Task 1

August 16, 2023

1 Task 1 - Graduate Admissions

2 Problem Statement

Based on the historical data of admitted students in the university, the chance of current students admission will be predicted using machine learning algorithms.

2.1 Importing required libraries

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline

import warnings
warnings.filterwarnings('ignore')

from sklearn.model_selection import train_test_split

from sklearn.linear_model import LinearRegression as LR

from sklearn.metrics import mean_absolute_error as mae, r2_score,␣
↪mean_squared_error, mean_absolute_error

from math import sqrt
```

2.2 Loading the csv file

[2]:
```
df=pd.read_csv("Admission_Predict_Ver1.1.csv")
```

[3]:
```
df.sample(5)
```

[3]:
```
     Serial No.  GRE Score  TOEFL Score  University Rating  SOP  LOR   CGPA  \
474         475        308          105                  4  3.0   2.5  7.95
317         318        300           99                  1  1.0   2.5  8.01
276         277        329          113                  5  5.0   4.5  9.45
331         332        311          105                  2  3.0   2.0  8.12
```

```
169         170        311           99                  2  2.5    3.0  7.98

     Research  Chance of Admit
474         1              0.67
317         0              0.58
276         1              0.89
331         1              0.73
169         0              0.65
```

[4]:
```
df.columns
```

[4]:
```
Index(['Serial No.', 'GRE Score', 'TOEFL Score', 'University Rating', 'SOP',
       'LOR ', 'CGPA', 'Research', 'Chance of Admit '],
      dtype='object')
```

[5]:
```
df.shape
```

[5]:
```
(500, 9)
```

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 500 entries, 0 to 499
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Serial No.         500 non-null    int64
 1   GRE Score          500 non-null    int64
 2   TOEFL Score        500 non-null    int64
 3   University Rating  500 non-null    int64
 4   SOP                500 non-null    float64
 5   LOR                500 non-null    float64
 6   CGPA               500 non-null    float64
 7   Research           500 non-null    int64
 8   Chance of Admit    500 non-null    float64
dtypes: float64(4), int64(5)
memory usage: 35.3 KB
```

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

[7]:
```
       Serial No.   GRE Score  TOEFL Score  University Rating         SOP  \
count  500.000000  500.000000   500.000000         500.000000  500.000000
mean   250.500000  316.472000   107.192000           3.114000    3.374000
std    144.481833   11.295148     6.081868           1.143512    0.991004
min      1.000000  290.000000    92.000000           1.000000    1.000000
25%    125.750000  308.000000   103.000000           2.000000    2.500000
50%    250.500000  317.000000   107.000000           3.000000    3.500000
75%    375.250000  325.000000   112.000000           4.000000    4.000000
```

```
max    500.000000  340.000000   120.000000           5.000000     5.000000

             LOR        CGPA    Research  Chance of Admit
count  500.00000  500.000000  500.000000        500.00000
mean     3.48400    8.576440    0.560000          0.72174
std      0.92545    0.604813    0.496884          0.14114
min      1.00000    6.800000    0.000000          0.34000
25%      3.00000    8.127500    0.000000          0.63000
50%      3.50000    8.560000    1.000000          0.72000
75%      4.00000    9.040000    1.000000          0.82000
max      5.00000    9.920000    1.000000          0.97000
```

2.3 Missing values

[8]:
```python
df.isnull().sum()
```

[8]:
```
Serial No.           0
GRE Score            0
TOEFL Score          0
University Rating    0
SOP                  0
LOR                  0
CGPA                 0
Research             0
Chance of Admit      0
dtype: int64
```

[9]:
```python
df.duplicated().sum()
```

[9]:
```
0
```

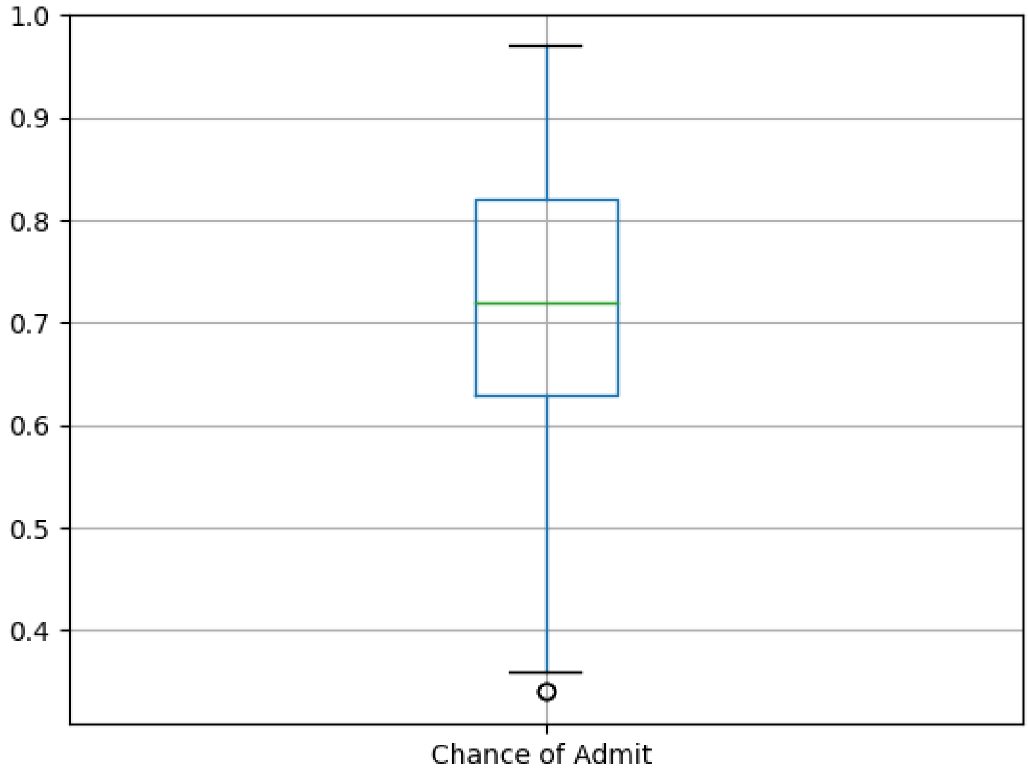
2.4 Creating a copy and removing the Sl.No column

[10]:
```python
df1=df.copy()
df1.drop(['Serial No.'],axis=1,inplace=True)
```

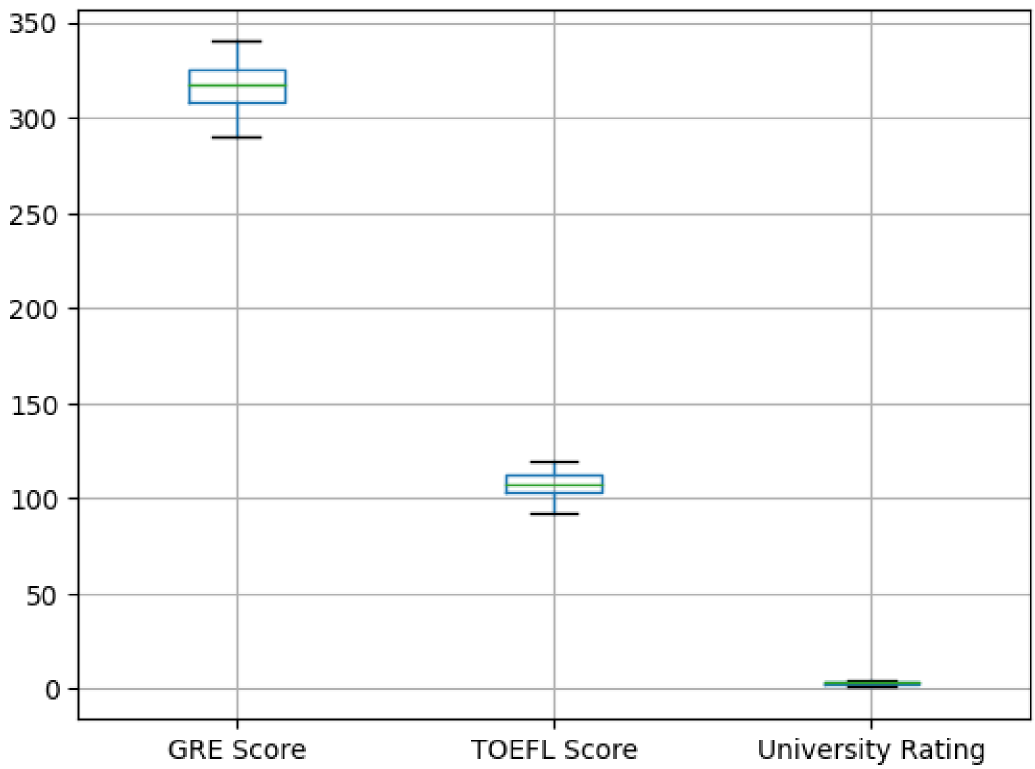
There are no missing and duplicated values in the dataset

2.5 Identifying & Removing outliers

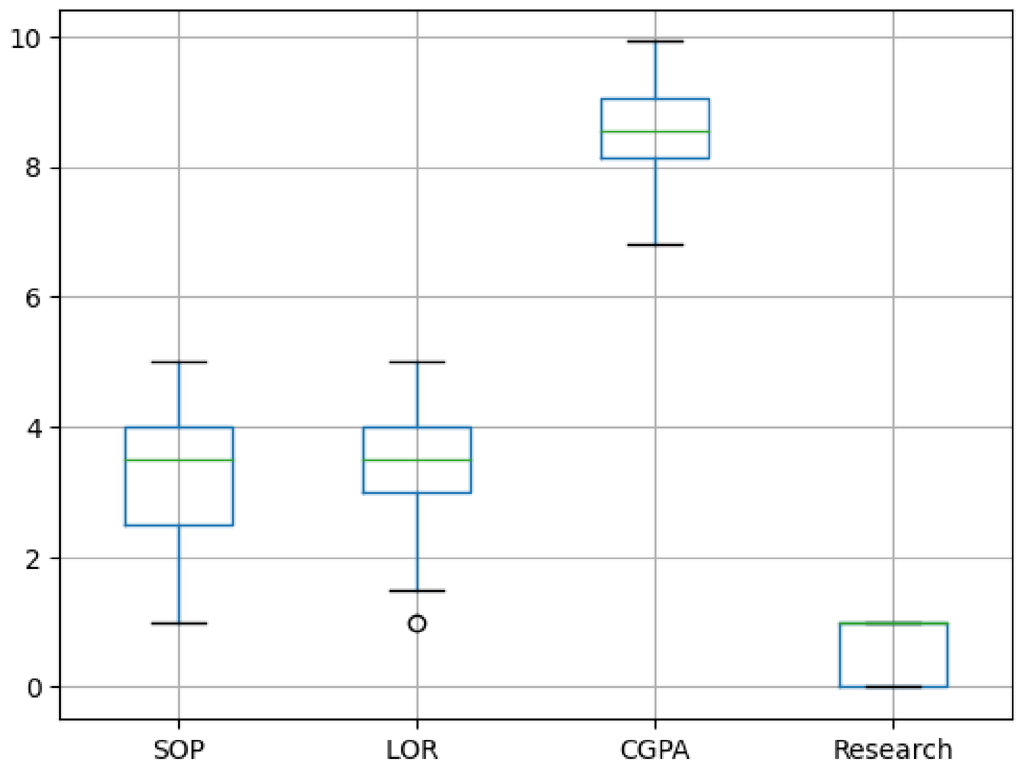
[11]:
```python
df1.boxplot(column=['Chance of Admit '])
plt.show()
```



[12]:
```
df1.boxplot(column=['GRE Score', 'TOEFL Score', 'University Rating'])
plt.show()
```



[13]:
```
df1.boxplot(column=['SOP','LOR ', 'CGPA', 'Research'])
plt.show()
```



As we can see there are outliers in chance of admit & LOR columns.

[14]:
```
Q1=df1.quantile(0.25)
Q3=df1.quantile(0.75)
IQR=Q3-Q1
IQR
```

[14]:
```
GRE Score            17.0000
TOEFL Score           9.0000
University Rating     2.0000
SOP                   1.5000
LOR                   1.0000
CGPA                  0.9125
Research              1.0000
Chance of Admit       0.1900
dtype: float64
```

[15]:
```
#upper limit
UL=Q3+IQR*1.5
print(UL)

#lower limit
LL=Q1-IQR*1.5
```

```
print(LL)
```

```
GRE Score            350.50000
TOEFL Score          125.50000
University Rating      7.00000
SOP                    6.25000
LOR                    5.50000
CGPA                  10.40875
Research               2.50000
Chance of Admit        1.10500
dtype: float64
GRE Score            282.50000
TOEFL Score           89.50000
University Rating     -1.00000
SOP                    0.25000
LOR                    1.50000
CGPA                   6.75875
Research              -1.50000
Chance of Admit        0.34500
dtype: float64
```

[16]:
```
df_outliers_removed=df1[(df1>LL) & (df1<UL)]
df_outliers_removed
```

[16]:
```
     GRE Score  TOEFL Score  University Rating  SOP  LOR   CGPA  Research  \
0          337          118                  4  4.5   4.5  9.65         1
1          324          107                  4  4.0   4.5  8.87         1
2          316          104                  3  3.0   3.5  8.00         1
3          322          110                  3  3.5   2.5  8.67         1
4          314          103                  2  2.0   3.0  8.21         0
..         …            …                 …  …   …    …         …
495        332          108                  5  4.5   4.0  9.02         1
496        337          117                  5  5.0   5.0  9.87         1
497        330          120                  5  4.5   5.0  9.56         1
498        312          103                  4  4.0   5.0  8.43         0
499        327          113                  4  4.5   4.5  9.04         0

     Chance of Admit
0               0.92
1               0.76
2               0.72
3               0.80
4               0.65
..               …
495             0.87
496             0.96
497             0.93
498             0.73
```

```
499              0.84

[500 rows x 8 columns]
```

[17]:
```
df_outliers_removed.isnull().sum()
```

[17]:
```
GRE Score             0
TOEFL Score           0
University Rating     0
SOP                   0
LOR                  12
CGPA                  0
Research              0
Chance of Admit       2
dtype: int64
```

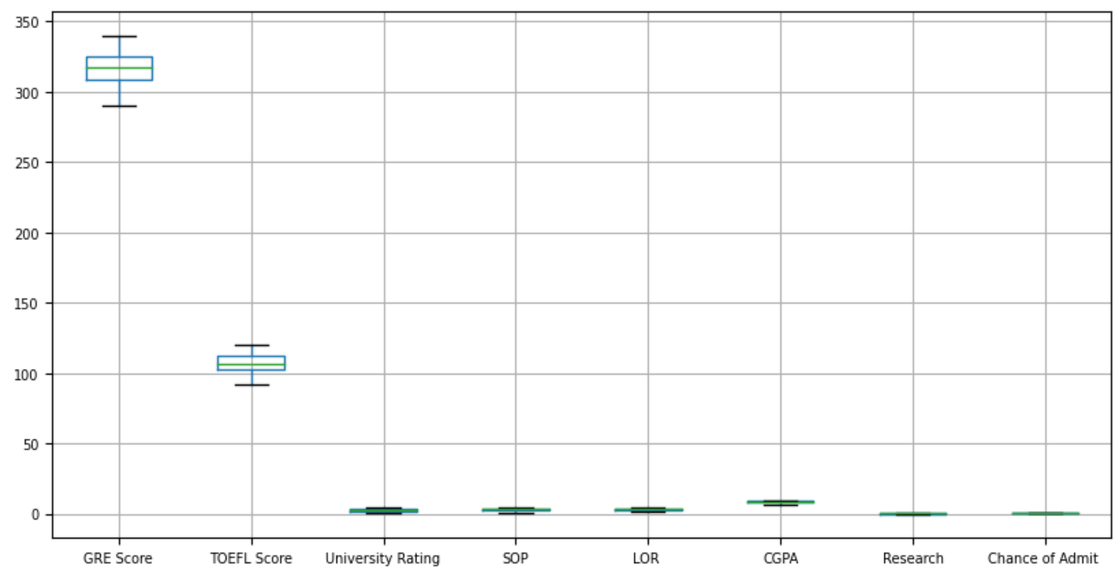
2.6 Droppimg the null values

[18]:
```
df_outliers_removed.dropna(inplace = True)
```

[19]:
```
df_outliers_removed.shape
```

[19]:
```
(486, 8)
```

[20]:
```
df_outliers_removed.boxplot(figsize=(10,5),fontsize=7)
plt.show()
```

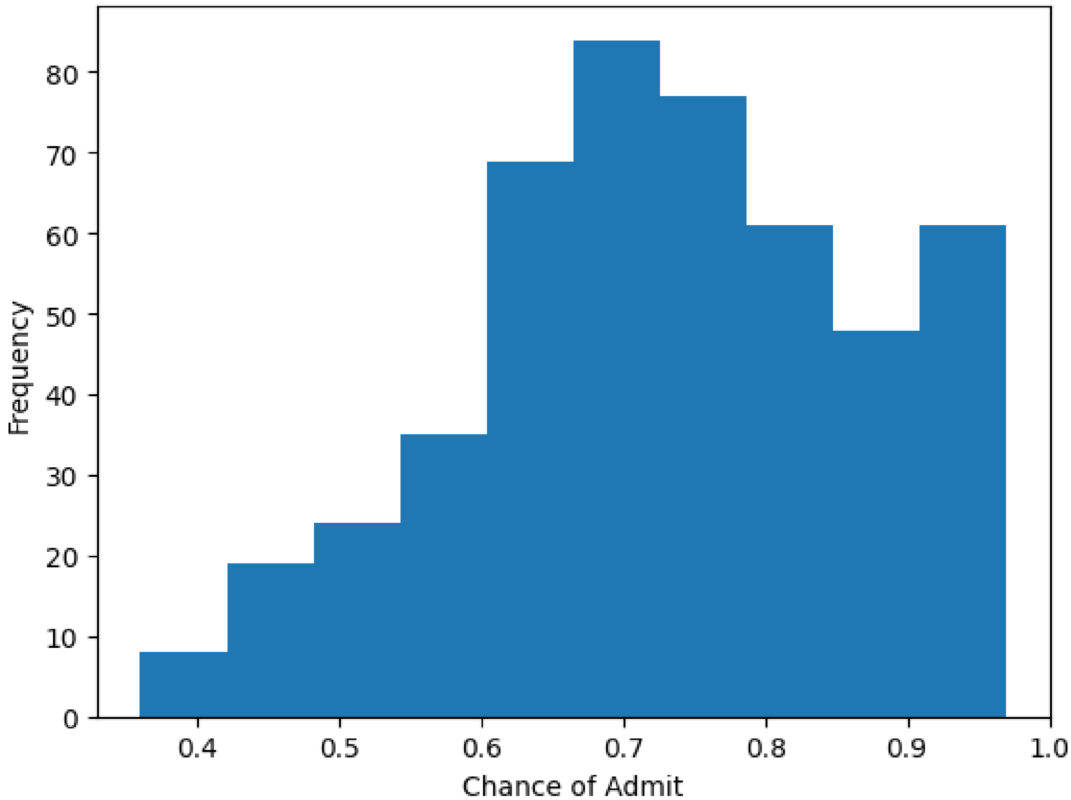


As we can see there are no outliers anymore.

[21]:
```
df2=df_outliers_removed.copy()
```

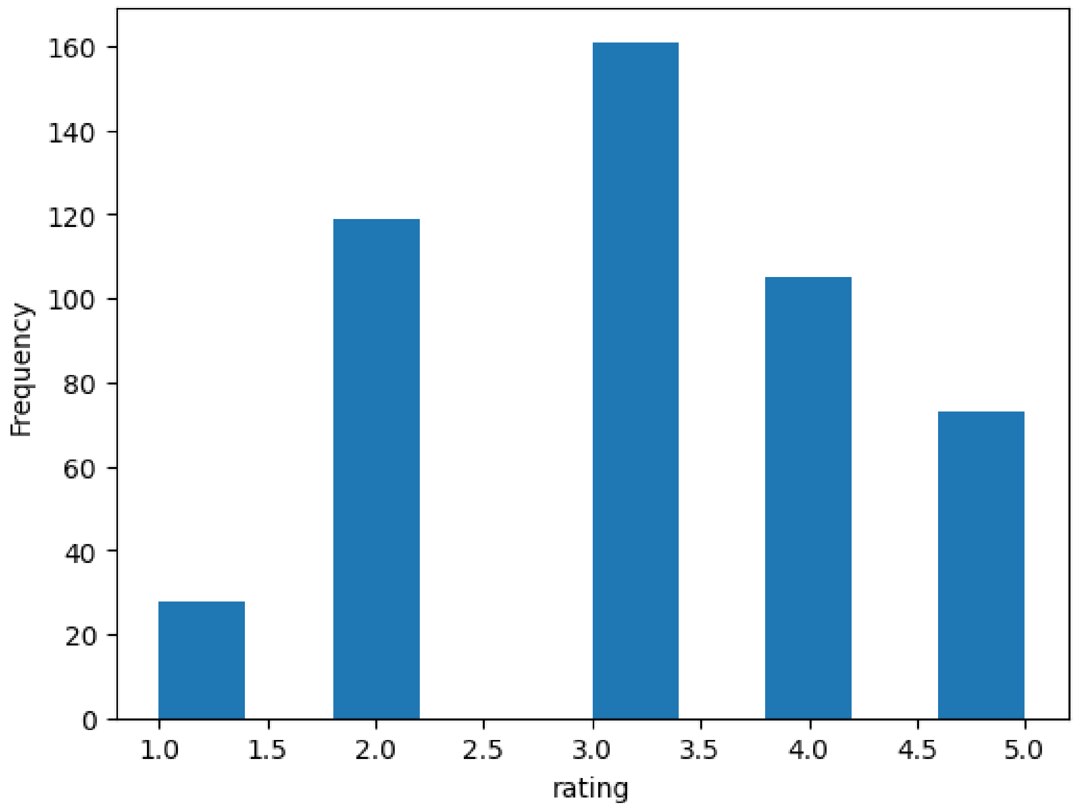
2.7 Univariate analysis

[22]:
```
df2['Chance of Admit '].plot.hist()
plt.xlabel('Chance of Admit')
plt.show()
```



There is some variation in data,so it is useful for the prediction.

[23]:
```
df2['University Rating'].plot.hist()
plt.xlabel('rating')
plt.show()
```



As we can see the maximun no.of students are getting rating from 3 to 3.5

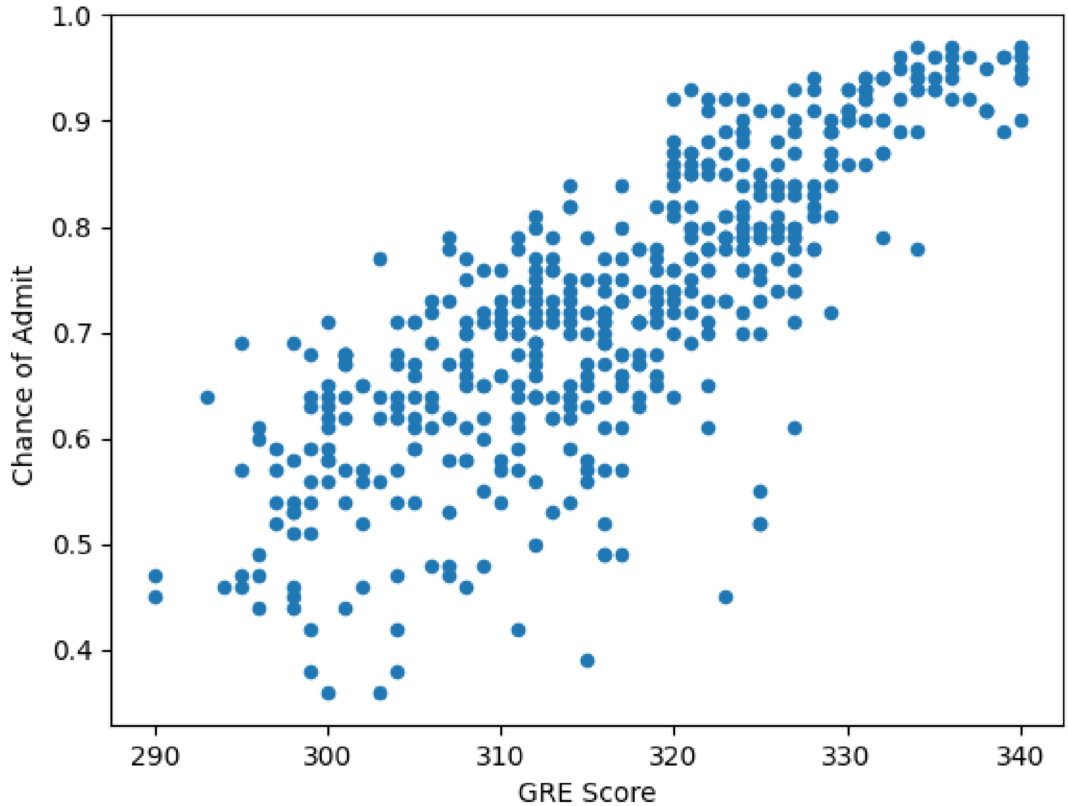
[24]:
```
df2['Research'].value_counts()
```

[24]:
```
1    277
0    209
Name: Research, dtype: int64
```

We can say that 277 students have research experience and 209 students have no experience

2.8 Bi-variate analysis

[25]:
```
df2.plot.scatter('GRE Score','Chance of Admit ')
plt.show()
```

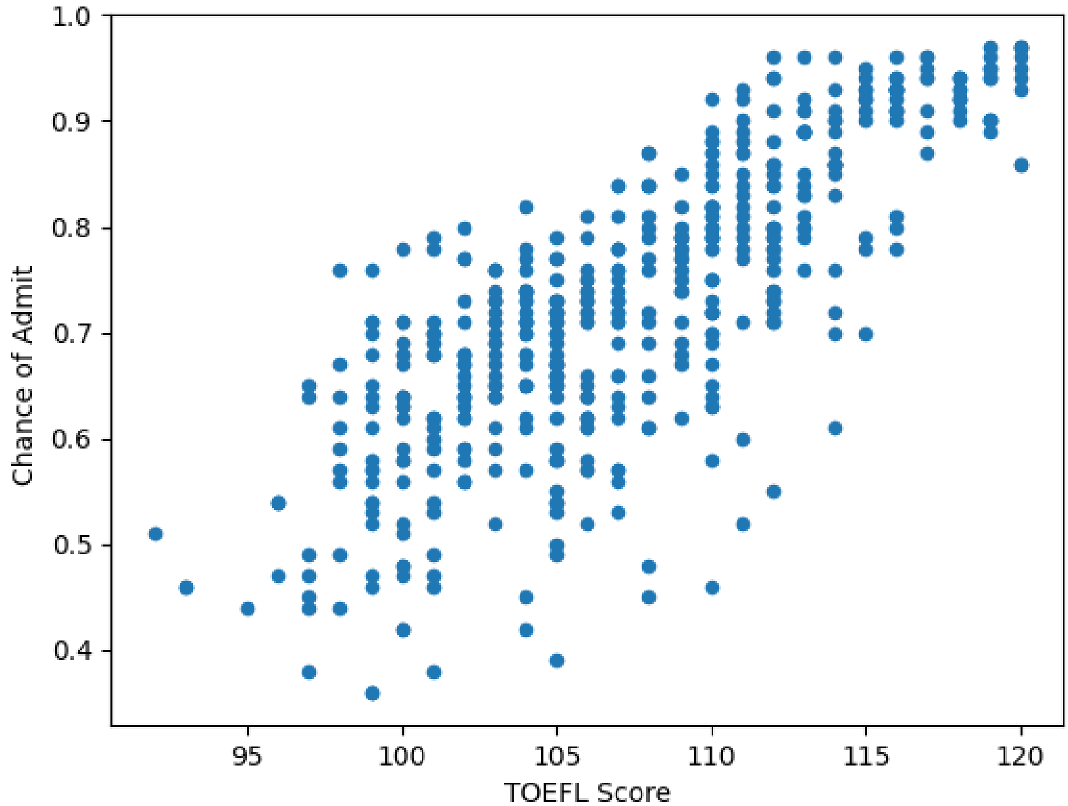


[26]:
```
df2['Chance of Admit '].corr(df2['GRE Score'])
```

[26]: 0.8031896044373015

As chance of admit and GRE score are positively correlated i.e.. if GRE score increases there is more chance of getting admission.

[27]:
```
df2.plot.scatter('TOEFL Score','Chance of Admit ')
plt.show()
```

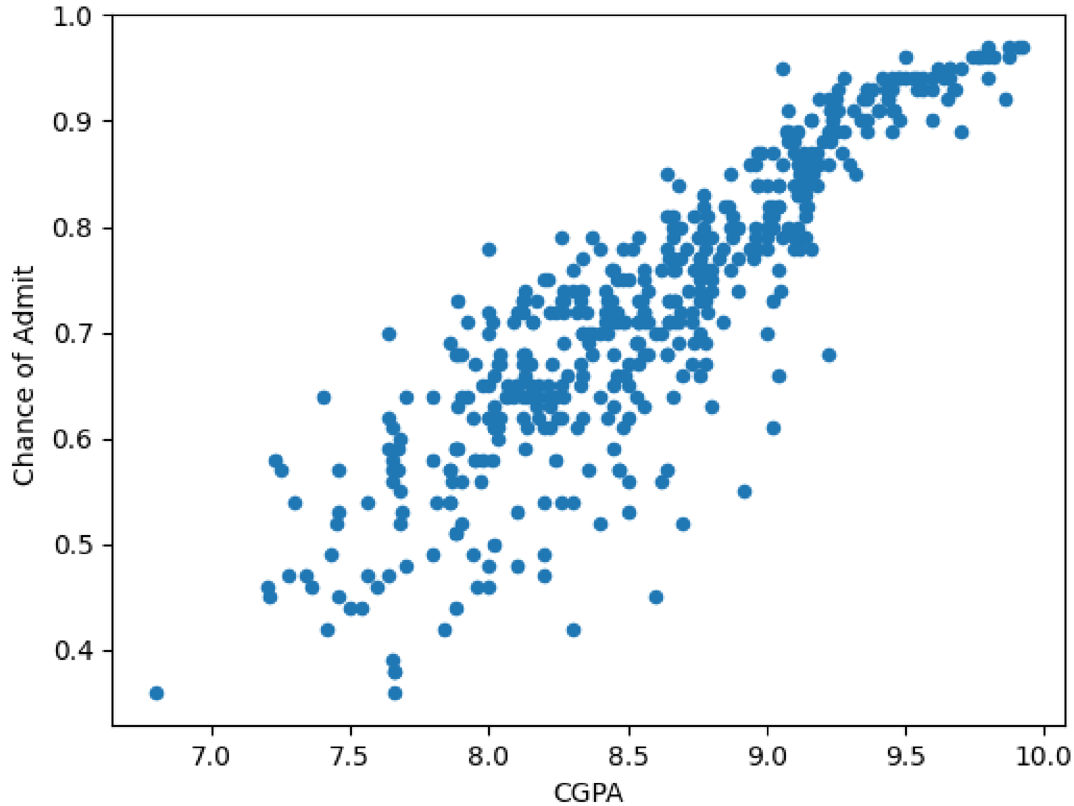


[28]:
```
df2['TOEFL Score'].corr(df2['Chance of Admit '])
```

[28]: 0.7857296232445918

As chance of admit and TOEFL score are positively correlated i.e.. if TOEFL score increases there is more chance of getting admission.

[29]:
```
df2.plot.scatter('CGPA','Chance of Admit ')
plt.show()
```

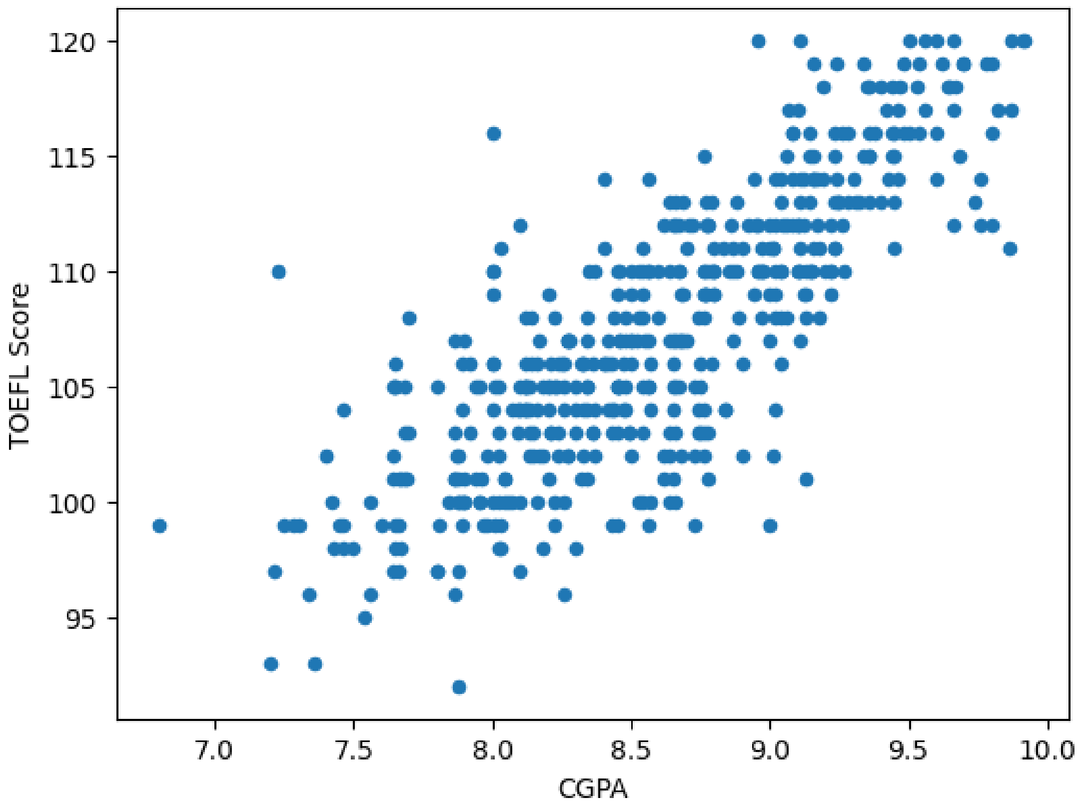


[30]:
```
df2['CGPA'].corr(df2['Chance of Admit '])
```

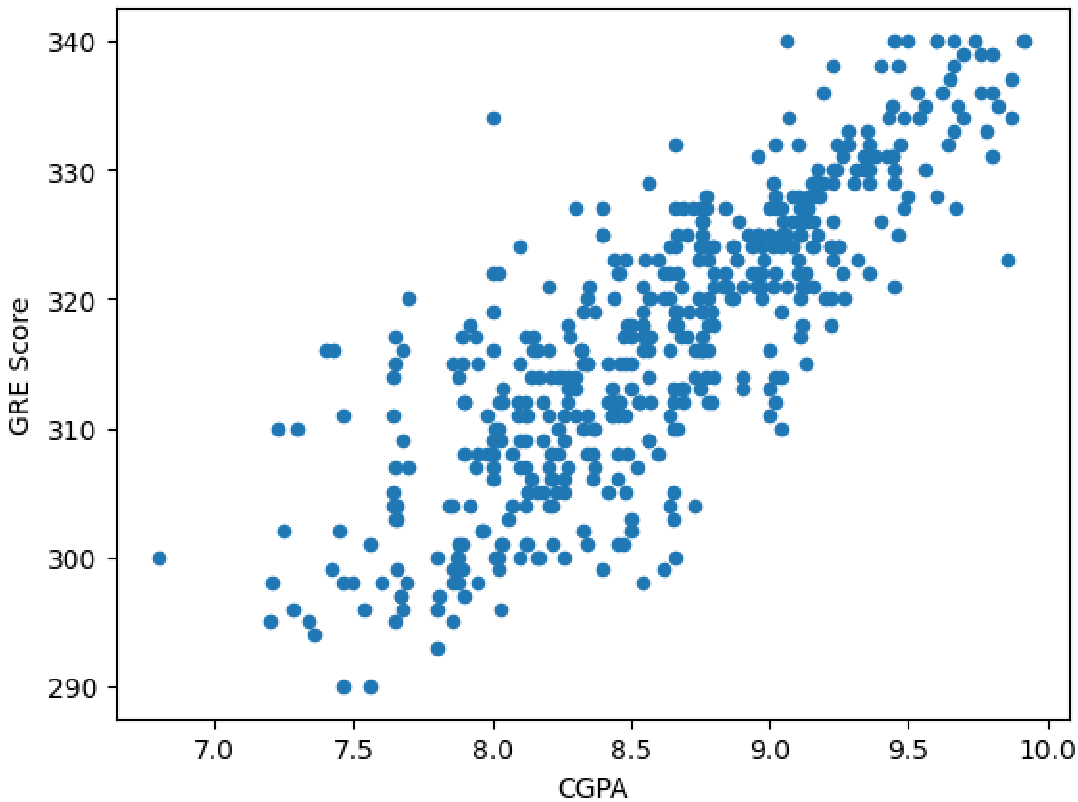
[30]: 0.8821495912854789

As chance of admit and CGPA are positively correlated i.e.. if CGPA increases there is more chance of getting admission.

[31]:
```
df2.plot.scatter('CGPA','TOEFL Score')
plt.show()
```



[32]:
```
df2.plot.scatter('CGPA','GRE Score')
plt.show()
```



[33]:
```
df2['CGPA'].corr(df2['GRE Score'])
```

[33]: 0.8208424849253344

[34]:
```
df2['CGPA'].corr(df2['TOEFL Score'])
```

[34]: 0.8081094221483263

Students who have good CGPA , will definitely get a good score in TOEFL and GRE exams.

2.9 Separating x and y

[35]:
```
x=df2.drop(['Chance of Admit '],axis=1)
y=df2['Chance of Admit ']
x.shape,y.shape
```

[35]: ((486, 7), (486,))

[36]:
```
train_x,test_x,train_y,test_y=train_test_split(x,y,random_state=56)
```

2.10 Fitting the data into a linear regression model

[37]:
```
lr=LR()
```

[38]:
```
lr.fit(train_x,train_y)
```

[38]:
```
LinearRegression()
```

2.11 Predicting over train and test set

[39]:
```
train_pre=lr.predict(train_x)
mae_train=mae(train_pre,train_y)
```

[40]:
```
mae_train
```

[40]:
```
0.04052008959676384
```

[41]:
```
test_pre=lr.predict(test_x)
mae_test=mae(test_pre,test_y)
```

[42]:
```
mae_test
```

[42]:
```
0.04345173324962815
```

2.12 Model Evaluation

[43]:
```
n = len(train_x)
m=len(test_x)
```

2.12.1 Train data

[44]:
```
RMSE = np.sqrt(mean_squared_error(train_y,train_pre))
MSE = mean_squared_error(train_y, train_pre)
MAE = mean_absolute_error(train_y, train_pre)
r2_train = r2_score(train_y, train_pre)
adj_r2 = 1-(1-r2_train)*(n-1)/(n-mae_train-1)
print(RMSE)
print(MSE)
print(MAE)
print(r2_train)
print(adj_r2)
```

```
0.0572018808365434
0.003272055171238111
0.04052008959676384
0.8186071138689355
0.8185868635203288
```

2.12.2 Test data

[45]:
```
RMSE_test = np.sqrt(mean_squared_error(test_y,test_pre))
MSE_test = mean_squared_error(test_y, test_pre)
MAE_test = mean_absolute_error(test_y, test_pre)
r2_test = r2_score(test_y, test_pre)
adj_r2_test = 1-(1-r2_test)*(m-1)/(m-mae_test-1)
print(RMSE_test)
print(MSE_test)
print(MAE_test)
print(r2_test)
print(adj_r2_test)
```

```
0.06207177414999459
0.003852905146127937
0.04345173324962815
0.8081700586095103
0.8081011467270034
```

2.13 Accuracy of the model

[46]:
```
print('Accuracy of train set :',r2_train)
print('Accuracy of test set :',r2_test)
```

```
Accuracy of train set : 0.8186071138689355
Accuracy of test set : 0.8081700586095103
```