In [1]:

```
# from google.colab import drive
# drive.mount('/content/drive')
# from pydrive.auth import GoogleAuth
# from pydrive.drive import GoogleDrive
# from google.colab import auth
# from oauth2client.client import GoogleCredentials
```

In [2]:

```
# from pydrive.auth import GoogleAuth
# from pydrive.drive import GoogleDrive
# from google.colab import auth
# from oauth2client.client import GoogleCredentials
```

In [5]:

```
import pandas as pd
# df=pd.read_csv('/content/drive/My Drive/Colab Notebooks/DM Project/airlines.csv')
# df1=pd.read_csv('/content/drive/My Drive/Colab Notebooks/DM Project/flights.csv')
# df2=pd.read_csv('/content/drive/My Drive/Colab Notebooks/DM Project/airports.csv')
df=pd.read_csv('airlines.csv')
df1=pd.read_csv('flights.csv')
df2=pd.read_csv('airports.csv')
```

In [6]:

```
df.head(30)
```

Out[6]:

	IATA_CODE	AIRLINE
0	UA	United Air Lines Inc.
1	AA	American Airlines Inc.
2	US	US Airways Inc.
3	F9	Frontier Airlines Inc.
4	B6	JetBlue Airways
5	OO	Skywest Airlines Inc.
6	AS	Alaska Airlines Inc.
7	NK	Spirit Air Lines
8	WN	Southwest Airlines Co.
9	DL	Delta Air Lines Inc.
10	EV	Atlantic Southeast Airlines
11	HA	Hawaiian Airlines Inc.
12	MQ	American Eagle Airlines Inc.
13	VX	Virgin America

In [7]:

```
df1.head
```

Out[7]:

```
<bound method NDFrame.head of          YEAR  MONTH  DAY  DAY_OF_WEEK AIRLI
NE  FLIGHT_NUMBER TAIL_NUMBER  \
0        2015      1    1            4      AS             98      N407AS
1        2015      1    1            4      AA           2336      N3KUAA
2        2015      1    1            4      US            840      N171US
3        2015      1    1            4      AA            258      N3HYAA
4        2015      1    1            4      AS            135      N527AS
...       ...    ...  ...          ...     ...            ...         ...
1048570  2015      3   25            3      AS            695      N767AS
1048571  2015      3   25            3      B6            746      N659JB
1048572  2015      3   25            3      B6            962      N564JB
1048573  2015      3   25            3      B6           1504      N606JB
1048574  2015      3   25            3      DL           2619      N931DN

        ORIGIN_AIRPORT DESTINATION_AIRPORT  SCHEDULED_DEPARTURE  ...  \
0                  ANC                 SEA                    5  ...
1                  LAX                 PBI                   10  ...
2                  SFO                 CLT                   20  ...
3                  LAX                 MIA                   20  ...
4                  SEA                 ANC                   25  ...
...                ...                 ...                  ...  ...
1048570            GEG                 SEA                  500  ...
1048571            PSE                 JFK                  500  ...
1048572            SJU                 BOS                  500  ...
1048573            SJU                 JFK                  500  ...
1048574            FAR                 MSP                  500  ...

         DIVERTED  CANCELLED  ON_TIME  Y  CANCELLATION_REASON  \
0               0          0        1  3                  NaN
1               0          0        1  3                  NaN
2               0          0        0  0                  NaN
3               0          0        1  3                  NaN
4               0          0        1  3                  NaN
...           ...        ...      ... ..                  ...
1048570         0          0        1  3                  NaN
1048571         0          0        1  3                  NaN
1048572         0          0        0  0                  NaN
1048573         0          0        1  3                  NaN
1048574         0          0        0  0                  NaN

         AIR_SYSTEM_DELAY  SECURITY_DELAY  AIRLINE_DELAY  LATE_AIRCRAFT_DE
LAY  \
0                     NaN             NaN            NaN
NaN
1                     NaN             NaN            NaN
NaN
2                     NaN             NaN            NaN
NaN
3                     NaN             NaN            NaN
NaN
4                     NaN             NaN            NaN
NaN
...                   ...             ...            ...
...
1048570               NaN             NaN            NaN
NaN
1048571               NaN             NaN            NaN
NaN
1048572               3.0             0.0            9.0
```

```
4.0
1048573               NaN             NaN            NaN
NaN
1048574               NaN             NaN            NaN
NaN

         WEATHER_DELAY
0                  NaN
1                  NaN
2                  NaN
3                  NaN
4                  NaN
...                ...
1048570            NaN
1048571            NaN
1048572            0.0
1048573            NaN
1048574            NaN

[1048575 rows x 34 columns]>
```

In [8]:

```
df2.head
```

Out[8]:

```
<bound method NDFrame.head of     IATA_CODE                              A
IRPORT  \
0         ABE  Lehigh Valley International Airport
1         ABI              Abilene Regional Airport
2         ABQ    Albuquerque International Sunport
3         ABR            Aberdeen Regional Airport
4         ABY   Southwest Georgia Regional Airport
..        ...                                  ...
317       WRG                      Wrangell Airport
318       WYS                Westerly State Airport
319       XNA  Northwest Arkansas Regional Airport
320       YAK                       Yakutat Airport
321       YUM           Yuma International Airport

                            CITY STATE COUNTRY  LATITUDE  LONGITUDE
0                      Allentown    PA     USA  40.65236  -75.44040
1                        Abilene    TX     USA  32.41132  -99.68190
2                     Albuquerque    NM     USA  35.04022 -106.60919
3                        Aberdeen    SD     USA  45.44906  -98.42183
4                          Albany    GA     USA  31.53552  -84.19447
..                            ...   ...     ...       ...        ...
317                      Wrangell    AK     USA  56.48433 -132.36982
318                West Yellowstone    MT     USA  44.68840 -111.11764
319  Fayetteville/Springdale/Rogers    AR     USA  36.28187  -94.30681
320                        Yakutat    AK     USA  59.50336 -139.66023
321                           Yuma    AZ     USA  32.65658 -114.60597

[322 rows x 7 columns]>
```

In [9]:

```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1048575 entries, 0 to 1048574
Data columns (total 34 columns):
 #   Column                Non-Null Count    Dtype  
---  ------                --------------    -----  
 0   YEAR                  1048575 non-null  int64  
 1   MONTH                 1048575 non-null  int64  
 2   DAY                   1048575 non-null  int64  
 3   DAY_OF_WEEK           1048575 non-null  int64  
 4   AIRLINE               1048575 non-null  object 
 5   FLIGHT_NUMBER         1048575 non-null  int64  
 6   TAIL_NUMBER           1041777 non-null  object 
 7   ORIGIN_AIRPORT        1048575 non-null  object 
 8   DESTINATION_AIRPORT   1048575 non-null  object 
 9   SCHEDULED_DEPARTURE   1048575 non-null  int64  
 10  DEPARTURE_TIME        1014990 non-null  float64
 11  DEPARTURE_DELAY       1014990 non-null  float64
 12  TAXI_OUT              1014399 non-null  float64
 13  WHEELS_OFF            1014399 non-null  float64
 14  SCHEDULED_TIME        1048573 non-null  float64
 15  ELAPSED_TIME          1012055 non-null  float64
 16  AIR_TIME              1012055 non-null  float64
 17  DISTANCE              1048575 non-null  int64  
 18  WHEELS_ON             1013595 non-null  float64
 19  TAXI_IN               1013595 non-null  float64
 20  SCHEDULED_ARRIVAL     1048575 non-null  int64  
 21  ARRIVAL_TIME          1013595 non-null  float64
 22  ARRIVAL_DELAY         1012055 non-null  float64
 23  ARRIVAL_DELAY_STATUS  1048575 non-null  int64  
 24  DIVERTED              1048575 non-null  int64  
 25  CANCELLED             1048575 non-null  int64  
 26  ON_TIME               1048575 non-null  int64  
 27  Y                     1048575 non-null  int64  
 28  CANCELLATION_REASON   42928 non-null    object 
 29  AIR_SYSTEM_DELAY      252613 non-null   float64
 30  SECURITY_DELAY        252613 non-null   float64
 31  AIRLINE_DELAY         252613 non-null   float64
 32  LATE_AIRCRAFT_DELAY   252613 non-null   float64
 33  WEATHER_DELAY         252613 non-null   float64
dtypes: float64(16), int64(13), object(5)
memory usage: 272.0+ MB
```

No of flights Cancelled For each Airline

In [11]:

```
  import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline
fig,axes = plt.subplots(figsize=(14, 5))
new_indexes=[]
AIRLINES = df1.groupby('AIRLINE').CANCELLED.sum().sort_values(ascending = False)
airline_labels  = AIRLINES.index
AIRLINES       = AIRLINES.values
for i in range(len(airline_labels)):
    dfb = int(df[df['IATA_CODE']==airline_labels[i]].index[0])
    new_indexes.append(df.AIRLINE[dfb])
axes.bar(new_indexes, AIRLINES, align="center", width=0.5, alpha=0.5,color = 'g')
axes.set_ylabel('CANCELLED FLIGHTS')
axes.set_title('FLIGHTS CANCELLED FOR EACH AIRLINE')
axes.set_xticklabels(new_indexes)
plt.setp(axes.get_xticklabels(),rotation=45,ha='right',rotation_mode='anchor')
```

Out[11]:

```
[None,
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```
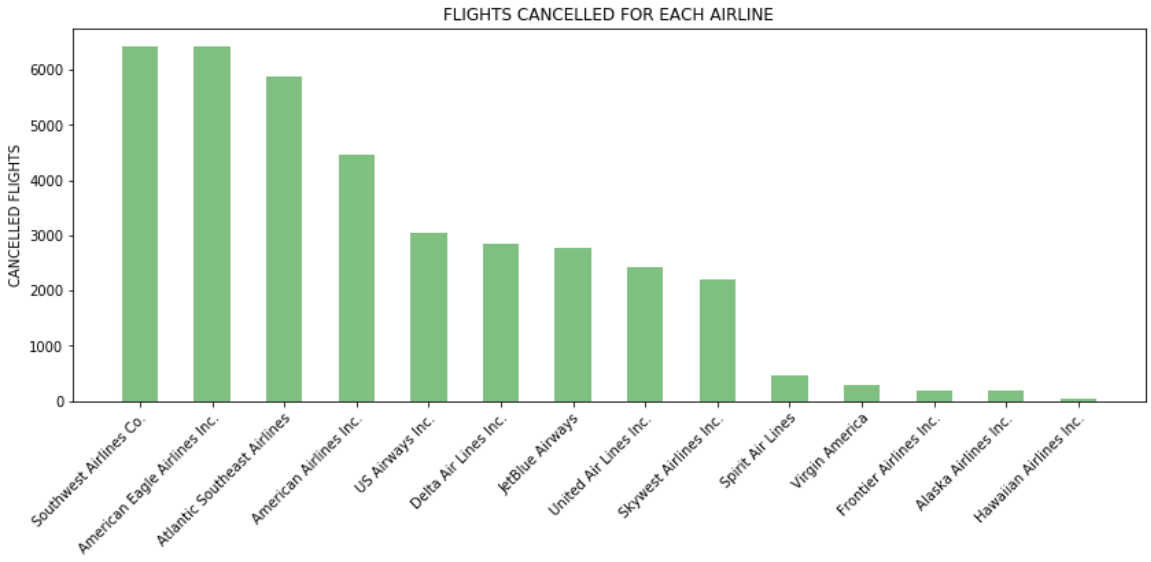
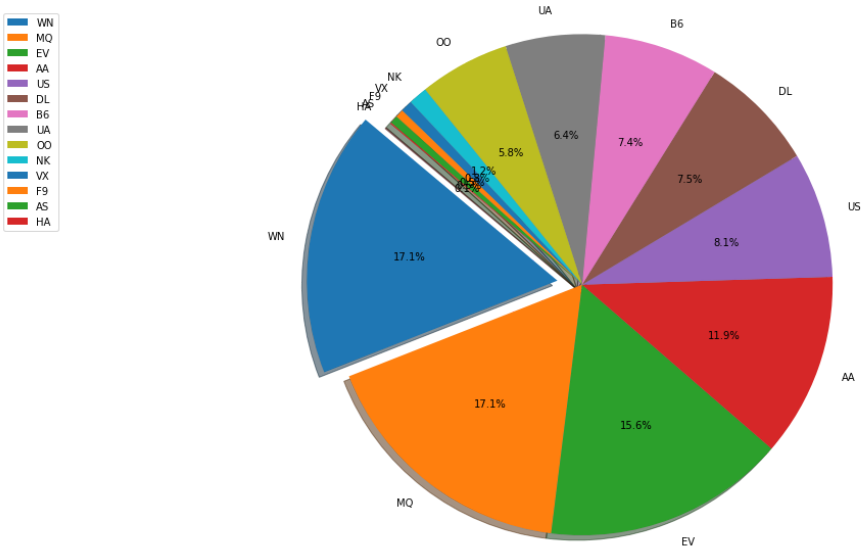



As we can see in the graph above , the number of flights cancelled for the airlines "Southwest Airlines Co." and "American Eagle Airlines Co. " , These airlines have maximum cancelled flights reaching above 6000 While 'hawaiian Airlines Inc." have the least number of flights cancelled.

Cancellation Percentage from Overall Cancell Flights

In [12]:

```
labels = airline_labels
sizes = AIRLINES
fig, axes = plt.subplots(figsize=(20, 10))
explode = (0.1, 0, 0, 0,0,0,0,0,0,0,0,0,0,0)  # explode 1st slice

# Plot
axes.pie(sizes, explode=explode, labels=labels,
autopct='%1.1f%%', shadow=True, startangle=140)

axes.axis('equal')
plt.legend(loc='upper left')
plt.show()
```



Flights Status Of Each Airline

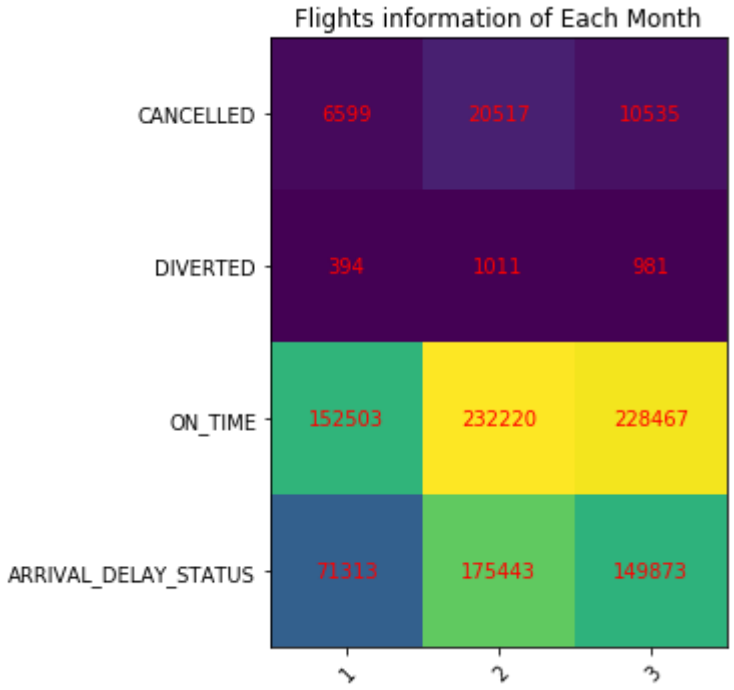
In [13]:

```
features=['CANCELLED','DIVERTED','ON_TIME','ARRIVAL_DELAY_STATUS']
c1=df1.groupby('AIRLINE').CANCELLED.sum()
c2=df1.groupby('AIRLINE').DIVERTED.sum()
c3=df1.groupby('AIRLINE').ON_TIME.sum()
c4=df1.groupby('AIRLINE').ARRIVAL_DELAY_STATUS.sum()
harvest = np.array([c1,c2,c3,c4])
new_indexes=[]
airline_labels=c1.index
for i in range(len(airline_labels)):
      dfb = int(df[df['IATA_CODE']==airline_labels[i]].index[0])
      new_indexes.append(df.AIRLINE[dfb])

airlines=new_indexes
fig, ax = plt.subplots(figsize=(10, 5))
im = ax.imshow(harvest)
# We want to show all ticks...
ax.set_xticks(np.arange(len(airlines)))
ax.set_yticks(np.arange(len(features)))
# ... and label them with the respective list entries
ax.set_xticklabels(airlines)
ax.set_yticklabels(features)
# Rotate the tick labels and set their alignment.
plt.setp(ax.get_xticklabels(), rotation=45,ha="right",
         rotation_mode="anchor")

# Loop over data dimensions and create text annotations.
for i in range(len(features)):
    for j in range(len(airlines)):
        text = ax.text(j, i, harvest[i, j],
                       ha="center", va="center", color="red")

ax.set_title("Flights information of Each Airline")
fig.tight_layout()
plt.show()
```

Flights Status On Monthly Basis

In [14]:

```
  features=['CANCELLED','DIVERTED','ON_TIME','ARRIVAL_DELAY_STATUS']
total_flights=df1["MONTH"].value_counts()
c1=df1.groupby('MONTH').CANCELLED.sum()
c2=df1.groupby('MONTH').DIVERTED.sum()
c3=df1.groupby('MONTH').ON_TIME.sum()
c4=df1.groupby('MONTH').ARRIVAL_DELAY_STATUS.sum()
harvest = np.array([c1,c2,c3,c4])
new_indexes=[]
airline_labels=df1["MONTH"].unique()
#for i in range(len(airline_labels)):
 #     dfb = int(df[df['IATA_CODE']==airline_labels[i]].index[0])
  #    new_indexes.append(df.AIRLINE[dfb])

airlines=airline_labels
fig, ax = plt.subplots(figsize=(10, 5))
im = ax.imshow(harvest)
# We want to show all ticks...
ax.set_xticks(np.arange(len(airlines)))
ax.set_yticks(np.arange(len(features)))
# ... and label them with the respective list entries
ax.set_xticklabels(airlines)
ax.set_yticklabels(features)
# Rotate the tick labels and set their alignment.
plt.setp(ax.get_xticklabels(), rotation=45,ha="right",
         rotation_mode="anchor")

# Loop over data dimensions and create text annotations.
for i in range(len(features)):
    for j in range(len(airlines)):
        text = ax.text(j, i, harvest[i, j],
                       ha="center", va="center", color="red")

ax.set_title("Flights information of Each Month")
fig.tight_layout()
plt.show()
```



In [15]:

```
#df1['DepDate'] = pd.to_datetime(df1.YEAR*10000+df1.MONTH*100+df1.DAY,format='%Y%m%d')
#df1=df1.drop(['YEAR'],axis=1)
#df1=df1.drop(['MONTH'],axis=1)
#df1=df1.drop(['DAY'],axis=1)
```

In [16]:

```
#dups_color = df1.pivot_table(index=['ORIGIN_AIRPORT'], aggfunc='size')
#print(dups_color.index)
#print(type(dups_color))
```

Top 10 Busiest Airports

In [17]:

```
fig, axes = plt.subplots(figsize=(14, 5))
new_indexes=[]
AIRLINES = df1.pivot_table(index=['ORIGIN_AIRPORT'], aggfunc='size')
airlines=AIRLINES.nlargest(10)
airline_labels  = airlines.index
AIRLINES1       = airlines.values
for i in range(len(airline_labels)):

  dfb = int(df2[df2['IATA_CODE']==airline_labels[i]].index[0])
  new_indexes.append(df2.AIRPORT[dfb])
axes.bar(new_indexes, AIRLINES1, align="center", width=0.5, alpha=0.5,color = 'g')
axes.set_ylabel('Number of flights')
axes.set_title('Top 10 Busiest Airports ')
axes.set_xticklabels(new_indexes)
plt.setp(axes.get_xticklabels(),rotation=45,ha='right',rotation_mode='anchor')
```

Out[17]:

```
[None,
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```

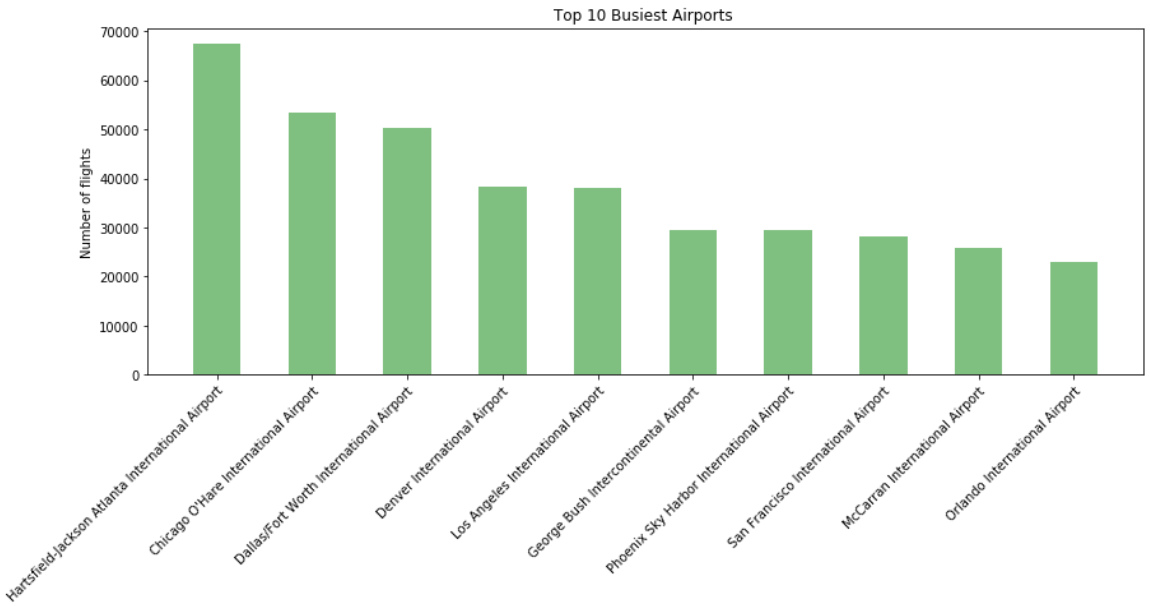

In [ ]:

```
```

In [18]:

```
x=df1['DISTANCE']
y=int(df1['ELAPSED_TIME'].mean(skipna=True))
df1['ELAPSED_TIME'].fillna(y,inplace=True)
y1=df1['ELAPSED_TIME']
```

Top 10 Lest Busiest Airports In 3 Months

In [19]:

```
fig, axes = plt.subplots(figsize=(14, 5))
new_indexes1=[]
AIRLINES = df1.pivot_table(index=['ORIGIN_AIRPORT'], aggfunc='size')
airlines=AIRLINES.nsmallest(10)
airline_labels  = airlines.index
AIRLINES1       = airlines.values
for i in range(len(airline_labels)):
  dfb = (df2[df2['IATA_CODE']==airline_labels[i]].index[0])
  new_indexes1.append(df2.AIRPORT[dfb])
#print(new_indexes1)
axes.bar(new_indexes1, AIRLINES1, align="center", width=0.5, alpha=0.5,color = 'g')
axes.set_ylabel('Number of flights')
axes.set_title('10  least Busiest Airports ')
axes.set_xticklabels(new_indexes1)
plt.setp(axes.get_xticklabels(),rotation=45,ha='right',rotation_mode='anchor')
```

Out[19]:

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[None,
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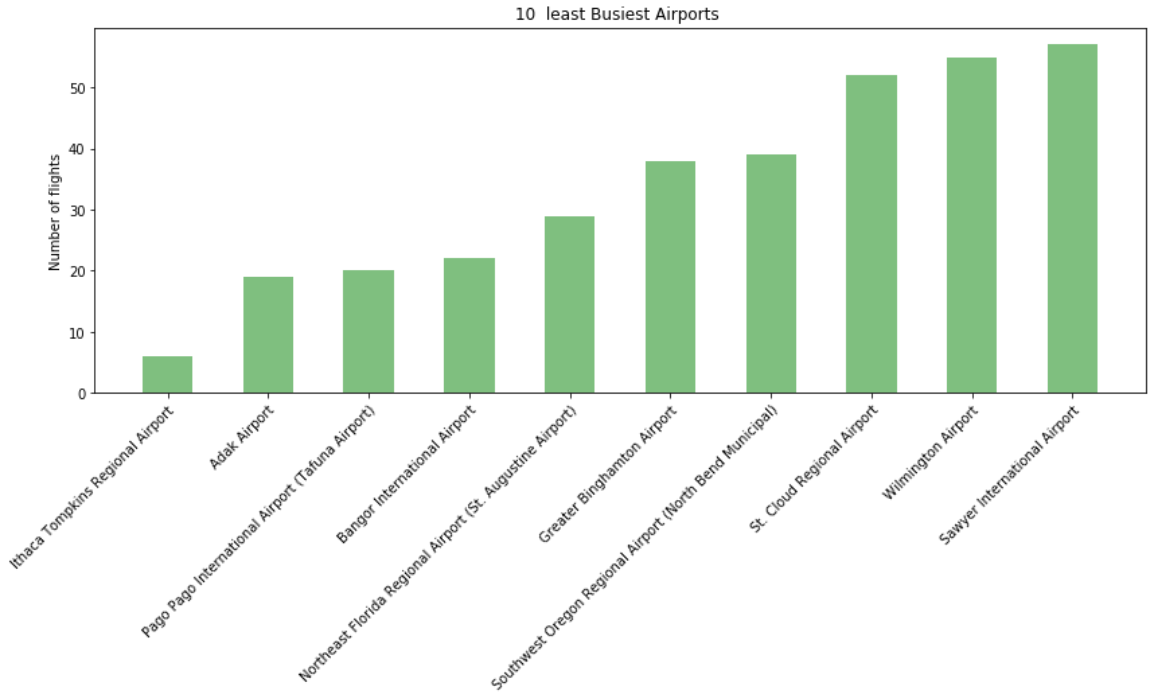
```



Top 10 Airports With Maximum Tax Collection

In [20]:

```
fig, axes = plt.subplots(figsize=(14, 5))
new_indexes=[]
AIRLINES = df1.groupby("ORIGIN_AIRPORT").TAXI_OUT.sum()
AIRLINES1 = df1.groupby("DESTINATION_AIRPORT").TAXI_IN.sum()
sumof_ailines=AIRLINES+AIRLINES1
airlines=sumof_ailines.nlargest(10)
airline_labels  = airlines.index
AIRLINES1       = airlines.values

for i in range(len(airline_labels)):
  dfb = int(df2[df2['IATA_CODE']==airline_labels[i]].index[0])
  new_indexes.append(df2.AIRPORT[dfb])
axes.bar(new_indexes, AIRLINES1, align="center", width=0.5, alpha=0.5,color = 'g')
axes.set_ylabel('Number of flights')
axes.set_title('Top 10 Airports with maximum Tax Collection')
axes.set_xticklabels(new_indexes)
plt.setp(axes.get_xticklabels(),rotation=45,ha='right',rotation_mode='anchor')
```

Out[20]:

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[None,
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```

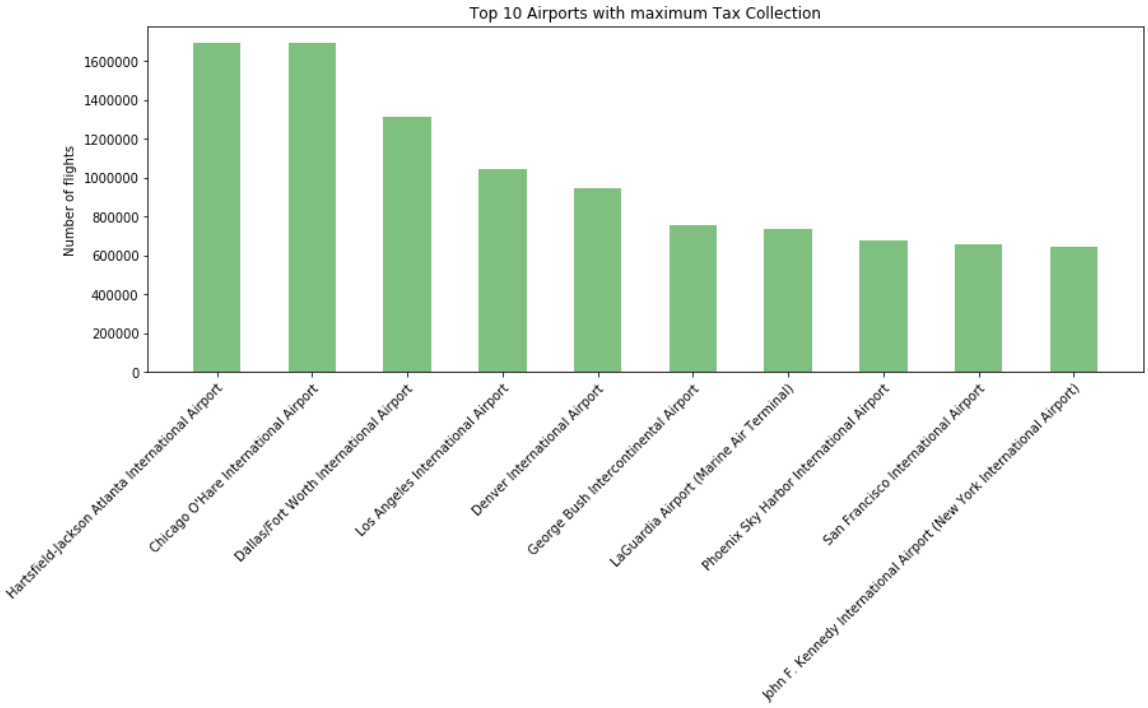

In [21]:

```
df1
```

Out[21]:

	YEAR	MONTH	DAY	DAY_OF_WEEK	AIRLINE	FLIGHT_NUMBER	TAIL_NUMBER
0	2015	1	1	4	AS	98	N407AS
1	2015	1	1	4	AA	2336	N3KUAA
2	2015	1	1	4	US	840	N171US
3	2015	1	1	4	AA	258	N3HYAA
4	2015	1	1	4	AS	135	N527AS
...	...	...	...	...	...	...	...
1048570	2015	3	25	3	AS	695	N767AS
1048571	2015	3	25	3	B6	746	N659JB
1048572	2015	3	25	3	B6	962	N564JB
1048573	2015	3	25	3	B6	1504	N606JB
1048574	2015	3	25	3	DL	2619	N931DN

1048575 rows × 34 columns

Percentage of ON Time flights Of each Airline

In [22]:

```
fig, axes = plt.subplots(figsize=(14, 5))
new_indexes=[]
AIRLINES = df1["AIRLINE"].value_counts()
cancelled=df1.groupby("AIRLINE").ON_TIME.sum().sort_values(ascending = False)
percent=(cancelled/AIRLINES).sort_values(ascending=False)

airline_labels  = percent.index
AIRLINES       =  percent.values
for i in range(len(airline_labels)):
  dfb = int(df[df['IATA_CODE']==airline_labels[i]].index[0])
  new_indexes.append(df.AIRLINE[dfb])
axes.bar(new_indexes, AIRLINES, align="center", width=0.5, alpha=0.5,color = 'g')
axes.set_ylabel(' % of ON TIME FLIGHTS')
axes.set_title('PERCENTAGE OF FLIGHTS ON TIME FOR EACH AIRLINE')
axes.set_xticklabels(new_indexes)
plt.setp(axes.get_xticklabels(),rotation=45,ha='right',rotation_mode='anchor')
```

Out[22]:

```
[None,
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```
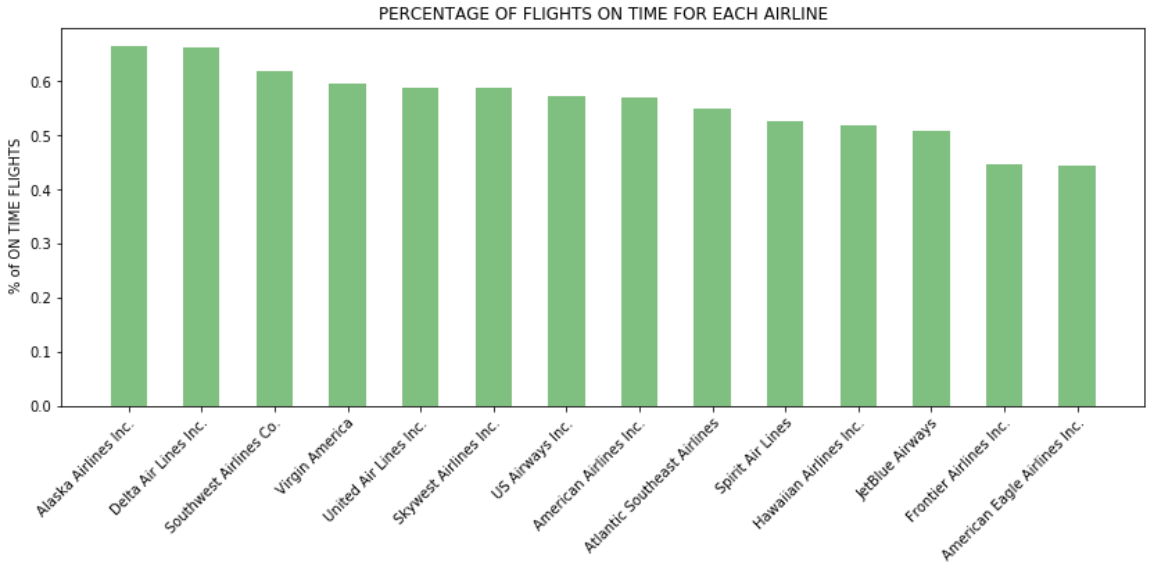



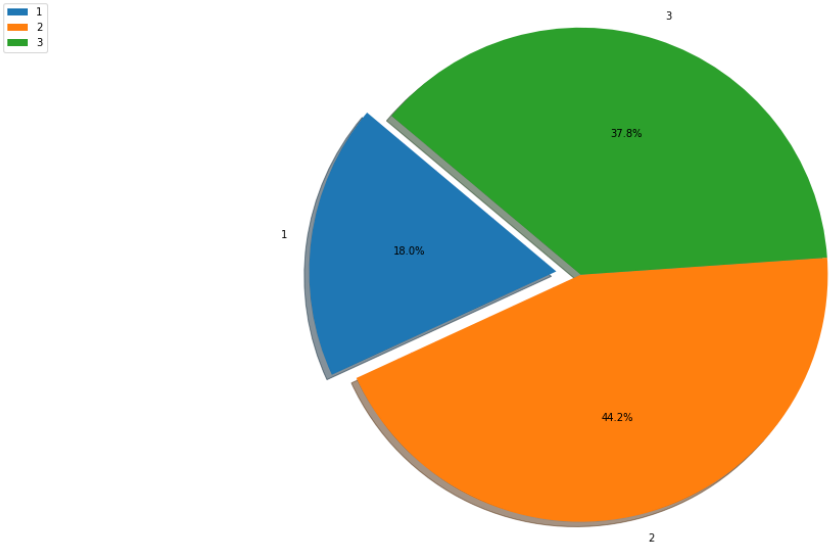
Flights Representation On daily Bases

In [ ]:

OVERAALL DELAY PERCENTAGE IN MONTHS

In [23]:

```
delay=df1.groupby("MONTH").ARRIVAL_DELAY_STATUS.sum()
labels = delay.index
sizes = delay.values
fig, axes = plt.subplots(figsize=(20, 10))
explode = (0.1, 0, 0)  # explode 1st slice

# Plot
axes.pie(sizes, explode=explode, labels=labels,
autopct='%1.1f%%', shadow=True, startangle=140)

axes.axis('equal')
plt.legend(loc='upper left')
plt.show()
```



Average Delay Of Each Airline

In [24]:

```
x=df1.groupby("AIRLINE").ARRIVAL_DELAY.sum()
y=df1["AIRLINE"].value_counts()
z=(x/y).sort_values(ascending=False)
fig, axes = plt.subplots(figsize=(14, 5))
new_indexes=[]
airline_labels  = z.index
AIRLINES       =  z.values
for i in range(len(airline_labels)):
  dfb = int(df[df['IATA_CODE']==airline_labels[i]].index[0])
  new_indexes.append(df.AIRLINE[dfb])
axes.bar(new_indexes, AIRLINES, align="center", width=0.5, alpha=0.5,color = 'g')
axes.set_ylabel(' No of minutes')
axes.set_title('Average Delay FOR EACH AIRLINE')
axes.set_xticklabels(new_indexes)
plt.setp(axes.get_xticklabels(),rotation=45,ha='right',rotation_mode='anchor')
```

Out[24]:

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[None,
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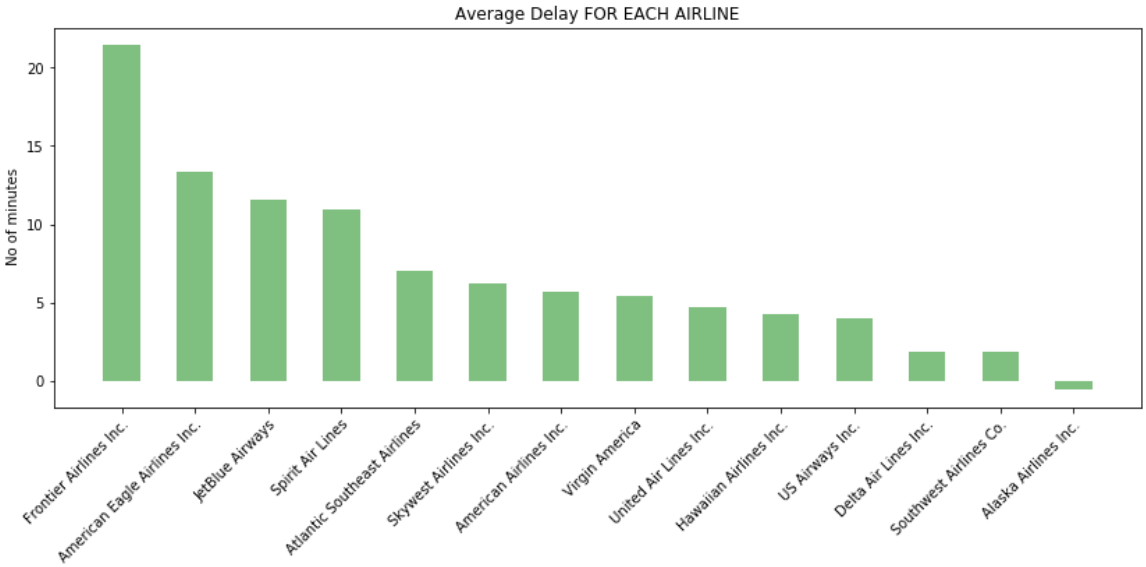
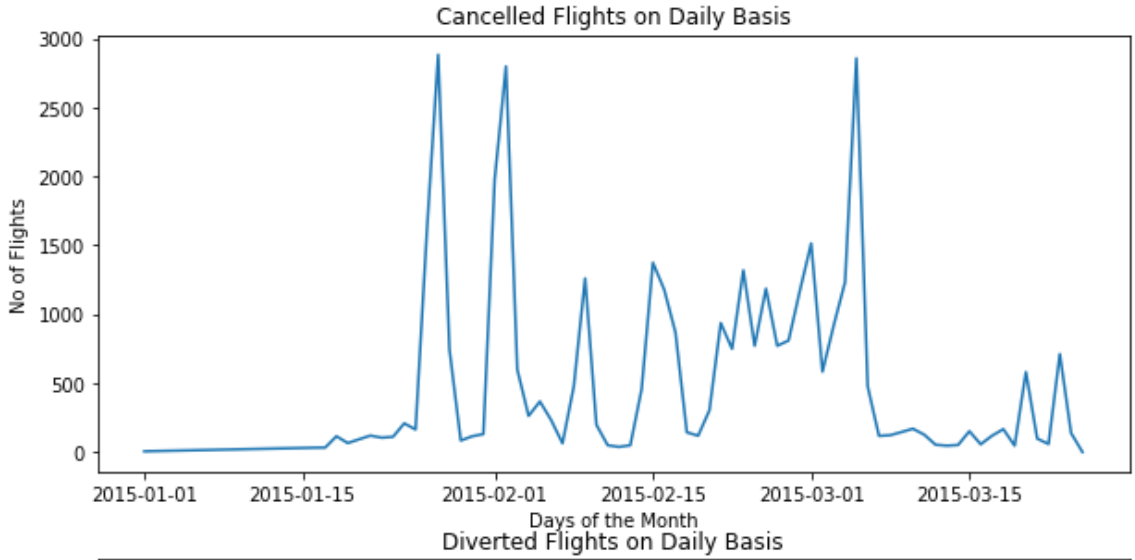


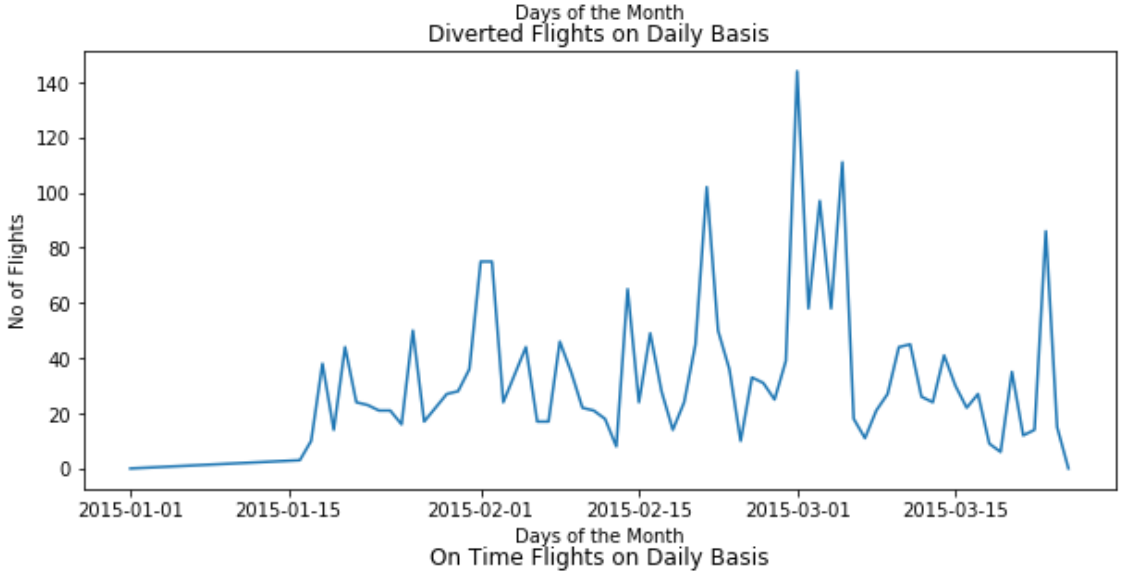
In [25]:

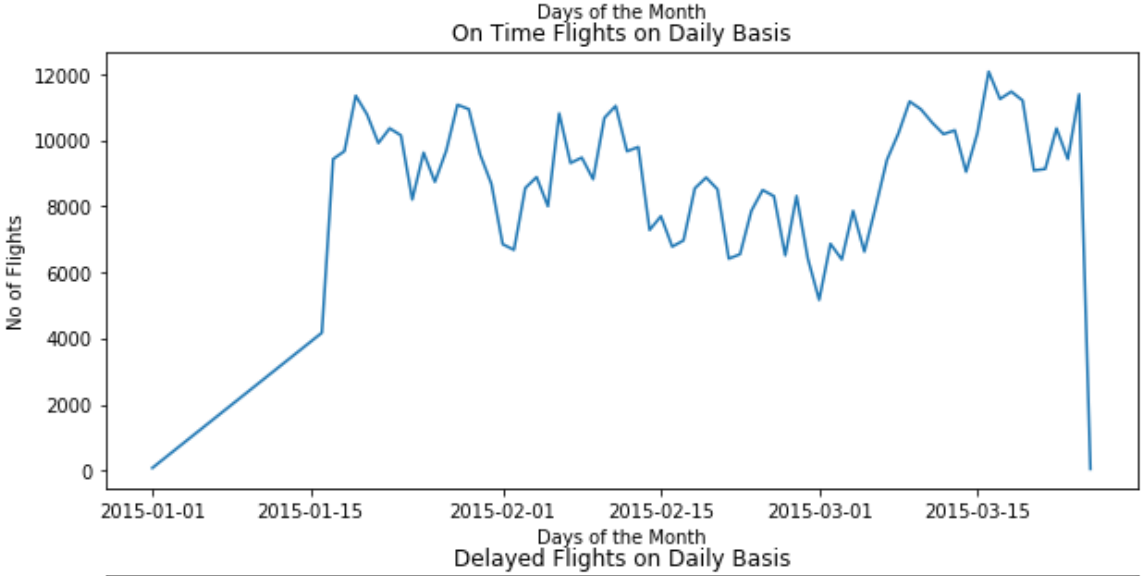
```
df1['DepDate'] = pd.to_datetime(df1.YEAR*10000+df1.MONTH*100+df1.DAY,format='%Y%m%d')
df1=df1.drop(['YEAR'],axis=1)
df1=df1.drop(['MONTH'],axis=1)
df1=df1.drop(['DAY'],axis=1)
```

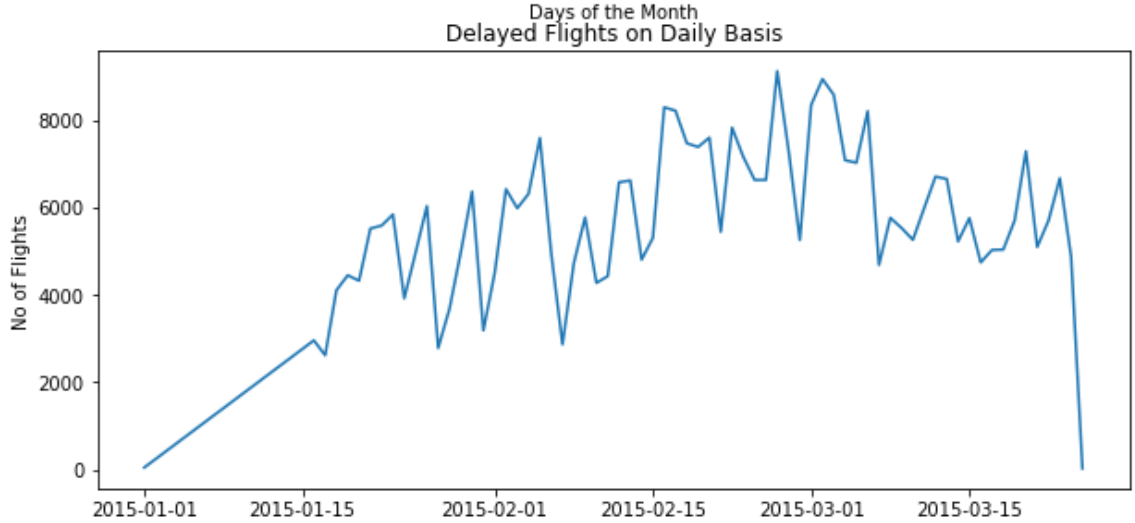
In [26]:

```
diverted=df1.groupby("DepDate").DIVERTED.sum()
on_time=df1.groupby("DepDate").ON_TIME.sum()
arrival_delay=df1.groupby("DepDate").ARRIVAL_DELAY_STATUS.sum()
cancelled=df1.groupby("DepDate").CANCELLED.sum()
index=cancelled.index
values=cancelled.values
fig, axes = plt.subplots(4, 1,figsize=(10,20))
#fig.suptitle('Horizontally stacked subplots')
axes[0].plot(index, cancelled.values)
axes[0].set_title("Cancelled Flights on Daily Basis")
axes[1].plot(index, diverted.values)
axes[1].set_title("Diverted Flights on Daily Basis")
axes[2].plot(index,on_time.values)
axes[2].set_title("On Time Flights on Daily Basis")
axes[3].plot(index,arrival_delay.values)
axes[3].set_title("Delayed Flights on Daily Basis")
for ax in axes.flat:
    ax.set(xlabel='Days of the Month', ylabel='No of Flights')
```


Cancelled Flights on Daily Basis
No of Flights
Days of the Month
2015-01-01
2015-01-15
2015-02-01
2015-02-15
2015-03-01
2015-03-15


Diverted Flights on Daily Basis
No of Flights
Days of the Month
2015-01-01
2015-01-15
2015-02-01
2015-02-15
2015-03-01
2015-03-15


On Time Flights on Daily Basis
No of Flights
Days of the Month
2015-01-01
2015-01-15
2015-02-01
2015-02-15
2015-03-01
2015-03-15


Delayed Flights on Daily Basis
No of Flights
2015-01-01
2015-01-15
2015-02-01
2015-02-15
2015-03-01
2015-03-15

Days of the Month

In [0]:

```

```