CMTH642 - Data Analytics: Advanced Methods

Assignment 1

Assignment 1 is worth 15% of the final grade. Submit the ipynb file and the generated pdf output file. Failing to submit both files will be subject to a mark deduction.

Preparation

The dataset is related to Forest Fires. For more info: https://archive.ics.uci.edu/ml/datasets/forest+fires

```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

Q1.

Read the csv file from the this URL https://archive.ics.uci.edu/ml/machine-learning-databases/forest-fires/forestfires.csv. Save it to a data frame called Forest. Check the first five records. (10 points) Relevant Pandas API

```
Forest = pd.read_csv('https://archive.ics.uci.edu/ml/machine-learning-databases/forest-fires/forestfires.csv')
Forest.head()
```

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	7	5	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.0
1	7	4	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.0
2	7	4	oct	sat	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.0
3	8	6	mar	fri	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.0
4	8	6	mar	sun	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.0

Next steps: View recommended plots

Q2.

How many observations are there in the dataset? How many observations are there with both a significant fire (burned area > 0) and rain? (10 points) Relevent API1 , Relevant Pandas API 2

```
#Number of observations in the dataset
num_rows = Forest.shape[0]
print('There are a total of', num_rows, 'observations.')

#Filtering for observations that meet criteria
criteria = (Forest['area'] > 0) & (Forest['rain'] > 0)
filtered_df = Forest[criteria]

#Number of filtered observations
num_filtered_observations = filtered_df.shape[0]
print('There are', num_filtered_observations, 'observations with both a significant fire (burned area >0) and rain (rai
```

```
There are a total of 517 observations.
There are 2 observations with both a significant fire (burned area >0) and rain (rain > 0).
```

Q3.

Show the columns month, day, area of all the observations with a significant fire (burned area >0). (10 points) Relevant Pandas API

```
#Filter for columns
month_day_area = Forest[["month","day","area"]]

#Filter for observations with a significant fire
sig_fire = month_day_area["area"] > 0
month_day_area.loc[sig_fire]
```

	month	day	area
138	jul	tue	0.36
139	sep	tue	0.43
140	sep	mon	0.47
141	aug	wed	0.55
142	aug	fri	0.61
...	...	...	...
509	aug	fri	2.17
510	aug	fri	0.43
512	aug	sun	6.44
513	aug	sun	54.29
514	aug	sun	11.16

270 rows × 3 columns

Q4.

How large are the five largest fires (i.e. having largest area)? (10 points) Relevant API

```
#Sort df by area
sorted_area = Forest.sort_values(by = 'area', ascending = False)

#Display area of the five largest fires
sorted_area['area'].head()
```

```
238    1090.84
415     746.28
479     278.53
237     212.88
236     200.94
Name: area, dtype: float64
```

Q5.

For the records you obtained from the previous question, what are the corresponding month, temp, RH, wind, rain, area? (10 points)

```
sorted_area[['month','temp', 'RH', 'wind', 'rain', 'area']].head()
```

	month	temp	RH	wind	rain	area
238	sep	25.1	27	4.0	0.0	1090.84
415	aug	27.5	27	4.9	0.0	746.28
479	jul	22.6	57	4.9	0.0	278.53
237	sep	18.8	40	2.2	0.0	212.88
236	sep	18.2	46	1.8	0.0	200.94

Q6.

For the whole dataset, reorder factor levels of month to be from Jan to Dec. (10 points)

