Support Vector Regression Practical Implementation - Admission dataset

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In [1]:

```
# Importing necessary libraries
import pandas as pd
import numpy as np

import warnings
warnings.filterwarnings("ignore")

import seaborn as sns
import matplotlib.pyplot as plt

%matplotlib inline
```

Data Ingestion

In [2]:

```
raw_df = pd.read_csv("https://raw.githubusercontent.com/srinivasav22/Graduate-Admission-Prediction/master/Admission_Predict_
```

Profile of the dataset

In [72]:

```
raw_df.head()
```

Out[72]:

	Serial No.	GRE Score	TOEFL Score	University Rating	SOP	LOR	CGPA	Research	Chance of Admit
0	1	337	118	4	4.5	4.5	9.65	1	0.92
1	2	324	107	4	4.0	4.5	8.87	1	0.76
2	3	316	104	3	3.0	3.5	8.00	1	0.72
3	4	322	110	3	3.5	2.5	8.67	1	0.80
4	5	314	103	2	2.0	3.0	8.21	0	0.65

In [73]:

```
print("This dataset contains {} rows and {} columns.".format(raw_df.shape[0],raw_df.shape[1]))
```

```
This dataset contains 500 rows and 9 columns.
```

In [74]:

```
raw_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
```

In [75]:

```
raw_df.describe()
```

Out[75]:

	Serial No.	GRE Score	TOEFL Score	University Rating	SOP	LOR	CGPA	Research	Chance of Admit
count	500.000000	500.000000	500.000000	500.000000	500.000000	500.00000	500.000000	500.000000	500.00000
mean	250.500000	316.472000	107.192000	3.114000	3.374000	3.48400	8.576440	0.560000	0.72174
std	144.481833	11.295148	6.081868	1.143512	0.991004	0.92545	0.604813	0.496884	0.14114
min	1.000000	290.000000	92.000000	1.000000	1.000000	1.00000	6.800000	0.000000	0.34000
25%	125.750000	308.000000	103.000000	2.000000	2.500000	3.00000	8.127500	0.000000	0.63000
50%	250.500000	317.000000	107.000000	3.000000	3.500000	3.50000	8.560000	1.000000	0.72000
75%	375.250000	325.000000	112.000000	4.000000	4.000000	4.00000	9.040000	1.000000	0.82000
max	500.000000	340.000000	120.000000	5.000000	5.000000	5.00000	9.920000	1.000000	0.97000

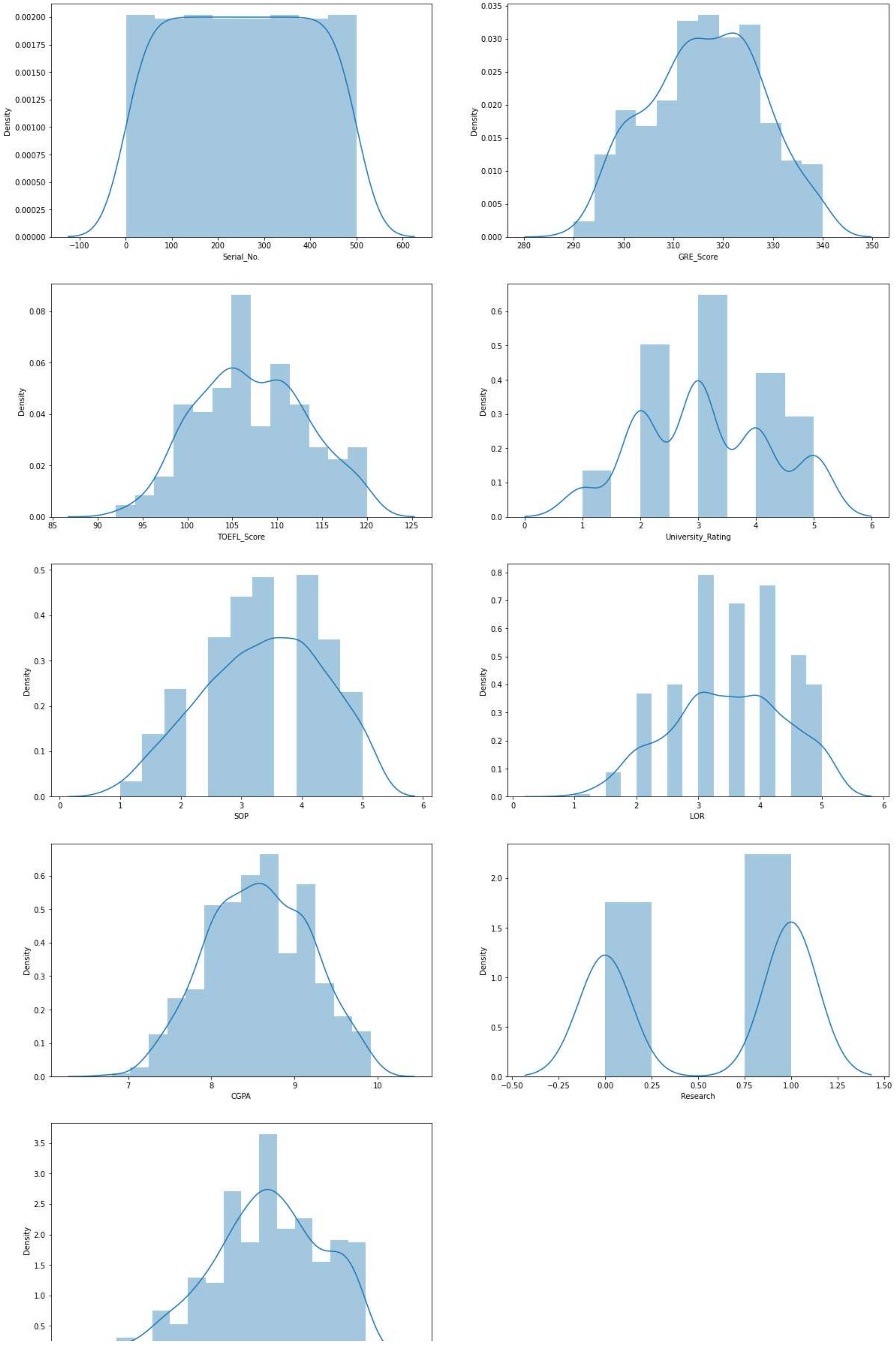
In [76]:

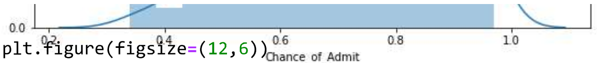
```
    raw_df.rename(columns = {'Serial No.':'Serial_No.', 'GRE Score': 'GRE_Score', 'TOEFL Score': 'TOEFL_Score', 'University Rati
```

Exploratory Data Analysis

In [77]:

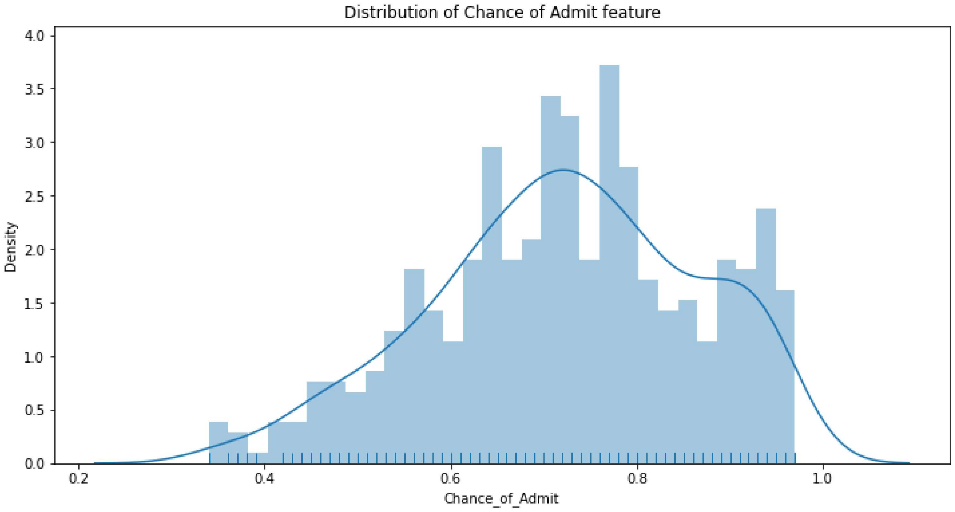
```
cols = raw_df.columns
plt.figure(figsize=(20,40), facecolor='white')

for i in range(0, len(cols)):
    plt.subplot(6, 2, i+1)
    sns.distplot(x=raw_df[cols[i]],kde=True)
    plt.xlabel(cols[i])
```


Density
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
−100
0
100
200
300
400
500
600
Serial_No.
Density
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
280
290
300
310
320
330
340
350
GRE_Score
Density
0.08
0.06
0.04
0.02
0.00
85
90
95
100
105
110
115
120
125
TOEFL_Score
Density
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
University_Rating
Density
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
SOP
Density
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
LOR
Density
0.6
0.5
0.4
0.3
0.2
0.1
0.0
7
8
9
10
CGPA
Density
2.0
1.5
1.0
0.5
0.0
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Research
Density
3.5
3.0
2.5
2.0
1.5
1.0
0.5



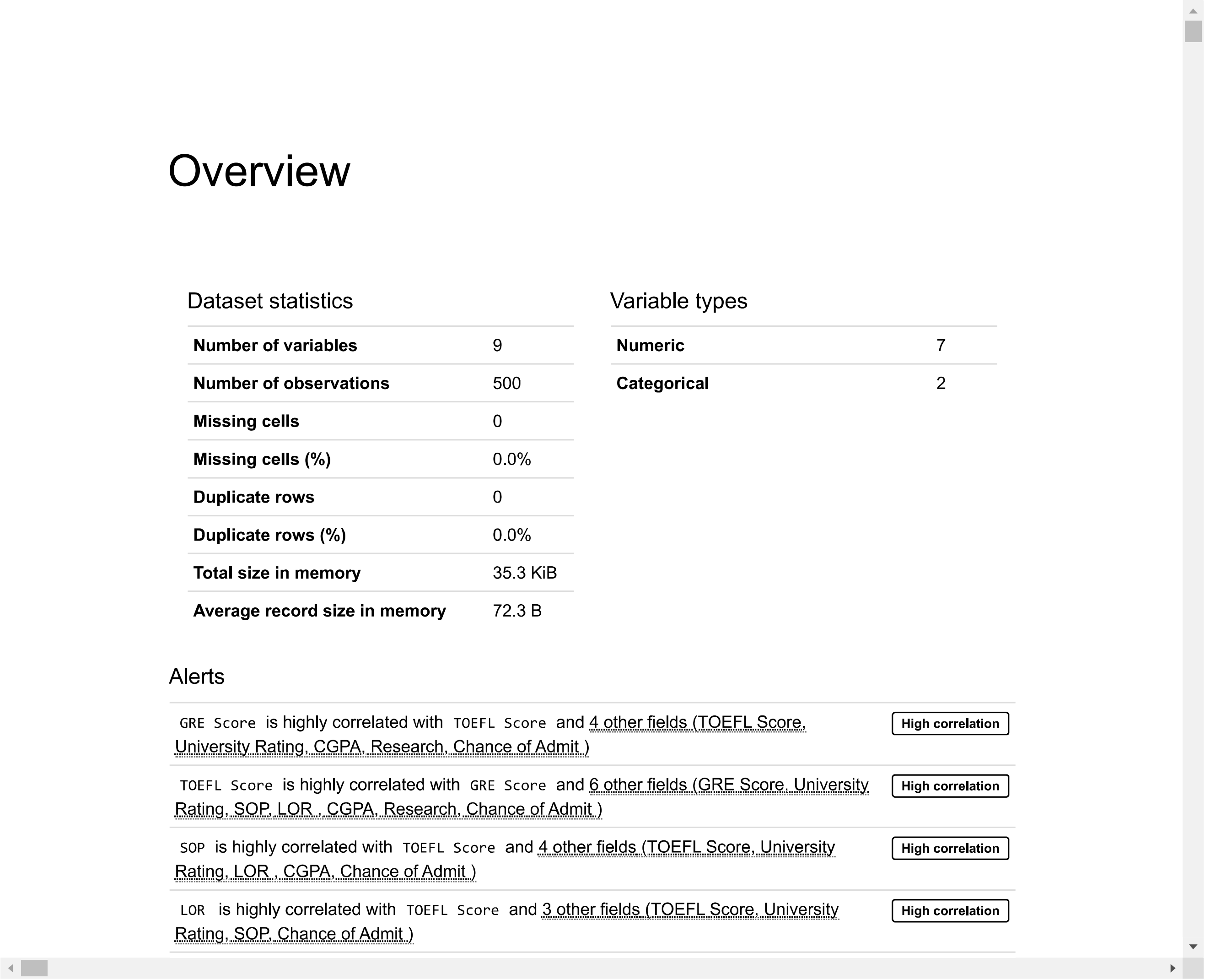
In [78]:
```
plt.figure(figsize=(12,6))
plt.title('Distribution of Chance of Admit feature')
sns.distplot(raw_df['Chance_of_Admit'],bins = 30,rug=True)
```

Out[78]:
```
<AxesSubplot:title={'center':'Distribution of Chance of Admit feature'}, xlabel='Chance_of_Admit', ylabel='Density'>
```



In [3]:
```python
from pandas_profiling import ProfileReport

# EDA using pandas-profiling
profile = ProfileReport(raw_df, explorative=True)

# Displaying report in notebook cell.
profile.to_notebook_iframe()
```

```
Summarize dataset: 100%                                   72/72 [00:53<00:00, 1.62it/s, Completed]

Generate report structure: 100%                               1/1 [00:15<00:00, 15.00s/it]

Render HTML: 100%                                         1/1 [00:08<00:00, 8.23s/it]
```



Overview

Dataset statistics

Number of variables	9
Number of observations	500
Missing cells	0
Missing cells (%)	0.0%
Duplicate rows	0
Duplicate rows (%)	0.0%
Total size in memory	35.3 KiB
Average record size in memory	72.3 B

Variable types

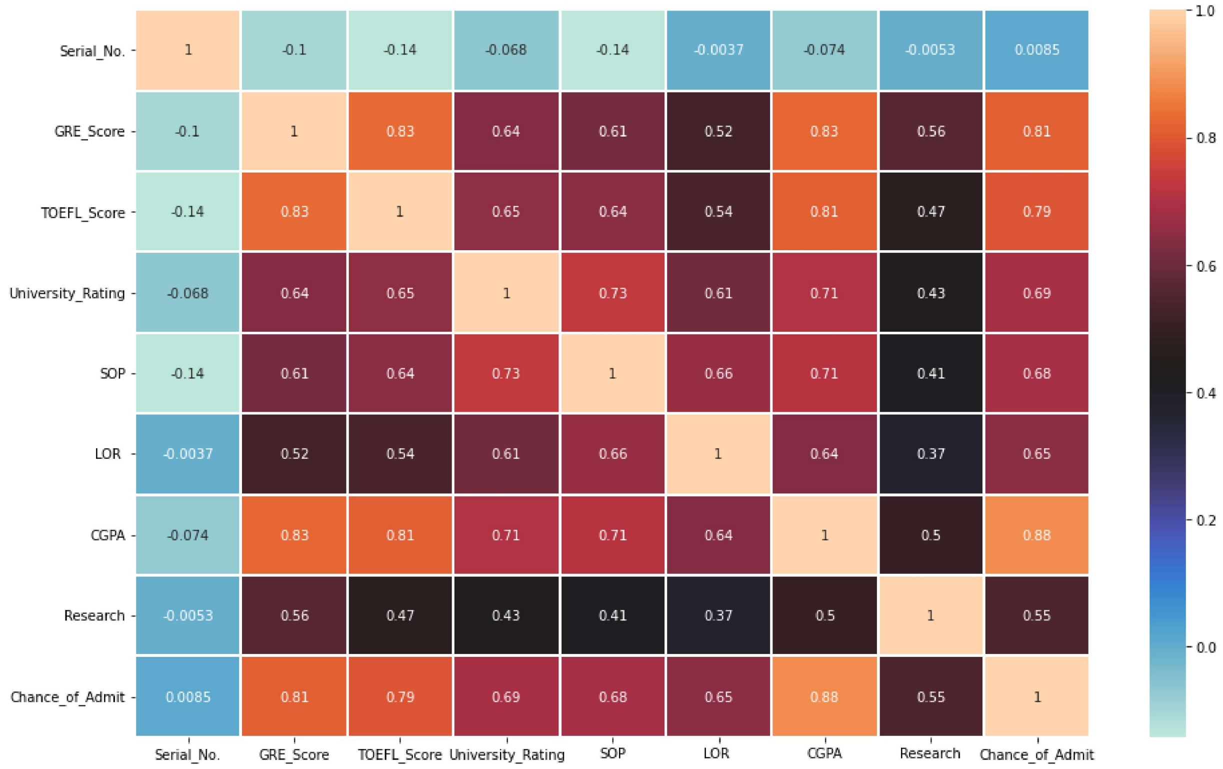
Numeric	7
Categorical	2

Alerts

`GRE Score` is highly correlated with `TOEFL Score` and 4 other fields (TOEFL Score, University Rating, CGPA, Research, Chance of Admit)	High correlation
`TOEFL Score` is highly correlated with `GRE Score` and 6 other fields (GRE Score, University Rating, SOP, LOR , CGPA, Research, Chance of Admit)	High correlation
`SOP` is highly correlated with `TOEFL Score` and 4 other fields (TOEFL Score, University Rating, LOR , CGPA, Chance of Admit)	High correlation
`LOR` is highly correlated with `TOEFL Score` and 3 other fields (TOEFL Score, University Rating, SOP, Chance of Admit)	High correlation

In [79]:
```
plt.figure(figsize=(16,10))

sns.heatmap(raw_df.corr(),annot=True,cmap='icefire',linewidths=0.2)
```

Out[79]:
```
<AxesSubplot:>
```



Train test split

In [80]:
```
X = raw_df.drop('Chance_of_Admit', axis =1) # Independent Features
```

In [81]:
```
y = raw_df["Chance_of_Admit"] # Dependent Feature
```

In [82]:
```
X.head()
```

Out[82]:

	Serial_No.	GRE_Score	TOEFL_Score	University_Rating	SOP	LOR	CGPA	Research
0	1	337	118	4	4.5	4.5	9.65	1
1	2	324	107	4	4.0	4.5	8.87	1
2	3	316	104	3	3.0	3.5	8.00	1
3	4	322	110	3	3.5	2.5	8.67	1
4	5	314	103	2	2.0	3.0	8.21	0

In [83]:
```
y.head()
```

Out[83]:
```
0    0.92
1    0.76
2    0.72
3    0.80
4    0.65
Name: Chance_of_Admit, dtype: float64
```

In [84]:
```
from sklearn.model_selection import train_test_split
```

In [85]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)
```

In [86]:

```
print("Train dataset contains {} rows and {} columns.".format(X_train.shape[0],X_train.shape[1]))
print("Test dataset contains {} rows and {} columns.".format(X_test.shape[0],X_test.shape[1]))
print("Train dataset contains {} rows.".format(y_train.shape[0]))
print("Test dataset contains {} rows.".format(y_test.shape[0]))
```

```
Train dataset contains 335 rows and 8 columns.
Test dataset contains 165 rows and 8 columns.
Train dataset contains 335 rows.
Test dataset contains 165 rows.
```

Feature Scaling

In [87]:

```
from sklearn.preprocessing import StandardScaler
```

In [88]:

```
scaler = StandardScaler()
```

In [89]:

```
scaler.fit(X_train)
```

Out[89]:

```
▾ StandardScaler

StandardScaler()
```

In [90]:

```
print(scaler.mean_)
```

```
[255.35820896 316.7641791  107.31343284   3.09552239   3.38059701
   3.50149254   8.58498507   0.56716418]
```

In [91]:

```
X_train_scaled = scaler.transform(X_train)
```

In [92]:

```
X_train_scaled
```

Out[92]:

```
array([[ 1.55816388e+00, -5.25174731e-01, -7.06985745e-01, ...,
         5.38819022e-01, -8.35765678e-01, -1.14470294e+00],
       [-1.64243247e+00,  4.77035981e-01,  2.76433873e-01, ...,
        -1.61323061e-03,  3.63045482e-01, -1.14470294e+00],
       [-1.77908715e+00, -7.98504925e-01, -1.03479228e+00, ...,
         5.38819022e-01, -1.15657430e+00, -1.14470294e+00],
       ...,
       [ 6.73504661e-01, -1.34516531e+00, -1.36259882e+00, ...,
        -1.62290999e+00, -2.25407747e+00, -1.14470294e+00],
       [ 1.29923923e+00, -7.07394861e-01, -3.79179206e-01, ...,
         5.38819022e-01, -1.52803691e+00, -1.14470294e+00],
       [-1.09581377e+00, -2.51844537e-01, -2.15275936e-01, ...,
        -1.61323061e-03, -5.65611050e-01, -1.14470294e+00]])
```

In [93]:

```
X_test_scaled = scaler.transform(X_test)
```

In [94]:

```
X_test_scaled
```

Out[94]:

```
array([[ 7.67005229e-01,  1.57035676e+00,  1.42375676e+00, ...,
        -1.61323061e-03,  1.61251063e+00,  8.73589088e-01],
       [-1.30439196e+00, -2.51844537e-01,  1.12530603e-01, ...,
         5.38819022e-01,  7.68277423e-01,  8.73589088e-01],
       [ 8.60505796e-01, -1.60734472e-01, -3.79179206e-01, ...,
        -1.08247774e+00, -1.57869090e+00, -1.14470294e+00],
       ...,
       [ 1.24889277e+00, -6.96244077e-02, -7.06985745e-01, ...,
         1.07925128e+00,  2.61737496e-01, -1.14470294e+00],
       [-1.62085542e+00, -6.16284796e-01, -1.36259882e+00, ...,
        -1.62290999e+00, -2.16965415e+00, -1.14470294e+00],
       [ 1.31362393e+00,  2.14856571e-02, -2.15275936e-01, ...,
        -1.61323061e-03, -1.57869090e+00,  8.73589088e-01]])
```

Model training

In [95]:

```
from sklearn.svm import SVR
```

In [96]:

```
SVR_model = SVR(kernel="rbf")
```

In [97]:

```
SVR_model.fit(X_train_scaled, y_train)
```

Out[97]:

```
▾ SVR

SVR()
```

```
In [98]:   SVR_prediction = SVR_model.predict(X_test_scaled)
```

```
In [99]:   SVR_prediction
```

```
Out[99]: array([0.85327566, 0.70566642, 0.56577617, 0.68513912, 0.73073652,
                0.84759115, 0.50884113, 0.63512354, 0.71546806, 0.75966639,
                0.57183244, 0.71682881, 0.6228902 , 0.87034528, 0.80538203,
                0.45539152, 0.78034293, 0.51298148, 0.52072102, 0.57781496,
                0.65704711, 0.53857913, 0.7306496 , 0.78872557, 0.69357076,
                0.5926933 , 0.843987  , 0.82839114, 0.59525329, 0.75285329,
                0.56177445, 0.761017  , 0.57579346, 0.84035618, 0.57955442,
                0.7686765 , 0.50127929, 0.88017372, 0.66595737, 0.64142824,
                0.87065485, 0.52080723, 0.63350483, 0.85528765, 0.82310479,
                0.47790267, 0.85620031, 0.74364715, 0.76326758, 0.85361512,
                0.81739371, 0.55214794, 0.6810001 , 0.53159075, 0.90702514,
                0.56836681, 0.83980413, 0.59580852, 0.6745631 , 0.45741035,
                0.59644739, 0.72846957, 0.5933817 , 0.62610304, 0.48959131,
                0.54214166, 0.83976541, 0.8396225 , 0.67509268, 0.69812838,
                0.65151703, 0.79682174, 0.69471546, 0.58558049, 0.51274623,
                0.71102862, 0.80506604, 0.81858292, 0.44022248, 0.60626074,
                0.68135064, 0.78816077, 0.64312672, 0.80921569, 0.73883943,
                0.65342583, 0.60539529, 0.7375616 , 0.77339084, 0.69785607,
                0.74867341, 0.84240892, 0.87871142, 0.69710495, 0.78844475,
                0.47504067, 0.62947709, 0.71640435, 0.73414257, 0.53127454,
                0.80409686, 0.70927605, 0.52625603, 0.69155924, 0.70891608,
                0.54575333, 0.74120688, 0.76668693, 0.69705305, 0.65675686,
                0.61229395, 0.87815292, 0.84078298, 0.86092636, 0.40223106,
                0.81305237, 0.69935842, 0.8792775 , 0.53706344, 0.60163982,
                0.7232158 , 0.88432815, 0.7642912 , 0.68918653, 0.71857187,
                0.72130402, 0.60175527, 0.88525868, 0.7665937 , 0.51965101,
                0.5964044 , 0.66245068, 0.78301881, 0.47545906, 0.73839942,
                0.41141632, 0.81003235, 0.81342825, 0.56221156, 0.71162865,
                0.62552657, 0.65219413, 0.79610622, 0.47227593, 0.90804817,
                0.67646231, 0.86353569, 0.76570903, 0.67480056, 0.68310625,
                0.75301945, 0.59900557, 0.75347854, 0.58116682, 0.58316801,
                0.67492506, 0.6141046 , 0.76912297, 0.451248  , 0.51861873,
                0.62686496, 0.75779807, 0.66431766, 0.45720304, 0.61809108])
```

Performance Metrics

```
In [100]:  #Performance Metrics
           from sklearn.metrics import mean_squared_error
           from sklearn.metrics import mean_absolute_error
           from sklearn.metrics import r2_score
```

```
In [101]:  print(mean_squared_error(y_test,SVR_prediction))

           0.004878474514395206
```

```
In [102]:  print(mean_absolute_error(y_test,SVR_prediction))

           0.05626497201211845
```

```
In [103]:  score=r2_score(y_test,SVR_prediction)
           score

Out[103]:  0.7632199437959383
```

Thank you!