Algerian Forest Fire EDA Practical Implementation

Life cycle of Machine learning Project

```
Understanding the Problem Statement
Data Collection
Exploratory data analysis
Data Cleaning
Data Pre-Processing
Model Training
Choose best model
```

1) Problem statement.

```
The dataset Comprises of two regions of Algeria, namely the Bejaia region located in the northeast of Algeria and the Sidi Bel-abbes region located in the northwest of Algeria.

If User can Predict that Algerian Forest will Catch Fire or Not based on Input Features.

Prediction result can be used for Forest Fire Situation Tackers & Make Correct Preventions to Avoid it in future.
```

2) Data Collection.

```
The Dataset is collected from Website named, UCI Machine Learning Repository.

The data consists of 15 columns and 244 rows.
```

Import Data and Required Packages

In [ ]:

```
#importing required libraies
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import warnings

warnings.importwarnings("ignore")
%matplotlib inline
```

loading csv dataset as dataframe

In [16]:
```
df = pd.read_csv(r"C:\Users\user\Downloads\Algerian_forest_fires_dataset_UPD
```

showing top 5 records

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

Out[17]:

	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

shape of the dataset

In [19]:
```
df.shape
```

Out[19]: (246, 14)

summary of the dataset

In [23]:
```
df.describe()
```

Out[23]:

	day	month	year	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	FWI	Class
count	246	245	245	245	245	245	245	245	245	245	245	245	245	2
unique	33	5	2	20	63	19	40	174	167	199	107	175	128	
top	01	07	2012	35	64	14	0	88.9	7.9	8	1.1	3	0.4	f
freq	8	62	244	29	10	43	133	8	5	5	8	5	12	1

Check Datatypes in the dataset

In [26]:
```
df.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
```

3) DATA Cleaning

Removing Unnecessary Rows From Dataset

In [28]:
```
df.drop(index=[122,123], inplace=True)
df.reset_index(inplace=True)
df.drop('index', axis=1, inplace=True)
```

Adding New Feature, named 'Region' in a Dataset

In [30]:
```
df.loc[:122, 'region'] = 'bejaia'
df.loc[122:, 'region'] = 'Sidi-Bel Abbes'
```

Stripping the names of the columns

In [32]:
```
df.columns = [i.strip() for i in df.columns]
df.columns
```

Out[32]:
```
Index(['day', 'month', 'year', 'Temperature', 'RH', 'Ws', 'Rain', 'FFMC',
       'DMC', 'DC', 'ISI', 'BUI', 'FWI', 'Classes', 'region'],
      dtype='object')
```

Stripping the Classes Features data

In [34]:
```
df.Classes = df.Classes.str.strip()
df['Classes'].unique()
```

Out[34]:
```
array(['not fire', 'fire', nan], dtype=object)
```

In [35]:
```
df.head()
```

Out[35]:

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

Changing The DataTypes of the Columns

In [37]:
```
df['day']=df['day'].astype(int)
df['month']=df['month'].astype(int)
df['year']=df['year'].astype(int)
df['Temperature']=df['Temperature'].astype(int)
df['RH']=df['RH'].astype(int)
df['Rain']=df['Rain'].astype(float)
df['FFMC']=df['FFMC'].astype(float)
df['DMC']=df['DMC'].astype(float)
df['BUI']=df['BUI'].astype(float)
df['ISI']=df['ISI'].astype(float)
df['Ws']=df['Ws'].astype(float)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 244 entries, 0 to 243
Data columns (total 15 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   day          244 non-null    int32  
 1   month        244 non-null    int32  
 2   year         244 non-null    int32  
 3   Temperature  244 non-null    int32  
 4   RH           244 non-null    int32  
 5   Ws           244 non-null    float64
 6   Rain         244 non-null    float64
 7   FFMC         244 non-null    float64
 8   DMC          244 non-null    float64
 9   DC           244 non-null    object 
 10  ISI          244 non-null    float64
 11  BUI          244 non-null    float64
 12  FWI          244 non-null    object 
 13  Classes      243 non-null    object 
 14  region       244 non-null    object 
dtypes: float64(6), int32(5), object(4)
memory usage: 24.0+ KB
```

Adding New Feature,named 'Date' by Replacing Unnecessary feature like 'day','month','year'

In [43]:
```
df["date"] = pd.to_datetime(df[["day","month","year"]])
df.drop(["day","month","year"],axis=1,inplace = True)
```

Showing Updated Dataset after Modification Done.

In [44]:
```
1 df.head()
```

Out[44]:

	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	FWI	Classes	region	date
0	29	57	18.0	0.0	65.7	3.4	7.6	1.3	3.4	0.5	not fire	bejaia	2012-06-01
1	29	61	13.0	1.3	64.4	4.1	7.6	1.0	3.9	0.4	not fire	bejaia	2012-06-02
2	26	82	22.0	13.1	47.1	2.5	7.1	0.3	2.7	0.1	not fire	bejaia	2012-06-03
3	25	89	13.0	2.5	28.6	1.3	6.9	0.0	1.7	0	not fire	bejaia	2012-06-04
4	27	77	16.0	0.0	64.8	3.0	14.2	1.2	3.9	0.5	not fire	bejaia	2012-06-05

4) EXPLORING DATA

Profile of the Data

shape of the dataset

In [46]:
```
1 df.shape
```

Out[46]:
```
(244, 13)
```

Observation

In this Dataset there are 13 Columns & 244 Rows

columns of the dataset

In [48]:
```
1 df.columns
```

Out[48]:
```
Index(['Temperature', 'RH', 'Ws', 'Rain', 'FFMC', 'DMC', 'DC', 'ISI', 'BUI',
       'FWI', 'Classes', 'region', 'date'],
      dtype='object')
```

Check Missing Value in Dataset

In [50]:
```
1 df.isnull().sum()
```

Out[50]:
```
Temperature    0
RH             0
Ws             0
Rain           0
FFMC           0
DMC            0
DC             0
ISI            0
BUI            0
FWI            0
Classes        1
region         0
date           0
dtype: int64
```

Observation

we got one null value in classes feature

Handling Categorical Feature Classes

In [51]:
```
1 df['Classes']=df['Classes'].map({'not fire':0,'fire':1})
2 df.head()
```

Out[51]:

	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	FWI	Classes	region	date
0	29	57	18.0	0.0	65.7	3.4	7.6	1.3	3.4	0.5	0.0	bejaia	2012-06-01
1	29	61	13.0	1.3	64.4	4.1	7.6	1.0	3.9	0.4	0.0	bejaia	2012-06-02
2	26	82	22.0	13.1	47.1	2.5	7.1	0.3	2.7	0.1	0.0	bejaia	2012-06-03
3	25	89	13.0	2.5	28.6	1.3	6.9	0.0	1.7	0	0.0	bejaia	2012-06-04
4	27	77	16.0	0.0	64.8	3.0	14.2	1.2	3.9	0.5	0.0	bejaia	2012-06-05

In [52]:
```
1 df['Classes']
```

Out[52]:
```
0      0.0
1      0.0
2      0.0
3      0.0
4      0.0
      ...
239    1.0
240    0.0
241    0.0
242    0.0
243    0.0
Name: Classes, Length: 244, dtype: float64
```

Focus on Replacing Null Value

In [54]:
```
df['Classes'].mode()[0]
```

Out[54]:
```
1.0
```

In [55]:
```
df['Classes']=df['Classes'].fillna(df['Classes'].mode()[0])
```

In [56]:
```
df.isnull().sum()
```

Out[56]:
```
Temperature    0
RH             0
Ws             0
Rain           0
FFMC           0
DMC            0
DC             0
ISI            0
BUI            0
FWI            0
Classes        0
region         0
date           0
dtype: int64
```

Observations

after modification now we have Zero Null Value in dataset

In [62]:
```
df["Classes"].unique()
```

Out[62]:
```
array([0., 1.])
```

Check Datatypes in the dataset

In [63]:
```
1 df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 244 entries, 0 to 243
Data columns (total 13 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   Temperature  244 non-null    int32
 1   RH           244 non-null    int32
 2   Ws           244 non-null    float64
 3   Rain         244 non-null    float64
 4   FFMC         244 non-null    float64
 5   DMC          244 non-null    float64
 6   DC           244 non-null    object
 7   ISI          244 non-null    float64
 8   BUI          244 non-null    float64
 9   FWI          244 non-null    object
 10  Classes      244 non-null    float64
 11  region       244 non-null    object
 12  date         244 non-null    datetime64[ns]
dtypes: datetime64[ns](1), float64(7), int32(2), object(3)
memory usage: 23.0+ KB
```

observations

```
1 There is total 244 rows and 13 columns.
2 There are No Null Value in Dataset
3 There is total 4 data types float64, int64, object and datetime64.
4 Dtypes Included float64 = 7 Columns, int64 = 2 Columns, object = 3 Columns
  and datetime64 = 1
5 Total Memory Usage is 23.0+ KB
```

Checking the usage of the memory by the dataset

In [65]:
```
1 df.memory_usage()
```

Out[65]:
```
Index           128
Temperature     976
RH              976
Ws             1952
Rain           1952
FFMC           1952
DMC            1952
DC             1952
ISI            1952
BUI            1952
FWI            1952
Classes        1952
region         1952
date           1952
dtype: int64
```

Numerical and Categorical Columns

Numerical dataset

In [66]:
```
# 1. Getting Numerical features from dataset
# 2. Creating Numerical dataframe
numerical_features = [feature for feature in df.columns if df[feature].dtype

# Print Numerical Features
print('We have {} numerical features : {}'.format(len(numerical_features), n
```

```
We have 10 numerical features : ['Temperature', 'RH', 'Ws', 'Rain', 'FFMC', 'DM
C', 'ISI', 'BUI', 'Classes', 'date']
```

Categorical dataset

In [71]:
```
# 1. Getting categorical features from dataset
# 2. Creating categorical dataframe
categorical_features = [feature for feature in df.columns if df[feature].dty

# Print Numerical Features
print('We have {} categorical features : {}'.format(len(categorical_features
```

```
We have 3 categorical features : ['DC', 'FWI', 'region']
```

Feature Information

In [72]:
```
df.head()
```

Out[72]:

	Temperature	RH	Ws	Rain	FFMC	DMC	DC	ISI	BUI	FWI	Classes	region	date
0	29	57	18.0	0.0	65.7	3.4	7.6	1.3	3.4	0.5	0.0	bejaia	2012-06-01
1	29	61	13.0	1.3	64.4	4.1	7.6	1.0	3.9	0.4	0.0	bejaia	2012-06-02
2	26	82	22.0	13.1	47.1	2.5	7.1	0.3	2.7	0.1	0.0	bejaia	2012-06-03
3	25	89	13.0	2.5	28.6	1.3	6.9	0.0	1.7	0	0.0	bejaia	2012-06-04
4	27	77	16.0	0.0	64.8	3.0	14.2	1.2	3.9	0.5	0.0	bejaia	2012-06-05

Weather data observations

```
Temperature : temperature noon (temperature max) in Celsius degrees: 22 to
42
RH : Relative Humidity in %: 21 to 90
Ws :Wind speed in km/h: 6 to 29
Rain: total day in mm: 0 to 16.8
```

FWI Components

```
(FFMC) Fine Fuel Moisture Code index from the FWI system: 28.6 to 92.5
(DMC) Duff Moisture Code index from the FWI system: 1.1 to 65.9
(DC) Drought Code index from the FWI system: 7 to 220.4
(ISI) Initial Spread Index from the FWI system: 0 to 18.5
(BUI) Buildup Index from the FWI system: 1.1 to 68
(FWI) Fire Weather Index: 0 to 31.1

Classes: two classes, namely Fire and not Fire.

Region: Two Regions, namely Bejaia Region indicated with 0 and Sidi Bel-Abbes Region indicated with 1.
```

DATE Observations (DD/MM/YYYY) :-

Date Displayed in (DD/MM/YYYY) format in dataset

Univariate Analysis

The term univariate analysis refers to the analysis of one variable prefix Ã¢Â€Âœuni Ã¢Â€Â means Ã¢Â€Âœone.Ã¢Â€Â The purpose of univariate analysis is to understand the distribution of values for a single variable.

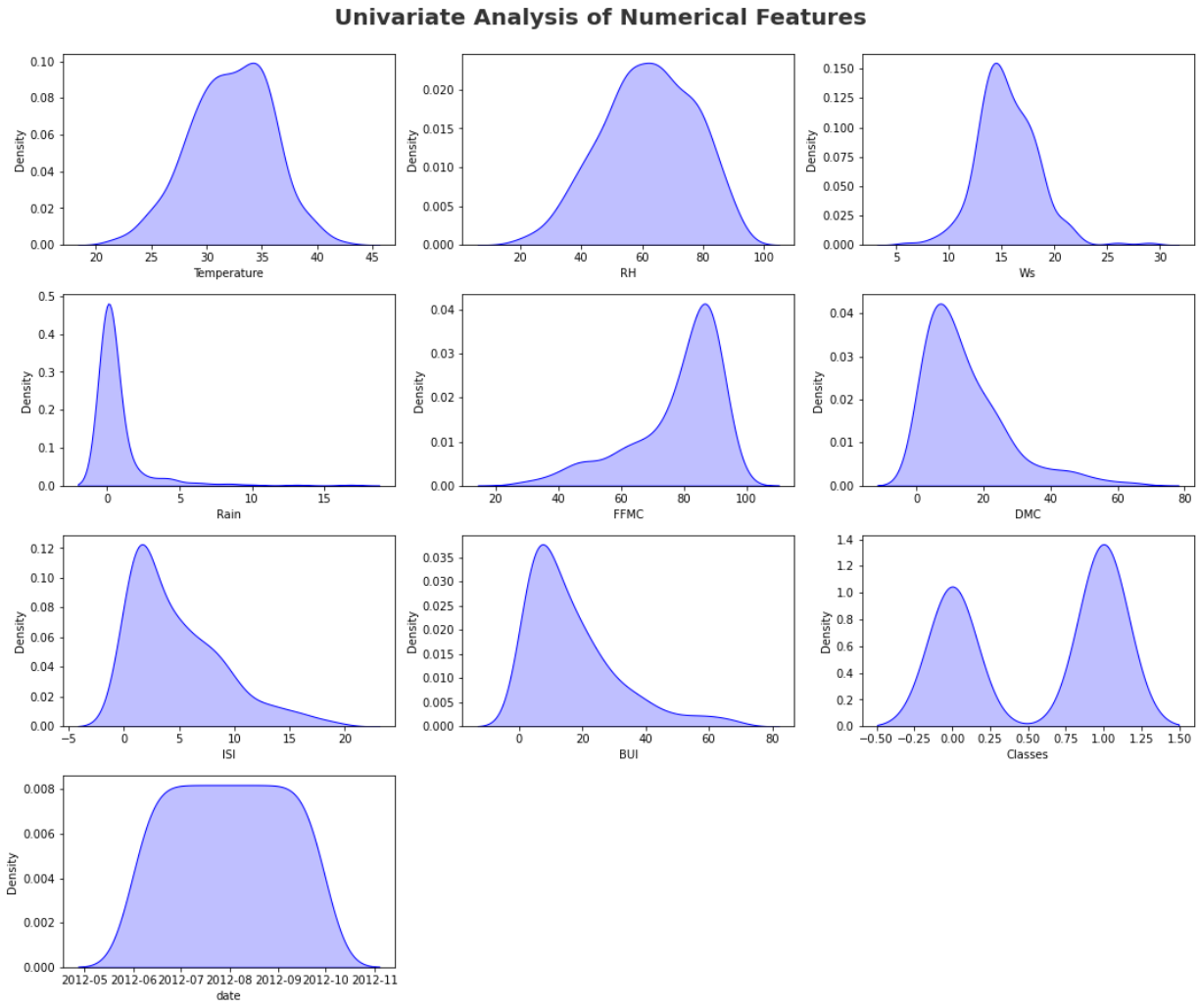
In [75]:
```
df.var()
```

```
C:\Users\user\AppData\Local\Temp\ipykernel_8576\1568254755.py:1: FutureWarning:
Dropping of nuisance columns in DataFrame reductions (with 'numeric_only=None')
is deprecated; in a future version this will raise TypeError.  Select only vali
d columns before calling the reduction.
  df.var()
```

Out[75]:
```
Temperature     13.204817
RH             221.539415
Ws               7.897102
Rain             3.997623
FFMC           205.565939
DMC            152.968382
ISI             17.433281
BUI            201.777024
Classes          0.246711
dtype: float64
```

Numerical Features

In [77]:
```
plt.figure(figsize=(15, 15))
plt.suptitle('Univariate Analysis of Numerical Features', fontsize=20, fontw

for i in range(0, len(numerical_features)):
    plt.subplot(5, 3, i+1)
    sns.kdeplot(x=df[numerical_features[i]],shade=True, color='b')
    plt.xlabel(numerical_features[i])
    plt.tight_layout()
```

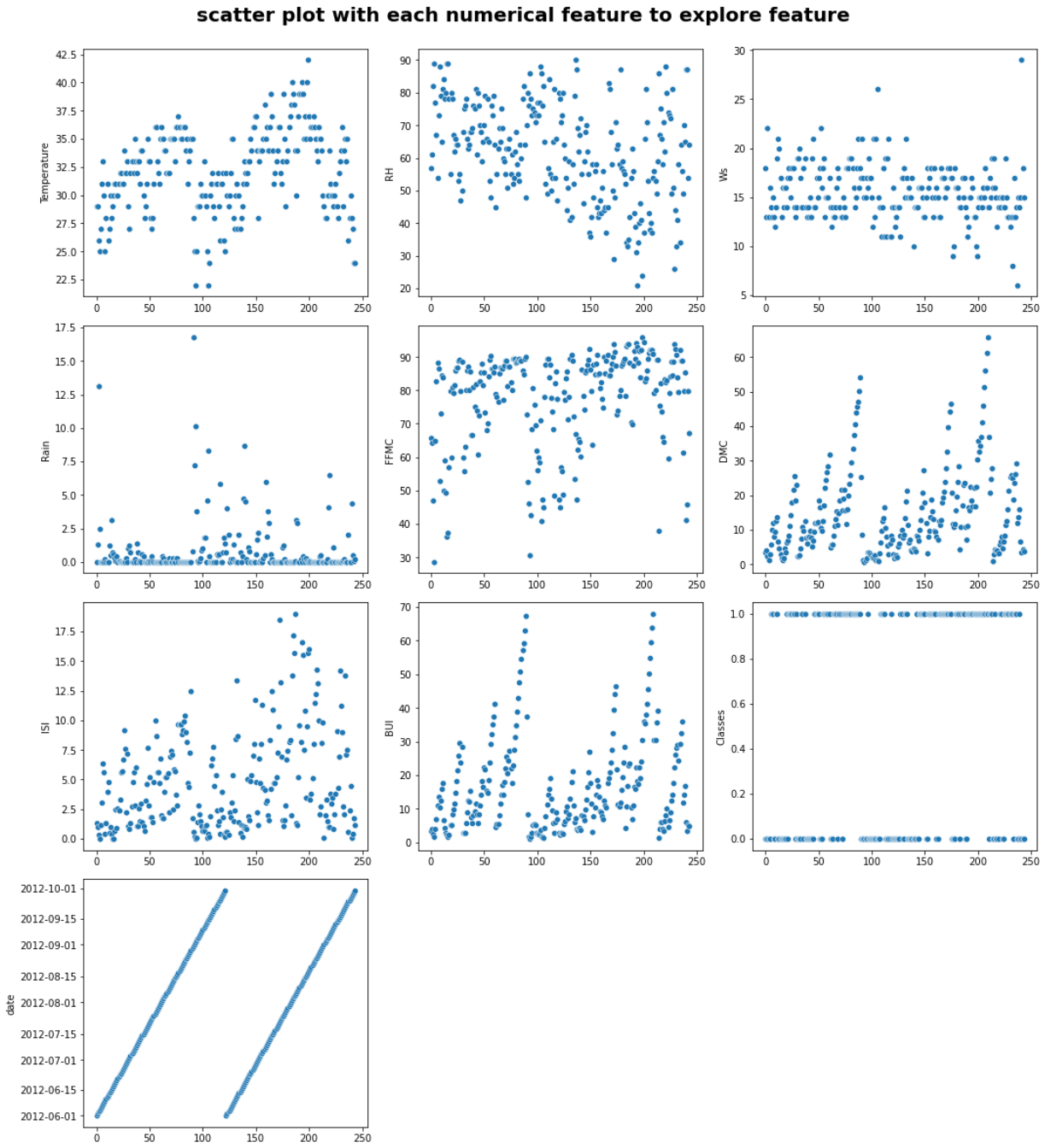


Observations

```
Rain,ISI,BUI,DMC are right skewed and postively skewed.
FFMC is a Left skewed and Negetively skewed.
Outliers in Rain, ISI, BUI, DMC and FFMC
```

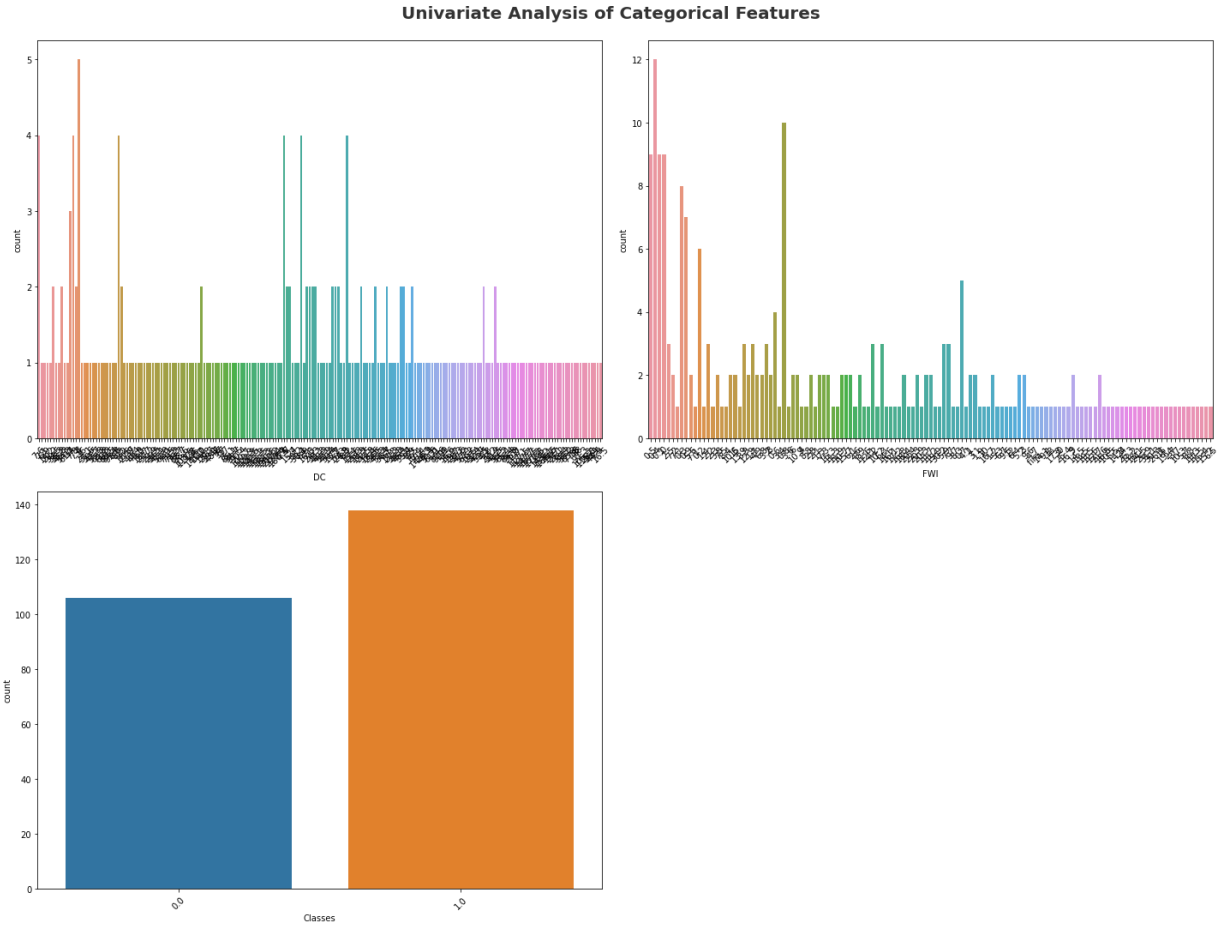
Scatter plot to see the trends in each numerical column

In [79]:
```
plt.figure(figsize=(15, 20))
plt.suptitle('scatter plot with each numerical feature to explore feature',

for i in range(0, len(numerical_features)):
    plt.subplot(5, 3, i+1)
    sns.scatterplot(y=numerical_features[i], x=df.index, data=df)
    plt.tight_layout()
```



Categorical Features

In [81]:
```
plt.figure(figsize=(20, 15))
plt.suptitle('Univariate Analysis of Categorical Features', fontsize=20, fon
cat1 = ['DC', 'FWI', 'Classes']
for i in range(0, len(cat1)):
    plt.subplot(2, 2, i+1)
    sns.countplot(x=df[cat1[i]])
    plt.xlabel(cat1[i])
    plt.xticks(rotation=45)
    plt.tight_layout()
```



observations

```
Extreme value of Temperature is above 40
Most of the time RH is above 30
WS values lie between 10 to 20
```

In [83]:
```
# Bivariate analysis and multivariate analysis
# stripplot (categorical vs numerical)
# scatterplot / pairplot (numerical vs numerical) (check correlation)
# boxplot (outlies)
# heatmap (correlation)
# lineplot (trend in numerical feature with time)
```

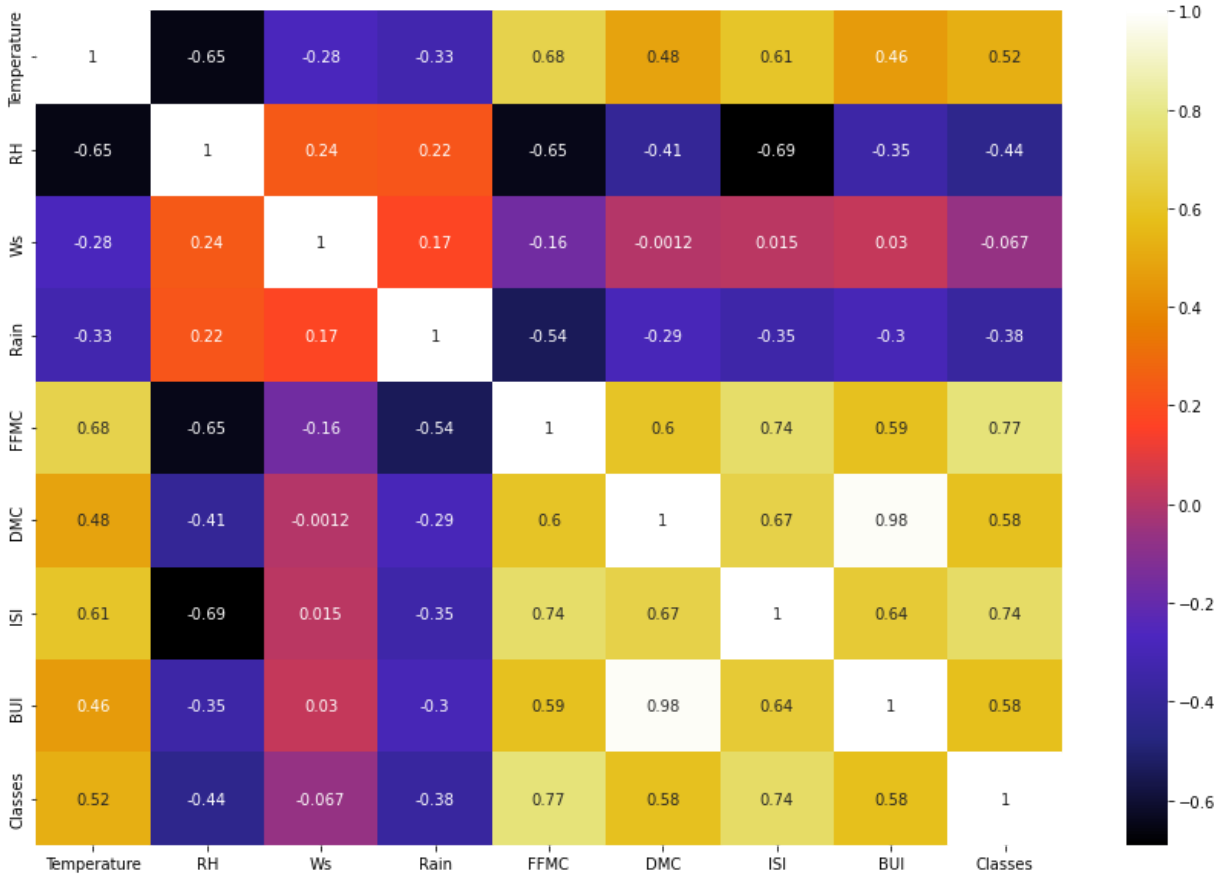
Multicolleniarity in numerical features

In [84]:
```
df.corr()
```

Out[84]:

	Temperature	RH	Ws	Rain	FFMC	DMC	ISI	B
Temperature	1.000000	-0.654443	-0.278132	-0.326786	0.677491	0.483105	0.607551	0.4555(
RH	-0.654443	1.000000	0.236084	0.222968	-0.645658	-0.405133	-0.690637	-0.3485
Ws	-0.278132	0.236084	1.000000	0.170169	-0.163255	-0.001246	0.015248	0.0297
Rain	-0.326786	0.222968	0.170169	1.000000	-0.544045	-0.288548	-0.347105	-0.2991
FFMC	0.677491	-0.645658	-0.163255	-0.544045	1.000000	0.602391	0.739730	0.5896
DMC	0.483105	-0.405133	-0.001246	-0.288548	0.602391	1.000000	0.674499	0.9820
ISI	0.607551	-0.690637	0.015248	-0.347105	0.739730	0.674499	1.000000	0.6358
BUI	0.455504	-0.348587	0.029756	-0.299171	0.589652	0.982073	0.635891	1.0000(
Classes	0.518119	-0.435023	-0.066529	-0.379449	0.770114	0.584188	0.735511	0.5838

In [85]:
```
plt.figure(figsize = (15,10))
sns.heatmap(df.corr(), cmap="CMRmap", annot=True)
plt.show()
```



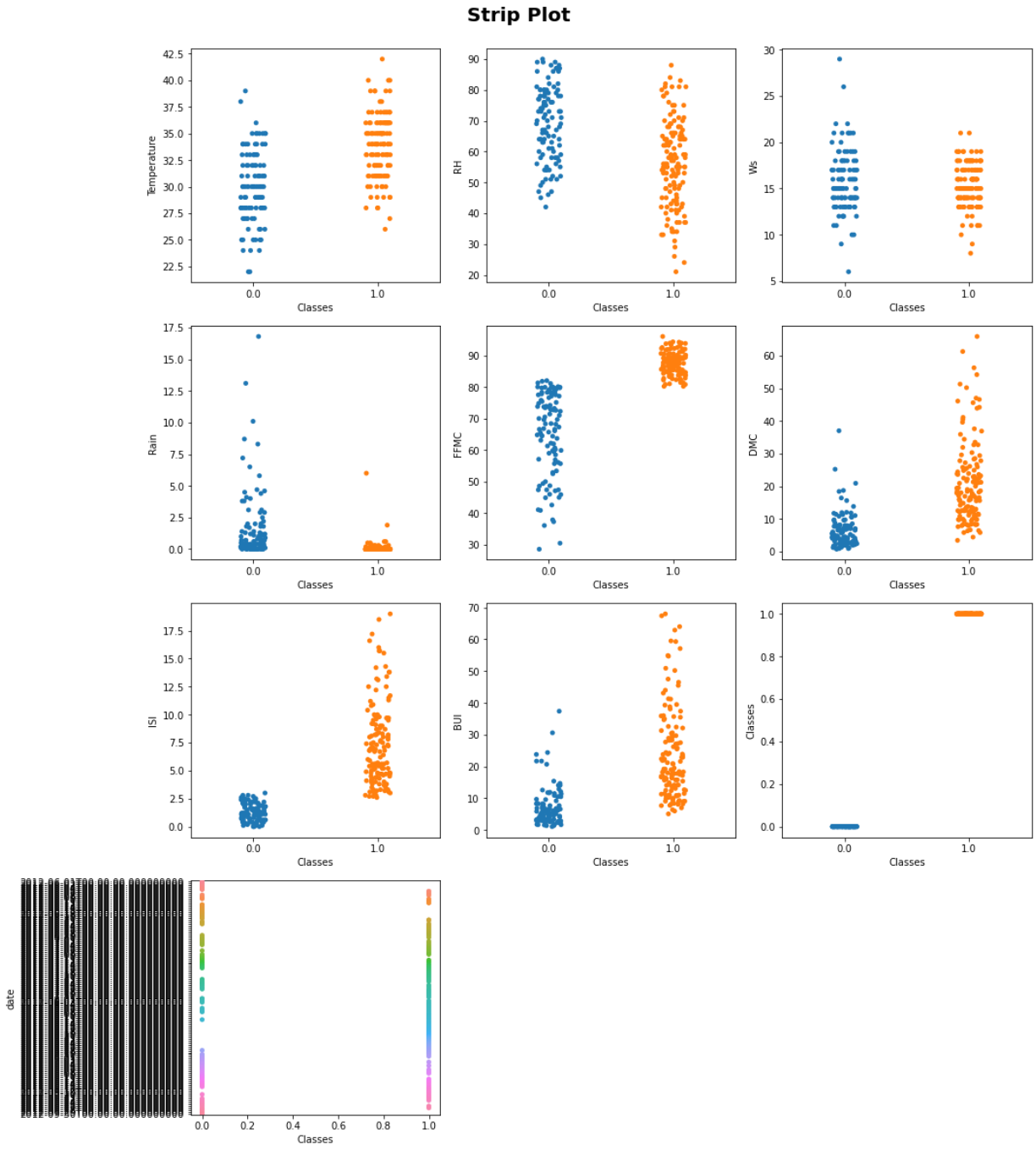
observation

Highly +ve correlated features are DMC and

Highly -ve correlated features are RH and Temp, RH and FFMC, RH and ISI

strip plot to see the relationship between numerical features and target

In [86]:
```
plt.figure(figsize=(15, 20))
plt.suptitle('Strip Plot', fontsize=20, fontweight='bold', alpha=1, y=1)

for i in range(0, len(numerical_features)):
    plt.subplot(5, 3, i+1)
    sns.stripplot(y=numerical_features[i], x='Classes', data=df)
    plt.tight_layout()
```



observation -

Note :- Here 0 = 'not Fire' and 1 = 'Fire'

places with higher temperature has fire

places with lower RH has fire

places wiht ffmc > 80 has fire

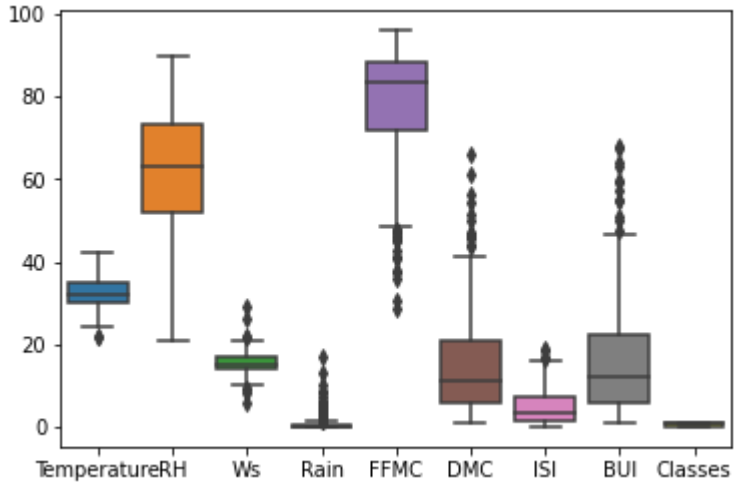
places wiht ISI > 2.5 has fire

places with Rain < 2 has fire

Boxplot to find Outliers in the features

In [87]:
```
1 sns.boxplot(data = df,orient="v")
```

Out[87]: <AxesSubplot:>



Observation:-

RH, Rain, FFMC, DMC BUI has many outliers

Statistical Analysis

In [88]:
```
1 df.describe()
```

Out[88]:

	Temperature	RH	Ws	Rain	FFMC	DMC	ISI	
count	244.000000	244.000000	244.000000	244.000000	244.000000	244.000000	244.000000	244.0
mean	32.172131	61.938525	15.504098	0.760656	77.887705	14.673361	4.774180	16.6
std	3.633843	14.884200	2.810178	1.999406	14.337571	12.368039	4.175318	14.2
min	22.000000	21.000000	6.000000	0.000000	28.600000	0.700000	0.000000	1.1
25%	30.000000	52.000000	14.000000	0.000000	72.075000	5.800000	1.400000	6.0
50%	32.000000	63.000000	15.000000	0.000000	83.500000	11.300000	3.500000	12.2
75%	35.000000	73.250000	17.000000	0.500000	88.300000	20.750000	7.300000	22.5
max	42.000000	90.000000	29.000000	16.800000	96.000000	65.900000	19.000000	68.0

Observation

df.describe() return all Statistics Summary of Numeric Columns

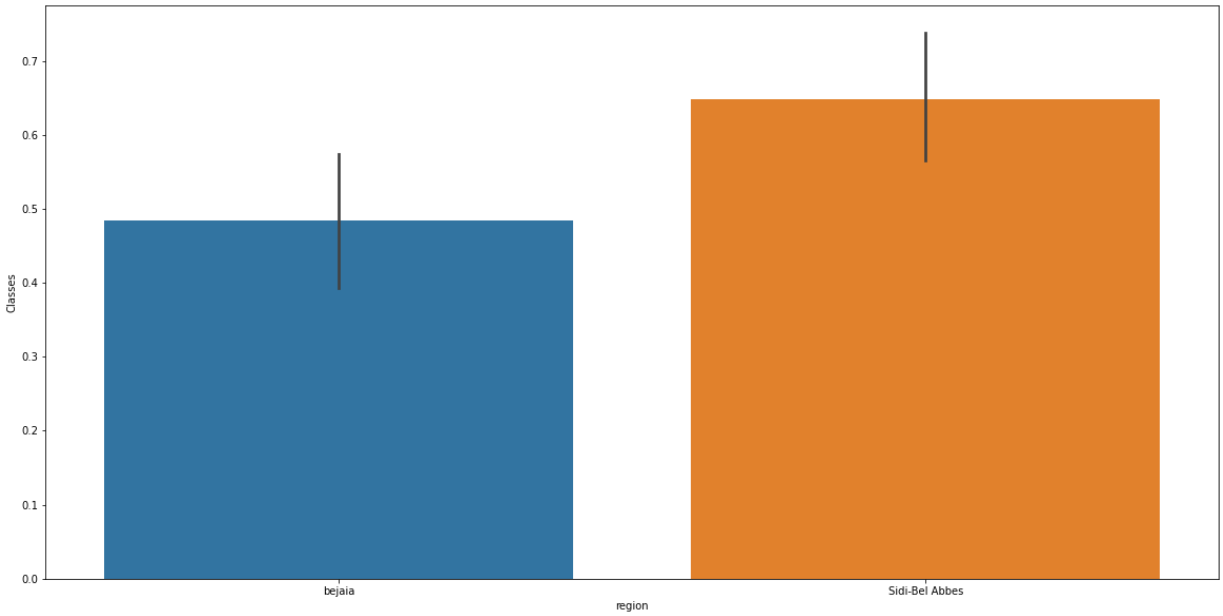
Its Return function like:- count(), mean(), std(), min(), 25%(), 50%(), 75%(), max().

Graphical Analysis

Which area has most of the time fire happen ?

In [90]:
```
import matplotlib
matplotlib.rcParams['figure.figsize']=(20,10)

sns.barplot(x="region",y="Classes",data=df)
```

Out[90]: <AxesSubplot:xlabel='region', ylabel='Classes'>

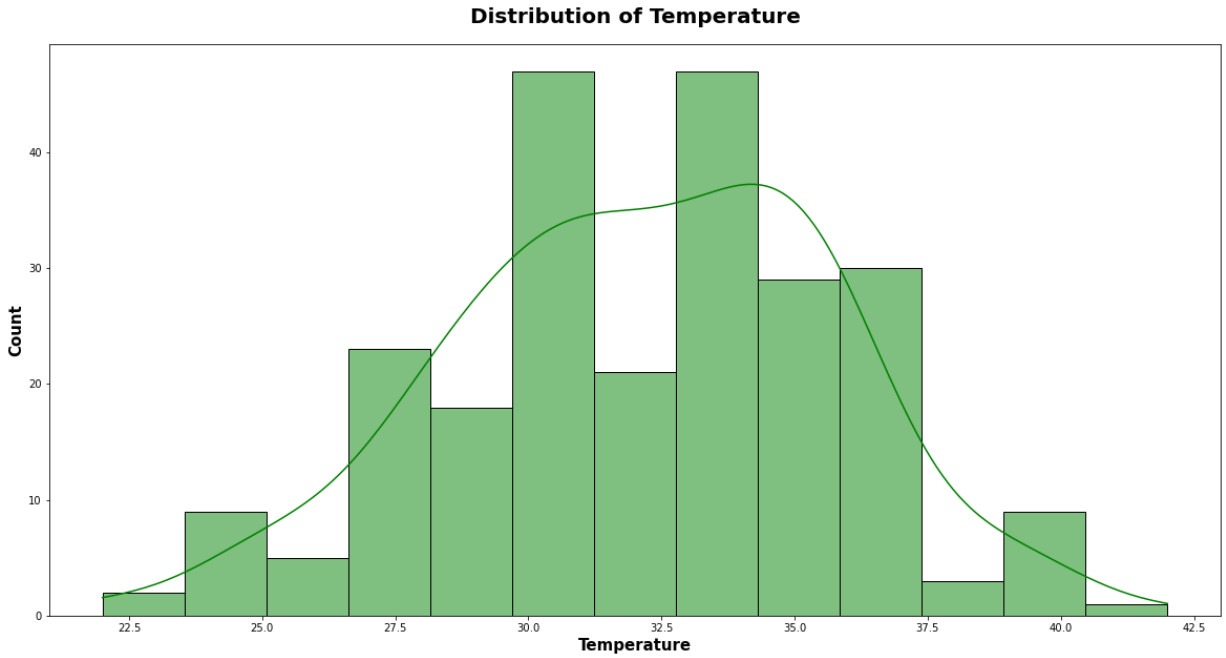


Observation

Sidi-Bel-Abbes Region has Most of the Time Fire Took Placed.

Temperature Range which is in most of the places ?

In [91]:
```
plt.subplots(figsize=(20,10))
sns.histplot("Distribution of Temperature",x=df.Temperature,color='g',kde=Tr
plt.title("Distribution of Temperature",weight='bold',fontsize=20,pad=20)
plt.xlabel("Temperature",weight='bold',fontsize=15)
plt.ylabel("Count",weight='bold',fontsize=15)
plt.show()
```



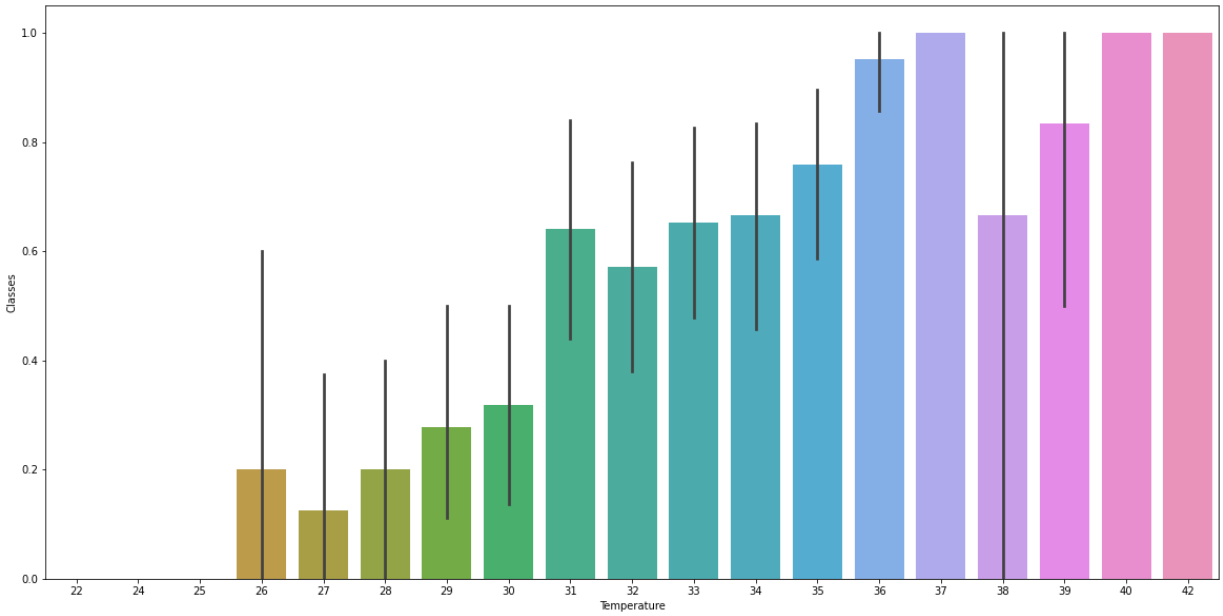
Observation:-

Temperature occur most of the time in range 32.5 to 35.0

Highest Temperature attained

In [92]:
```
import matplotlib
matplotlib.rcParams['figure.figsize']=(20,10)

sns.barplot(x="Temperature",y="Classes",data=df)
```

Out[92]: <AxesSubplot:xlabel='Temperature', ylabel='Classes'>



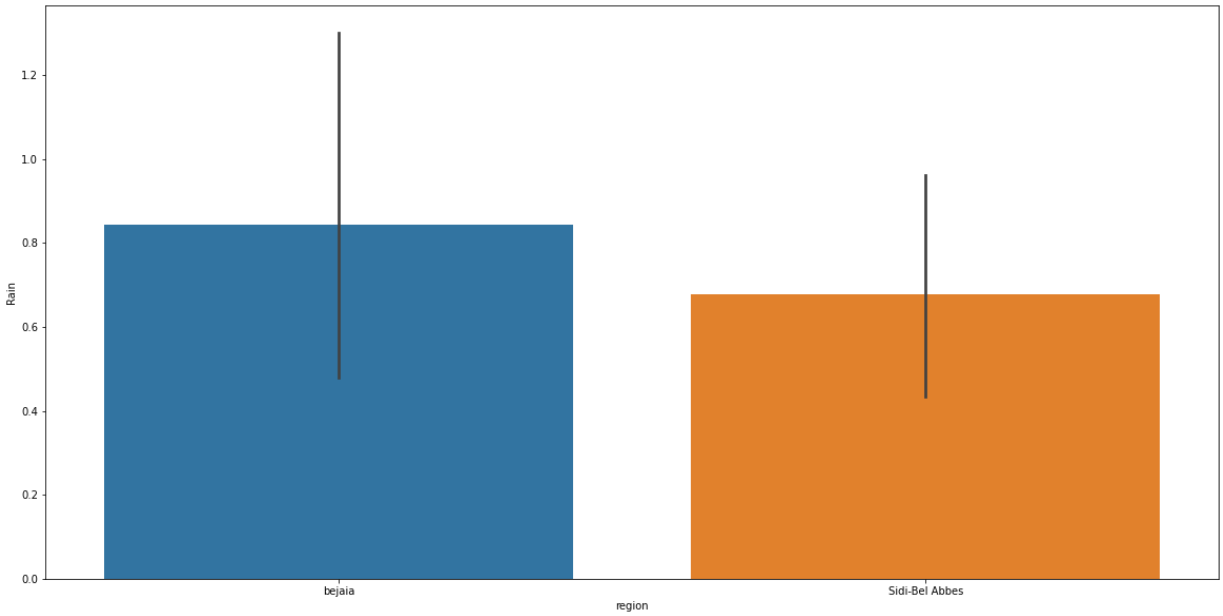
Observation:-

Highest temperature is 42,40,37

Which region has most time rain happens

In [93]:
```
import matplotlib
matplotlib.rcParams['figure.figsize']=(20,10)

sns.barplot(x="region",y="Rain",data=df)
```

Out[93]: <AxesSubplot:xlabel='region', ylabel='Rain'>



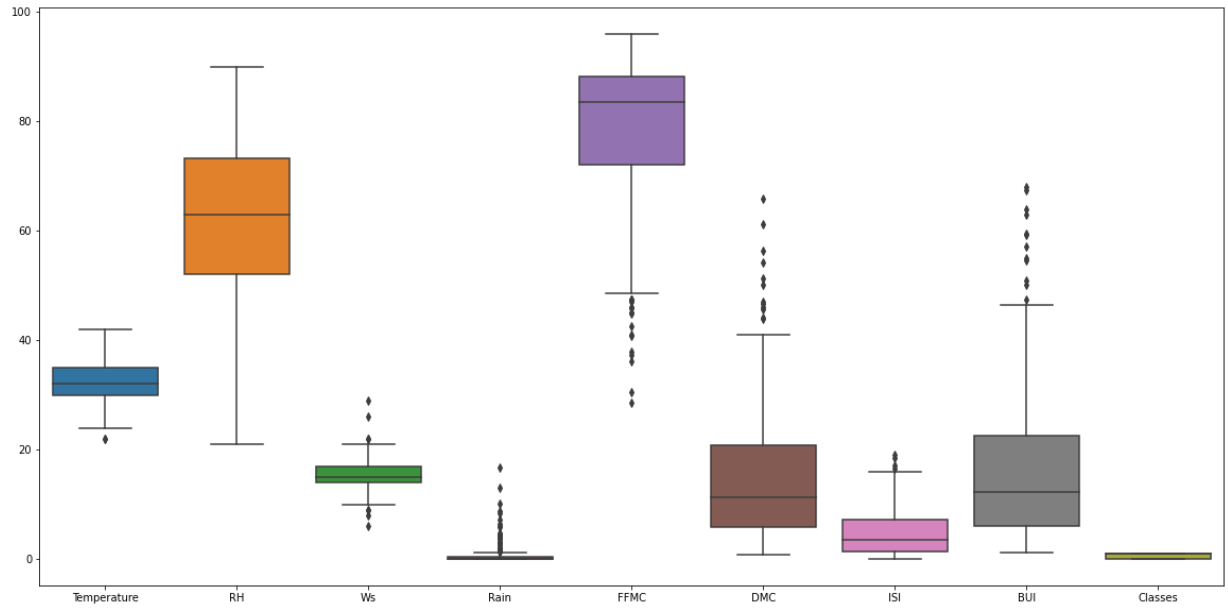
observation

Bejaia is the region in which most of the time rain happens

Boxplot to find Outliers in the features

In [94]:
```
1 sns.boxplot(data = df,orient="v")
```

Out[94]: <AxesSubplot:>



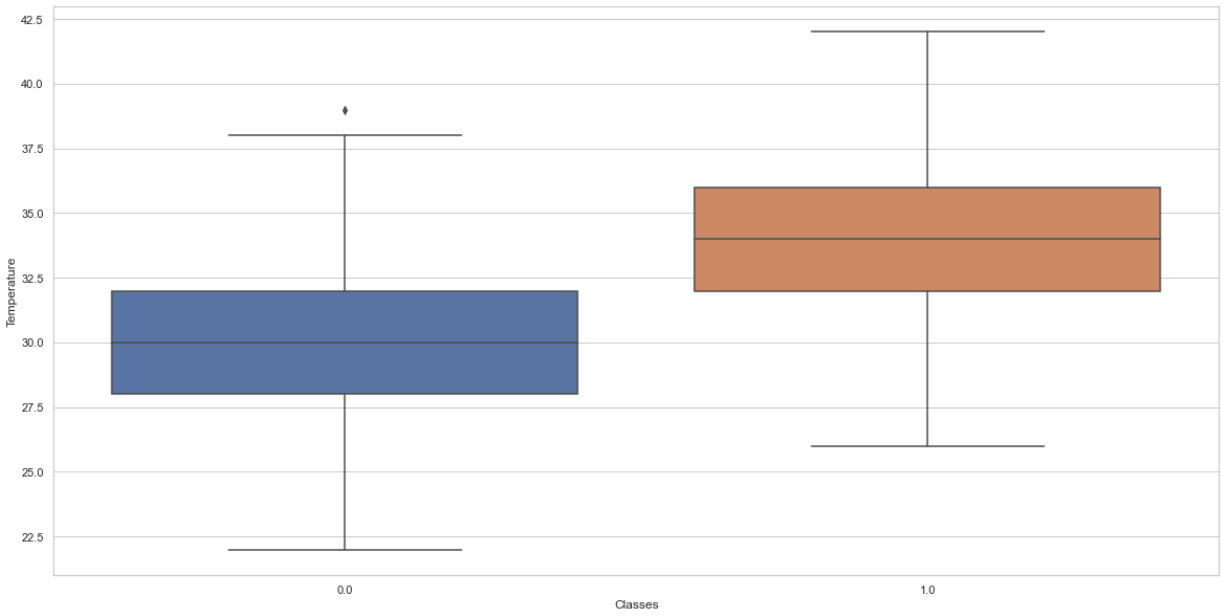
Observation:-

RH, Rain, FFMC, DMC BUI has many outliers

Boxplot of Class Vs Temperature

In [96]:
```
# Python program to illustrate
# boxplot using inbuilt data-set
# given in seaborn

# importing the required module
import seaborn

# use to set style of background of plot
seaborn.set(style="whitegrid")

# loading data-set

seaborn.boxplot(x ='Classes', y ='Temperature', data = df)
```

Out[96]: <AxesSubplot:xlabel='Classes', ylabel='Temperature'>



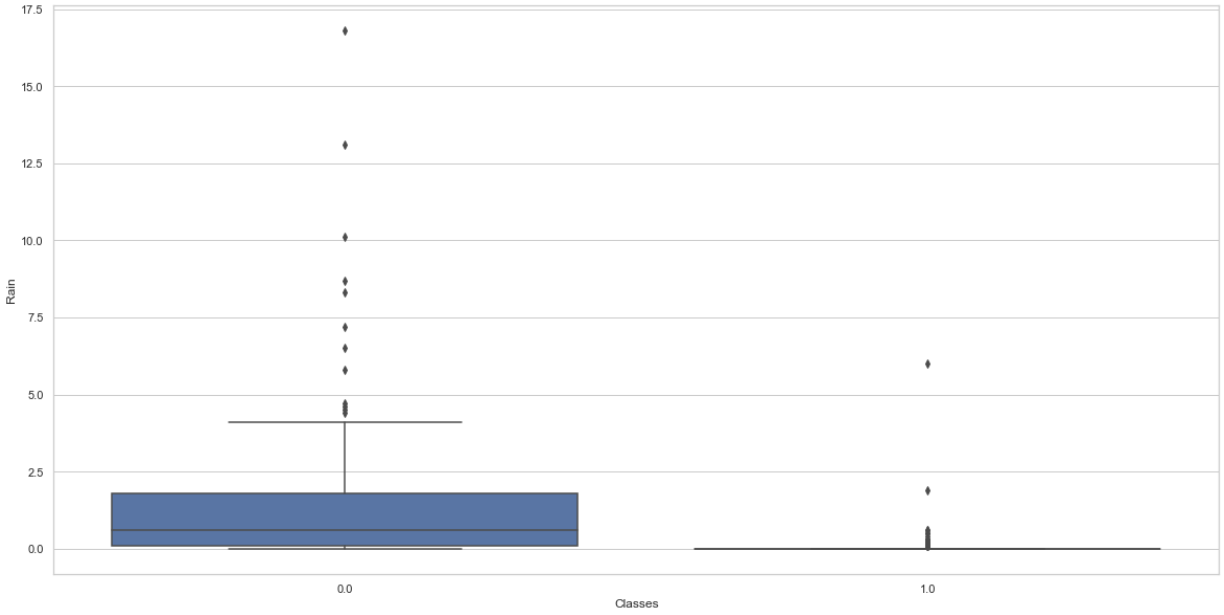
Observations:-

One day at lower temperature fires occur

Boxplot of Classes Vs Rain

In [97]:
```
# Python program to illustrate
# boxplot using inbuilt data-set
# given in seaborn

# importing the required module
import seaborn

# use to set style of background of plot
seaborn.set(style="whitegrid")

# loading data-set

seaborn.boxplot(x ='Classes', y ='Rain', data = df)
```

Out[97]: <AxesSubplot:xlabel='Classes', ylabel='Rain'>



Observation:-

In many days after having rain also fire occur