```
Forest['month'] = pd.Categorical(Forest['month'], categories=['jan', 'feb', 'mar', 'apr', 'may', 'jun', 'jul', 'aug', 'se
Forest = Forest.sort_values('month')
Forest
```

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
104	2	4	jan	sat	82.1	3.7	9.3	2.9	5.3	78	3.1	0.0	0.00
379	4	5	jan	sun	18.7	1.1	171.4	0.0	5.2	100	0.9	0.0	0.00
96	3	4	feb	sat	83.9	8.0	30.2	2.6	12.7	48	1.8	0.0	0.00
59	2	2	feb	fri	86.6	13.2	43.0	5.3	12.3	51	0.9	0.0	0.00
202	7	4	feb	sun	83.9	8.7	32.1	2.1	8.8	68	2.2	0.0	13.05
...	...	...	...	...	...	...	...	...	...	...	...	...	...
274	8	6	dec	wed	84.0	27.8	354.6	5.3	5.1	61	8.0	0.0	11.19
281	6	5	dec	tue	85.4	25.4	349.7	2.6	5.1	24	8.5	0.0	24.77
273	4	6	dec	sun	84.4	27.2	353.5	6.8	4.8	57	8.5	0.0	8.98
279	4	4	dec	mon	85.4	25.4	349.7	2.6	4.6	21	8.5	0.0	9.77
278	4	4	dec	mon	85.4	25.4	349.7	2.6	4.6	21	8.5	0.0	22.03

517 rows × 13 columns

Next steps: View recommended plots

Q7.

Add one column to the data indicating whether a fire occurred for each observation ('TRUE' for area>0 and 'FALSE' for area==0). (10 points)

```
Forest['fire occured'] = Forest['area'] > 0
Forest
```

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area	fire occured
104	2	4	jan	sat	82.1	3.7	9.3	2.9	5.3	78	3.1	0.0	0.00	False
379	4	5	jan	sun	18.7	1.1	171.4	0.0	5.2	100	0.9	0.0	0.00	False
96	3	4	feb	sat	83.9	8.0	30.2	2.6	12.7	48	1.8	0.0	0.00	False
59	2	2	feb	fri	86.6	13.2	43.0	5.3	12.3	51	0.9	0.0	0.00	False
202	7	4	feb	sun	83.9	8.7	32.1	2.1	8.8	68	2.2	0.0	13.05	True
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
274	8	6	dec	wed	84.0	27.8	354.6	5.3	5.1	61	8.0	0.0	11.19	True
281	6	5	dec	tue	85.4	25.4	349.7	2.6	5.1	24	8.5	0.0	24.77	True
273	4	6	dec	sun	84.4	27.2	353.5	6.8	4.8	57	8.5	0.0	8.98	True
279	4	4	dec	mon	85.4	25.4	349.7	2.6	4.6	21	8.5	0.0	9.77	True
278	4	4	dec	mon	85.4	25.4	349.7	2.6	4.6	21	8.5	0.0	22.03	True

Next steps: View recommended plots

Q8.

What is the mean area/wind/temp/RH per month? (10 points)

```
Forest.groupby('month')[['area', 'wind', 'temp', 'RH']].mean()
```

	area	wind	temp	RH
month				
jan	0.000000	2.000000	5.250000	89.000000
feb	6.275000	3.755000	9.635000	55.700000
mar	4.356667	4.968519	13.083333	40.000000
apr	8.891111	4.666667	12.044444	46.888889
may	19.240000	4.450000	14.650000	67.000000
jun	5.841176	4.135294	20.494118	45.117647
jul	14.369687	3.734375	22.109375	45.125000
aug	12.489076	4.086413	21.631522	45.489130
sep	17.942616	3.557558	19.612209	42.843023
oct	6.638000	3.460000	17.093333	37.466667
nov	0.000000	4.500000	11.800000	31.000000
dec	13.330000	7.644444	4.522222	38.444444

Q9.

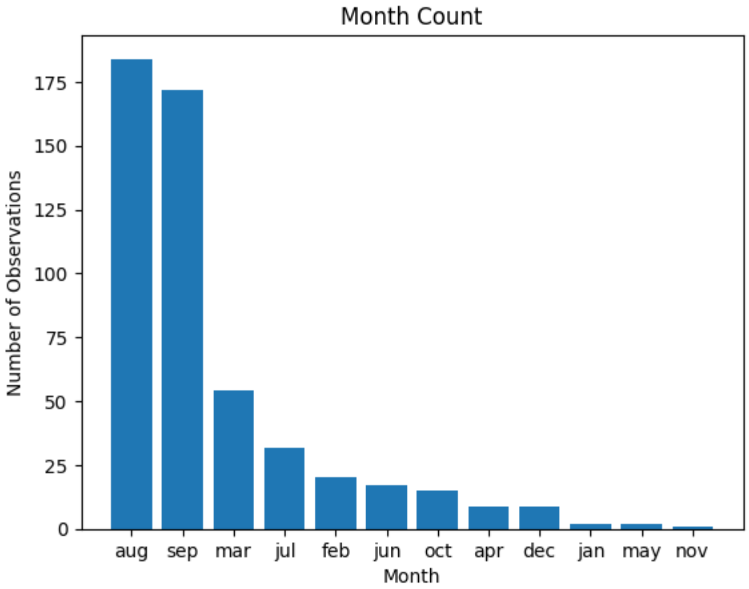
How many observations are there in each month? Visualize by using a barplot in descending order. (10 points) Relevant API 1 Relevant API 2

```
#Count the number of observations in each month
month_count = Forest['month'].value_counts()

#Sort dscending order
month_count = month_count.sort_values(ascending = False)
print('Number of observations in each month:\n', month_count)

#Extract month and counts for plotting
months = month_count.index
counts = month_count.values

#Create a bar plot
plt.bar(months, counts)
plt.xlabel('Month')
plt.ylabel('Number of Observations')
plt.title('Month Count')
plt.show
```

```
Number of observations in each month:
 aug    184
sep    172
mar     54
jul     32
feb     20
jun     17
oct     15
apr      9
dec      9
jan      2
may      2
nov      1
Name: month, dtype: int64
```

```
matplotlib.pyplot.show
def show(*args, **kwargs)
```

```
/usr/local/lib/python3.10/dist-packages/matplotlib/pyplot.py
Display all open figures.

Parameters
----------
block : bool, optional
```



Q10.

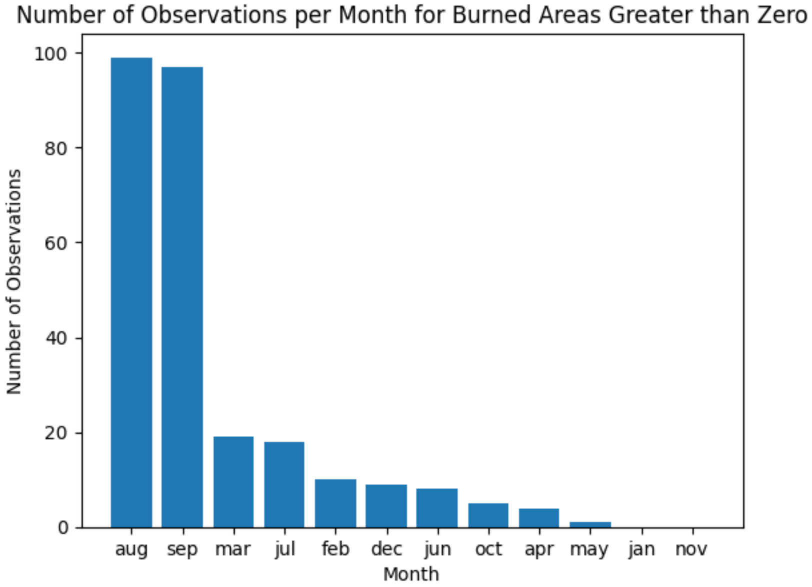
How many observations are there with burned area greater than zero in each month? Visualize by using a barplot in descending order. (10 points)

```
#Filter for observations with area > 0
number_area_per_month = Forest[Forest['area'] > 0]

#Count number observations by month
number_area_per_month = number_area_per_month['month'].value_counts()
print('Number of observations in each month for burned area greater than zero:\n', number_area_per_month)

#Extract month and counts for plotting
month = number_area_per_month.index
count = number_area_per_month.values

#Create a bar plot
plt.bar(month, count)
plt.xlabel('Month')
plt.ylabel('Number of Observations')
plt.title('Number of Observations per Month for Burned Areas Greater than Zero')
plt.show
```

```
Number of observations in each month for burned area greater than zero:
 aug    99
sep    97
mar    19
jul    18
feb    10
dec     9
jun     8
oct     5
apr     4
may     1
jan     0
nov     0
Name: month, dtype: int64
```

```
matplotlib.pyplot.show
def show(*args, **kwargs)
```

```
/usr/local/lib/python3.10/dist-packages/matplotlib/pyplot.py
Display all open figures.

Parameters
----------
block : bool, optional
```


Number of Observations per Month for Burned Areas Greater than Zero
Number of Observations
Month
aug
sep
mar
jul
feb
dec
jun
oct
apr
may
jan
nov