Session 11: Missing Data

1. What is a NaN Value?

```
[1]: from numpy import nan      #stands for Not A Number
     nan==3
```

```
False
```

```
[2]: nan!=3
```

```
True
```

```
[3]: nan is nan
```

```
True
```

```
[4]: nan==nan
```

```
False
```

```
[5]: nan+3
```

```
nan
```

```
[6]: 2*nan
```

```
nan
```

```
[7]: sum([nan,3])
```

```
nan
```

```
[8]: import pandas as pd
     pd.Series([nan,3,2]).sum()
```

```
5.0
```

```
[9]: pd.Series([nan,3,2]).sum(skipna=False)
```

```
nan
```

```
[10]: import pandas as pd
      pd.isnull(nan)
      # Opposite is pd.notnull
```

```
True
```

```
[11]: pd.isnull('nan')
```

```
False
```

Q1: Predict the output of the each of the following lines without typing them, and then verify by typing.

```
nan==True
nan==False
nan**2
nan!=nan
pd.isnull('null')
pd.isnull(nan==True)
```

Q2: Explain the output of the following code using your knowledge of NaNs.

```
[12]: df=pd.DataFrame([[nan,10],[50,nan],[nan,20],[20,10]],columns=['Capacity','Demand'])
      df

   Capacity  Demand
0       NaN    10.0
1      50.0     NaN
2       NaN    20.0
3      20.0    10.0

[13]: (df['Capacity']-df['Demand']).sum()

10.0

[15]: df['Capacity'].sum()-df['Demand'].sum()

30.0

[16]: df.sum(axis=0)

Capacity    70.0
Demand      40.0
dtype: float64

[17]: df.sum(axis=1)

0    10.0
1    50.0
2    20.0
3    30.0
dtype: float64

[18]: df.sum(axis=1,skipna=False)

0     NaN
1     NaN
2     NaN
3    30.0
dtype: float64
```

2. Handling Missing Values

Loading the Ebola Dataset

[55]:
```
import pandas as pd
base='https://raw.githubusercontent.com/chendaniely/pandas_for_everyone/master/data/'
filename='country_timeseries.csv'
ebola=pd.read_csv(base+filename)
ebola['Date']=pd.to_datetime(ebola['Date'])
ebola.set_index('Date',inplace=True)
ebola.iloc[:5,:4]
```

Date	Day	Cases_Guinea	Cases_Liberia	Cases_SierraLeone
2015-01-05	289	2776.0	NaN	10030.0
2015-01-04	288	2775.0	NaN	9780.0
2015-01-03	287	2769.0	8166.0	9722.0
2015-01-02	286	NaN	8157.0	NaN
2014-12-31	284	2730.0	8115.0	9633.0

Counting Missing Entries

[56]:
```
ebola.iloc[:5,:4].isnull()
```

Date	Day	Cases_Guinea	Cases_Liberia	Cases_SierraLeone
2015-01-05	False	False	True	False
2015-01-04	False	False	True	False
2015-01-03	False	False	False	False
2015-01-02	False	True	False	True
2014-12-31	False	False	False	False

[21]:
```
ebola.isnull().sum()
```

```
Day                     0
Cases_Guinea           29
Cases_Liberia          39
Cases_SierraLeone      35
Cases_Nigeria          84
Cases_Senegal          97
Cases_UnitedStates    104
Cases_Spain           106
Cases_Mali            110
Deaths_Guinea          30
Deaths_Liberia         41
Deaths_SierraLeone     35
Deaths_Nigeria         84
Deaths_Senegal        100
Deaths_UnitedStates   104
Deaths_Spain          106
Deaths_Mali           110
dtype: int64
```

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

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 122 entries, 2015-01-05 to 2014-03-22
Data columns (total 17 columns):
Day                     122 non-null int64
Cases_Guinea            93 non-null float64
Cases_Liberia           83 non-null float64
Cases_SierraLeone       87 non-null float64
Cases_Nigeria           38 non-null float64
Cases_Senegal           25 non-null float64
Cases_UnitedStates      18 non-null float64
Cases_Spain             16 non-null float64
Cases_Mali              12 non-null float64
Deaths_Guinea           92 non-null float64
Deaths_Liberia          81 non-null float64
Deaths_SierraLeone      87 non-null float64
Deaths_Nigeria          38 non-null float64
Deaths_Senegal          22 non-null float64
Deaths_UnitedStates     18 non-null float64
Deaths_Spain            16 non-null float64
Deaths_Mali             12 non-null float64
dtypes: float64(16), int64(1)
memory usage: 17.2 KB
```

```
[23]: ebola['Deaths_Mali'].count()

12
```

Q3-a: Count the number of missing entries in each column of the `df` DataFrame from Q2.

Q3-b: Write a command to count the number of rows in which the difference between capacity and demand is missing.

Q3-c: Similar to Q3-b, except count the number of rows in which the difference is not missing.

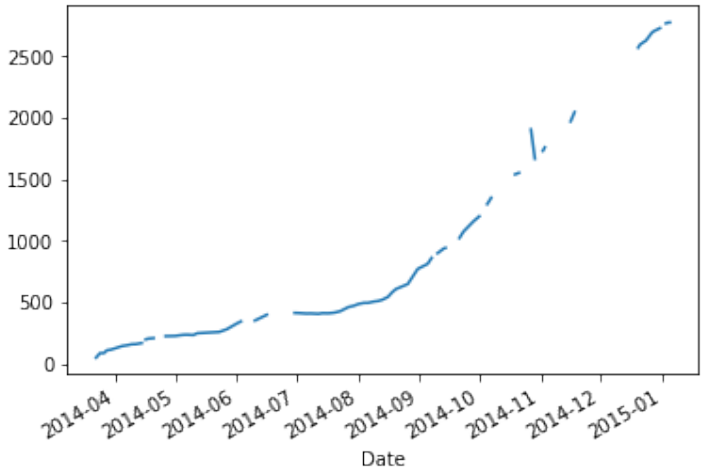
Filling Missing Values

```
[28]: guinea=ebola['Cases_Guinea']
      guinea.head()

Date
2015-01-05    2776.0
2015-01-04    2775.0
2015-01-03    2769.0
2015-01-02       NaN
2014-12-31    2730.0
Name: Cases_Guinea, dtype: float64
```

```
[54]: guinea.plot()

<matplotlib.axes._subplots.AxesSubplot at 0x7fa12ce670f0>
```

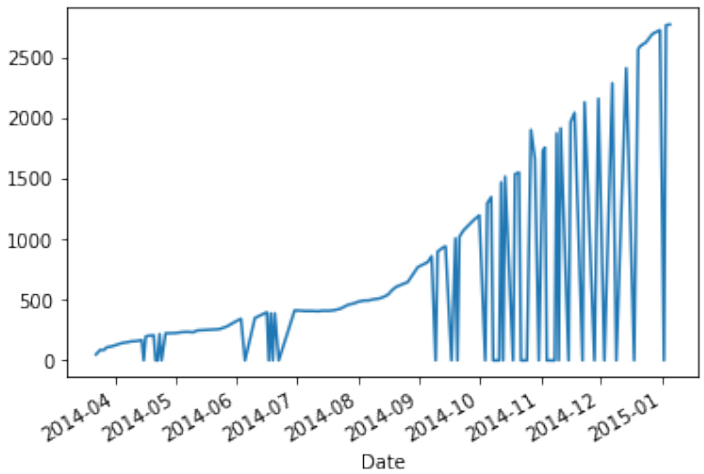


[30]: guinea.fillna(0).head()

```
Date
2015-01-05    2776.0
2015-01-04    2775.0
2015-01-03    2769.0
2015-01-02       0.0
2014-12-31    2730.0
Name: Cases_Guinea, dtype: float64
```

[31]: guinea.fillna(0).plot()

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fa12ced2d68>
```

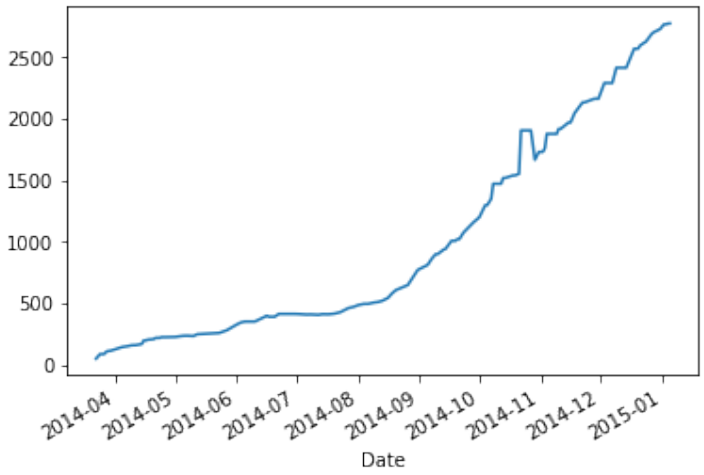


[32]: guinea.fillna(method='ffill').head()

```
Date
2015-01-05    2776.0
2015-01-04    2775.0
2015-01-03    2769.0
2015-01-02    2769.0
2014-12-31    2730.0
Name: Cases_Guinea, dtype: float64
```

```
[33]: guinea.fillna(method='ffill').plot()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fa12ce43438>
```




```
[34]: guinea.fillna(method='bfill').head()
```

```
Date
2015-01-05    2776.0
2015-01-04    2775.0
2015-01-03    2769.0
2015-01-02    2730.0
2014-12-31    2730.0
Name: Cases_Guinea, dtype: float64
```

```
[35]: guinea.interpolate().head()
```

```
Date
2015-01-05    2776.0
2015-01-04    2775.0
2015-01-03    2769.0
2015-01-02    2749.5
2014-12-31    2730.0
Name: Cases_Guinea, dtype: float64
```

```
[36]: df
```

```
   Capacity  Demand
0       NaN    10.0
1      50.0     NaN
2       NaN    20.0
3      20.0    10.0
```

```
[37]: df['Capacity'].fillna(df['Demand'])
```

```
0    10.0
1    50.0
2    20.0
3    20.0
Name: Capacity, dtype: float64
```

```
[38]: df.dropna()
```

```
   Capacity  Demand
3      20.0    10.0
```

```
[39]: df['Capacity'].first_valid_index()
```

```
1
```

```
[40]: df['Capacity'].last_valid_index()
```

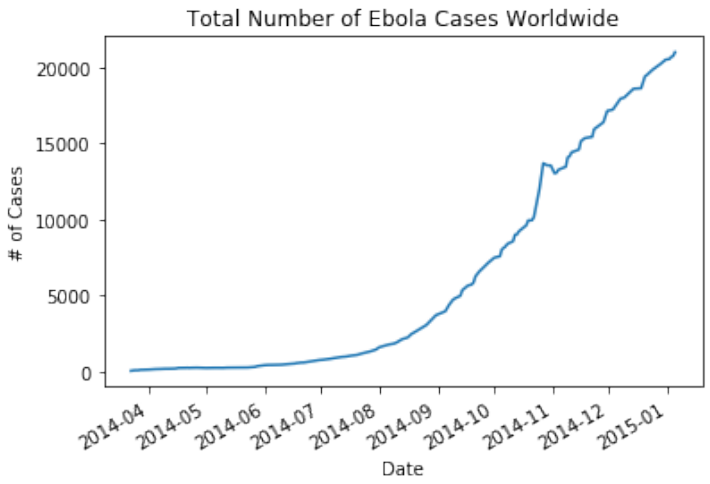
```
3
```

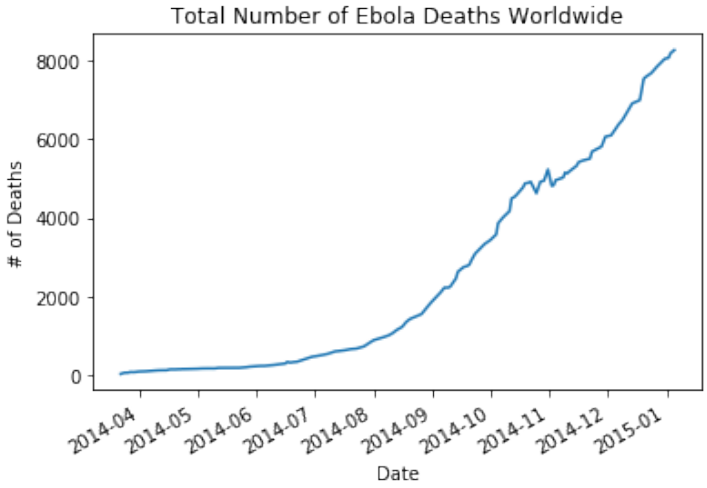
Q4-a: An analyst would like to calculate the average value of the "Cases_Guinea" column of the the ebola Dataset. The analyst runs the below command. Explain why this result might be misleading.

Q4-b: Write a command that corrects the above issue.

Q5: Plot the total number of cases and the total number of deaths due to Ebola in the data set from all of the countries, while handling missing data appropriately.

```
[45]:
```





Q6: Obtain the first non-null value of the column "Cases_UnitedStates", as well as the date on which this is recorded. (Since the dates are ordered backward, this is the last recorded value and the last recorded date). Do the same also for the last non-null value of the column.

Q7: Based on the information in the dataset, obtain an estimate of the number of cases of ebola in each of the countries in the dataset on Jan 5, 2015. Appropriately display the information in a pie chart.

[50]:

```
Cases_Guinea           2776.0
Cases_Liberia          8166.0
Cases_SierraLeone     10030.0
Cases_Nigeria            20.0
Cases_Senegal             1.0
Cases_UnitedStates        4.0
Cases_Spain               1.0
Cases_Mali                7.0
Name: 2015-01-05 00:00:00, dtype: float64
```

[51]: