Weather Application

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Prediction Accuracy of Weather Data Set using Machine Learning Algorithms

Import Packages

In [2]:

```
#Import the libraries
import warnings
warnings.filterwarnings('ignore')

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from pandas.api.types import is_string_dtype

from sklearn.preprocessing import StandardScaler
from matplotlib.colors import ListedColormap
from sklearn.model_selection import train_test_split
from sklearn import metrics
from sklearn.metrics import classification_report
from sklearn.metrics import accuracy_score
from sklearn.metrics import cohen_kappa_score
from sklearn.metrics import confusion_matrix

import statsmodels
import statsmodels.api as sm
```

In [3]:

```
pd.options.display.max_columns = None
pd.options.display.max_rows = None

np.set_printoptions(suppress=True)
```

In [4]:

```
df= pd.read_csv("seattle-weather.csv")
df.head(10)
```

Out[4]:

	date	precipitation	temp_max	temp_min	wind	weather
0	2012-01-01	0.0	12.8	5.0	4.7	drizzle
1	2012-01-02	10.9	10.6	2.8	4.5	rain
2	2012-01-03	0.8	11.7	7.2	2.3	rain
3	2012-01-04	20.3	12.2	5.6	4.7	rain
4	2012-01-05	1.3	8.9	2.8	6.1	rain
5	2012-01-06	2.5	4.4	2.2	2.2	rain
6	2012-01-07	0.0	7.2	2.8	2.3	rain
7	2012-01-08	0.0	10.0	2.8	2.0	sun
8	2012-01-09	4.3	9.4	5.0	3.4	rain
9	2012-01-10	1.0	6.1	0.6	3.4	rain

In [5]:

```
df.tail(10)
```

Out[5]:

	date	precipitation	temp_max	temp_min	wind	weather
1451	2015-12-22	4.6	7.8	2.8	5.0	rain
1452	2015-12-23	6.1	5.0	2.8	7.6	rain
1453	2015-12-24	2.5	5.6	2.2	4.3	rain
1454	2015-12-25	5.8	5.0	2.2	1.5	rain
1455	2015-12-26	0.0	4.4	0.0	2.5	sun
1456	2015-12-27	8.6	4.4	1.7	2.9	rain
1457	2015-12-28	1.5	5.0	1.7	1.3	rain
1458	2015-12-29	0.0	7.2	0.6	2.6	fog
1459	2015-12-30	0.0	5.6	-1.0	3.4	sun
1460	2015-12-31	0.0	5.6	-2.1	3.5	sun

Understanding the data

In [7]:

```
df.shape
```

Out[7]:

```
(1461, 6)
```

In [8]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1461 entries, 0 to 1460
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   date           1461 non-null   object 
 1   precipitation  1461 non-null   float64
 2   temp_max       1461 non-null   float64
 3   temp_min       1461 non-null   float64
 4   wind           1461 non-null   float64
 5   weather        1461 non-null   object 
dtypes: float64(4), object(2)
memory usage: 68.6+ KB
```

In [9]:

```
df.dtypes
```

Out[9]:

```
date              object
precipitation    float64
temp_max         float64
temp_min         float64
wind             float64
weather           object
dtype: object
```

In [10]:
```
df.describe()
```

Out[10]:

	precipitation	temp_max	temp_min	wind
count	1461.000000	1461.000000	1461.000000	1461.000000
mean	3.029432	16.439083	8.234771	3.241136
std	6.680194	7.349758	5.023004	1.437825
min	0.000000	-1.600000	-7.100000	0.400000
25%	0.000000	10.600000	4.400000	2.200000
50%	0.000000	15.600000	8.300000	3.000000
75%	2.800000	22.200000	12.200000	4.000000
max	55.900000	35.600000	18.300000	9.500000

In [11]:
```
df.describe(include='object')
```

Out[11]:

	date	weather
count	1461	1461
unique	1461	5
top	2012-01-01	rain
freq	1	641

In [12]:
```
Total = df.isnull().sum().sort_values(ascending = False)

Percent = (df.isnull().sum()*100/df.isnull().count()).sort_values(ascending = False)

missing_data = pd.concat([Total, Percent], axis = 1, keys = ['Total', 'Percentage of Missing
missing_data
```

Out[12]:

	Total	Percentage of Missing Values
date	0	0.0
precipitation	0	0.0
temp_max	0	0.0
temp_min	0	0.0
wind	0	0.0
weather	0	0.0

In [13]:
```
df.nunique()
```

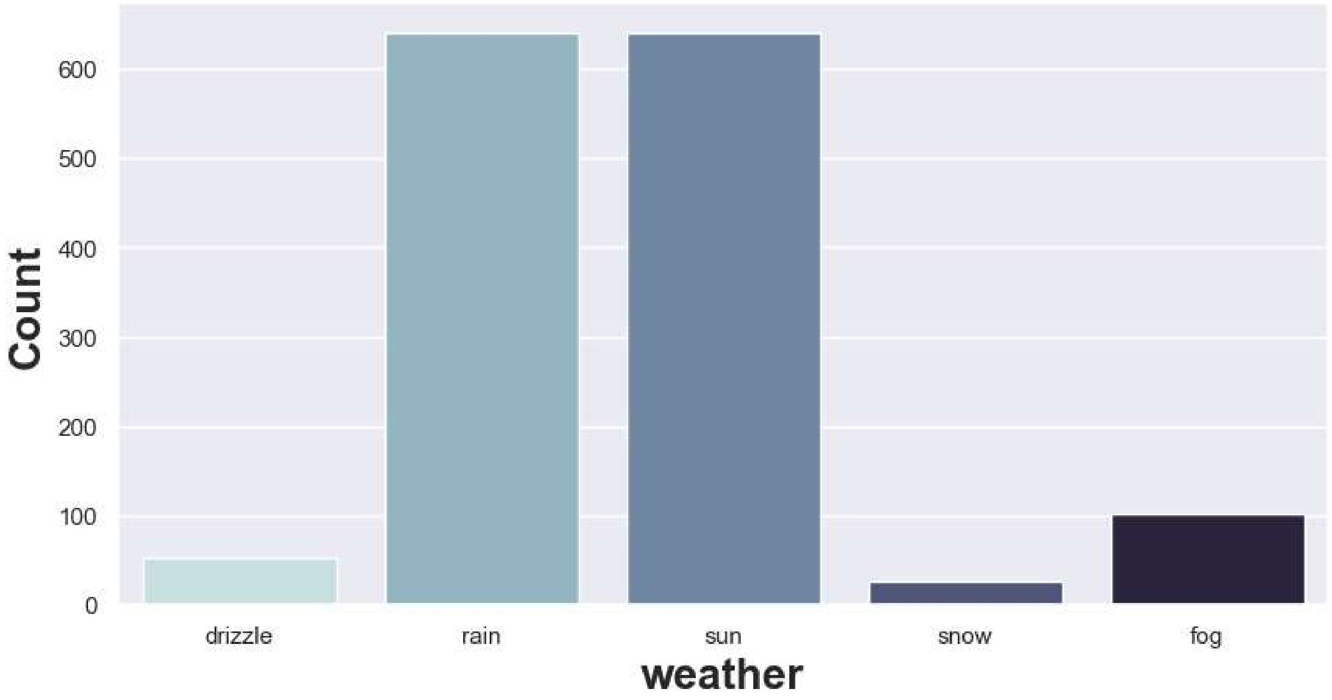
Out[13]:
```
date             1461
precipitation     111
temp_max           67
temp_min           55
wind               79
weather             5
dtype: int64
```

In [14]:
```
df['weather'].value_counts()
```

Out[14]:
```
rain       641
sun        640
fog        101
drizzle     53
snow        26
Name: weather, dtype: int64
```

In [15]:

