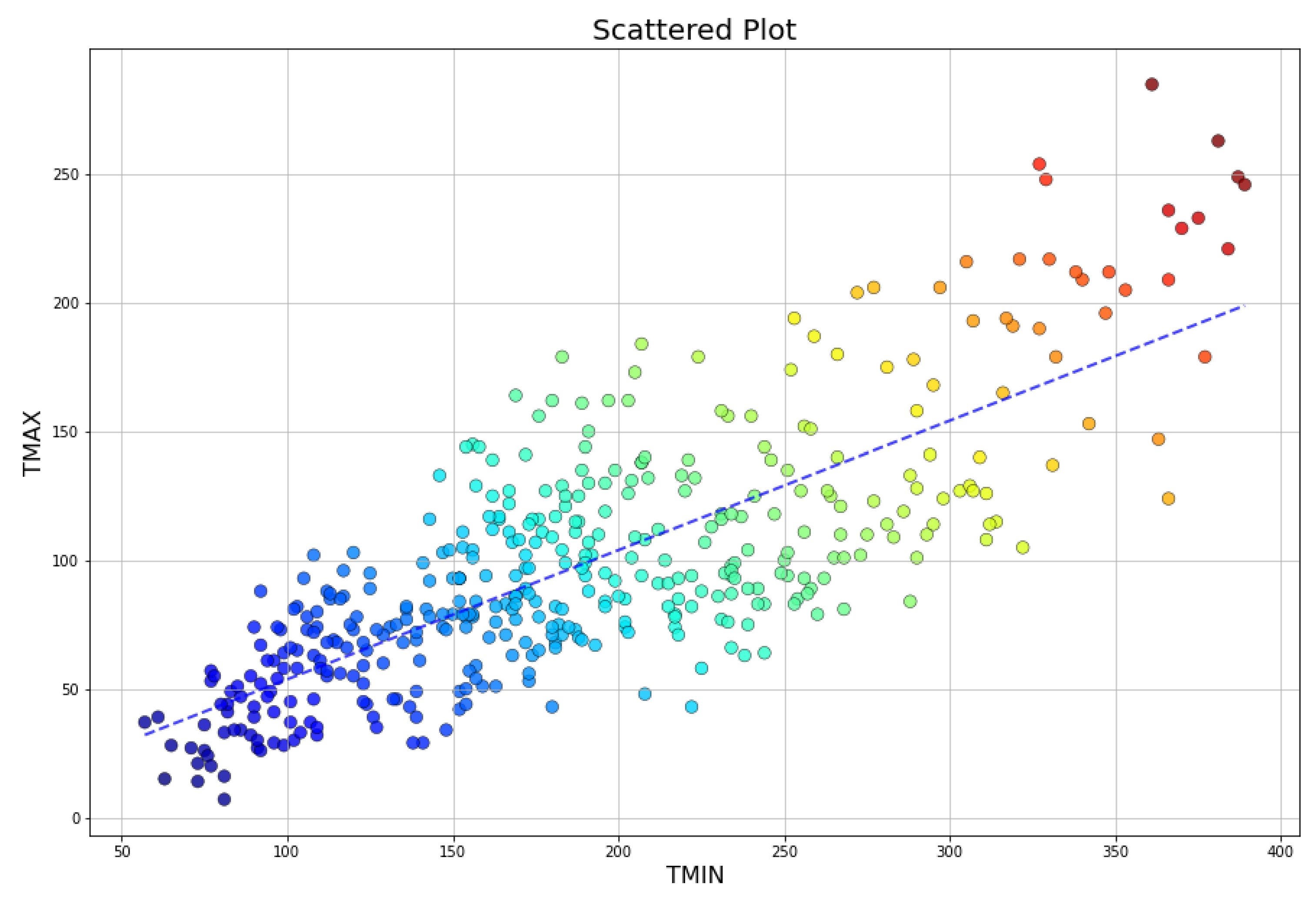
In [4]:
```
slope, intercept, r_value, p_value, std_err = stats.linregress(df1, df2)
x = np.linspace(min(df1),max(df1),1000)
y = slope*x + intercept
```

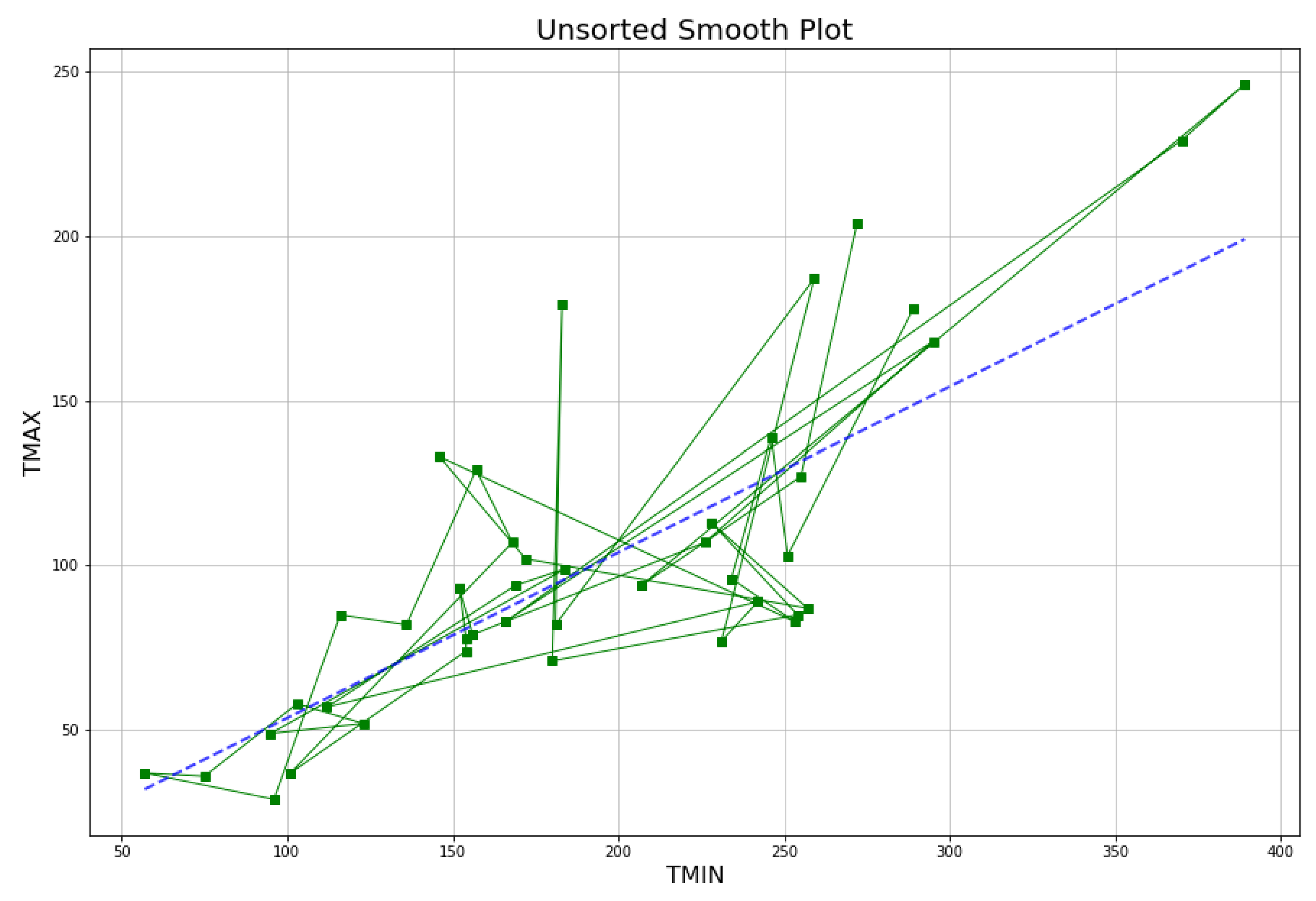
In [5]:
```
print('r   : ' + str(r_value))
print('r^2 : ' + str(r_value*r_value))
```

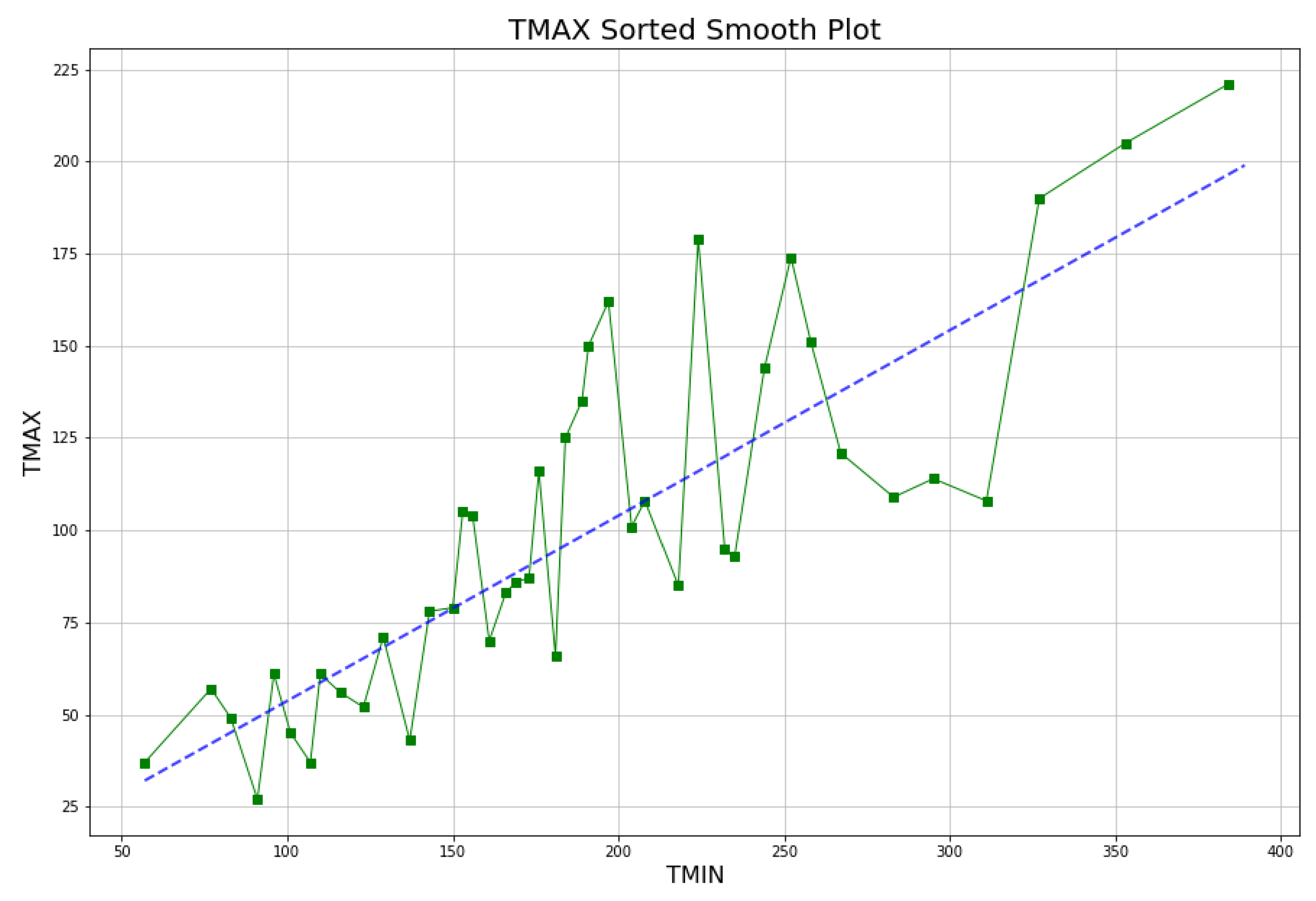
```
r   : 0.7745365160843741
r^2 : 0.5999068147481199
```

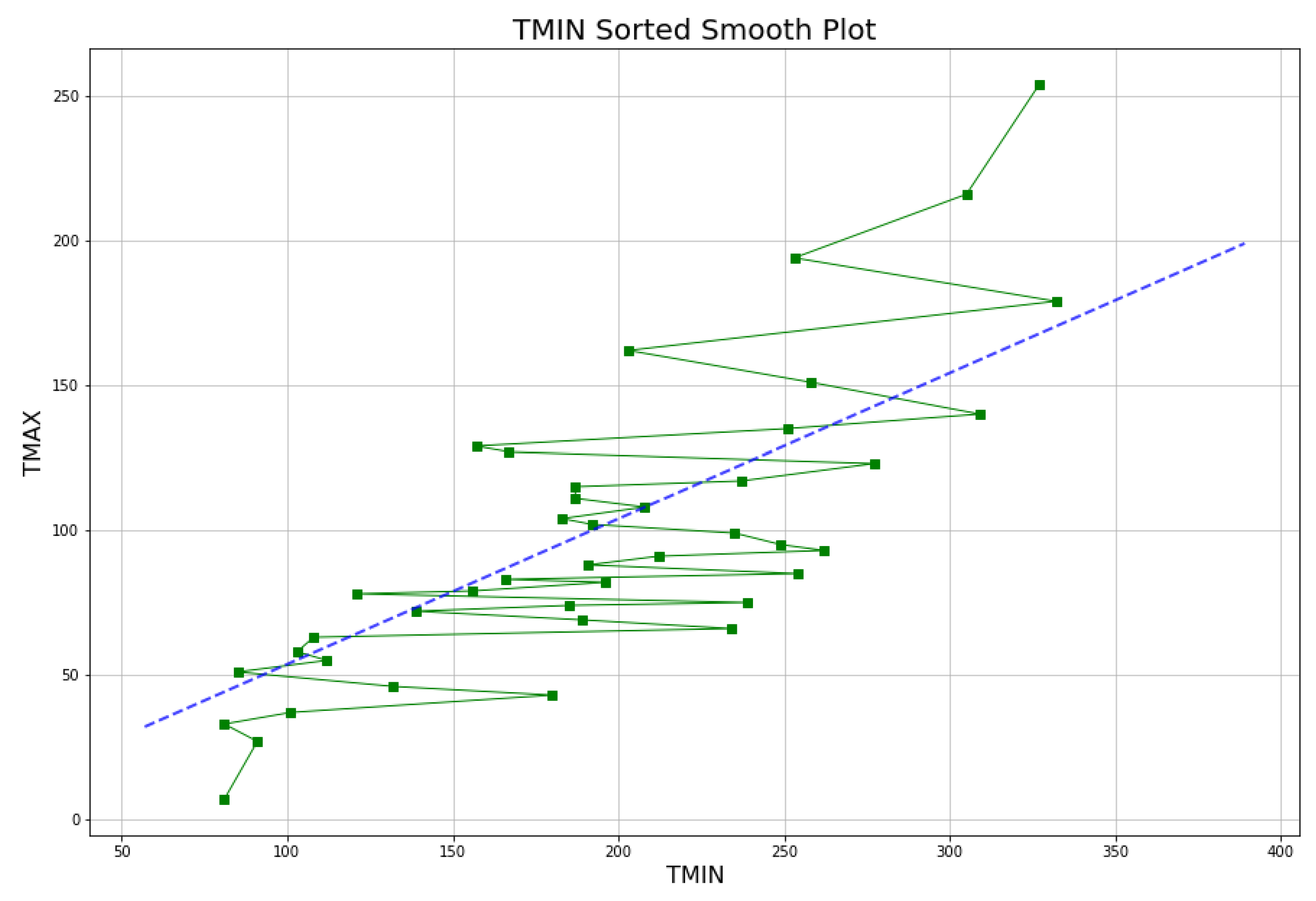
Above we have the r and r^2 values printed

In [6]:
```
plt.figure(figsize=(15, 10))
plt.scatter(df1, df2, c=df1+df2, cmap="jet", s=75, alpha=0.8, edgecolor='#000000', linewidth = 0.5)
plt.plot(x,y, 'b--', alpha=0.75, linewidth = 2)
plt.title('Scattered Plot', fontsize=20)
plt.xlabel('TMIN', fontsize=16)
plt.ylabel('TMAX', fontsize=16)
plt.grid(alpha=0.75)
plt.show()

plt.figure(figsize=(15, 10))
plt.plot(df1.iloc[0::10], df2.iloc[0::10], linewidth = 1, color='green')
plt.plot(df1.iloc[0::10], df2.iloc[0::10], 's', linewidth = 0.5, color='green')
plt.plot(x,y, 'b--', alpha=0.75, linewidth = 2)
plt.title('Unsorted Smooth Plot', fontsize=20)
plt.xlabel('TMIN', fontsize=16)
plt.ylabel('TMAX', fontsize=16)
plt.grid(alpha=0.75)
plt.show()

plt.figure(figsize=(15, 10))
dfs = df.sort_values(by=['TMAX'])
df11 = dfs['TMAX']
df22 = dfs['TMIN']
plt.plot(df11.iloc[0::10], df22.iloc[0::10], linewidth = 1, color='green')
plt.plot(df11.iloc[0::10], df22.iloc[0::10], 's', linewidth = 0.5, color='green')
plt.plot(x,y, 'b--', alpha=0.75, linewidth = 2)
plt.title('TMAX Sorted Smooth Plot', fontsize=20)
plt.xlabel('TMIN', fontsize=16)
plt.ylabel('TMAX', fontsize=16)
plt.grid(alpha=0.75)
plt.show()

plt.figure(figsize=(15, 10))
dfs = df.sort_values(by=['TMIN'])
df11 = dfs['TMAX']
df22 = dfs['TMIN']
plt.plot(df11.iloc[0::10], df22.iloc[0::10], linewidth = 1, color='green')
plt.plot(df11.iloc[0::10], df22.iloc[0::10], 's', linewidth = 0.5, color='green')
plt.plot(x,y, 'b--', alpha=0.75, linewidth = 2)
plt.title('TMIN Sorted Smooth Plot', fontsize=20)
plt.xlabel('TMIN', fontsize=16)
plt.ylabel('TMAX', fontsize=16)
plt.grid(alpha=0.75)
plt.show()
```









As we can see, after sorting the smooth scattered plot gives a better idea of how the data is distributed along and around the regression line. Instead of looking at the clouds in the normal scatter plot, we get a better idea about the linear distribution of data in smooth plots. sorting one of the axes wrt to the other one gives us continuous connected lines starting at lower value and ending at a higher value smoothly without jumps and hence gives us a better visualisation of the data.

In [ ]: