amazon-rain-forest-fire-analysis

November 15, 2024

1 AMAZON RAIN FOREST FIRE ANALYSIS

The Amazon rainforest is the world's largest rainforest and river system, and it is the home to millions of species. It's also vital to life on Earth, as it: 1. Stabilizes the climate 2. Influences global weather 3. Is home to millions of species 4. Is home to over 400 indigenous groups

The Amazon Rainforest has been experiencing increasingly frequent and intense forest fires in recent years. Understanding the patterns of these fires is high priority for addressing the environmental and ecological impacts. In this project, we analyze the data related to forest fires in Brazil, focusing on the Amazon region. The dataset consists of the number of forest fires in different states of Brazil, recorded from 1998 to 2017. This analysis aims to uncover trends, identify the months, years, and states most affected by fires, and gain insights that can inform future conservation efforts.

The dataset includes the following columns:

year: The year in which the fire data was recorded.

state: The state of Brazil where the fires occurred.

month: The month of the year when the fires were recorded.

number: The number of forest fires reported.

date: The exact date of the reported fire.

1.1 Install and Import Required Libraries

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

1.1.1 Read the csv file

[ ]:
```
Path='location of file'
```

[2]:
```
df=pd.read_csv(r'Path',encoding='ISO-8859-1')
```

Display the first few rows and last rows of the dataset

[6]:
```
df.head()
```

[6]:

	year	state	month	number	date
0	1998	Acre	Janeiro	0.0	1998-01-01
1	1999	Acre	Janeiro	0.0	1999-01-01
2	2000	Acre	Janeiro	0.0	2000-01-01
3	2001	Acre	Janeiro	0.0	2001-01-01
4	2002	Acre	Janeiro	0.0	2002-01-01

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

[7]:

	year	state	month	number	date
6449	2012	Tocantins	Dezembro	128.0	2012-01-01
6450	2013	Tocantins	Dezembro	85.0	2013-01-01
6451	2014	Tocantins	Dezembro	223.0	2014-01-01
6452	2015	Tocantins	Dezembro	373.0	2015-01-01
6453	2016	Tocantins	Dezembro	119.0	2016-01-01

Basic Info and Data Processing

[8]:
```
df.shape
```

[8]:
```
(6454, 5)
```

[9]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6454 entries, 0 to 6453
Data columns (total 5 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   year    6454 non-null   int64
 1   state   6454 non-null   object
 2   month   6454 non-null   object
 3   number  6454 non-null   float64
 4   date    6454 non-null   object
dtypes: float64(1), int64(1), object(3)
memory usage: 252.2+ KB
```

Check for duplicate rows and remove them

[10]:
```
df.drop_duplicates(inplace=True)
```

Check for null values in dataset

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

[13]:
```
year      0
state     0
month     0
number    0
date      0
dtype: int64
```

[14]:
```
df['month'].unique()
```

[14]:
```
array(['Janeiro', 'Fevereiro', 'Março', 'Abril', 'Maio', 'Junho', 'Julho',
       'Agosto', 'Setembro', 'Outubro', 'Novembro', 'Dezembro'],
      dtype=object)
```

Change Month names to English

[15]:
```
month_names={'Janeiro':'January', 'Fevereiro':'February', 'Março':'March',␣
 ↪'Abril':'April',
             'Maio':'May', 'Junho':'June', 'Julho':'July','Agosto':'August',
             'Setembro':'September', 'Outubro':'October', 'Novembro':
 ↪'November', 'Dezembro':'December'}
```

[16]:
```
df['month']=df['month'].map(month_names)
```

1.2 Exploratory Data Analysis(EDA)

[17]:
```
df.describe()
```

[17]:

	year	number
count	6422.000000	6422.000000
mean	2007.490969	108.815178
std	5.731806	191.142482
min	1998.000000	0.000000
25%	2003.000000	3.000000
50%	2007.000000	24.497000
75%	2012.000000	114.000000
max	2017.000000	998.000000

Monthly fire Analysis

[18]:
```
#grouping with months and summation of fires in each month
monthly_fire=df.groupby('month')['number'].sum()
```

[14]:
```
monthly_fire
```

[14]:
```
month
April        28184.770
August       88050.435
```

```
December     57535.480
February     30839.050
January      47681.844
July         92319.113
June         55997.675
March        30709.405
May          34725.363
November     85508.054
October      88681.579
September    58578.305
Name: number, dtype: float64
```

[19]:
```
#to find the month with maximum fires
max_fires_month=monthly_fire.idxmax()
```

[16]:
```
max_fires_month
```

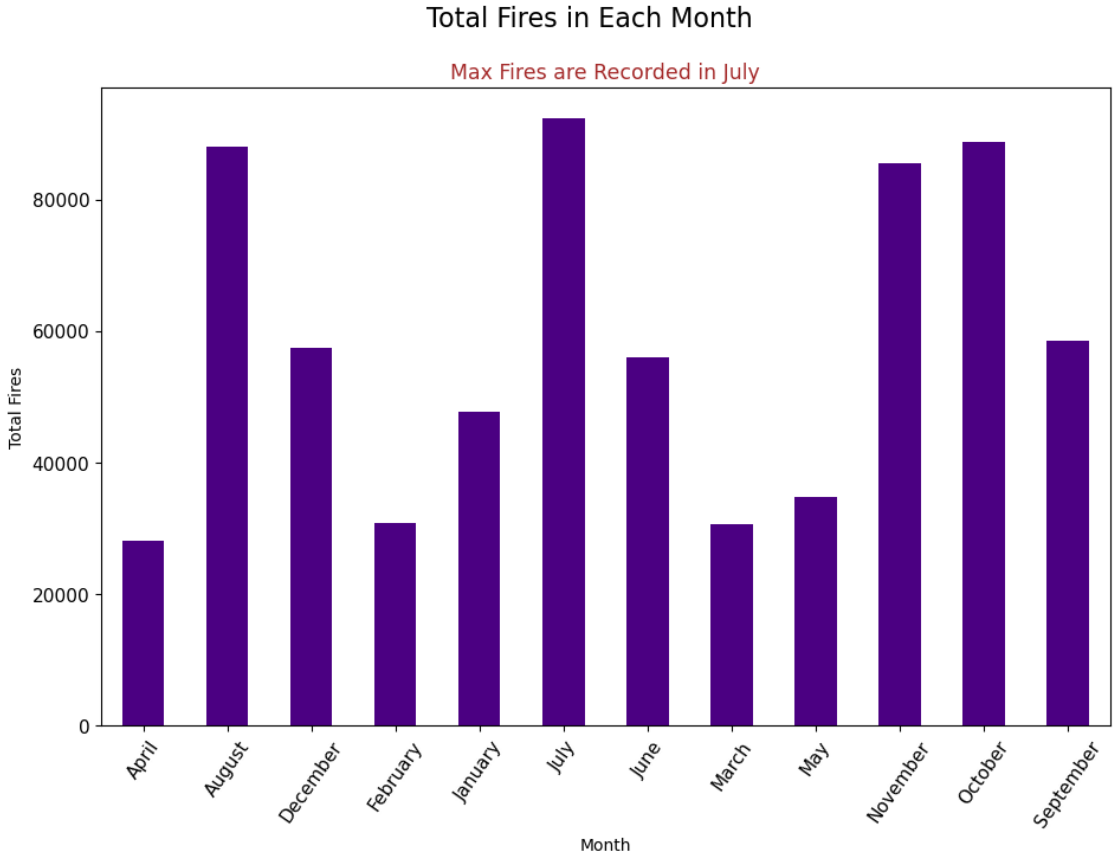
[16]:
```
'July'
```

[17]:
```
max_fire=monthly_fire[max_fires_month]
```

[18]:
```
max_fire
```

[18]:
```
92319.113
```

[19]:
```
#visualize the monthly fires
plt.figure(figsize=(11,7))
monthly_fire.plot(kind='bar',color='indigo',xlabel="Month",ylabel="Total␣
 ↪Fires",fontsize=11)
plt.xticks(rotation=55)
plt.suptitle("Total Fires in Each Month",fontsize=16)
plt.title(f"Max Fires are Recorded in {max_fires_month}",fontsize=12.
 ↪5,color='brown')
plt.show()
max_fires_month,max_fire
```



[19]:
```
('July', 92319.113)
```

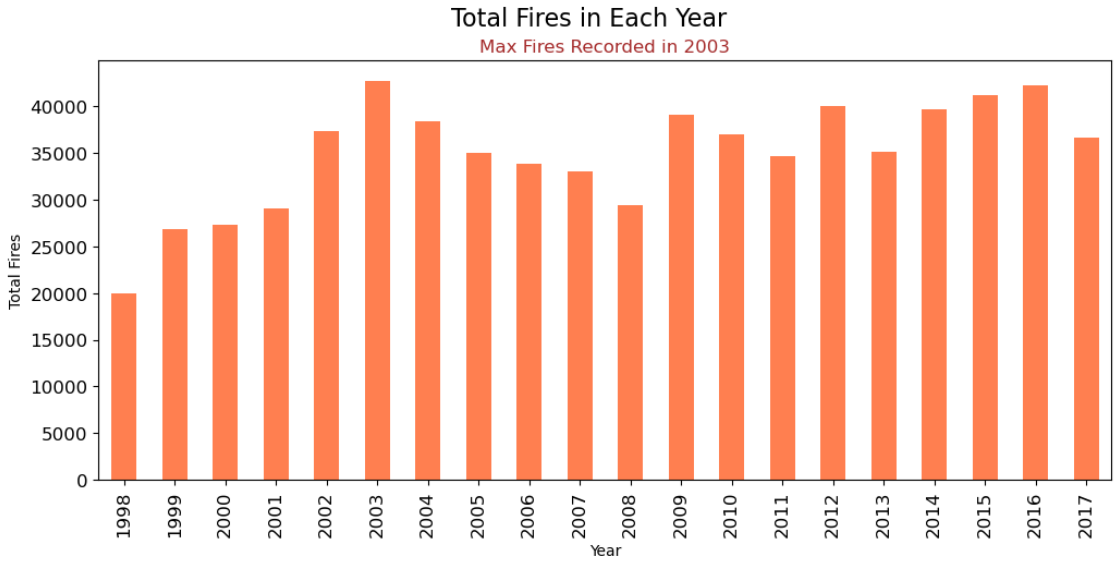
Yearly Forest Fires Analysis

[20]:
```
yearly_fires=df.groupby('year')['number'].sum()
```

[21]:
```
max_fires_year=yearly_fires.idxmax()
```

[22]:
```
max_fires=yearly_fires[max_fires_year]
```

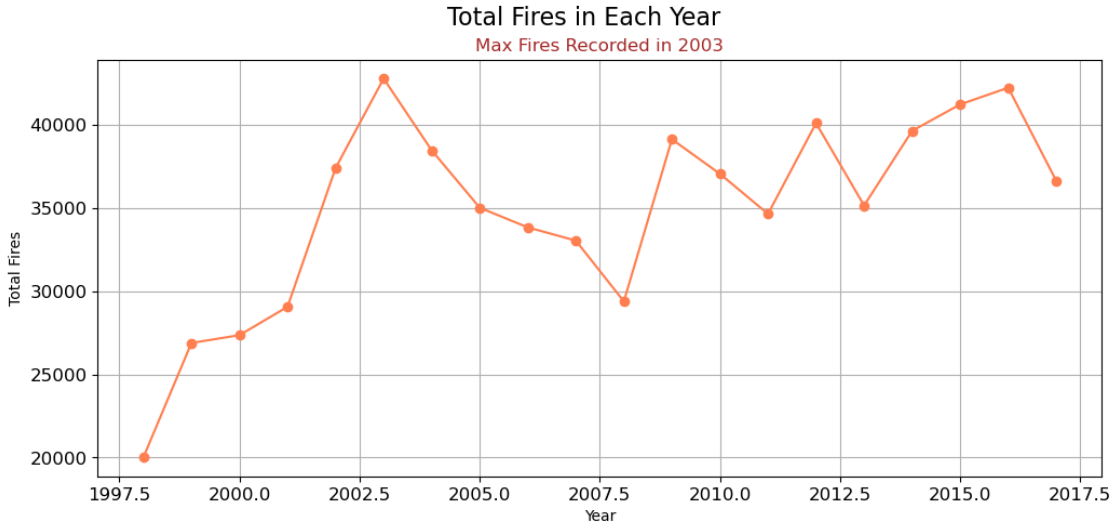
[23]:
```
plt.figure(figsize=(12,5))
yearly_fires.plot(kind='bar', color='coral', xlabel='Year',ylabel='Total␣
 ↪Fires',fontsize=12)
plt.suptitle("Total Fires in Each Year",fontsize=16)
plt.title(f'Max Fires Recorded in {max_fires_year}',fontsize=12,color='brown')
plt.show()
max_fires_year,max_fires
```



[23]: (2003, 42760.674)

Similarly using line graph

[24]:
```
plt.figure(figsize=(12,5))
yearly_fires.plot(kind='line', color='coral',marker='o',␣
↪xlabel='Year',ylabel='Total Fires',fontsize=12)
plt.suptitle("Total Fires in Each Year",fontsize=16)
plt.title(f'Max Fires Recorded in {max_fires_year}',fontsize=12,color='brown')
plt.grid(True)
plt.show()
max_fires_year,max_fires
```



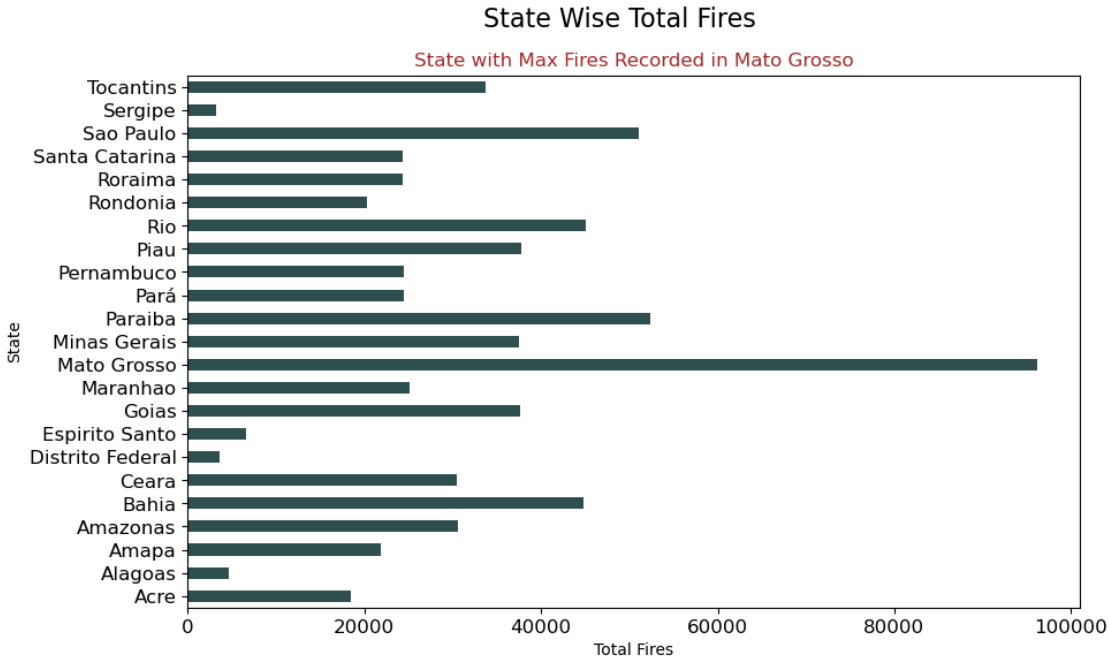
[24]: (2003, 42760.674)

State Wise Forest Fire Analysis

[25]:
```
state_fires=df.groupby('state')['number'].sum()
```

[26]:
```
max_fires_state=state_fires.idxmax()
max_fires=state_fires[max_fires_state]
```

[27]:
```
plt.figure(figsize=(10,6))
state_fires.plot(kind='barh',color='darkslategray',xlabel='Total␣
 ↪Fires',ylabel='State',fontsize=12)
plt.suptitle("State Wise Total Fires",fontsize=16)
plt.title(f'State with Max Fires Recorded in␣
 ↪{max_fires_state}',fontsize=12,color='brown')
plt.show()
max_fires_state,max_fires
```



[27]: ('Mato Grosso', 96246.028)

1.2.1 STATE FIRE REPORT FOR SAO PAULO

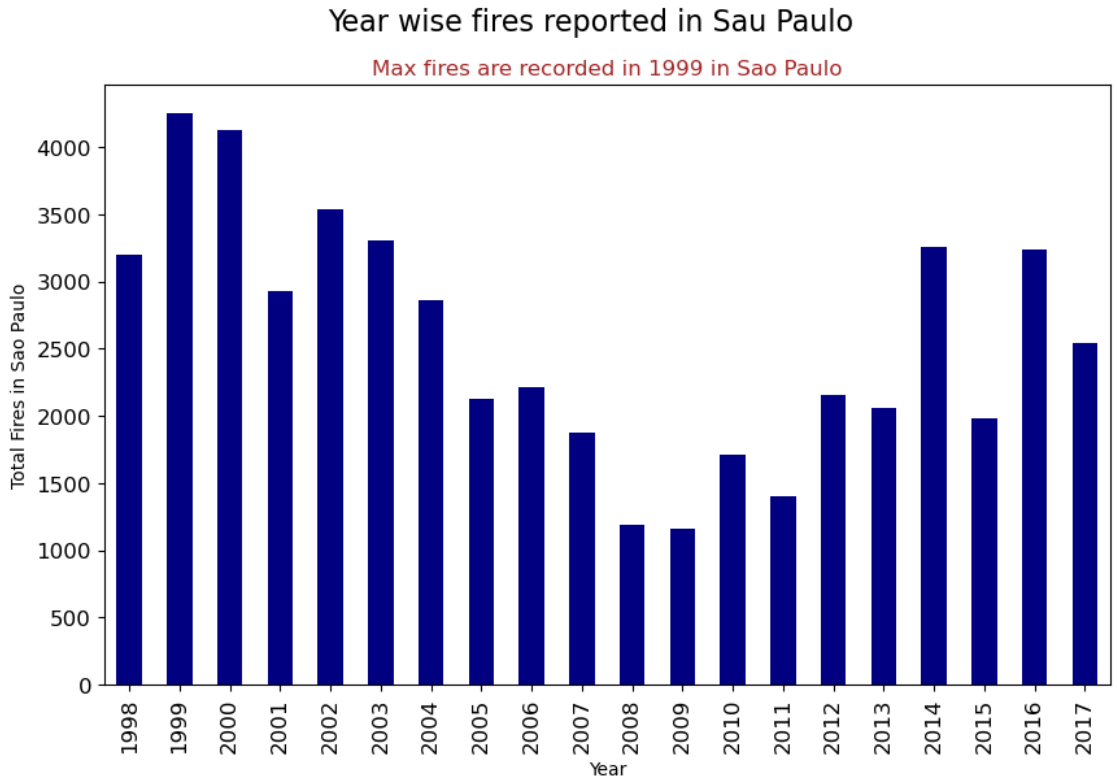
Year-wise Analysis-Sao Paulo

[28]:
```
sao_paulo_fire=df[df['state']=='Sao Paulo']
```

[29]:
```
yearly_sao_paulo_fire=sao_paulo_fire.groupby('year')['number'].sum()
```

[30]:
```
max_yearly_sao_paulo_fire=yearly_sao_paulo_fire.idxmax()
max_sao_paulo_fire=yearly_sao_paulo_fire[max_yearly_sao_paulo_fire]
```

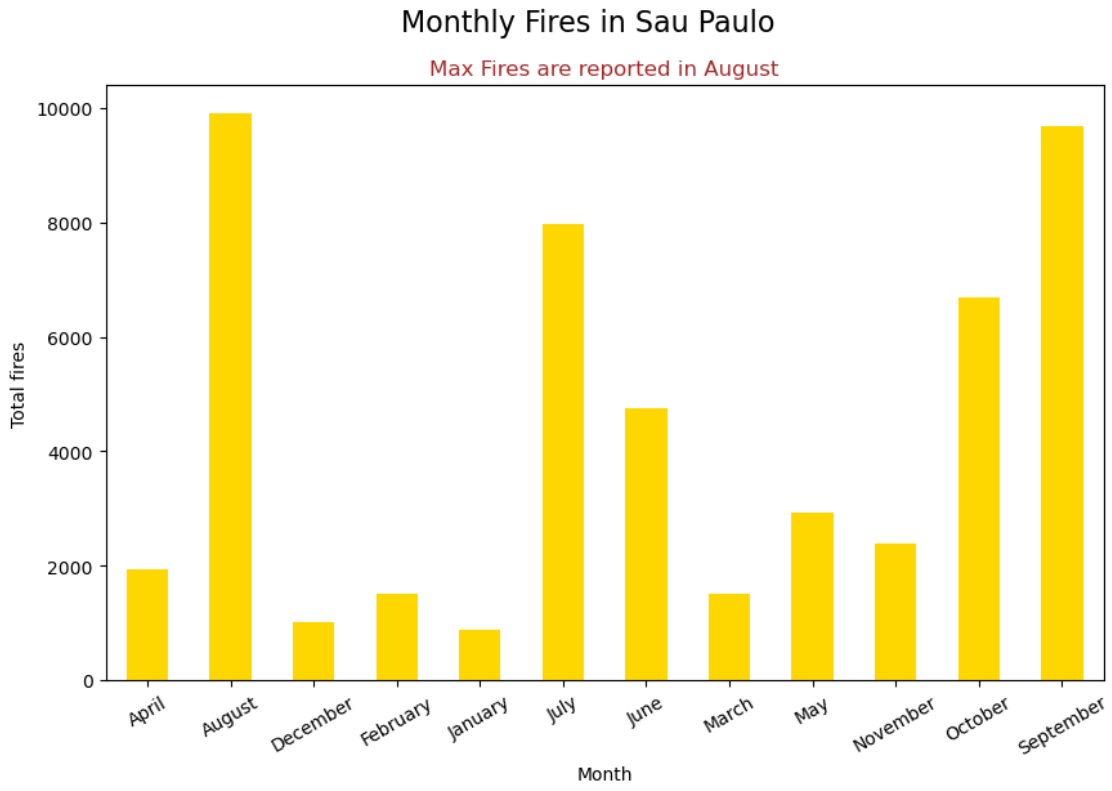
[31]:
```
plt.figure(figsize=(10,6))
yearly_sao_paulo_fire.plot(kind='bar',color='navy',xlabel='Year',ylabel='Total␣
↪Fires in Sao Paulo',fontsize=12)
plt.suptitle('Year wise fires reported in Sau Paulo',fontsize=16)
plt.title(f'Max fires are recorded in {max_yearly_sao_paulo_fire} in Sao␣
↪Paulo',fontsize=12,color='brown')
plt.show()
```



Month-wise Fire Report(Sau Paulo)

[32]:
```
sau_paulo_monthly_fires=sao_paulo_fire.groupby('month')['number'].sum()
max_fire_month_sau_paulo=sau_paulo_monthly_fires.idxmax()
max_sau_paulo_monthly_fires=sau_paulo_monthly_fires[max_fire_month_sau_paulo]
```

[33]:
```
plt.figure(figsize=(10,6))
sau_paulo_monthly_fires.
 ↪plot(kind='bar',color='gold',xlabel='Month',ylabel='Total fires',fontsize=10)
plt.xticks(rotation=30)
plt.suptitle('Monthly Fires in Sau Paulo',fontsize=16)
plt.title(f'Max Fires are reported in␣
 ↪{max_fire_month_sau_paulo}',color='brown',fontsize=12)
plt.show()
sau_paulo_monthly_fires
```



[33]:
```
month
April        1949.000
August       9902.545
December     1009.000
February     1504.000
January       872.000
July         7961.000
June         4746.000
March        1507.000
May          2924.000
November     2394.000
October      6681.000
```

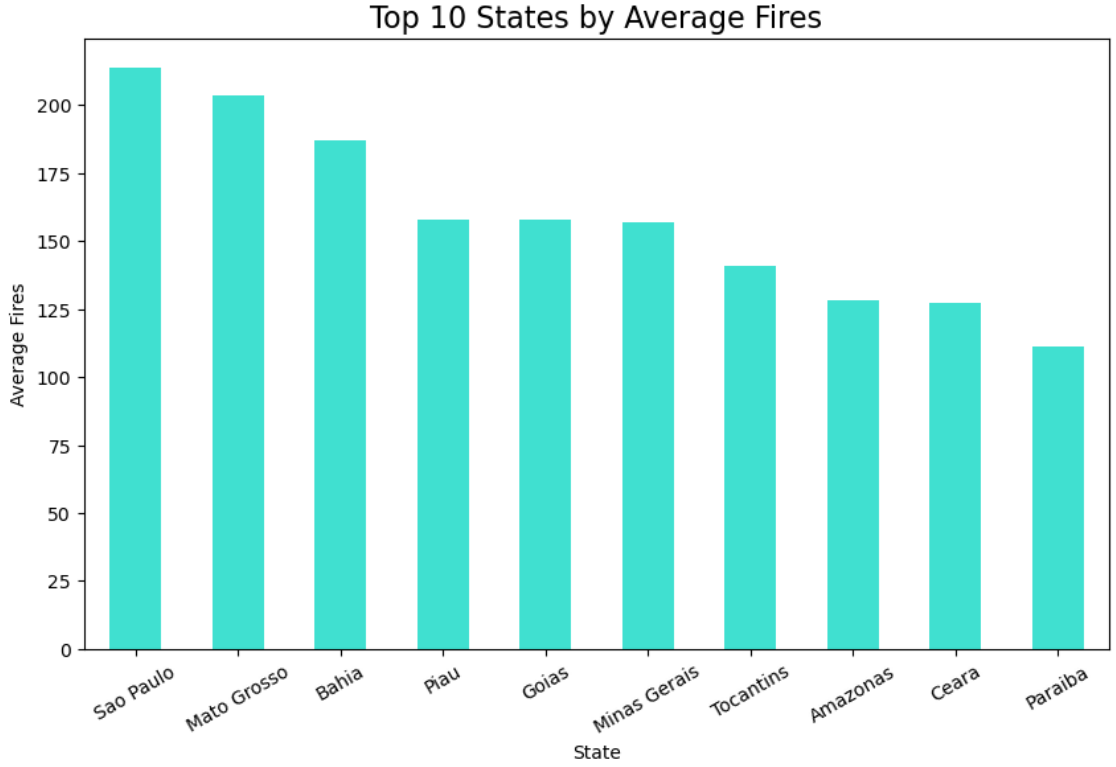
```
September    9671.653
Name: number, dtype: float64
```

1.2.2 Special Analysis

State-wise Average Fire Reports

[34]:
```
state_avg_fires= df.groupby('state')['number'].mean().
 ↪sort_values(ascending=False)
```

[36]:
```
#visualize for the top 10 states by average fires recorded
plt.figure(figsize=(10,6))
state_avg_fires.head(10).
 ↪plot(kind='bar',color='turquoise',xlabel='State',ylabel='Average Fires')
plt.title('Top 10 States by Average Fires',fontsize=16)
plt.xticks(rotation=30)
plt.show()
```



Monthly Fires Analysis in 2016 & 2017

[21]:
```
fires_2016_17=df[(df['year']==2016)|(df['year']==2017)]
```

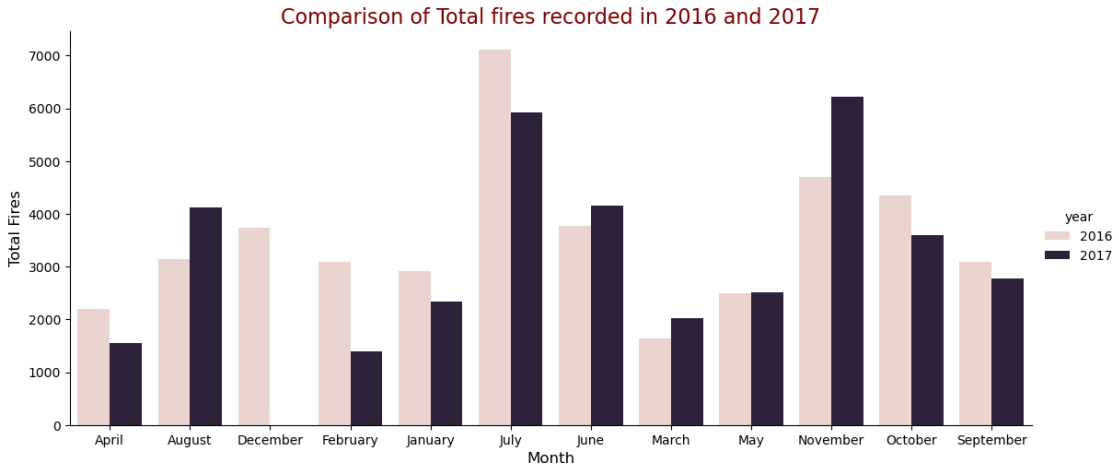
[22]:
```
monthly_fires_2016_17=fires_2016_17.groupby(['year','month'])['number'].sum()
```

[23]:
```
monthly_fires_2016_17.info()
```

```
<class 'pandas.core.series.Series'>
MultiIndex: 23 entries, (2016, 'April') to (2017, 'September')
Series name: number
Non-Null Count  Dtype
--------------  -----
23 non-null     float64
dtypes: float64(1)
memory usage: 433.0+ bytes
```

[24]:
```
#convert the series to dataframe
df2=monthly_fires_2016_17.to_frame()
```

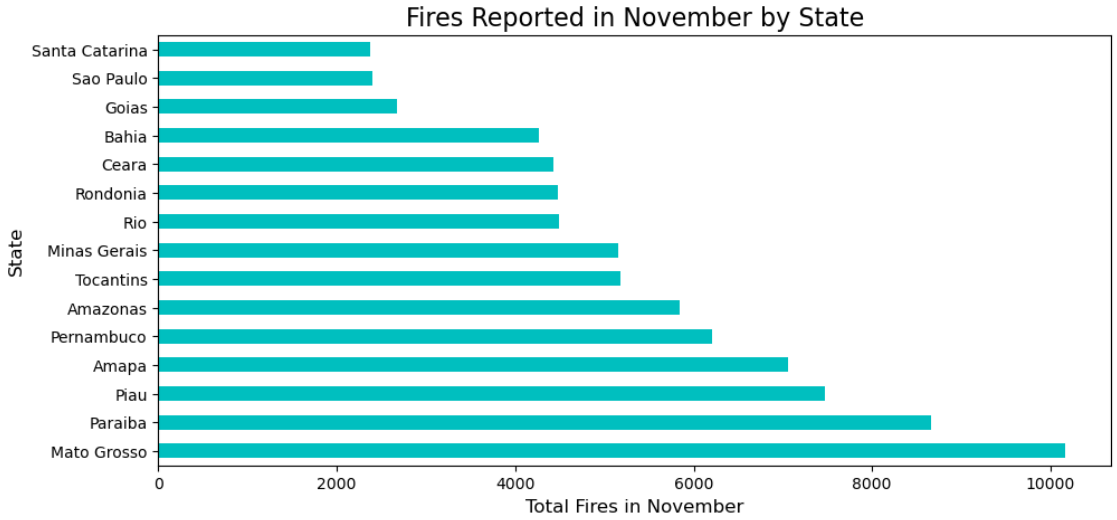
[34]:
```
sns.catplot(x = 'month', y='number',
               hue = 'year',data=df2, kind='bar',aspect=16/7)
plt.xlabel('Month',fontsize=12)
plt.ylabel('Total Fires',fontsize=12)
plt.title('Comparison of Total fires recorded in 2016 and␣
 ↪2017',fontsize=16,color='maroon')
plt.show()
```



[51]:
```
# Filter data for November month
November_fires= df[df['month'] == 'November']
November_state_fires = November_fires.groupby('state')['number'].sum()

# Visualization of November fires by state
plt.figure(figsize=(11, 5))
November_state_fires.sort_values(ascending=False).head(15).plot(kind='barh',␣
 ↪color='c')
plt.title("Fires Reported in November by State", fontsize=16,)
```

```
plt.xlabel("Total Fires in November", fontsize=12)
plt.ylabel("State", fontsize=12)
plt.show()
```



2 Conclusion

The Amazon Rainforest fire analysis has provided some crucial insights into the occurrence of forest fires. The main findings include:

1. **Month with Maximum Fires:** Providing a valuable insight into seasonal fire trends, We have identified the month with the highest number of fires.
2. **Year with Maximum Fires:** We have identified the Peak fire seasons by the analysis of yearly trends.
3. **State with Maximum Fires:** With the help of state wise data we are able to find the state with highest fires and we identified Mato Grosso as the state with highest fires recorded which emphasizes the need of attention in this area.
4. **Year-wise Analysis for Sau Paulo:** The year-wise distribution of fires in Sau Paulo has revealed the significant trends in fire occurrences over the time period.
5. **Monthly Comparision Analysis for 2016 and 2017:** A breakdown of fires by month in 2016 and 2017 has provided insight into when fires were most concentrated during those years.
6. **Average Fires by State:** With the help of average fires analysis by state has revealed the top states with most frequently forest fires.

These insights are very crucial for understanding of the patterns of forest fires and their impacts. The visualization and analysis provides a base for further research, which may include investigating the causes behind the trends observed. The results can be helpful for controlling and reducing the

frequency of forest fires in the Amazon region, which is vital for preserving the rainforest and mitigating climate change.