```
plt.figure(figsize=(10,5))
sns.set_theme()
sns.countplot(x = 'weather',data = df,palette="ch:start=.2,rot=-.3")
plt.xlabel("weather",fontweight='bold',size=20)
plt.ylabel("Count",fontweight='bold',size=20)
plt.show()
```

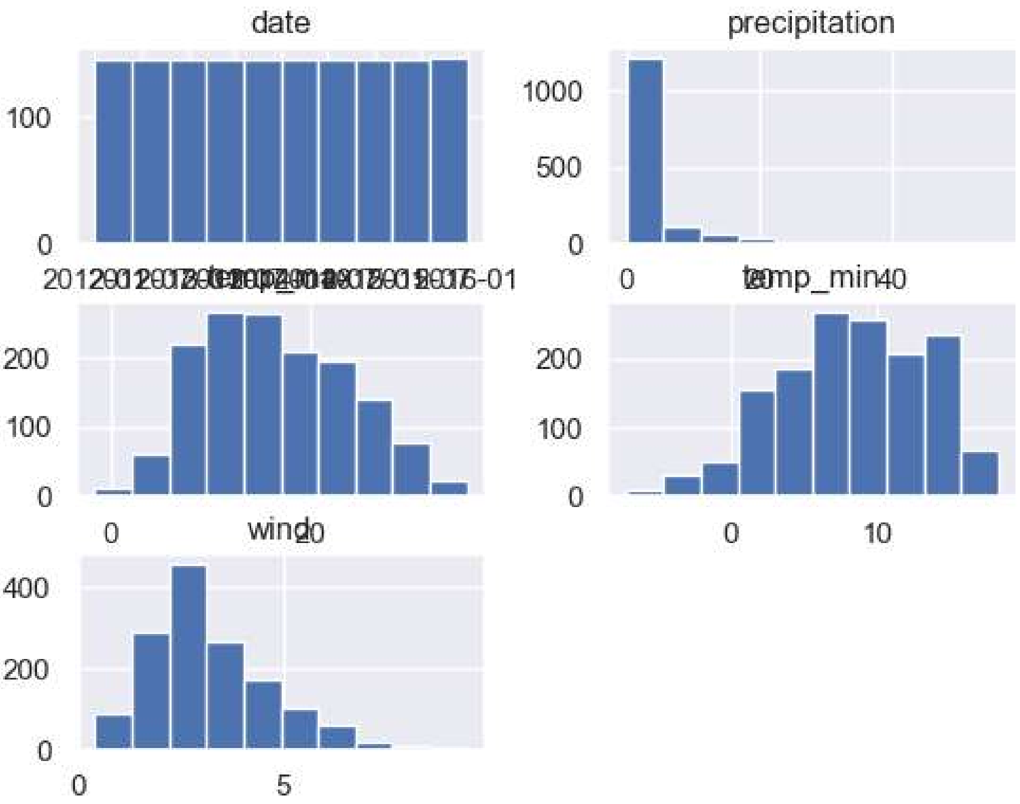


In [16]:

```
#convert the data type into datetime
df['date'] = pd.to_datetime(df['date'])
```

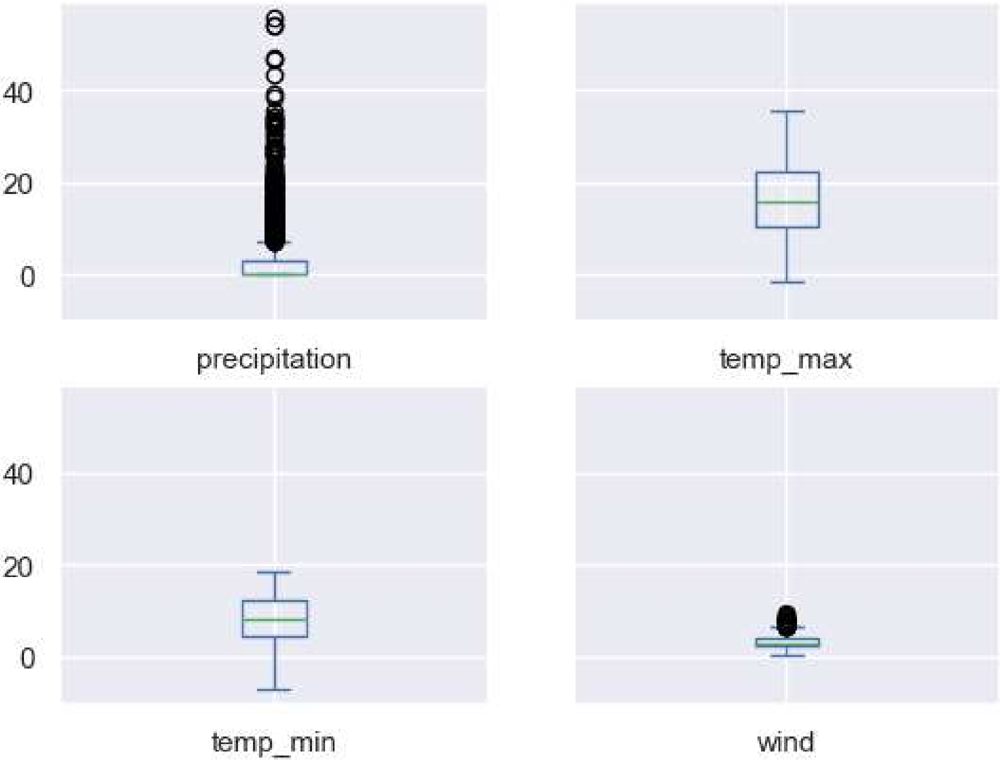
In [17]:
```
df.hist()
```

Out[17]:
```
array([[<AxesSubplot:title={'center':'date'}>,
        <AxesSubplot:title={'center':'precipitation'}>],
       [<AxesSubplot:title={'center':'temp_max'}>,
        <AxesSubplot:title={'center':'temp_min'}>],
       [<AxesSubplot:title={'center':'wind'}>, <AxesSubplot:>]],
      dtype=object)
```

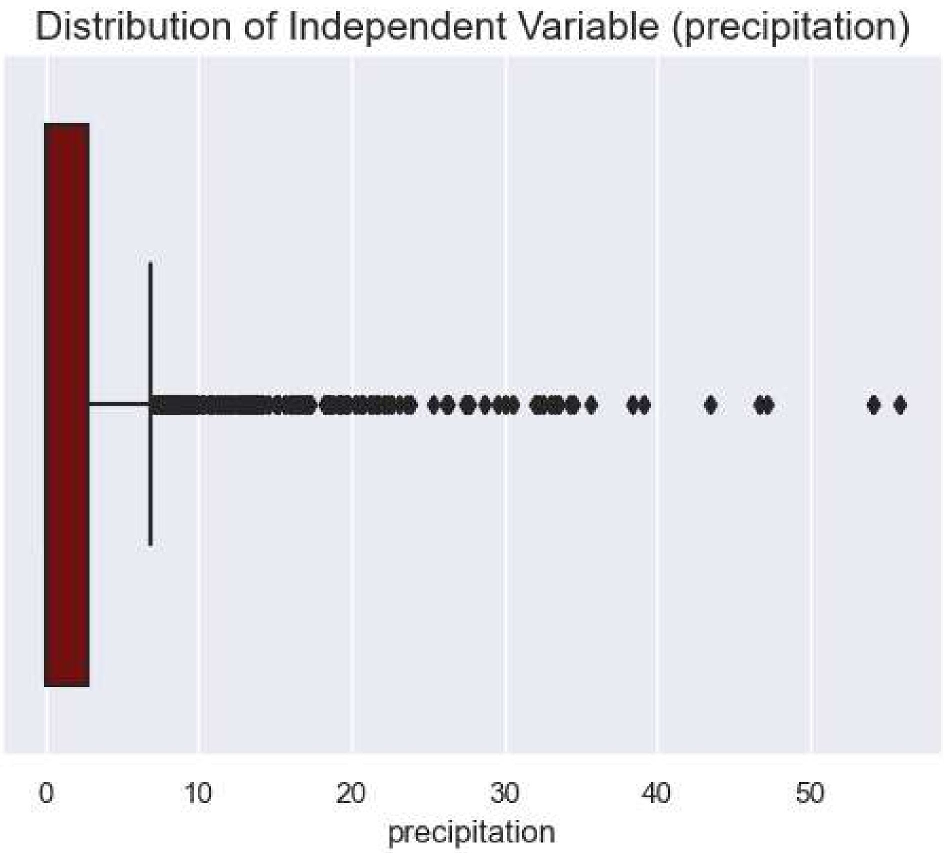


In [18]:
```
df.plot(kind='box', subplots=True, layout=(2, 2), sharex=True, sharey=True)
```

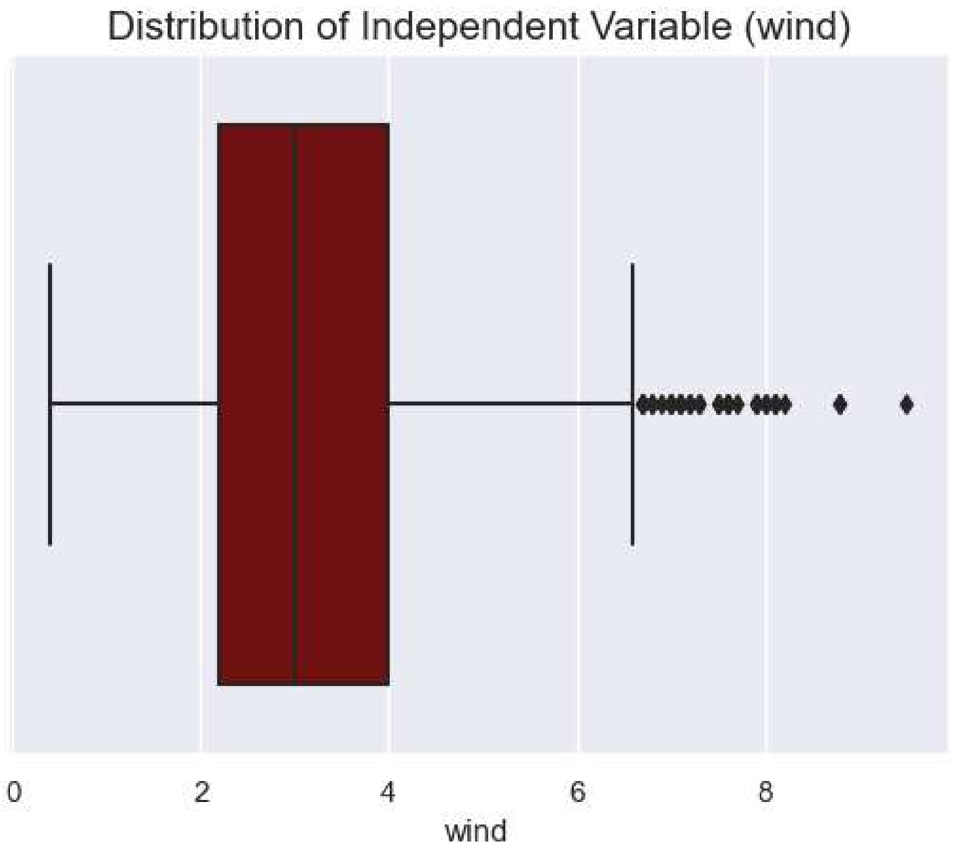
Out[18]:
```
precipitation       AxesSubplot(0.125,0.53;0.352273x0.35)
temp_max         AxesSubplot(0.547727,0.53;0.352273x0.35)
temp_min            AxesSubplot(0.125,0.11;0.352273x0.35)
wind             AxesSubplot(0.547727,0.11;0.352273x0.35)
dtype: object
```



```
In [19]: sns.boxplot(df['precipitation'], color='maroon')

         plt.title('Distribution of Independent Variable (precipitation)', fontsize = 15)

         # display the plot
         plt.show()
```



In [20]:
```
sns.boxplot(df['wind'], color='maroon')

plt.title('Distribution of Independent Variable (wind)', fontsize = 15)

# display the plot
plt.show()
```

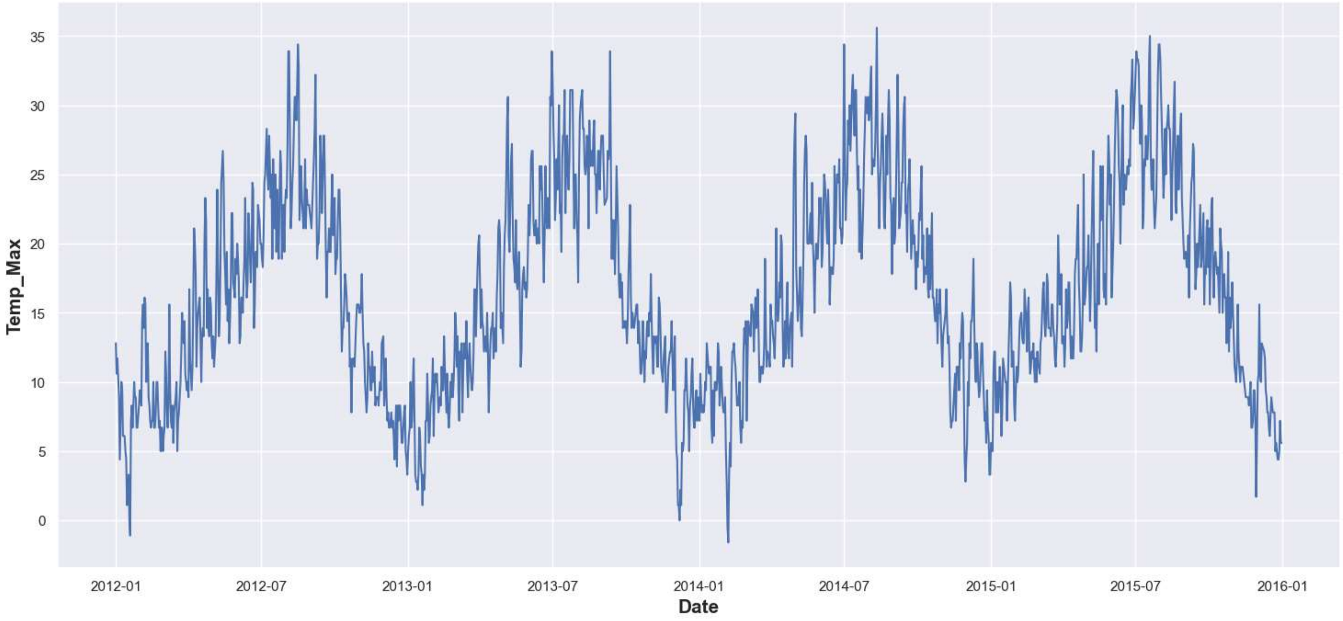


In [21]:
```
df = df[df['precipitation'] < 20]

# check the dimension of the data
df.shape
```

Out[21]:
```
(1410, 6)
```

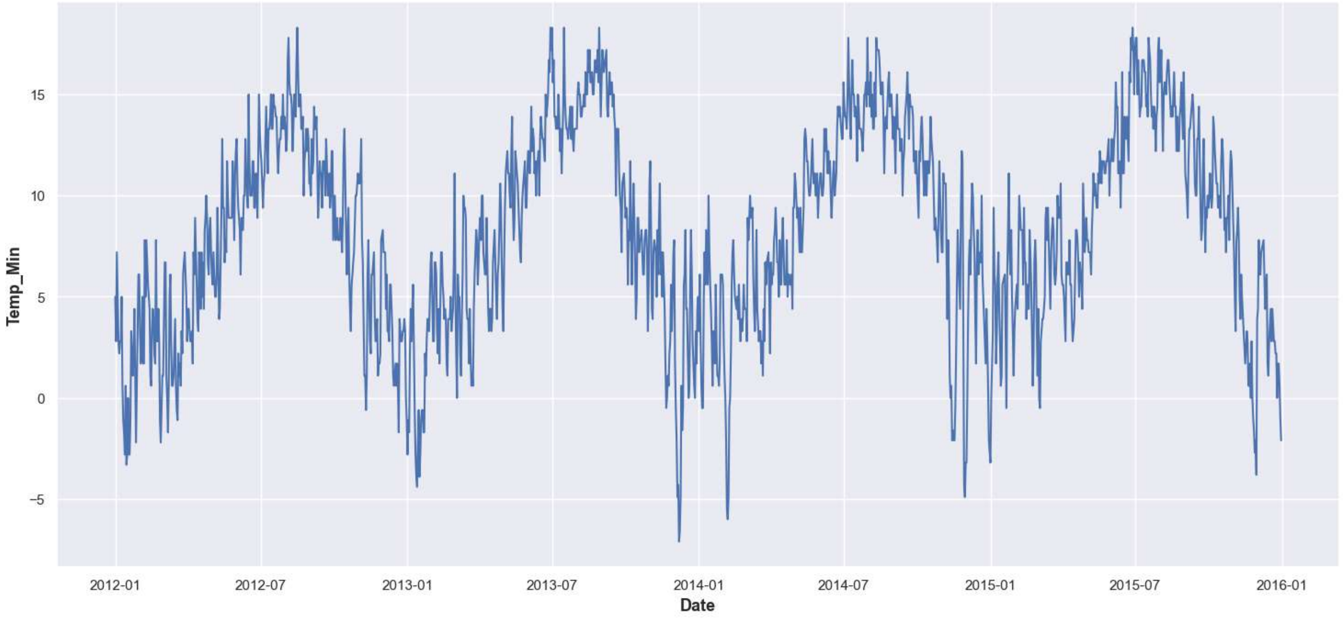
In [23]:

```
plt.figure(figsize=(18,8))
sns.set_theme()
sns.lineplot(x = 'date',y='temp_max',data=df)
plt.xlabel("Date",fontweight='bold',size=15)
plt.ylabel("Temp_Max",fontweight='bold',size=15)
plt.show()
```

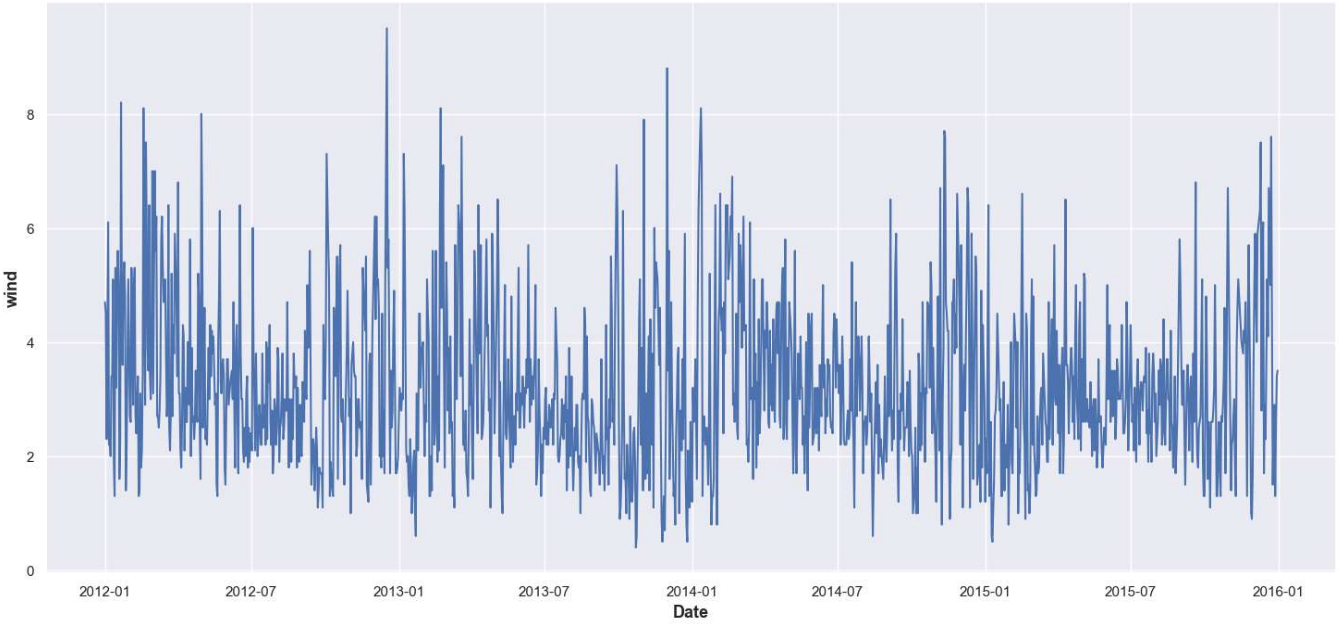


In [24]:

```
plt.figure(figsize=(18,8))
sns.set_theme()
sns.lineplot(x = 'date',y='temp_min',data=df)
plt.xlabel("Date",fontweight='bold',size=13)
plt.ylabel("Temp_Min",fontweight='bold',size=13)
plt.show()
```

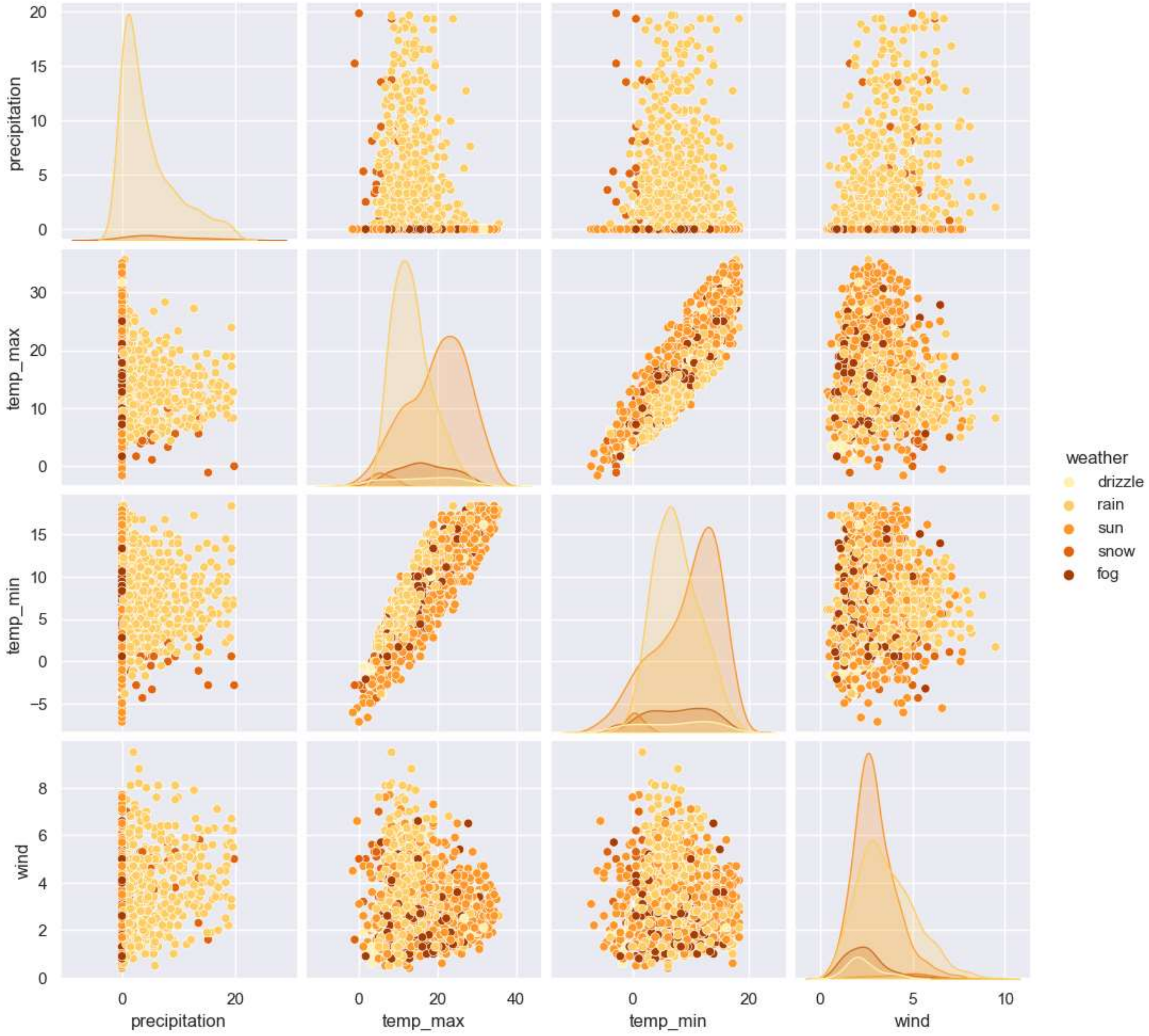


In [25]:
```
plt.figure(figsize=(18,8))
sns.set_theme()
sns.lineplot(x = 'date',y='wind',data=df)
plt.xlabel("Date",fontweight='bold',size=13)
plt.ylabel("wind",fontweight='bold',size=13)
plt.show()
```



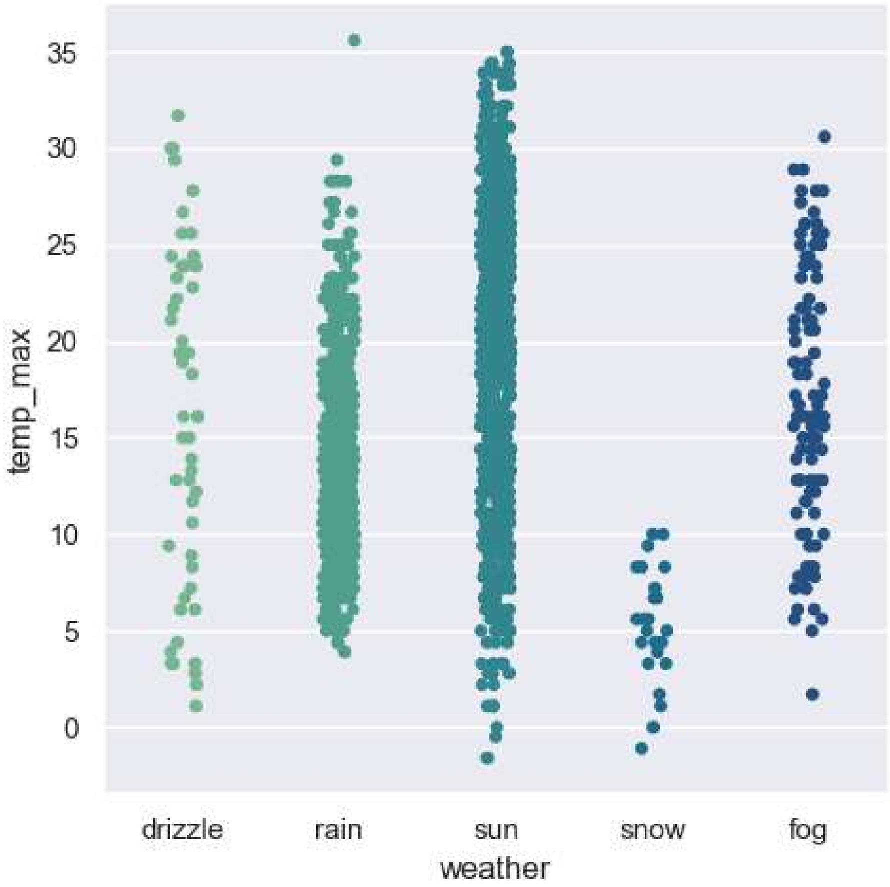
```
In [26]: plt.figure(figsize=(14,8))
         sns.pairplot(df.drop('date',axis=1),hue='weather',palette="YlOrBr")
         plt.show()
```

```
<Figure size 1400x800 with 0 Axes>
```



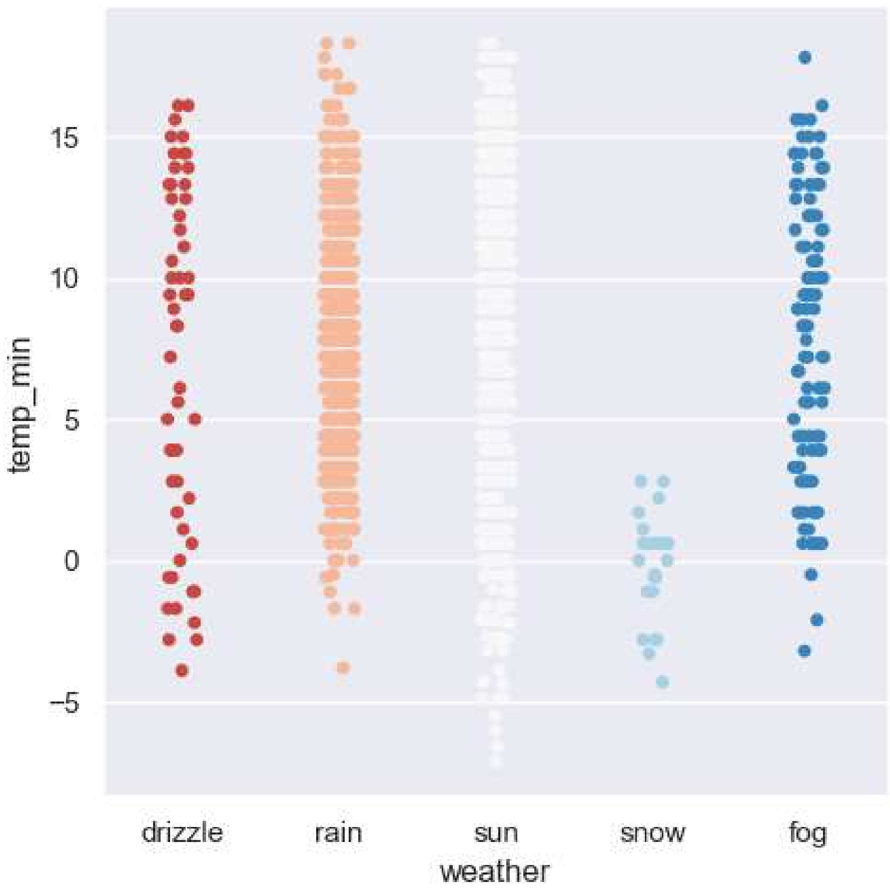
```
In [27]: plt.figure(figsize=(10,5))
         sns.catplot(x='weather',y ='temp_max',data=df,palette="crest")
         plt.show()
```

```
<Figure size 1000x500 with 0 Axes>
```



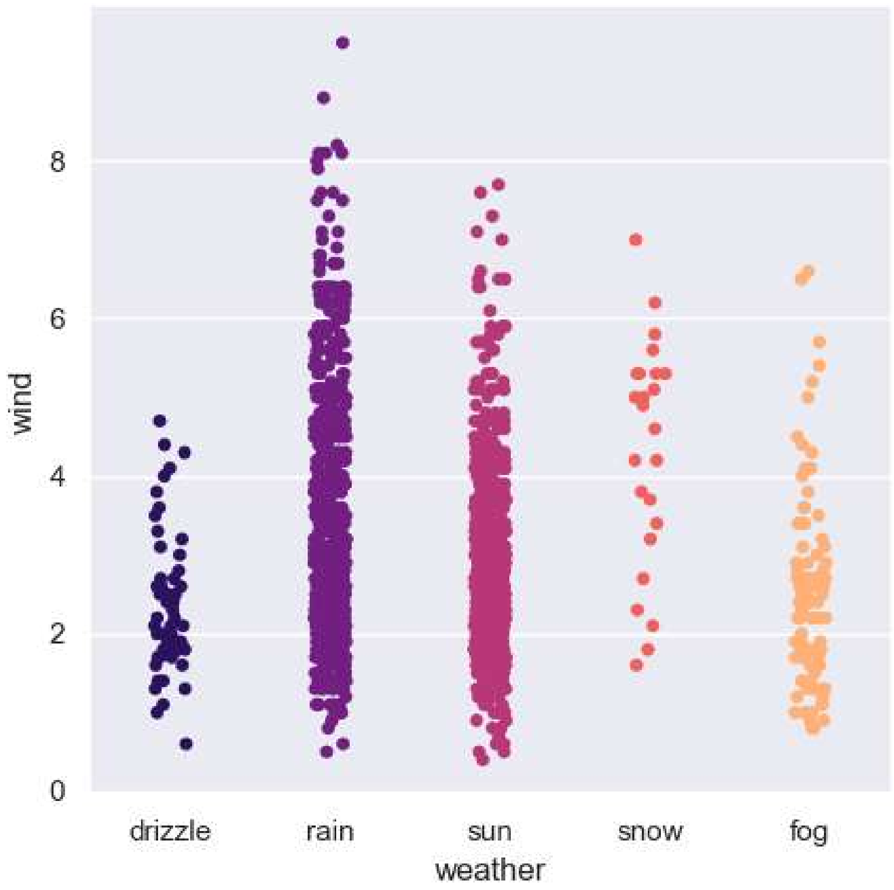
```
In [28]: plt.figure(figsize=(10,5))
         sns.catplot(x='weather',y ='temp_min',data=df,palette = "RdBu")
         plt.show()
```

```
<Figure size 1000x500 with 0 Axes>
```

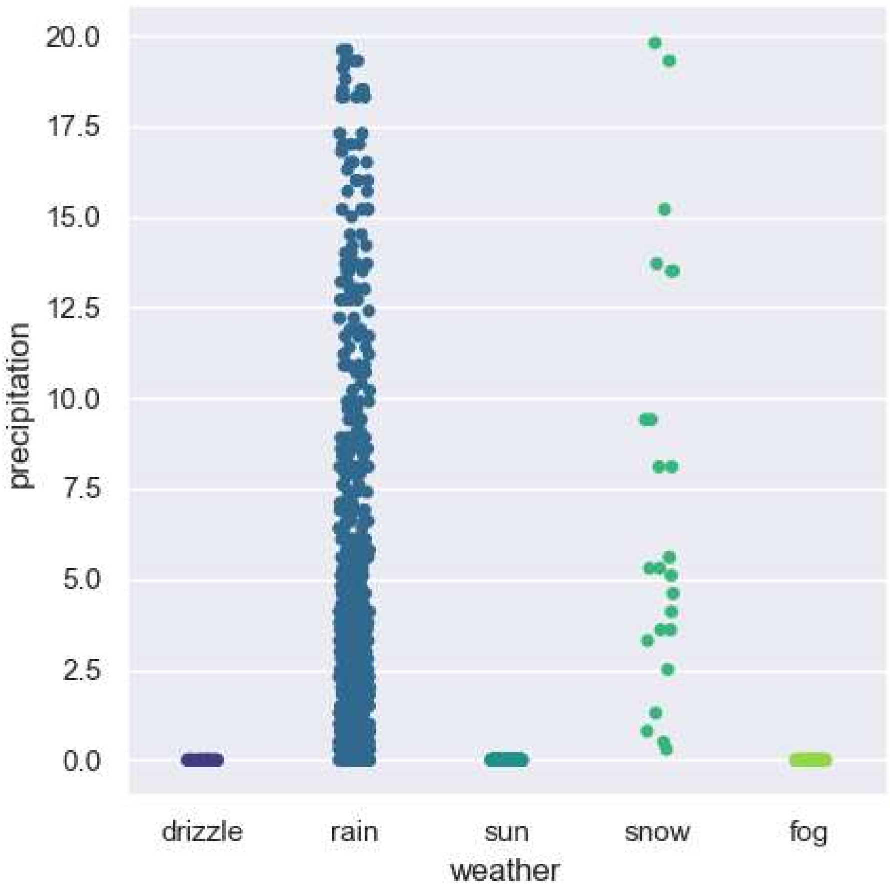


```
In [29]: plt.figure(figsize=(10,5))
         sns.catplot(x='weather',y ='wind',data=df,palette = "magma")
         plt.show()
```

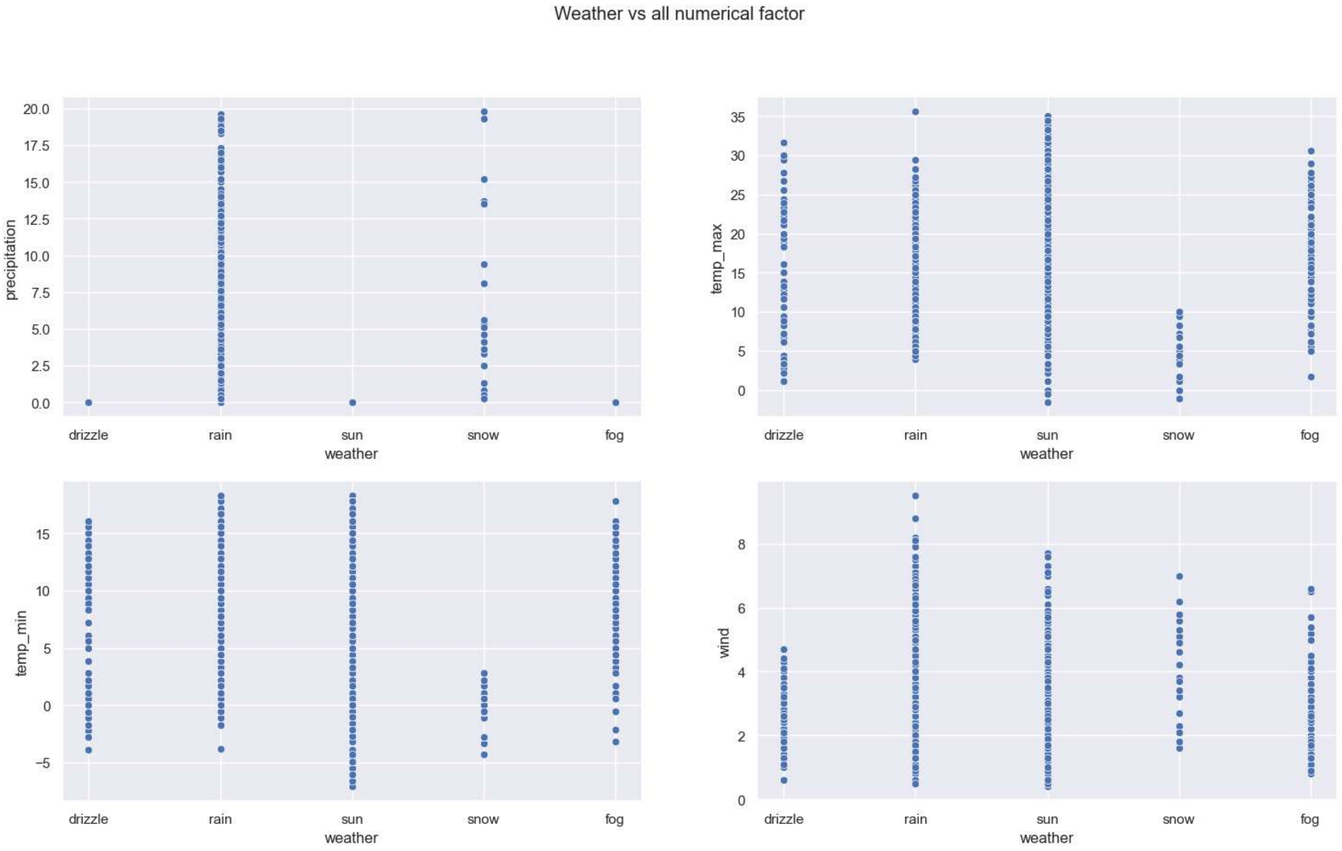
```
<Figure size 1000x500 with 0 Axes>
```



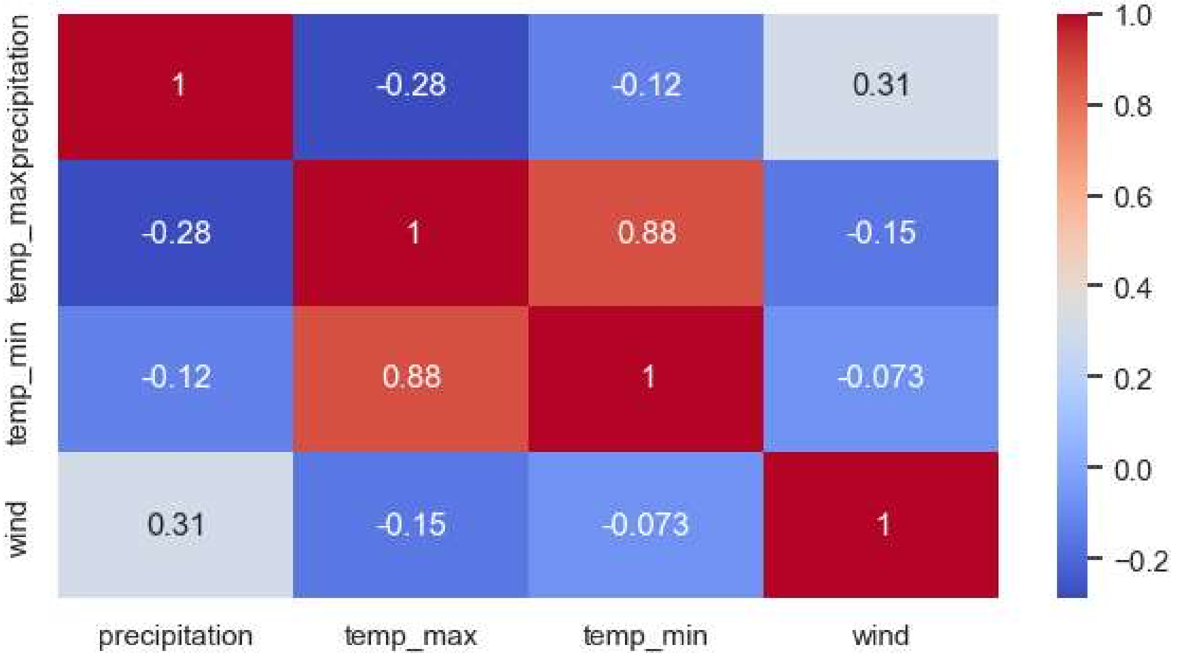
```
In [30]: sns.catplot(x='weather',y ='precipitation',data=df,palette = "viridis")
         plt.show()
```



In [31]:
```
fig, axes = plt.subplots(2, 2, figsize=(18, 10))

fig.suptitle('Weather vs all numerical factor')

sns.scatterplot(ax=axes[0, 0], data=df, x='weather', y='precipitation')
sns.scatterplot(ax=axes[0, 1], data=df, x='weather', y='temp_max')
sns.scatterplot(ax=axes[1, 0], data=df, x='weather', y='temp_min')
sns.scatterplot(ax=axes[1, 1], data=df, x='weather', y='wind')
plt.show()
```



In [32]:
```
cor=df.corr()
plt.figure(figsize=(8,4))
sns.heatmap(cor,annot=True,cmap='coolwarm')
plt.show()
```



In [33]:

```
def LABEL_ENCODING(c1):
    from sklearn import preprocessing
    label_encoder = preprocessing.LabelEncoder()
    df[c1]= label_encoder.fit_transform(df[c1])
    df[c1].unique()
LABEL_ENCODING("weather")
df.head()
```

Out[33]:

	date	precipitation	temp_max	temp_min	wind	weather
0	2012-01-01	0.0	12.8	5.0	4.7	0
1	2012-01-02	10.9	10.6	2.8	4.5	2
2	2012-01-03	0.8	11.7	7.2	2.3	2
4	2012-01-05	1.3	8.9	2.8	6.1	2
5	2012-01-06	2.5	4.4	2.2	2.2	2

In [34]:

```
df = df.drop('date',axis=1)
```

In [35]:

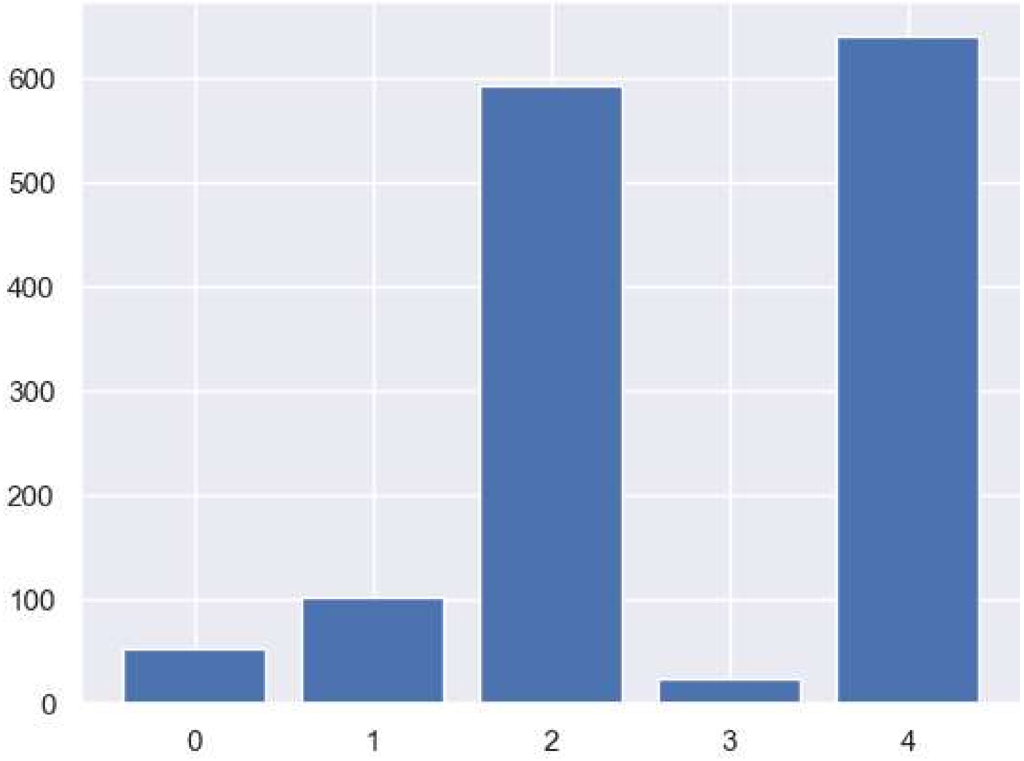
```
x = df.drop('weather',axis=1)
y = df['weather']
```

In [38]:

```
from collections import Counter
from matplotlib import pyplot
from sklearn.preprocessing import LabelEncoder
```

In [41]:
```
y = LabelEncoder().fit_transform(y)
# transform the dataset
# summarize distribution
counter = Counter(y)
for k,v in counter.items():
    per = v/len(y) * 100
    print('Class=%d, n=%d (%.3f%%)' % (k, v, per))
# plot the distribution
pyplot.bar(counter.keys(), counter.values())
pyplot.show()
```

```
Class=0, n=53 (3.759%)
Class=2, n=592 (41.986%)
Class=4, n=640 (45.390%)
Class=3, n=24 (1.702%)
Class=1, n=101 (7.163%)
```



In [42]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(x, y, test_size = 0.25, random_state = 42
```

In [43]:
```
print("*"*40)
print('\n')
print("Shape of x training data : ",X_train.shape)
print("Shape of y training data : ",y_train.shape)
print("*"*40, '\n')
print("Shape of x testing data : ",X_test.shape)
print("Shape of y testing data : ",y_test.shape)
print("*"*40)
```

```
****************************************



Shape of x training data :  (1057, 4)
Shape of y training data :  (1057,)
**************************************** 

Shape of x testing data :  (353, 4)
Shape of y testing data :  (353,)
****************************************
```

In [44]:
```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

In [45]:
```
def get_test_report(model):
    return(classification_report(y_test, y_pred))
```

In [46]:
```
def kappa_score(model):
    return(cohen_kappa_score(y_test,y_pred))
```

In [47]:
```
def plot_confusion_matrix(model):
    cm = confusion_matrix(y_test, y_pred)

    conf_matrix= pd.DataFrame(data= cm, columns= ['Predicted:0','Predicted:1','Predicted:2','
                             index= ['Actual:0','Actual:1','Actual:2','Actual:3','Actual:4'])
    sns.heatmap(conf_matrix, annot= True, fmt='d', cmap= ListedColormap(['lightskyblue']),
                cbar= False, linewidths=0.1, annot_kws={'size': 25})

    plt.xticks(fontsize=15, fontweight='bold')
    plt.yticks(fontsize=15, fontweight='bold')

    plt.show()
```

In [48]:
```
score_card = pd.DataFrame(columns=['Model', 'Precision Score', 'Recall Score',
                                   'Accuracy Score', 'Kappa Score', 'f1-score'])

def update_score_card(model_name):

    global score_card

    score_card = score_card.append({'Model': model_name,
                                    'Precision Score': metrics.precision_score(y_test, y_pred
                                    'Recall Score': metrics.recall_score(y_test, y_pred, pos_
                                    'Accuracy Score': metrics.accuracy_score(y_test, y_pred),
                                    'Kappa Score': cohen_kappa_score(y_test, y_pred),
                                    'f1-score': metrics.f1_score(y_test, y_pred, pos_label='p
                                    ignore_index = True)
    return(score_card)
```

Logistic Regression

In [50]:
```
from sklearn.linear_model import LogisticRegression
classifier = LogisticRegression(random_state = 42)
log_reg= classifier.fit(X_train, y_train)
```

In [51]:
```
y_pred = classifier.predict(X_test)
```

In [52]:
```
print(get_test_report(log_reg))
```

```
              precision    recall  f1-score   support

           0       0.00      0.00      0.00        12
           1       0.00      0.00      0.00        23
           2       0.93      0.86      0.89       152
           3       0.00      0.00      0.00         7
           4       0.73      0.97      0.84       159

    accuracy                           0.81       353
   macro avg       0.33      0.37      0.35       353
weighted avg       0.73      0.81      0.76       353
```

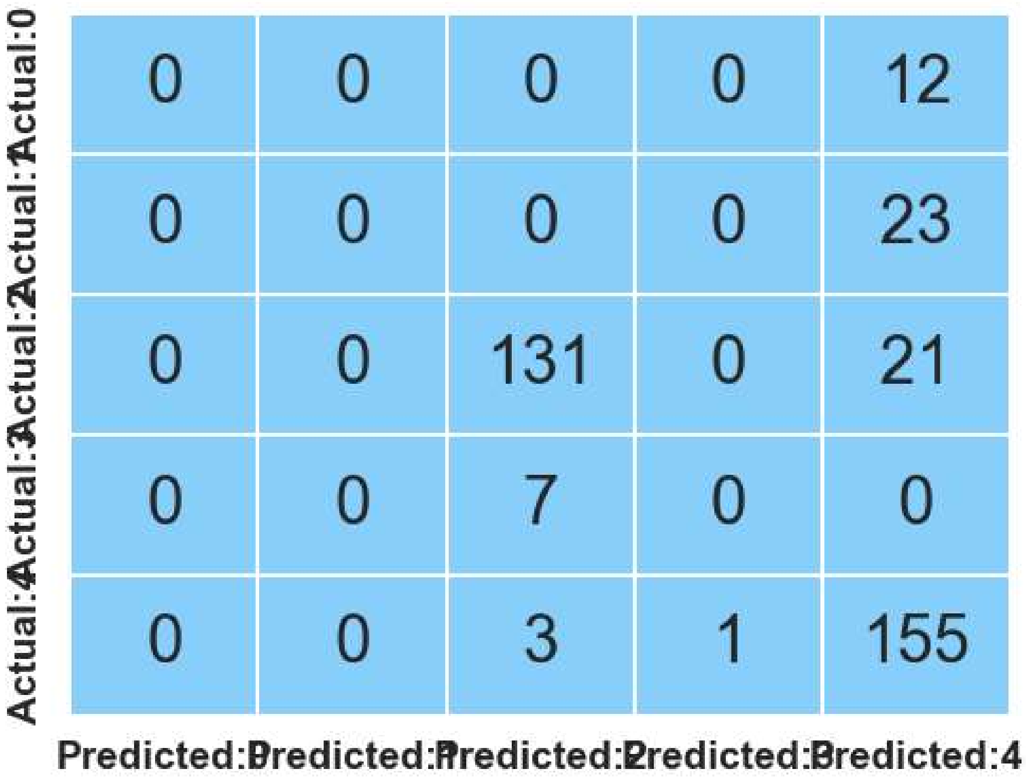
In [53]:
```
acc1 = accuracy_score(y_test, y_pred)
print(f"Accuracy score: {acc1}")
```

```
Accuracy score: 0.8101983002832861
```

In [54]:
```
kappa_score(log_reg)
```

Out[54]:
```
0.6602892805331725
```

In [55]:
```
plot_confusion_matrix(log_reg)
```



In [56]:
```
update_score_card(model_name= 'Logistic Regression')
```

Out[56]:

	Model	Precision Score	Recall Score	Accuracy Score	Kappa Score	f1-score
0	Logistic Regression	0.810198	0.810198	0.810198	0.660289	0.810198

Support Vector Machines (SVM)

In [58]:

```
from sklearn.svm import SVC
classifier = SVC(kernel = 'linear', random_state = 0)
SVC=classifier.fit(X_train, y_train)
```

In [59]:

```
y_pred = classifier.predict(X_test)
```

In [60]:

```
print(get_test_report(SVC))
```

```
              precision    recall  f1-score   support

           0       0.00      0.00      0.00        12
           1       0.00      0.00      0.00        23
           2       0.96      0.86      0.91       152
           3       0.00      0.00      0.00         7
           4       0.74      1.00      0.85       159

    accuracy                           0.82       353
   macro avg       0.34      0.37      0.35       353
weighted avg       0.74      0.82      0.77       353
```

In [61]:

```
acc2 = accuracy_score(y_test, y_pred)
print(f"Accuracy score: {acc2}")
```

```
Accuracy score: 0.8215297450424929
```

In [62]:

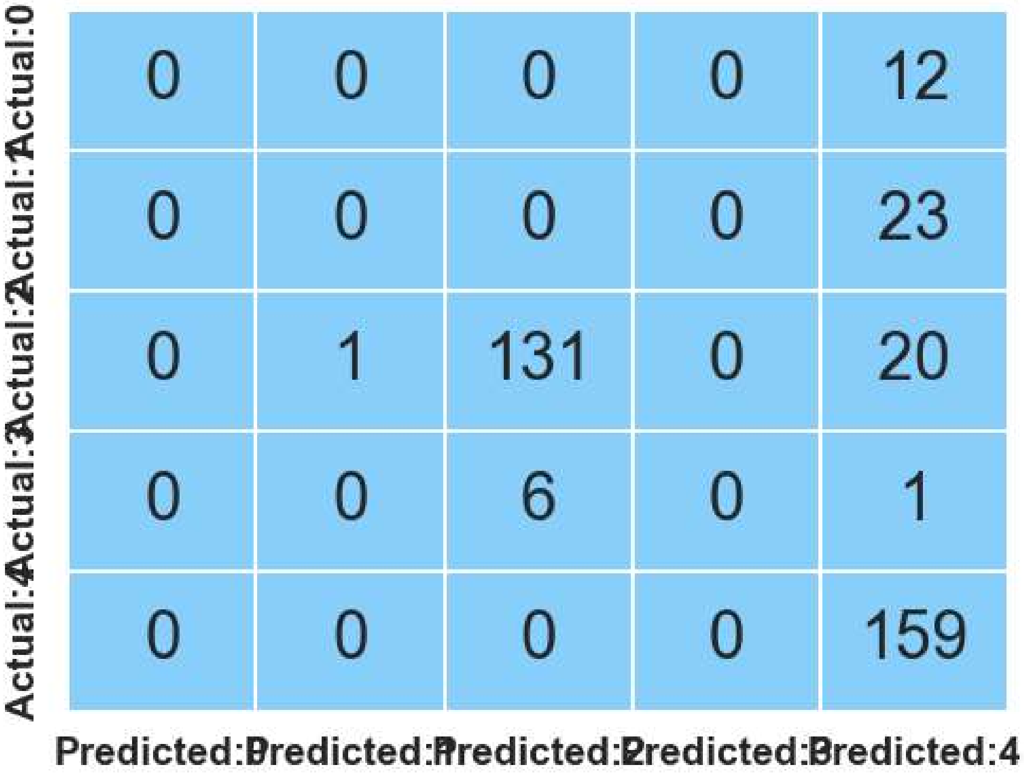
```
kappa_score(SVC)
```

Out[62]:

```
0.6803685125831813
```

In [63]:

```
plot_confusion_matrix(SVC)
```



	Predicted:0	Predicted:1	Predicted:2	Predicted:3	Predicted:4
Actual:0	0	0	0	0	12
Actual:1	0	0	0	0	23
Actual:2	0	1	131	0	20
Actual:3	0	0	6	0	1
Actual:4	0	0	0	0	159

In [64]:
```
update_score_card(model_name='SVC')
```

Out[64]:

	Model	Precision Score	Recall Score	Accuracy Score	Kappa Score	f1-score
0	Logistic Regression	0.810198	0.810198	0.810198	0.660289	0.810198
1	SVC	0.821530	0.821530	0.821530	0.680369	0.821530

Naive Bayes

In [66]:
```
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB()
GNB=classifier.fit(X_train, y_train)
```

In [67]:
```
y_pred = classifier.predict(X_test)
```

In [68]:
```
print(get_test_report(GNB))
```

```
              precision    recall  f1-score   support

           0       0.00      0.00      0.00        12
           1       0.00      0.00      0.00        23
           2       0.99      0.94      0.97       152
           3       1.00      0.86      0.92         7
           4       0.78      1.00      0.88       159

    accuracy                           0.87       353
   macro avg       0.56      0.56      0.55       353
weighted avg       0.80      0.87      0.83       353
```

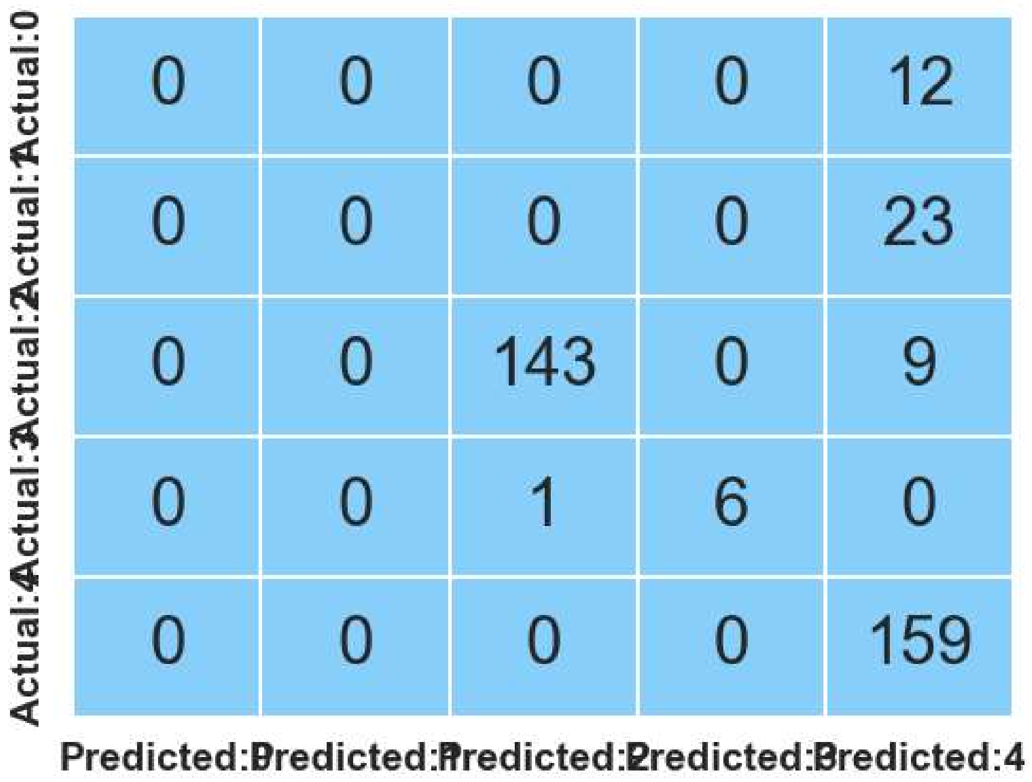
In [69]:
```
acc4 = accuracy_score(y_test, y_pred)
print(f"Accuracy score : {acc4}")
```

```
Accuracy score : 0.8725212464589235
```

In [70]:
```
kappa_score(GNB)
```

Out[70]:
```
0.7743672054771171
```

In [71]:
```
plot_confusion_matrix(GNB)
```



	Predicted:0	Predicted:1	Predicted:2	Predicted:3	Predicted:4
Actual:0	0	0	0	0	12
Actual:1	0	0	0	0	23
Actual:2	0	0	143	0	9
Actual:3	0	0	1	6	0
Actual:4	0	0	0	0	159

In [75]:
```
update_score_card(model_name= 'Naive Bayes')
```

Out[75]:

	Model	Precision Score	Recall Score	Accuracy Score	Kappa Score	f1-score
0	Logistic Regression	0.810198	0.810198	0.810198	0.660289	0.810198
1	SVC	0.821530	0.821530	0.821530	0.680369	0.821530
2	Naive Bayes	0.872521	0.872521	0.872521	0.774367	0.872521
3	Naive Bayes	0.872521	0.872521	0.872521	0.774367	0.872521

In [ ]: