Data Analysis, Visualization and Interpretation

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```
#load file
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.moun
```

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

```
#load real estate sales dataset
df_real_estate_sales = pd.read_csv("/content/drive/My Drive/Data Science with Python Spring20
```

```
## Summarize Data

# Descriptive statistics
# shape
print(df_real_estate_sales.shape)
# types
print(df_real_estate_sales.dtypes)
# head
print(df_real_estate_sales.head(20))
```

```
(145987, 11)
ID                  int64
SerialNumber        int64
ListYear            int64
DateRecorded       object
Town               object
Address            object
AssessedValue       int64
SaleAmount        float64
SalesRatio        float64
PropertyType       object
ResidentialType    object
dtype: object
    ID  SerialNumber  ListYear  ... SalesRatio PropertyType ResidentialType
0    1         14046      2014  ...   0.142933  Vacant Land             NaN
1    2         14011      2014  ...   0.805789  Residential   Single Family
2    3         15006      2015  ...   2.058000  Residential   Single Family
3    4         14044      2014  ...   0.846784  Residential   Single Family
4    5         14035      2014  ...   0.713043  Residential   Single Family
5    6         15051      2015  ...   0.833628  Residential   Single Family
6    7         14002      2014  ...   1.862500  Residential   Single Family
7    8         15011      2015  ...   0.640433  Residential   Single Family
8    9         14043      2014  ...   4.763636  Residential   Single Family
9   10         14029      2014  ...   7.807220  Residential   Single Family
10  11         14024      2014  ...   0.832827  Residential   Single Family
11  12         14030      2014  ...   0.653333  Vacant Land             NaN
12  13         15024      2015  ...   0.539200  Residential   Single Family
13  14         14023      2014  ...   0.666667  Residential   Single Family
14  15         15038      2015  ...   1.392784  Residential   Single Family
15  16         14037      2014  ...   0.656044  Residential   Single Family
16  17         15026      2015  ...   0.833333  Residential   Single Family
17  18         15029      2015  ...   0.675780  Residential   Single Family
18  19         14008      2014  ...   0.880658  Vacant Land             NaN
19  20         15004      2015  ...   0.764286  Vacant Land             NaN

[20 rows x 11 columns]
```

```
#load list of towns dataset
df_list_of_towns = pd.read_csv("/content/drive/My Drive/Data Science with Python Spring2020/w
```

```
## Summarize Data

# Descriptive statistics
# shape
print(df_list_of_towns.shape)
# types
print(df_list_of_towns.dtypes)
# head
print(df_list_of_towns.head(20))
```

```
(169, 7)
Number                       int64
Town                        object
Designation                 object
Established Year             int64
Land area (square miles)   float64
Population (in 2010)        object
County                      object
dtype: object
    Number          Town  ... Population (in 2010)            County
0        1       Andover  ...                3,303    Tolland County
1        2       Ansonia  ...               19,249  New Haven County
2        3       Ashford  ...                4,100    Windham County
3        4          Avon  ...               18,098   Hartford County
4        5   Barkhamsted  ...                3,620 Litchfield County
5        6  Beacon Falls  ...                6,049  New Haven County
6        7        Berlin  ...               19,866   Hartford County
7        8       Bethany  ...                5,563  New Haven County
8        9        Bethel  ...               18,584  Fairfield County
9       10     Bethlehem  ...                3,607 Litchfield County
10      11    Bloomfield  ...               20,486   Hartford County
11      12        Bolton  ...                4,980    Tolland County
12      13        Bozrah  ...                2,627 New London County
13      14      Branford  ...               28,026  New Haven County
14      15    Bridgeport  ...              144,229  Fairfield County
15      16   Bridgewater  ...                1,727 Litchfield County
16      17       Bristol  ...               60,477   Hartford County
17      18    Brookfield  ...               16,452  Fairfield County
18      19      Brooklyn  ...                8,210    Windham County
19      20    Burlington  ...                9,301   Hartford County

[20 rows x 7 columns]
```

```
# merge List of Towns file and Real Estate Sales file
df_result = pd.merge(df_real_estate_sales,
                    df_list_of_towns,
                    on='Town')


#find missing values
missing_values = df_result.isnull().sum(axis=0)
missing_values
```

```
ID                              0
SerialNumber                    0
ListYear                        0
DateRecorded                    6
Town                            0
Address                         2
AssessedValue                   0
SaleAmount                   5283
SalesRatio                      0
PropertyType                    0
ResidentialType             11905
Number                          0
Designation                     0
Established Year                0
Land area (square miles)        0
Population (in 2010)            0
County                          0
dtype: int64
```

```
#Replacing missing date recorded data with the corresponding year in ListYear column.
#df_result['DateRecorded'] = df_result['DateRecorded'].astype(str)
df_result['DateRecorded'].fillna('1/1/2014', inplace = True)
missing_values = df_result.isnull().sum(axis=0)
missing_values
```

```
ID                              0
SerialNumber                    0
ListYear                        0
DateRecorded                    0
Town                            0
Address                         2
AssessedValue                   0
SaleAmount                   5283
SalesRatio                      0
PropertyType                    0
ResidentialType             11905
Number                          0
Designation                     0
Established Year                0
Land area (square miles)        0
Population (in 2010)            0
County                          0
dtype: int64
```

```
#Replacing missing Sales Amount data with the corresponding assessed value column
df_result['SaleAmount'].fillna(df_result['AssessedValue'], inplace = True)
missing_values = df_result.isnull().sum(axis=0)
missing_values
```

```
ID                          0
SerialNumber                0
ListYear                    0
DateRecorded                0
Town                        0
Address                     2
AssessedValue               0
SaleAmount                  0
SalesRatio                  0
PropertyType                0
ResidentialType         11905
Number                      0
Designation                 0
Established Year            0
Land area (square miles)    0
Population (in 2010)        0
County                      0
dtype: int64
```

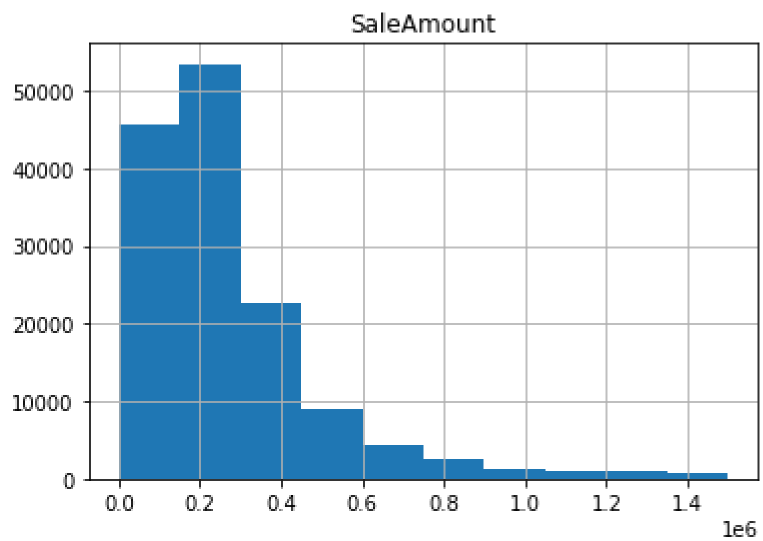
```
#Make a column “Property Value”
#Binning AssessedValue given the conditions:
#'LowRange' if Assessed Value <=300,000
#'MidRange' if Assessed Value >300,000 and <=800,000
#'HighRange' if Assessed Value >800,000
df_result['Property Value'] = pd.cut(df_result['AssessedValue'], bins=[-100000,300000,800000,
df_result.groupby('Property Value').size()
```

```
Property Value
LowRange     120076
MidRange      19486
HighRange      6425
dtype: int64
```

```
#removing , from population
df_result['Population (in 2010)'] = df_result['Population (in 2010)'].str.replace(',','')
df_result['Population (in 2010)'] = df_result['Population (in 2010)'].astype(int)

#descriptive statistics
df_result.describe()
```

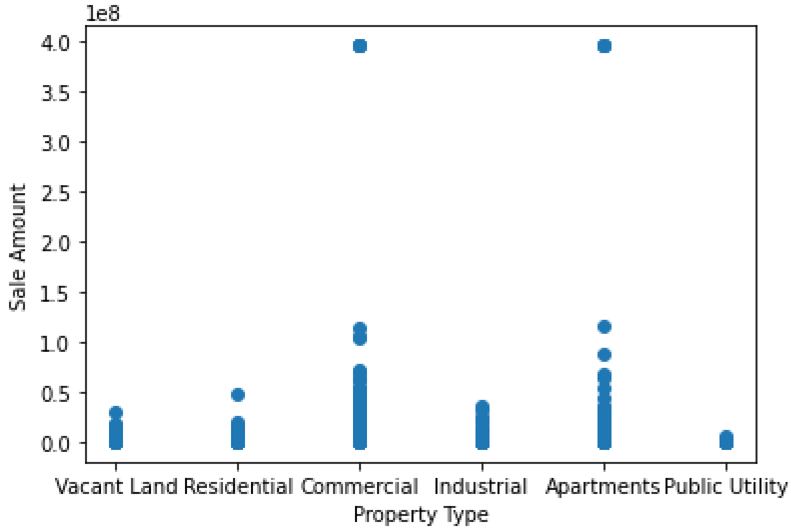
	ID	SerialNumber	ListYear	AssessedValue	SaleAmount	SalesR
count	145987.000000	1.459870e+05	145987.000000	1.459870e+05	1.459870e+05	145987.00
mean	72994.000000	2.645845e+05	2015.001438	3.105082e+05	4.119349e+05	2.43
std	42142.961211	1.174402e+06	0.824892	1.546245e+06	3.376906e+06	51.83
min	1.000000	1.610000e+02	2014.000000	0.000000e+00	0.000000e+00	0.00
25%	36497.500000	1.401250e+05	2014.000000	1.038650e+05	1.289000e+05	0.61
50%	72994.000000	1.501020e+05	2015.000000	1.547000e+05	2.150000e+05	0.70
75%	109490.500000	1.601300e+05	2016.000000	2.434600e+05	3.500000e+05	0.88
max	145987.000000	1.400028e+08	2016.000000	1.389588e+08	3.955000e+08	4516.08

```
#Data visualization for Sales Amount using histogram
subData_SA = df_result[df_result['SaleAmount']<1500000]
subData_SA.hist('SaleAmount')
plt.show()

##########################################
#most of the sales are less 1500000
```

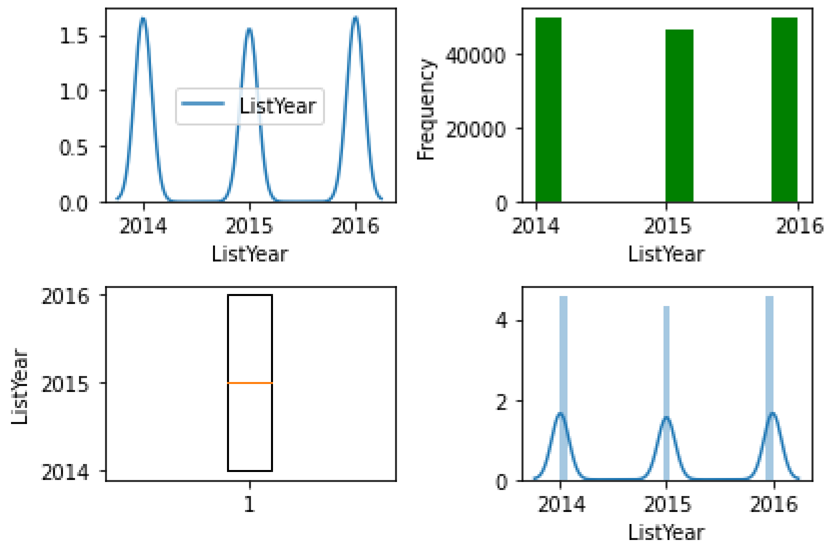



```
#Data visualization for Property Type and Sale Amount using scatter plot
plt.scatter(df_result.PropertyType,df_result.SaleAmount)
plt.xlabel('Property Type')
plt.ylabel('Sale Amount')

###################################################
# We can observe huge variation in the prices for ‘Commercial’ and ‘Apartments’ property type
```

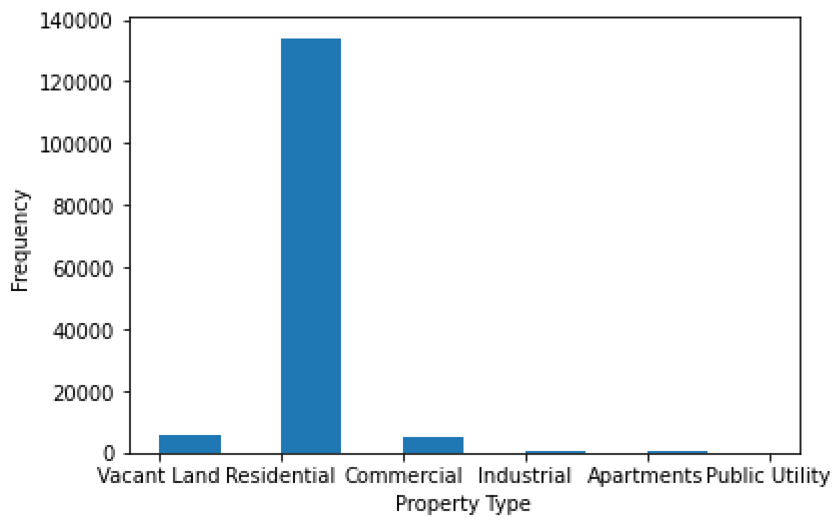
```
Text(0, 0.5, 'Sale Amount')
```




```
#Data visualization for list year using box plot, histogram, density plot
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns

#2 rows and 2columns
fig, ax = plt.subplots(2,2)

#density plot for ListYear
sns.kdeplot(df_result.ListYear,
            ax=ax[0,0])
ax[0,0].set_xlabel('ListYear')

#histogram for ListYear
ax[0,1].hist(df_result.ListYear, color='green')
ax[0,1].set_xlabel('ListYear')
ax[0,1].set_ylabel('Frequency')

#boxplot for ListYear
ax[1,0].boxplot(df_result.ListYear)
ax[1,0].set_ylabel('ListYear')

#overlapping density plot and histogram for ListYear
sns.distplot(df_result.ListYear,ax=ax[1,1])

fig.tight_layout()
plt.show()
```



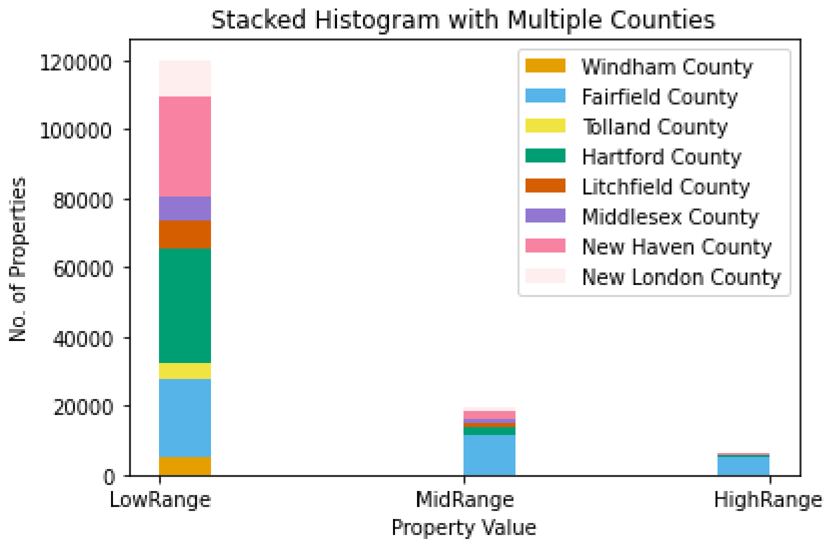

```
#Data visualization for Property Type using Bar Graph
plt.hist(df_result.PropertyType)
plt.xlabel('Property Type')
plt.ylabel('Frequency')
plt.show()
```



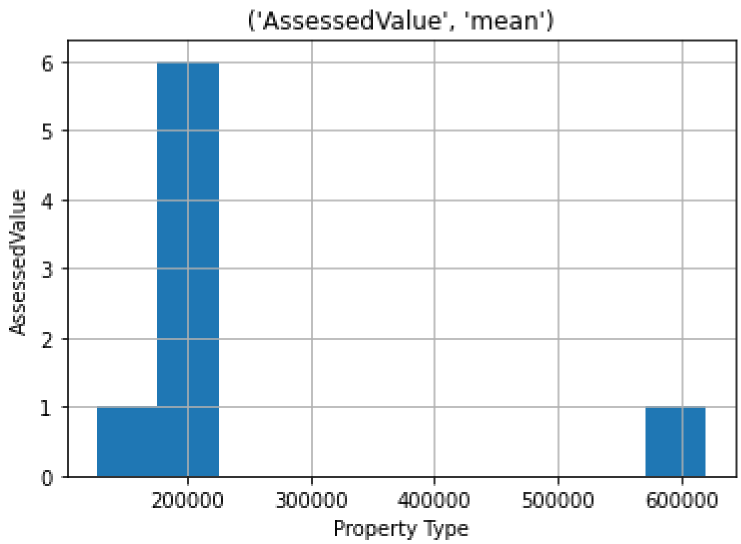

```
# Data visualization for County using histogram
x1 = list(df_result[df_result['County'] == 'Windham County']['Property Value'])
x2 = list(df_result[df_result['County'] == 'Fairfield County']['Property Value'])
x3 = list(df_result[df_result['County'] == 'Tolland County']['Property Value'])
x4 = list(df_result[df_result['County'] == 'Hartford County']['Property Value'])
x5 = list(df_result[df_result['County'] == 'Litchfield County']['Property Value'])
x6 = list(df_result[df_result['County'] == 'Middlesex County']['Property Value'])
x7 = list(df_result[df_result['County'] == 'New Haven County']['Property Value'])
x8 = list(df_result[df_result['County'] == 'New London County']['Property Value'])

#assigning colours and names
colors = ['#E69F00', '#56B4E9', '#F0E442','#009E73', '#D55E00', '#9177D2', '#F882A1', '#FFEEE
```

```
#Text(0, 0.5, 'Frequency')
names = ['Windham County','Fairfield County','Tolland County','Hartford County','Litchfield C

#plotting stacked histogram
plt.hist([x1, x2, x3, x4, x5, x6, x7, x8], bins = int(180/15), stacked=True, color=colors,lab
plt.legend()
plt.xlabel('Property Value')
plt.ylabel('No. of Properties')
plt.title('Stacked Histogram with Multiple Counties')

##########################################################################
#Fairfield has the maximum number of High range properties. Owning properties in the Fairfiel
#New Haven County has maximum Low range properties
```

```
Text(0.5, 1.0, 'Stacked Histogram with Multiple Counties')
```




```
#Frequency table based on the average Assessed value of properties in each County
subdataAV = df_result.groupby('County').agg({'AssessedValue': ['mean']})

#Data visualization for Assessed value of County using histogram
subdataAV.hist()
plt.xlabel('Property Type')
plt.ylabel('AssessedValue')
plt.show()

################################################################
# Owning properties in the Fairfield county is most profitable as they have the highest avera
```




```
df_result.dtypes
```

```
ID                           int64
SerialNumber                 int64
ListYear                     int64
DateRecorded                object
Town                        object
Address                     object
AssessedValue                int64
SaleAmount                 float64
SalesRatio                 float64
PropertyType                object
ResidentialType             object
Number                       int64
Designation                 object
Established Year             int64
Land area (square miles)   float64
Population (in 2010)         int64
County                      object
Property Value            category
dtype: object
```

```
#Frequency table based on the count of properties sold in each year.
df_result.groupby('ListYear').size()

#################################
#Among 2014, 2015, 2016- 2016 has highest sales
```

```
ListYear
2014    49563
2015    46651
2016    49773
dtype: int64
```

```
#Frequency table based on the average sale amount and land area of properties in each propert
subdataRT = df_result.groupby('PropertyType').agg({'SaleAmount': ['mean'],'Land area (square
```

```
subdataRT

################################################################
#Average sales amount for apartments was highest
#Public Utility covers minimum land area
```

	SaleAmount	Land area (square miles)
	mean	mean
PropertyType		
Apartments	3.904337e+06	24.627549
Commercial	1.898054e+06	27.566583
Industrial	1.445131e+06	28.319151
Public Utility	7.433107e+05	22.816923
Residential	3.372912e+05	28.550319
Vacant Land	2.233891e+05	31.640937

```
# multidimensional frequency table using the dataset based on Town, County and list year.
freq_table = pd.DataFrame(pd.crosstab([df_result.County, df_result.Town],
                   df_result.ListYear, margins=True))
freq_table
```

	ListYear	2014	2015	2016	All
County	Town				
Fairfield County	**Bethel**	356	370	352	1078
	Bridgeport	1741	0	1953	3694
	Brookfield	338	346	0	684
	Danbury	1013	1127	1156	3296
	Darien	453	345	408	1206
...	**...**	...	...	...	...
Windham County	**Sterling**	63	82	88	233
	Thompson	0	216	227	443
	Windham	277	317	335	929
	Woodstock	156	197	0	353
All		49563	46651	49773	145987

170 rows × 4 columns

```
#‘Property value’ based on the percentages of the row and an overall total of properties in e
freq_table_prop_value = pd.crosstab(index=df_result['Property Value'],
```

```
            columns="Number", margins=True, margins_name='Total')
freq_table_prop_value

freq_table_prop_value.columns=['Count','Total']
freq_table_prop_value.index=['LowRange','MidRange','HighRange','ColumnTotal']
freq_table_prop_value

freq_table_prop_value = (freq_table_prop_value/freq_table_prop_value.loc['ColumnTotal','Total
freq_table_prop_value

#################################################################
#Low range properties constitute 82.25% of total properties sold
```

	Count	Total
LowRange	82.251159	82.251159
MidRange	13.347764	13.347764
HighRange	4.401077	4.401077
ColumnTotal	100.000000	100.000000