Algerian Forest Fires Analysis

September 22, 2023

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

[2]:
```
dataset = pd.read_csv("E:/Algerian_forest_fires_dataset_UPDATE.csv",header=1)
```

[3]:
```
dataset.head()
```

[3]:

	day	month	year	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	FWI	Classes
0	01	06	2012	29	57	18	0	65.7	3.4	7.6	1.3	3.4	0.5	not fire
1	02	06	2012	29	61	13	1.3	64.4	4.1	7.6	1	3.9	0.4	not fire
2	03	06	2012	26	82	22	13.1	47.1	2.5	7.1	0.3	2.7	0.1	not fire
3	04	06	2012	25	89	13	2.5	28.6	1.3	6.9	0	1.7	0	not fire
4	05	06	2012	27	77	16	0	64.8	3	14.2	1.2	3.9	0.5	not fire

[4]:
```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 246 entries, 0 to 245
Data columns (total 14 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   day          246 non-null    object
 1   month        245 non-null    object
 2   year         245 non-null    object
 3   Temperature  245 non-null    object
 4    RH          245 non-null    object
 5    Ws          245 non-null    object
 6   Rain         245 non-null    object
```

```
 7   FFMC          245 non-null    object
 8   DMC           245 non-null    object
 9   DC            245 non-null    object
 10  ISI           245 non-null    object
 11  BUI           245 non-null    object
 12  FWI           245 non-null    object
 13  Classes       244 non-null    object
dtypes: object(14)
memory usage: 27.0+ KB
```

[5]:
```
dataset[dataset.isnull().any(axis=1)]
```

[5]:
```
                                day month  year Temperature   RH   Ws Rain   \
122  Sidi-Bel Abbes Region Dataset   NaN   NaN          NaN  NaN  NaN   NaN
167                               14    07  2012           37   37   18   0.2

     FFMC   DMC      DC   ISI   BUI      FWI Classes
122   NaN   NaN     NaN   NaN   NaN      NaN       NaN
167  88.9  12.9  14.6 9  12.5  10.4  fire          NaN
```

[6]:
```
dataset.loc[:122,"Region"]=0
dataset.loc[122:,"Region"]=1
df = dataset
```

[7]:
```
df.head()
```

[7]:
```
   day month  year Temperature  RH  Ws Rain   FFMC  DMC    DC  ISI  BUI  FWI  \
0  01    06  2012           29  57  18     0  65.7  3.4   7.6  1.3  3.4  0.5
1  02    06  2012           29  61  13   1.3  64.4  4.1   7.6    1  3.9  0.4
2  03    06  2012           26  82  22  13.1  47.1  2.5   7.1  0.3  2.7  0.1
3  04    06  2012           25  89  13   2.5  28.6  1.3   6.9    0  1.7    0
4  05    06  2012           27  77  16     0  64.8    3  14.2  1.2  3.9  0.5

     Classes    Region
0  not fire        0.0
1  not fire        0.0
2  not fire        0.0
3  not fire        0.0
4  not fire        0.0
```

[8]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 246 entries, 0 to 245
Data columns (total 15 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   day          246 non-null    object
```

```
 1   month        245 non-null    object
 2   year         245 non-null    object
 3   Temperature  245 non-null    object
 4    RH          245 non-null    object
 5    Ws          245 non-null    object
 6   Rain         245 non-null    object
 7   FFMC         245 non-null    object
 8   DMC          245 non-null    object
 9   DC           245 non-null    object
 10  ISI          245 non-null    object
 11  BUI          245 non-null    object
 12  FWI          245 non-null    object
 13  Classes      244 non-null    object
 14  Region       246 non-null    float64
dtypes: float64(1), object(14)
memory usage: 29.0+ KB
```

[9]:
```
df[['Region']]=df[['Region']].astype(int)
```

[10]:
```
df.head()
```

[10]:

	day	month	year	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	FWI	Classes	Region
0	01	06	2012	29	57	18	0	65.7	3.4	7.6	1.3	3.4	0.5	not fire	0
1	02	06	2012	29	61	13	1.3	64.4	4.1	7.6	1	3.9	0.4	not fire	0
2	03	06	2012	26	82	22	13.1	47.1	2.5	7.1	0.3	2.7	0.1	not fire	0
3	04	06	2012	25	89	13	2.5	28.6	1.3	6.9	0	1.7	0	not fire	0
4	05	06	2012	27	77	16	0	64.8	3	14.2	1.2	3.9	0.5	not fire	0

[11]:
```
## Removing the null values
df = df.dropna().reset_index(drop=True)
```

[12]:
```
df.head()
```

[12]:

	day	month	year	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	FWI	Classes	Region
0	01	06	2012	29	57	18	0	65.7	3.4	7.6	1.3	3.4	0.5	not fire	0
1	02	06	2012	29	61	13	1.3	64.4	4.1	7.6	1	3.9	0.4	not fire	0
2	03	06	2012	26	82	22	13.1	47.1	2.5	7.1	0.3	2.7	0.1	not fire	0
3	04	06	2012	25	89	13	2.5	28.6	1.3	6.9	0	1.7	0	not fire	0
4	05	06	2012	27	77	16	0	64.8	3	14.2	1.2	3.9	0.5	not fire	0

```
     Classes    Region
0  not fire          0
1  not fire          0
2  not fire          0
3  not fire          0
4  not fire          0
```

[13]:
```
df.isnull().sum()
```

[13]:
```
day            0
month          0
year           0
Temperature    0
 RH            0
 Ws            0
Rain           0
FFMC           0
DMC            0
DC             0
ISI            0
BUI            0
FWI            0
Classes        0
Region         0
dtype: int64
```

[14]:
```
df.iloc[[122]]
```

[14]:
```
     day  month  year  Temperature   RH   Ws  Rain   FFMC  DMC  DC  ISI  BUI  \
122  day  month  year  Temperature   RH   Ws  Rain   FFMC  DMC  DC  ISI  BUI

     FWI  Classes    Region
122  FWI  Classes         1
```

[15]:
```
## remove the 122nd row
df = df.drop(122).reset_index(drop=True)
```

[16]:
```
df.iloc[[122]]
```

[16]:
```
    day month  year Temperature  RH  Ws Rain   FFMC  DMC   DC  ISI  BUI  FWI  \
122  01    06  2012          32  71  12   0.7  57.1  2.5  8.2  0.6  2.8  0.2

       Classes    Region
122  not fire          1
```

[17]:
```
df.columns
```

[17]:
```
Index(['day', 'month', 'year', 'Temperature', ' RH', ' Ws', 'Rain ', 'FFMC',
       'DMC', 'DC', 'ISI', 'BUI', 'FWI', 'Classes  ', 'Region'],
      dtype='object')
```

[18]:
```
# fix spaces in columns names
df.columns = df.columns.str.strip()
df.columns
```

[18]:
```
Index(['day', 'month', 'year', 'Temperature', 'RH', 'Ws', 'Rain', 'FFMC',
       'DMC', 'DC', 'ISI', 'BUI', 'FWI', 'Classes', 'Region'],
      dtype='object')
```

[19]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 243 entries, 0 to 242
Data columns (total 15 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   day          243 non-null    object
 1   month        243 non-null    object
 2   year         243 non-null    object
 3   Temperature  243 non-null    object
 4   RH           243 non-null    object
 5   Ws           243 non-null    object
 6   Rain         243 non-null    object
 7   FFMC         243 non-null    object
 8   DMC          243 non-null    object
 9   DC           243 non-null    object
 10  ISI          243 non-null    object
 11  BUI          243 non-null    object
 12  FWI          243 non-null    object
 13  Classes      243 non-null    object
 14  Region       243 non-null    int32
dtypes: int32(1), object(14)
memory usage: 27.7+ KB
```

Changes the required columns as integer data type

[20]:
```
df.columns
```

[20]:
```
Index(['day', 'month', 'year', 'Temperature', 'RH', 'Ws', 'Rain', 'FFMC',
       'DMC', 'DC', 'ISI', 'BUI', 'FWI', 'Classes', 'Region'],
      dtype='object')
```

[21]:
```
df[['month','day','year','Temperature','RH','Ws']]=df[['month','day','year','Temperature','RH'
  ↪astype(int)
```

[22]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 243 entries, 0 to 242
Data columns (total 15 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   day          243 non-null    int32
 1   month        243 non-null    int32
 2   year         243 non-null    int32
 3   Temperature  243 non-null    int32
 4   RH           243 non-null    int32
 5   Ws           243 non-null    int32
 6   Rain         243 non-null    object
 7   FFMC         243 non-null    object
 8   DMC          243 non-null    object
 9   DC           243 non-null    object
 10  ISI          243 non-null    object
 11  BUI          243 non-null    object
 12  FWI          243 non-null    object
 13  Classes      243 non-null    object
 14  Region       243 non-null    int32
dtypes: int32(7), object(8)
memory usage: 22.0+ KB
```

changing the other columns to float data datatype

[23]:
```
objects=[features for features in df.columns if df[features].dtypes=='O']
```

[24]:
```
for i in objects:
    if i!='Classes':
        df[i]=df[i].astype(float)
```

[25]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 243 entries, 0 to 242
Data columns (total 15 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   day          243 non-null    int32
 1   month        243 non-null    int32
 2   year         243 non-null    int32
 3   Temperature  243 non-null    int32
 4   RH           243 non-null    int32
 5   Ws           243 non-null    int32
 6   Rain         243 non-null    float64
 7   FFMC         243 non-null    float64
```

```
 8   DMC          243 non-null    float64
 9   DC           243 non-null    float64
 10  ISI          243 non-null    float64
 11  BUI          243 non-null    float64
 12  FWI          243 non-null    float64
 13  Classes      243 non-null    object
 14  Region       243 non-null    int32
dtypes: float64(7), int32(7), object(1)
memory usage: 22.0+ KB
```

[26]:
```
objects
```

[26]:
```
['Rain', 'FFMC', 'DMC', 'DC', 'ISI', 'BUI', 'FWI', 'Classes']
```

[27]:
```
df.describe()
```

[27]:

	day	month	year	Temperature	RH	Ws
count	243.000000	243.000000	243.0	243.000000	243.000000	243.000000
mean	15.761317	7.502058	2012.0	32.152263	62.041152	15.493827
std	8.842552	1.114793	0.0	3.628039	14.828160	2.811385
min	1.000000	6.000000	2012.0	22.000000	21.000000	6.000000
25%	8.000000	7.000000	2012.0	30.000000	52.500000	14.000000
50%	16.000000	8.000000	2012.0	32.000000	63.000000	15.000000
75%	23.000000	8.000000	2012.0	35.000000	73.500000	17.000000
max	31.000000	9.000000	2012.0	42.000000	90.000000	29.000000

	Rain	FFMC	DMC	DC	ISI	BUI
count	243.000000	243.000000	243.000000	243.000000	243.000000	243.000000
mean	0.762963	77.842387	14.680658	49.430864	4.742387	16.690535
std	2.003207	14.349641	12.393040	47.665606	4.154234	14.228421
min	0.000000	28.600000	0.700000	6.900000	0.000000	1.100000
25%	0.000000	71.850000	5.800000	12.350000	1.400000	6.000000
50%	0.000000	83.300000	11.300000	33.100000	3.500000	12.400000
75%	0.500000	88.300000	20.800000	69.100000	7.250000	22.650000
max	16.800000	96.000000	65.900000	220.400000	19.000000	68.000000

	FWI	Region
count	243.000000	243.000000
mean	7.035391	0.497942
std	7.440568	0.501028
min	0.000000	0.000000
25%	0.700000	0.000000
50%	4.200000	0.000000
75%	11.450000	1.000000
max	31.100000	1.000000

[28]:
```
df.head()
```

[28]:
```
   day  month  year  Temperature  RH  Ws  Rain  FFMC  DMC    DC  ISI  BUI  \
0    1      6  2012           29  57  18   0.0  65.7  3.4   7.6  1.3  3.4
1    2      6  2012           29  61  13   1.3  64.4  4.1   7.6  1.0  3.9
2    3      6  2012           26  82  22  13.1  47.1  2.5   7.1  0.3  2.7
3    4      6  2012           25  89  13   2.5  28.6  1.3   6.9  0.0  1.7
4    5      6  2012           27  77  16   0.0  64.8  3.0  14.2  1.2  3.9

   FWI      Classes  Region
0  0.5  not fire          0
1  0.4  not fire          0
2  0.1  not fire          0
3  0.0  not fire          0
4  0.5  not fire          0
```

[29]:
```
## let ave the cleaned dataset
df.to_csv("E:/Algerian_forest_fires_dataset_cleaned.csv",index = False)
```

1 Exploratory Data Analysis

[30]:
```
## drop  day, month and year
df_copy = df.drop(['day','month','year'],axis=1)
```

[31]:
```
df_copy.head()
```

[31]:
```
   Temperature  RH  Ws  Rain  FFMC  DMC    DC  ISI  BUI  FWI      Classes  \
0           29  57  18   0.0  65.7  3.4   7.6  1.3  3.4  0.5  not fire
1           29  61  13   1.3  64.4  4.1   7.6  1.0  3.9  0.4  not fire
2           26  82  22  13.1  47.1  2.5   7.1  0.3  2.7  0.1  not fire
3           25  89  13   2.5  28.6  1.3   6.9  0.0  1.7  0.0  not fire
4           27  77  16   0.0  64.8  3.0  14.2  1.2  3.9  0.5  not fire

   Region
0       0
1       0
2       0
3       0
4       0
```

[32]:
```
# categories in classes
df_copy['Classes'].value_counts()
```

[32]:
```
fire            131
not fire        101
fire              4
fire              2
not fire          2
```

```
not fire           1
not fire           1
not fire           1
Name: Classes, dtype: int64
```

[33]:
```
df_copy.head()
```

[33]:
```
   Temperature  RH  Ws  Rain  FFMC  DMC    DC  ISI  BUI  FWI      Classes  \
0           29  57  18   0.0  65.7  3.4   7.6  1.3  3.4  0.5  not fire
1           29  61  13   1.3  64.4  4.1   7.6  1.0  3.9  0.4  not fire
2           26  82  22  13.1  47.1  2.5   7.1  0.3  2.7  0.1  not fire
3           25  89  13   2.5  28.6  1.3   6.9  0.0  1.7  0.0  not fire
4           27  77  16   0.0  64.8  3.0  14.2  1.2  3.9  0.5  not fire

   Region
0       0
1       0
2       0
3       0
4       0
```

[34]:
```
## categories in classes
df_copy['Classes'].value_counts()
```

[34]:
```
fire             131
not fire         101
fire               4
fire               2
not fire           2
not fire           1
not fire           1
not fire           1
Name: Classes, dtype: int64
```

[35]:
```
## Encoding of the categories in classes
df_copy['Classes'] = np.where(df_copy['Classes'].str.contains('not fire'),0,1)
```

[36]:
```
df_copy.head()
```

[36]:
```
   Temperature  RH  Ws  Rain  FFMC  DMC    DC  ISI  BUI  FWI  Classes  Region
0           29  57  18   0.0  65.7  3.4   7.6  1.3  3.4  0.5        0       0
1           29  61  13   1.3  64.4  4.1   7.6  1.0  3.9  0.4        0       0
2           26  82  22  13.1  47.1  2.5   7.1  0.3  2.7  0.1        0       0
3           25  89  13   2.5  28.6  1.3   6.9  0.0  1.7  0.0        0       0
4           27  77  16   0.0  64.8  3.0  14.2  1.2  3.9  0.5        0       0
```

[37]:
```
df_copy.tail()
```

[37]:
```
     Temperature  RH  Ws  Rain  FFMC   DMC    DC  ISI   BUI  FWI  Classes  \
238           30  65  14   0.0  85.4  16.0  44.5  4.5  16.9  6.5        1
239           28  87  15   4.4  41.1   6.5   8.0  0.1   6.2  0.0        0
240           27  87  29   0.5  45.9   3.5   7.9  0.4   3.4  0.2        0
241           24  54  18   0.1  79.7   4.3  15.2  1.7   5.1  0.7        0
242           24  64  15   0.2  67.3   3.8  16.5  1.2   4.8  0.5        0

     Region
238       1
239       1
240       1
241       1
242       1
```

[38]:
```
df_copy['Classes'].value_counts()
```

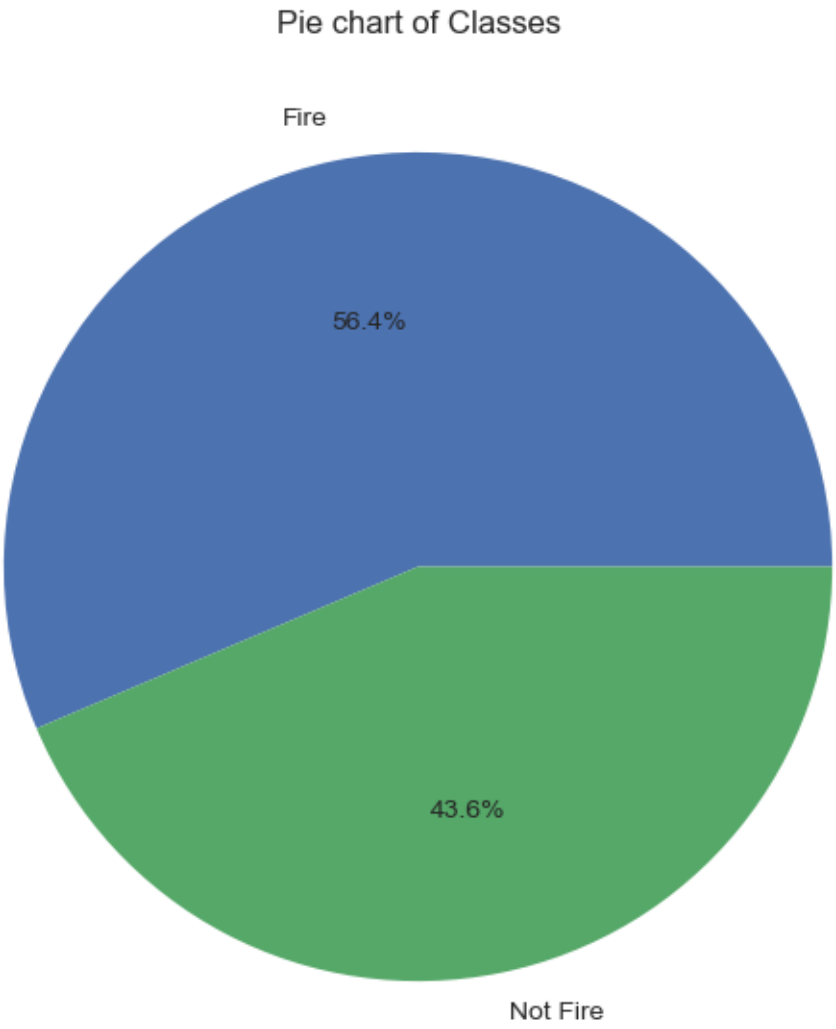
[38]:
```
1    137
0    106
Name: Classes, dtype: int64
```

[40]:
```
# Plot density plot for all features
plt.style.use('seaborn')
df_copy.hist(bins=50,figsize=(20,15))
plt.show()
```

```
C:\Users\gupta\AppData\Local\Temp\ipykernel_23148\3839170112.py:2:
MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are
deprecated since 3.6, as they no longer correspond to the styles shipped by
seaborn. However, they will remain available as 'seaborn-v0_8-<style>'.
Alternatively, directly use the seaborn API instead.
  plt.style.use('seaborn')
```

[41]:
```
# percentage for pie chart
percentage = df_copy['Classes'].value_counts(normalize = True)*100
```

[45]:
```
# plotting piechart
classlabels = ["Fire","Not Fire"]
plt.figure(figsize=(12,7))
plt.pie(percentage,labels=classlabels,autopct='%1.1f%%')
plt.title("Pie chart of Classes")
plt.show()
```



[46]:
```
df_copy.corr()
```

[46]:

	Temperature	RH	Ws	Rain	FFMC	DMC	\
Temperature	1.000000	-0.651400	-0.284510	-0.326492	0.676568	0.485687	
RH	-0.651400	1.000000	0.244048	0.222356	-0.644873	-0.408519	
Ws	-0.284510	0.244048	1.000000	0.171506	-0.166548	-0.000721	
Rain	-0.326492	0.222356	0.171506	1.000000	-0.543906	-0.288773	
FFMC	0.676568	-0.644873	-0.166548	-0.543906	1.000000	0.603608	
DMC	0.485687	-0.408519	-0.000721	-0.288773	0.603608	1.000000	
DC	0.376284	-0.226941	0.079135	-0.298023	0.507397	0.875925	
ISI	0.603871	-0.686667	0.008532	-0.347484	0.740007	0.680454	
BUI	0.459789	-0.353841	0.031438	-0.299852	0.592011	0.982248	
FWI	0.566670	-0.580957	0.032368	-0.324422	0.691132	0.875864	

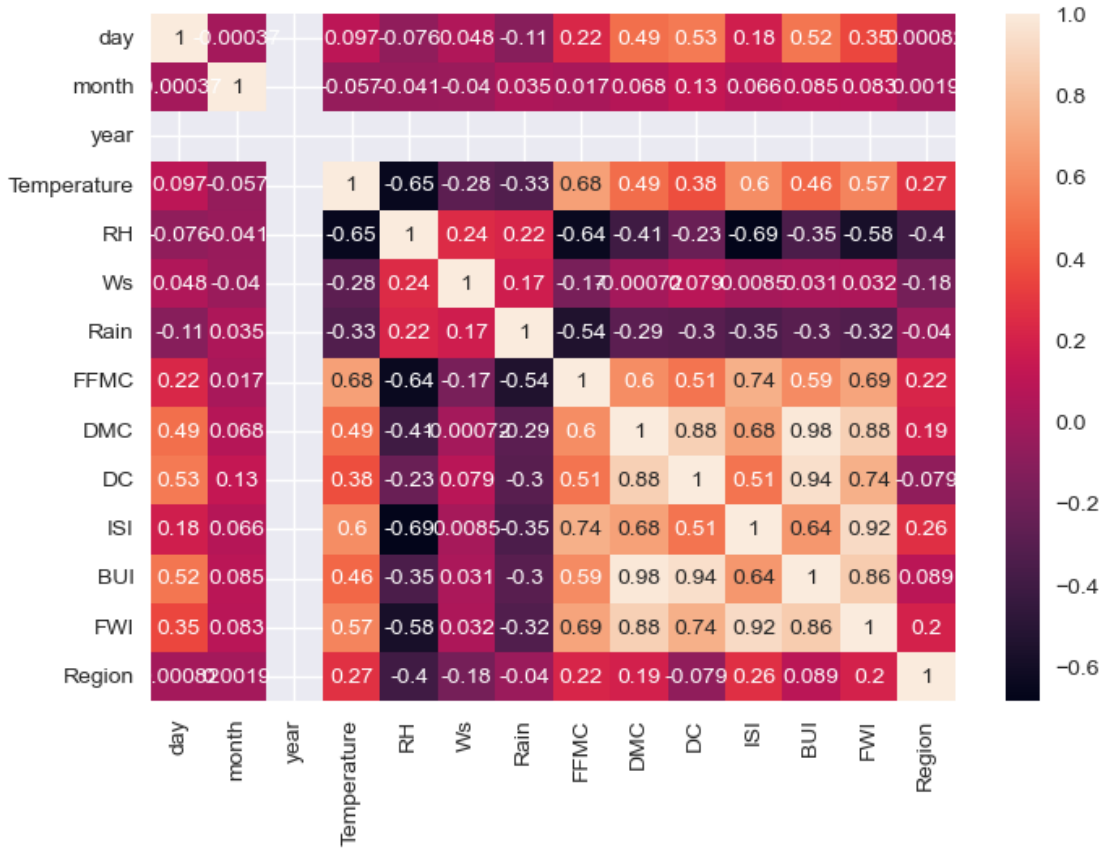
```
Classes         0.516015 -0.432161 -0.069964 -0.379097  0.769492  0.585658
Region          0.269555 -0.402682 -0.181160 -0.040013  0.222241  0.192089

                   DC       ISI       BUI       FWI   Classes    Region
Temperature  0.376284  0.603871  0.459789  0.566670  0.516015  0.269555
RH          -0.226941 -0.686667 -0.353841 -0.580957 -0.432161 -0.402682
Ws           0.079135  0.008532  0.031438  0.032368 -0.069964 -0.181160
Rain        -0.298023 -0.347484 -0.299852 -0.324422 -0.379097 -0.040013
FFMC         0.507397  0.740007  0.592011  0.691132  0.769492  0.222241
DMC          0.875925  0.680454  0.982248  0.875864  0.585658  0.192089
DC           1.000000  0.508643  0.941988  0.739521  0.511123 -0.078734
ISI          0.508643  1.000000  0.644093  0.922895  0.735197  0.263197
BUI          0.941988  0.644093  1.000000  0.857973  0.586639  0.089408
FWI          0.739521  0.922895  0.857973  1.000000  0.719216  0.197102
Classes      0.511123  0.735197  0.586639  0.719216  1.000000  0.162347
Region      -0.078734  0.263197  0.089408  0.197102  0.162347  1.000000
```

[47]:
```
sns.heatmap(df.corr(),annot=True)
```

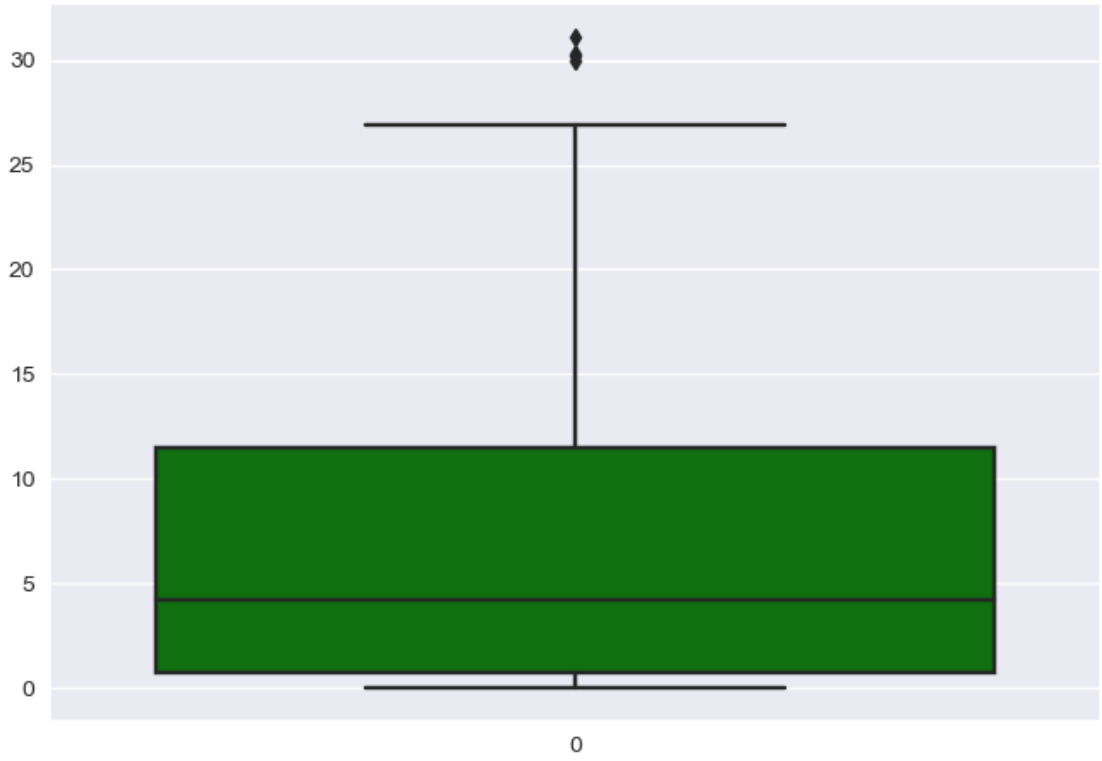
```
C:\Users\gupta\AppData\Local\Temp\ipykernel_23148\4277794465.py:1:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only valid
columns or specify the value of numeric_only to silence this warning.
  sns.heatmap(df.corr(),annot=True)
```

[47]: <Axes: >



[48]:
```
## Box plots
sns.boxplot(df['FWI'],color='green')
```

[48]: <Axes: >



[49]:
```
df.head()
```

[49]:

	day	month	year	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	\
0	1	6	2012	29	57	18	0.0	65.7	3.4	7.6	1.3	3.4	
1	2	6	2012	29	61	13	1.3	64.4	4.1	7.6	1.0	3.9	
2	3	6	2012	26	82	22	13.1	47.1	2.5	7.1	0.3	2.7	
3	4	6	2012	25	89	13	2.5	28.6	1.3	6.9	0.0	1.7	
4	5	6	2012	27	77	16	0.0	64.8	3.0	14.2	1.2	3.9	

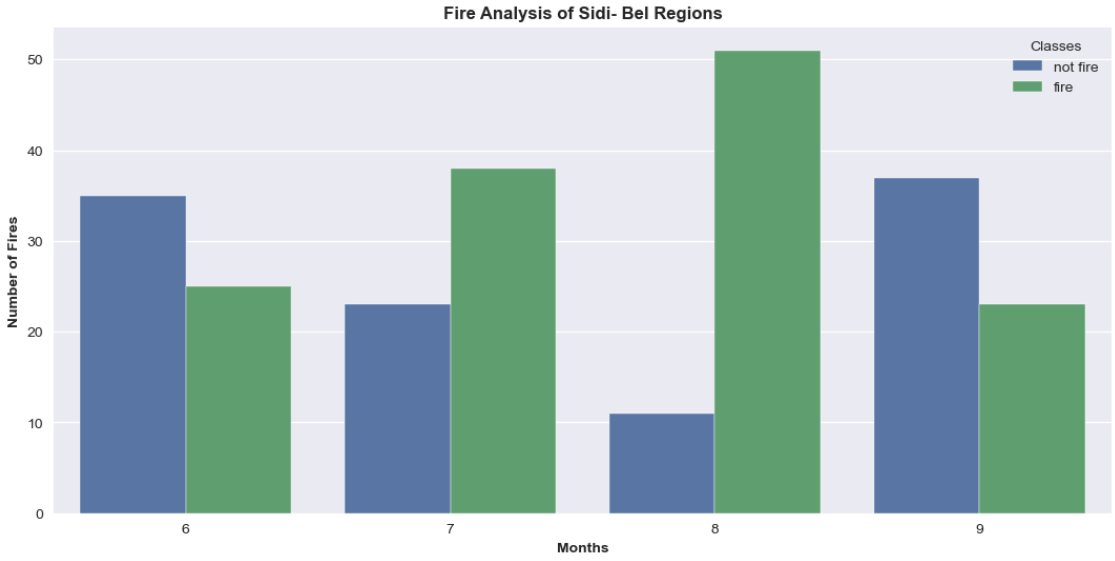
	FWI	Classes	Region
0	0.5	not fire	0
1	0.4	not fire	0
2	0.1	not fire	0
3	0.0	not fire	0
4	0.5	not fire	0

[50]:
```
df['Classes']=np.where(df['Classes'].str.contains('not fire'),'not fire','fire')
```

[52]:
```
## monthly fire analaysis
dftemp = df.loc[df['Region']==1]
plt.subplots(figsize=(13,6))
sns.set_style('whitegrid')
```

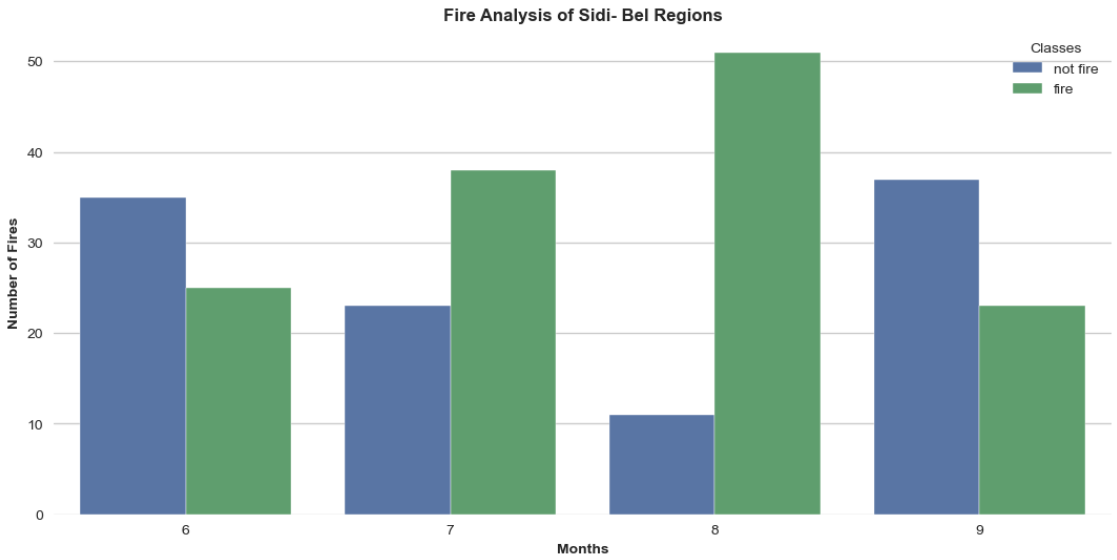
```
sns.countplot(x='month',hue='Classes',data=df)
plt.title("Fire Analysis of Sidi- Bel Regions",weight='bold')
plt.ylabel('Number of Fires',weight='bold')
plt.xlabel('Months',weight='bold')
```

[52]: Text(0.5, 0, 'Months')



[53]:
```
## monthly fire analaysis
dftemp = df.loc[df['Region']==0]
plt.subplots(figsize=(13,6))
sns.set_style('whitegrid')
sns.countplot(x='month',hue='Classes',data=df)
plt.title("Fire Analysis of Sidi- Bel Regions",weight='bold')
plt.ylabel('Number of Fires',weight='bold')
plt.xlabel('Months',weight='bold')
```

[53]: Text(0.5, 0, 'Months')



Its observed that August and September had the most number of forest fires for both regions. And from the above plot of months, we can understand few things

Most of the fires happened in August and very high Fires happened in only 3 months - June, July and August.

Less Fires was on Sep

[ ]: