In [156…

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

In [157…

```
# --- Read data ---
file_path = r'C:\Users\Adarshkumar\Documents\Naresh it\EDA\Pandas Assignment\loan_data.csv'
loan_df = pd.read_csv(file_path)
```

In [158…

```
# --- Separate categorical and numerical columns ---
categorical = loan_df.select_dtypes(include = 'object').columns
numerical = loan_df.select_dtypes(exclude ='object').columns
```

In [159…

```
print("Categorical Columns: ", categorical)
print("Numerical Columns:", numerical)
```

```
Categorical Columns:  Index(['Loan_ID', 'Gender', 'Married', 'Dependents', 'Education',
       'Self_Employed', 'Property_Area', 'Loan_Status'],
      dtype='object')
Numerical Columns: Index(['ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
       'Loan_Amount_Term', 'Credit_History'],
      dtype='object')
```

In [160…

```
# --- Data quick checks ---
print("\n Shape : ",loan_df.shape)
print("\n Size : ",loan_df.size)
print("\n Columns : ",loan_df.columns)
```

```
 Shape :  (614, 13)

 Size :  7982

 Columns :  Index(['Loan_ID', 'Gender', 'Married', 'Dependents', 'Education',
       'Self_Employed', 'ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
       'Loan_Amount_Term', 'Credit_History', 'Property_Area', 'Loan_Status'],
      dtype='object')
```

In [161…

```
# -- Null value analysis (before imputation) --
print("\n Null value analysis before imputation :\n",loan_df.isnull().sum())
```

```
 Null value analysis before imputation :
 Loan_ID               0
Gender               13
Married               3
Dependents           15
Education             0
Self_Employed        32
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount           22
Loan_Amount_Term     14
Credit_History       50
Property_Area         0
Loan_Status           0
dtype: int64
```

In [162…

```python
import warnings
warnings.filterwarnings('ignore')
loan_df.fillna(method='pad')
```

Out[162…

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	L
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	
...	...	...	...	...	...	...	...	...	...	
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	

614 rows × 13 columns

In [163…

```
# -- # Fill numerical nulls with median --
for i in numerical:
    loan_median = loan_df[i].median()
    loan_df[i].fillna(loan_median,inplace=True)

print(loan_df.isnull().sum())
```

```
Loan_ID               0
Gender               13
Married               3
Dependents           15
Education             0
Self_Employed        32
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount            0
Loan_Amount_Term      0
Credit_History        0
Property_Area         0
Loan_Status           0
dtype: int64
```

In [164…

```
# -- # Fill categorical nulls with mode --
for i in categorical:
    loan_mode = loan_df[i].mode().values[0]
    loan_df[i].fillna(loan_mode,inplace=True)

print(loan_df.isnull().sum())
```

```
Loan_ID              0
Gender               0
Married              0
Dependents           0
Education            0
Self_Employed        0
ApplicantIncome      0
CoapplicantIncome    0
LoanAmount           0
Loan_Amount_Term     0
Credit_History       0
Property_Area        0
Loan_Status          0
dtype: int64
```

In [165…

```
for col in categorical:
    numeric_version = pd.to_numeric(loan_df[col], errors="coerce")
    numeric_ratio = numeric_version.notnull().mean()
```

In [166…

```
for col in numerical:
    loan_df[col] = pd.to_numeric(loan_df[col], errors="coerce")
    loan_df[col].fillna(loan_df[col].median(), inplace=True)
```

In [167…

```
# Drop id columns
rows = len(loan_df)
id_columns = [
    col for col in loan_df.columns
    if loan_df[col].nunique() / rows > 0.90
]

loan_df.drop(columns=id_columns, inplace=True)
print("Dropped ID-type columns:",id_columns)
```

```
Dropped ID-type columns: ['Loan_ID']
```

In [168…

```
# Drop single value column
single_value_columns = [
    col for col in loan_df.columns
    if loan_df[col].nunique() == 1
]

loan_df.drop(columns=single_value_columns, inplace=True)

print(single_value_columns)
```

```
[]
```

In [169…

```
print("Final shape\n",loan_df.shape)
print("Remaining columns",loan_df.columns.tolist())
```

```
Final shape
 (614, 12)
Remaining columns ['Gender', 'Married', 'Dependents', 'Education', 'Self_Employed', 'ApplicantIncome', 'CoapplicantIn
come', 'LoanAmount', 'Loan_Amount_Term', 'Credit_History', 'Property_Area', 'Loan_Status']
```

In [170…

```
categorical = loan_df.select_dtypes(include='object').columns.tolist()
numerical   = loan_df.select_dtypes(exclude=['object']).columns.tolist()
```

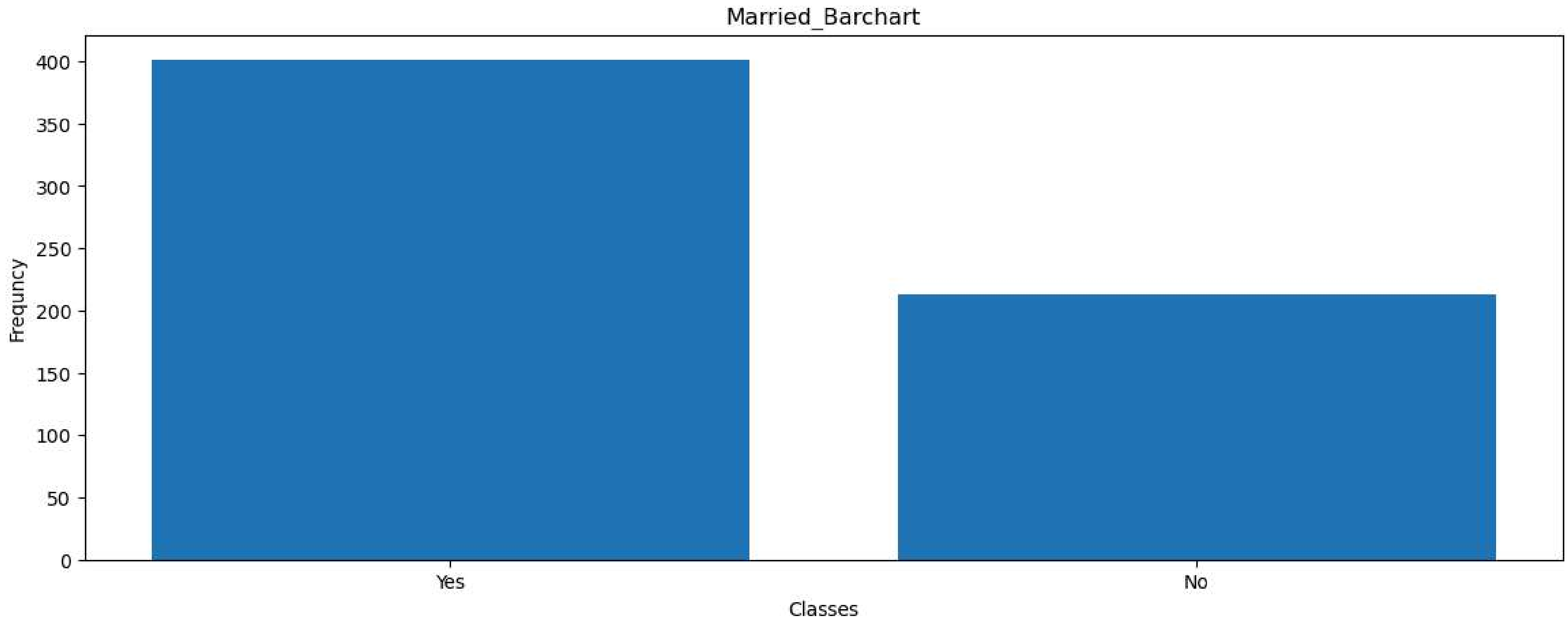
In [171…

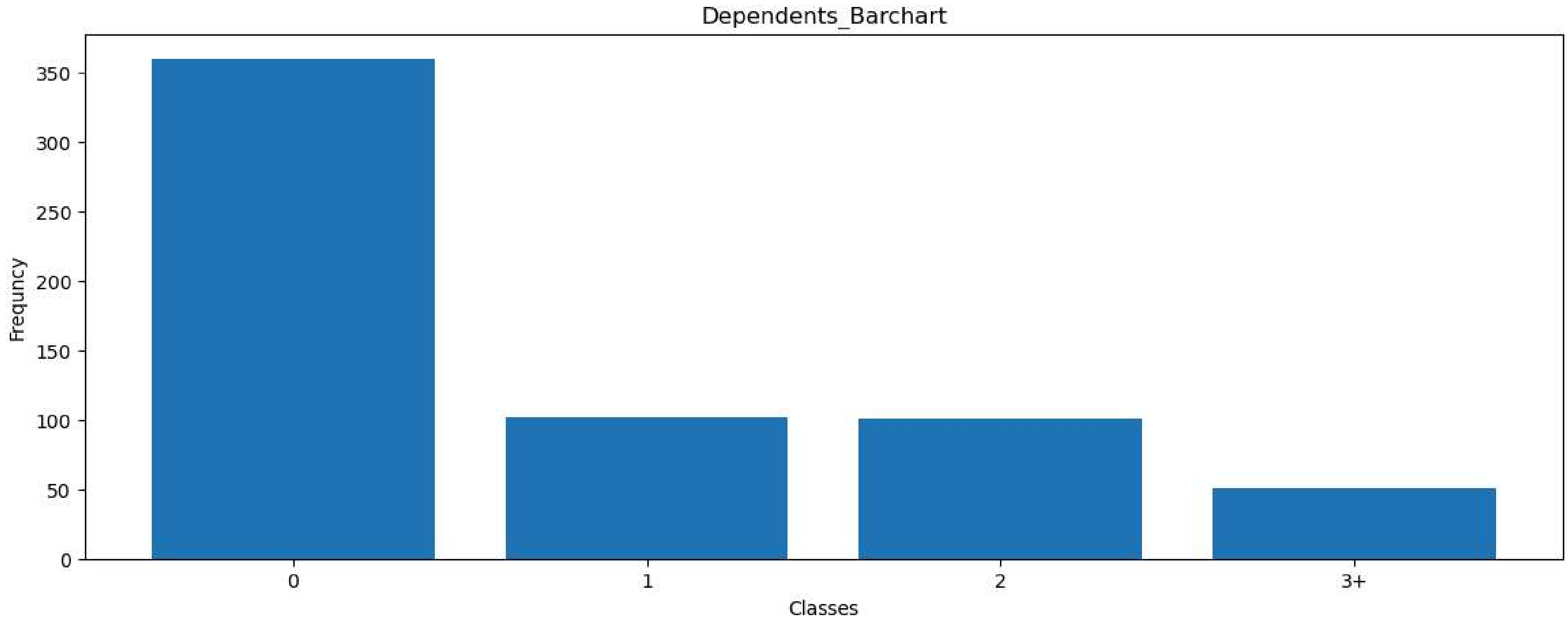
```
for i in categorical:
    print(loan_df[i].value_counts())
```

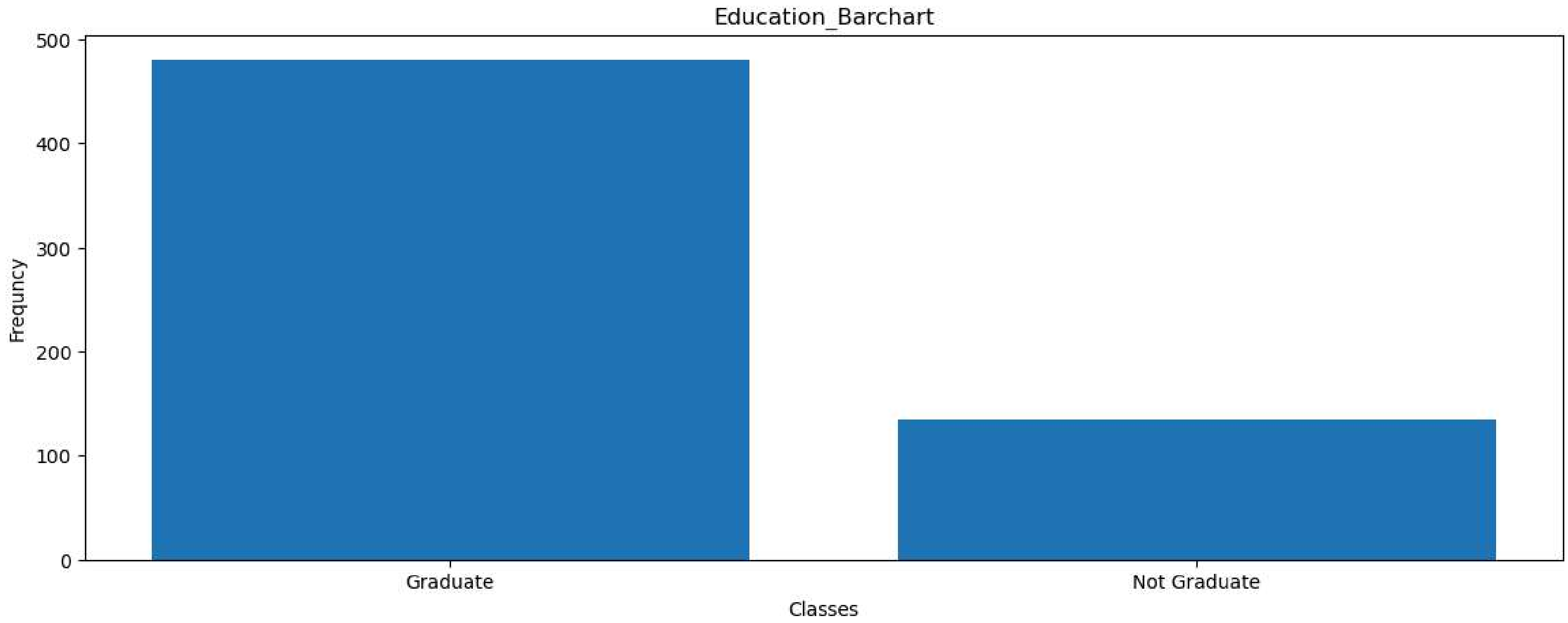
```
Gender
Male      502
Female    112
Name: count, dtype: int64
Married
Yes    401
No     213
Name: count, dtype: int64
Dependents
0     360
1     102
2     101
3+     51
Name: count, dtype: int64
Education
Graduate        480
Not Graduate    134
Name: count, dtype: int64
Self_Employed
No     532
Yes     82
Name: count, dtype: int64
Property_Area
Semiurban    233
Urban        202
Rural        179
Name: count, dtype: int64
Loan_Status
Y    422
N    192
Name: count, dtype: int64
```

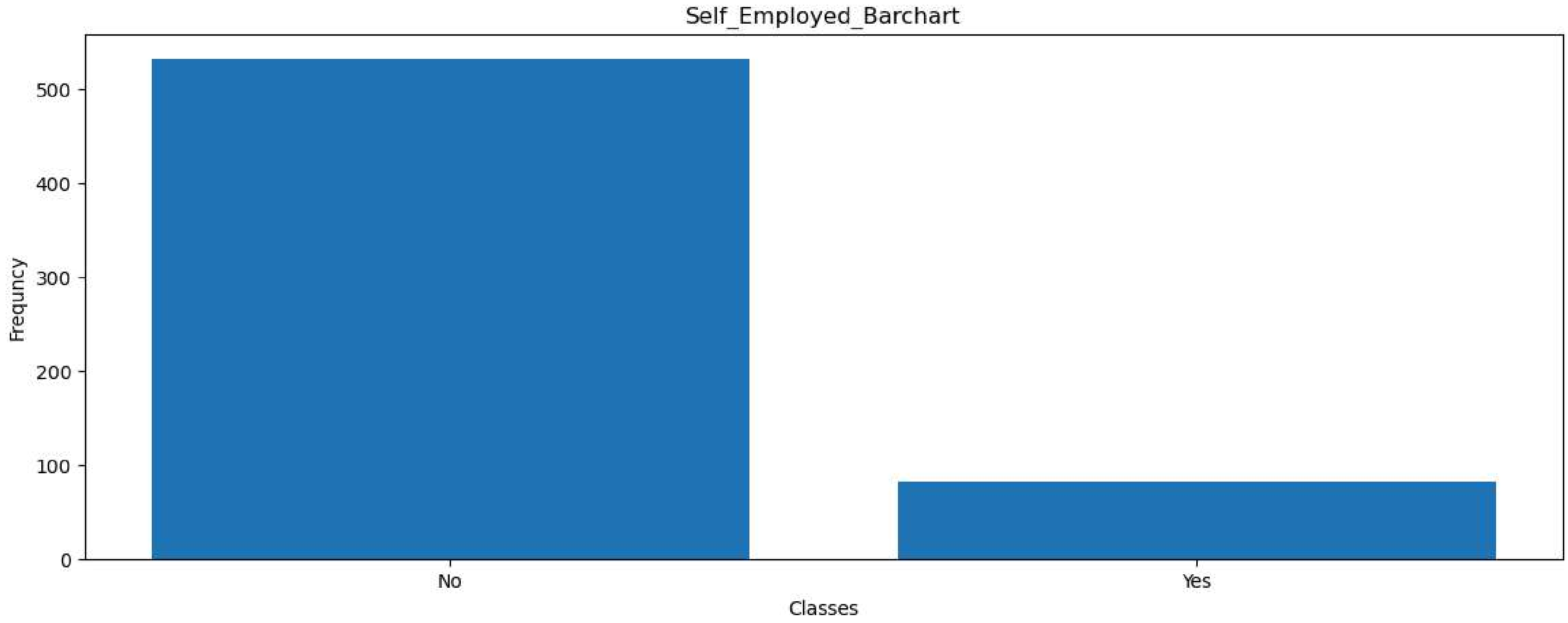
In [172…

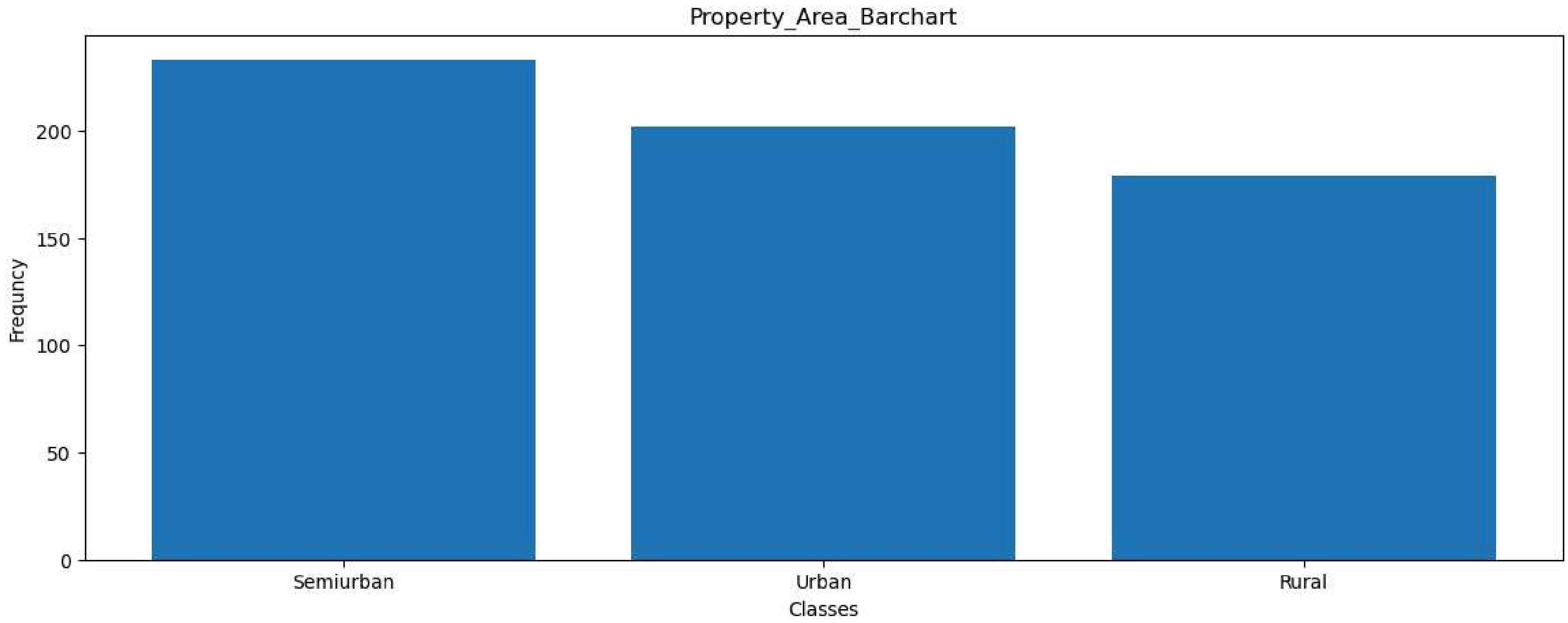
```
for i, j in enumerate(categorical[1:]):
    keys = loan_df[j].value_counts().keys()
    values = loan_df[j].value_counts().values
    plt.figure(figsize=(14,5))
    plt.bar(keys, values)

    plt.xlabel('Classes')
    plt.ylabel('Frequncy')
    plt.title(f'{j}_Barchart')
plt.show()
```


Married_Barchart
Frequncy
0
50
100
150
200
250
300
350
400
Yes
No
Classes

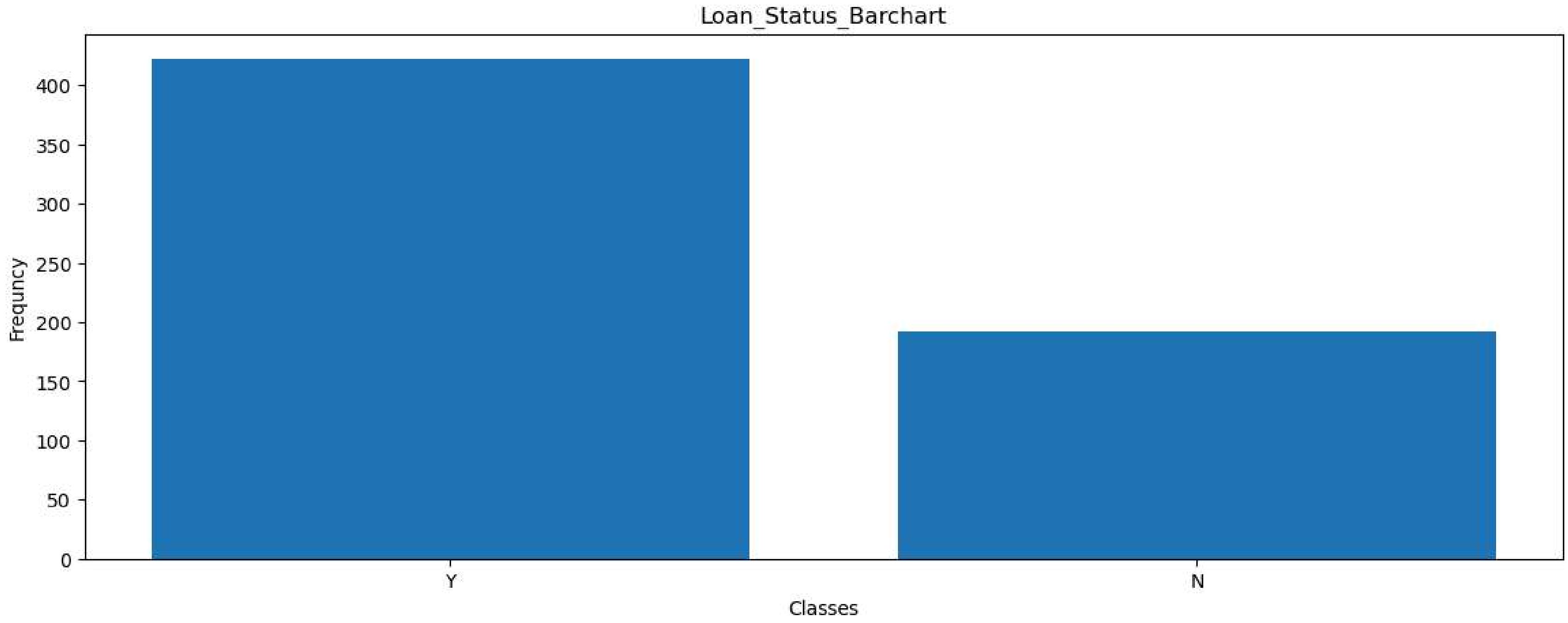

Dependents_Barchart
Frequncy
0
50
100
150
200
250
300
350
0
1
2
3+
Classes


Education_Barchart
Frequncy
0
100
200
300
400
500
Graduate
Not Graduate
Classes


Self_Employed_Barchart
Frequncy
0
100
200
300
400
500
No
Yes
Classes



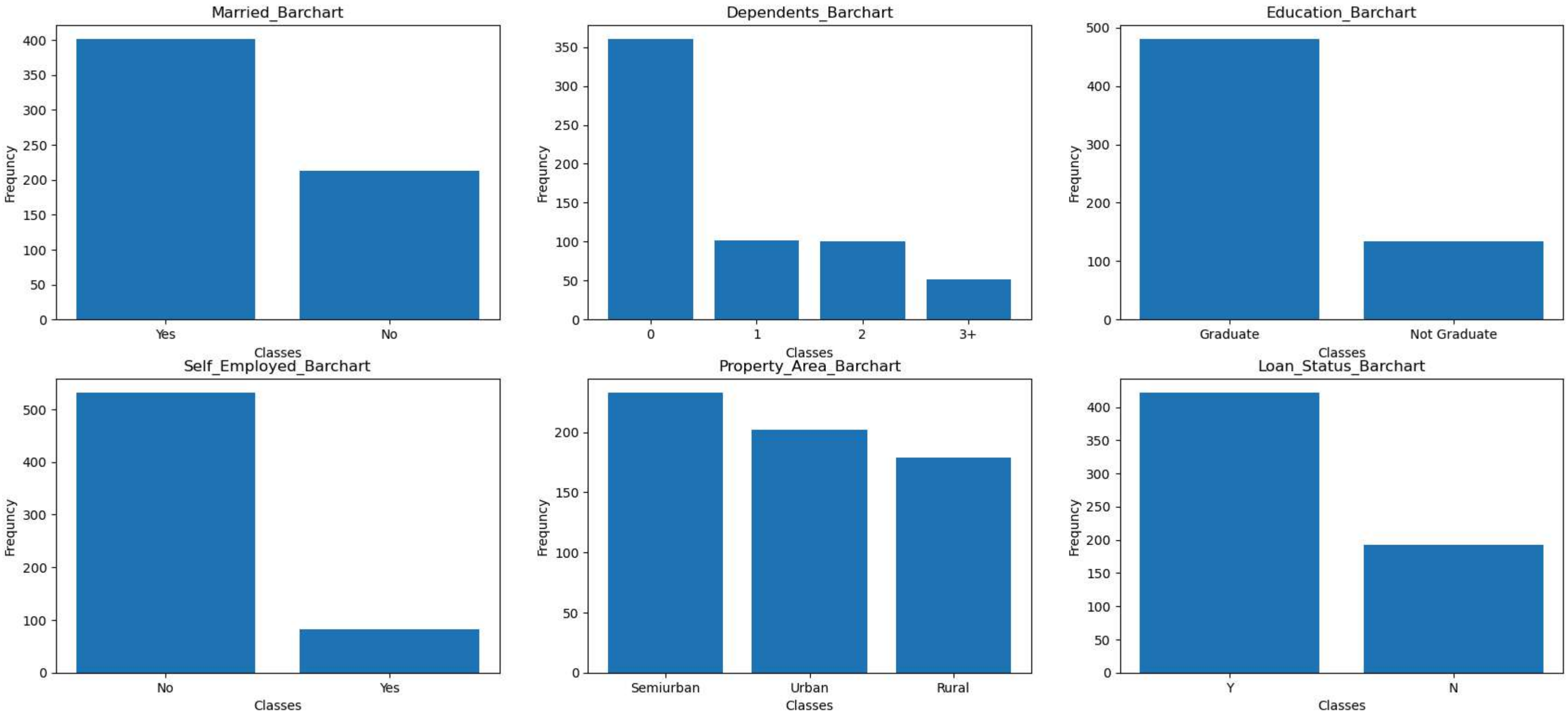
Property_Area_Barchart



Loan_Status_Barchart

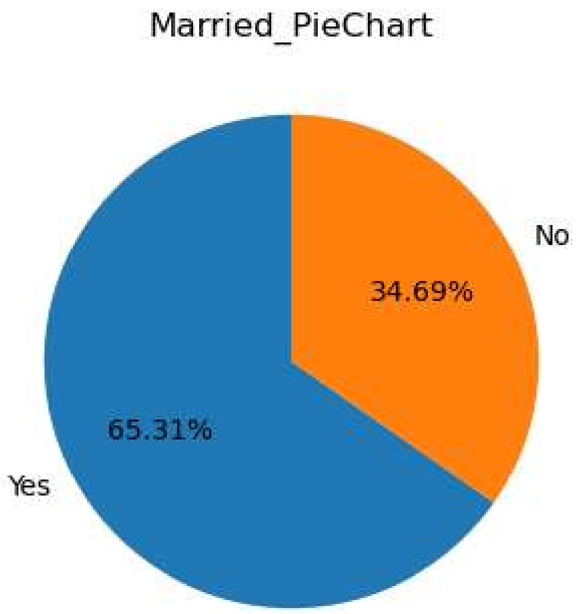
In [173…

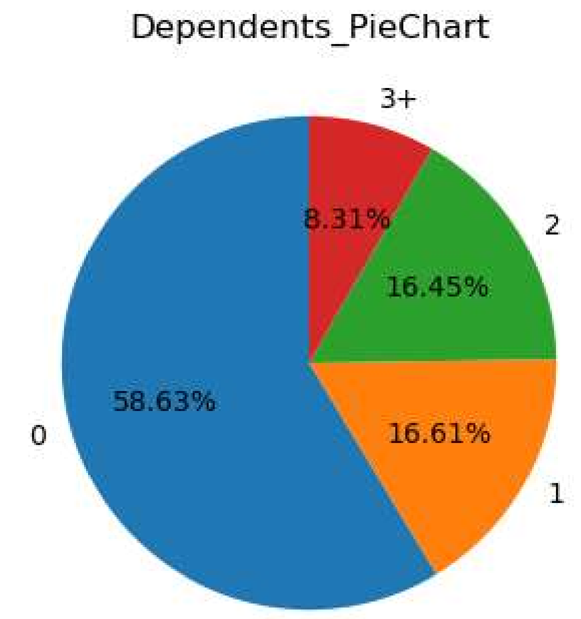
```
plt.figure(figsize=(21,14))

for i, j in enumerate(categorical[1:]):
    keys = loan_df[j].value_counts().keys()
    values = loan_df[j].value_counts().values
    plt.subplot(3,3,i+1)
    plt.bar(keys, values)

    plt.xlabel('Classes')
    plt.ylabel('Frequncy')
    plt.title(f'{j}_Barchart')
plt.show()
```

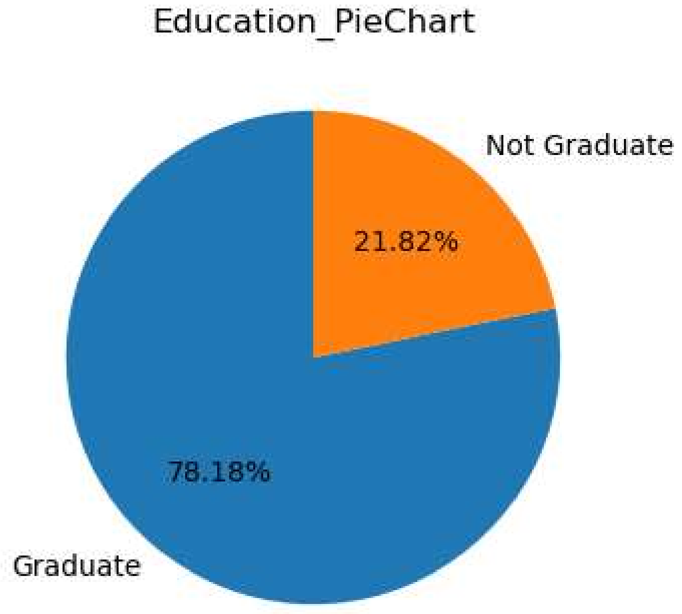


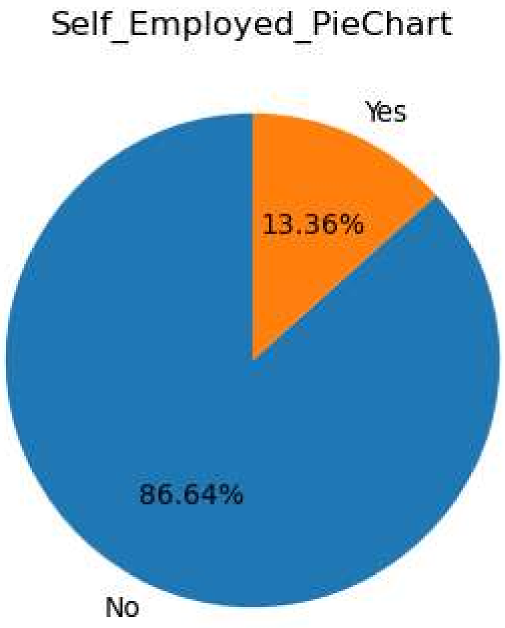
In [174…

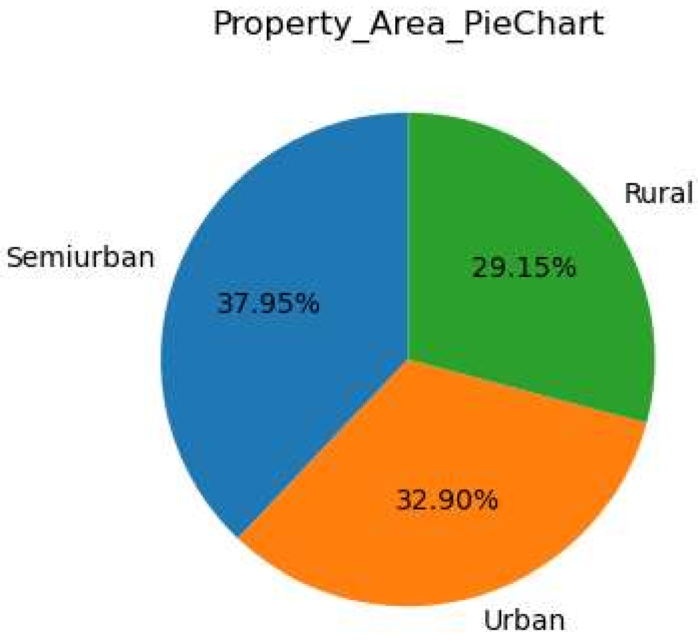
```
for i in categorical[1:]:
    counts = loan_df[i].value_counts()
    plt.figure(figsize=(10,4))
    plt.pie(counts.values, autopct = '%1.2f%%',startangle = 90, labels = counts.index)
    plt.title(f'{i}_PieChart')
    plt.show()
```

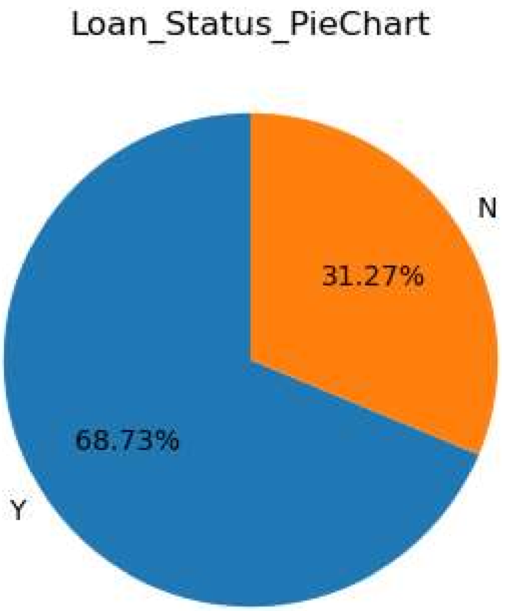



Dependents_PieChart


Education_PieChart


Self_Employed_PieChart
Yes
13.36%
86.64%
No


Property_Area_PieChart
Rural
29.15%
Semiurban
37.95%
32.90%
Urban

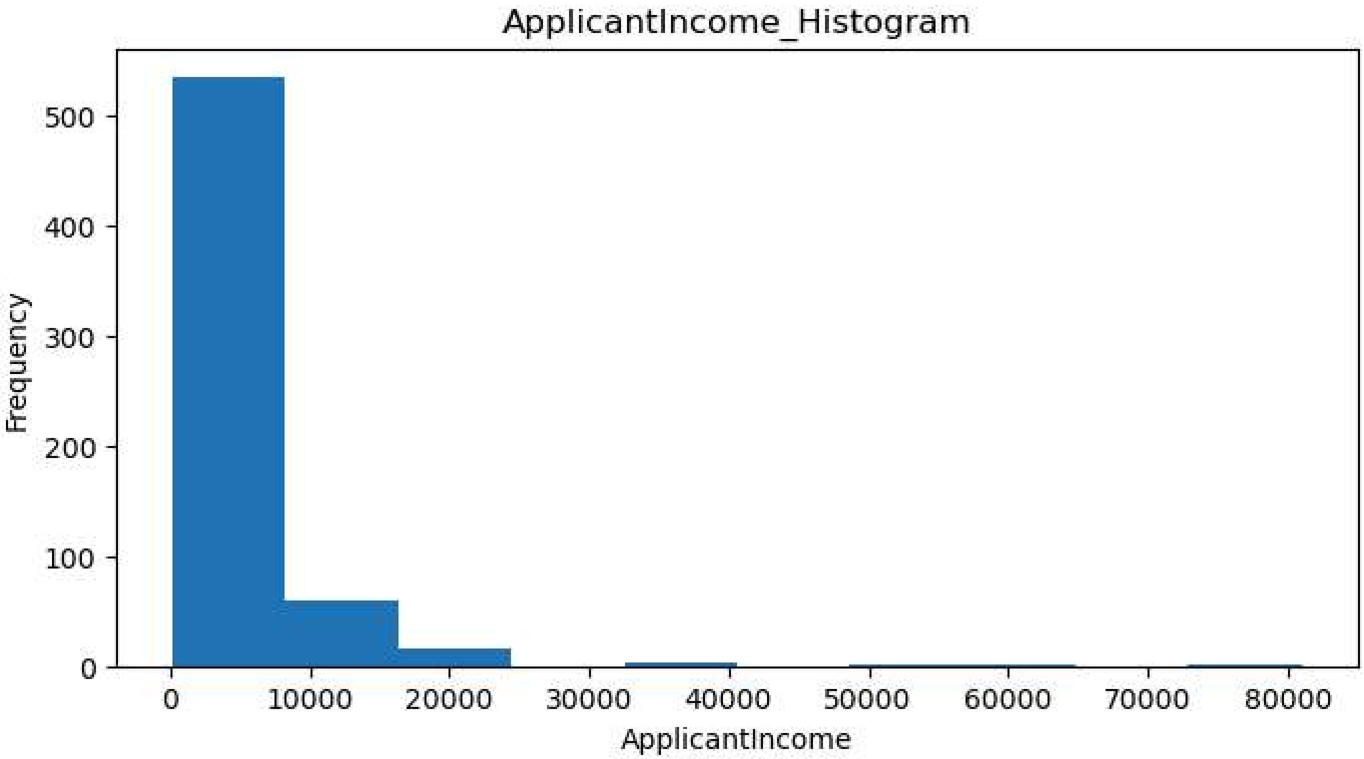


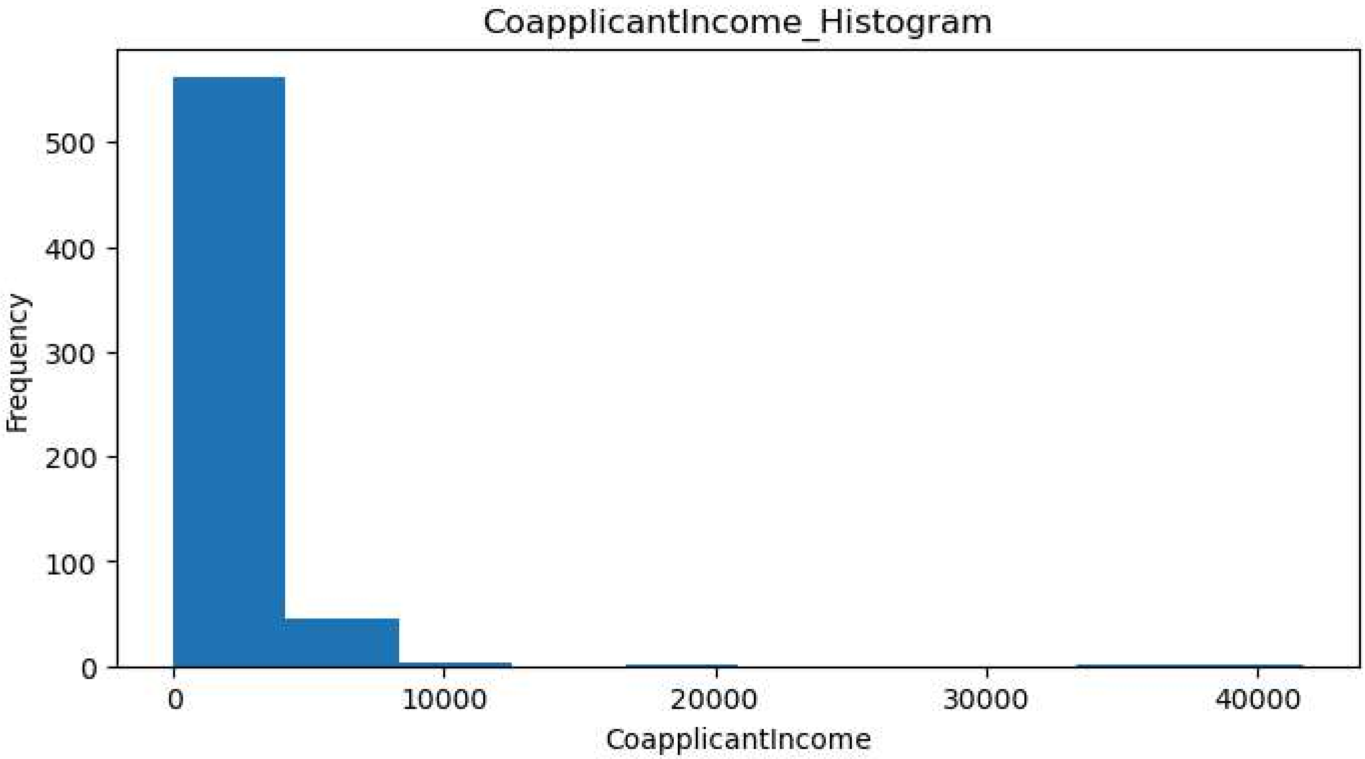
Numerical Column Analysis

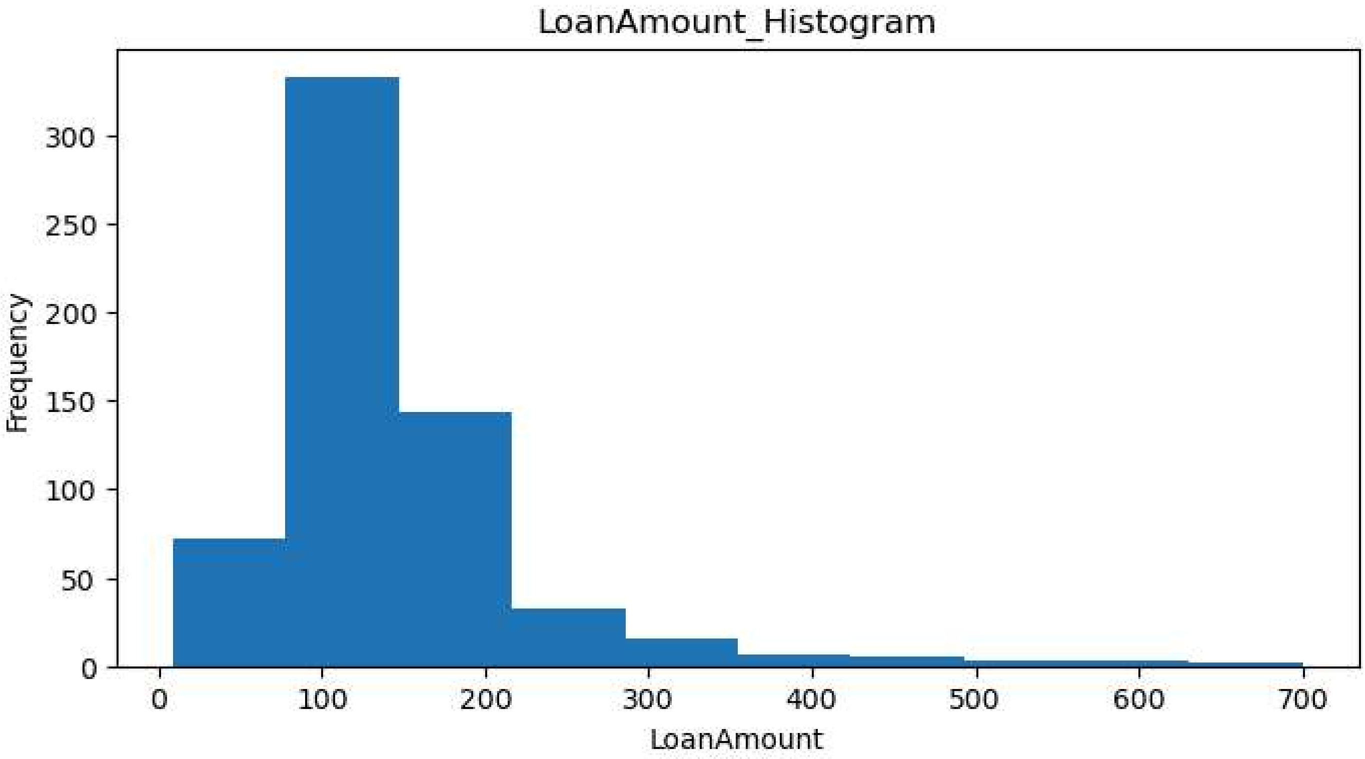
- **Histogram**

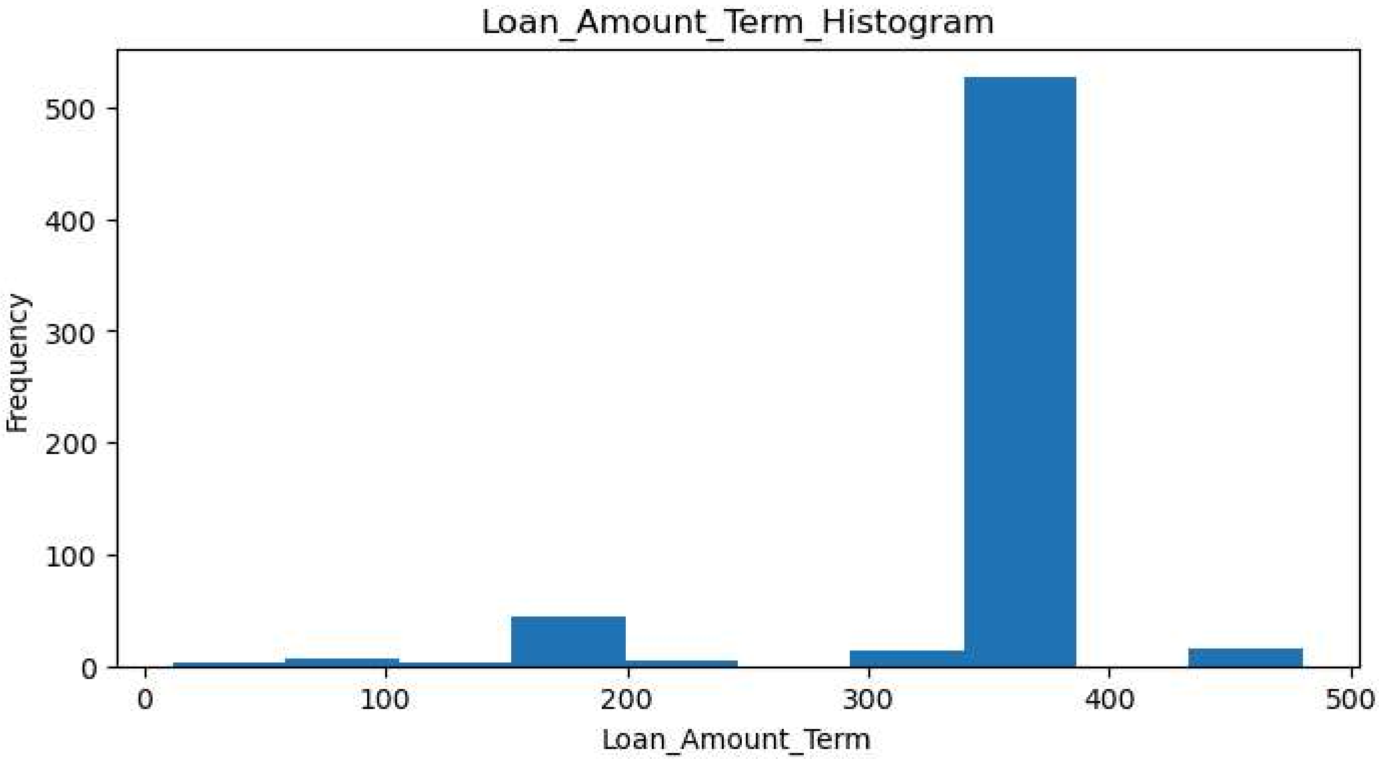
In [175…

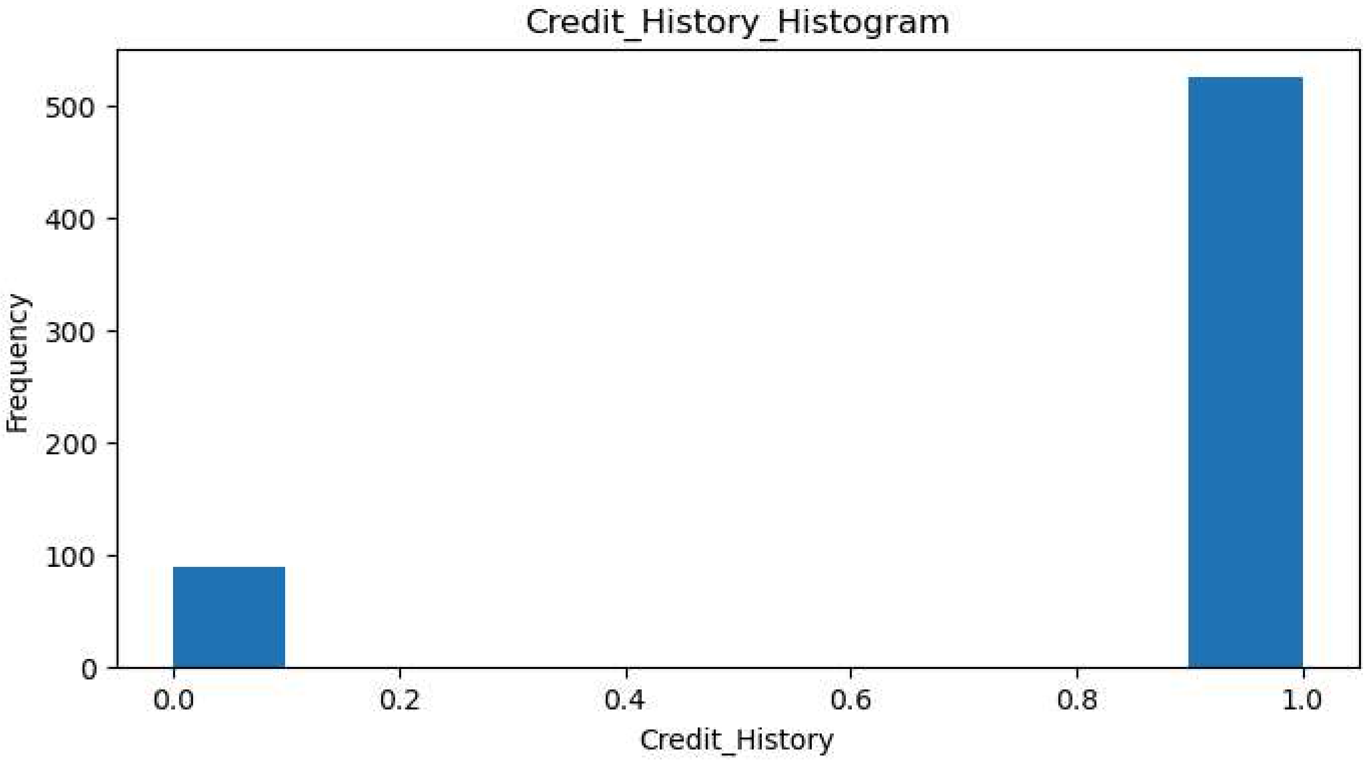
```
for i in numerical:
    plt.figure(figsize=(8,4))
    plt.hist(loan_df[i])
    plt.xlabel(i)
    plt.ylabel("Frequency")
    plt.title(f"{i}_Histogram")
    plt.show()
```


ApplicantIncome_Histogram
Frequency
500
400
300
200
100
0
0
10000
20000
30000
40000
50000
60000
70000
80000
ApplicantIncome


CoapplicantIncome_Histogram
Frequency
500
400
300
200
100
0
0
10000
20000
30000
40000
CoapplicantIncome

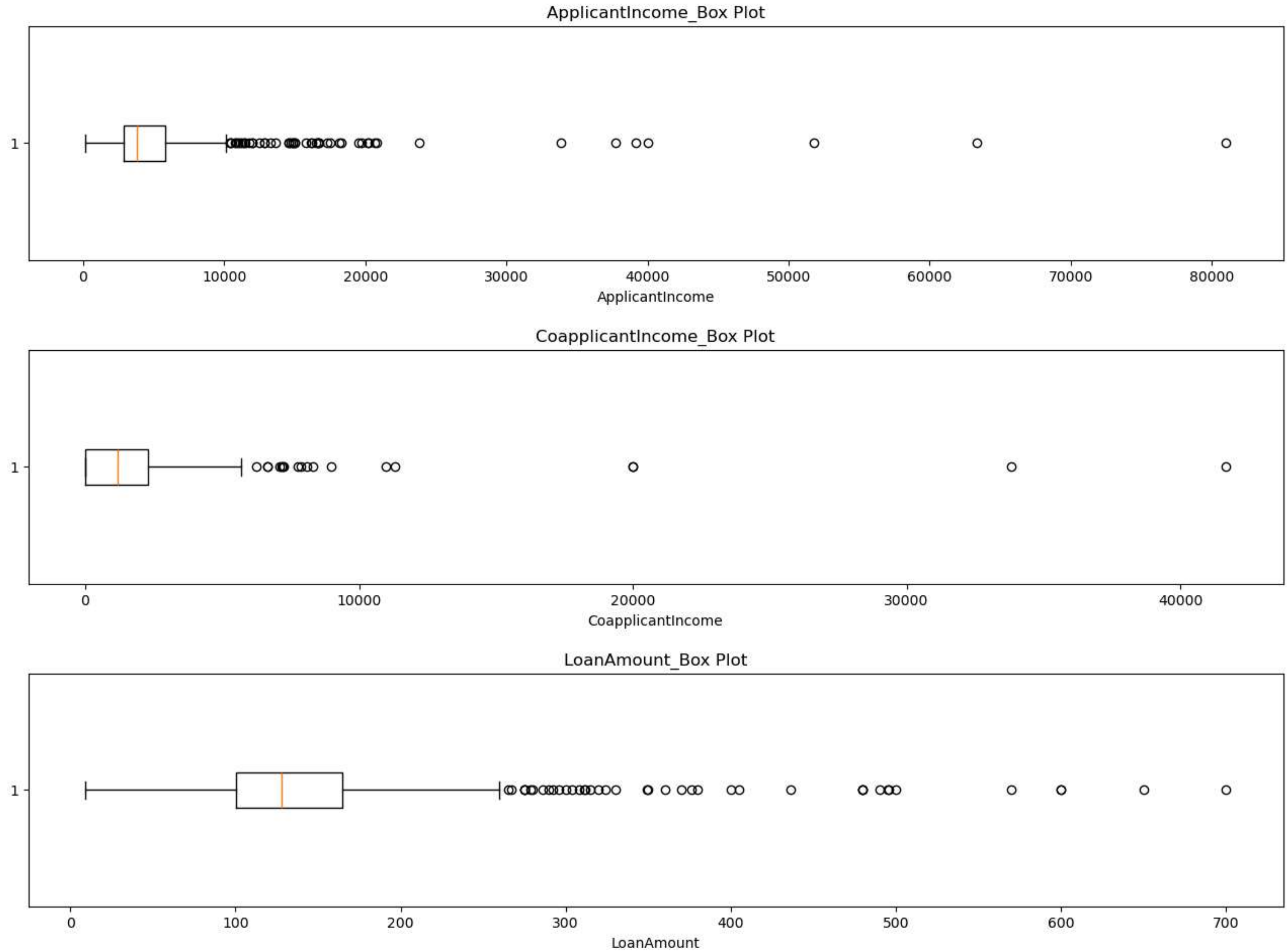

LoanAmount_Histogram
Frequency
0
50
100
150
200
250
300
0
100
200
300
400
500
600
700
LoanAmount


Loan_Amount_Term_Histogram
Frequency
0
100
200
300
400
500
0
100
200
300
400
500
Loan_Amount_Term



In [176…

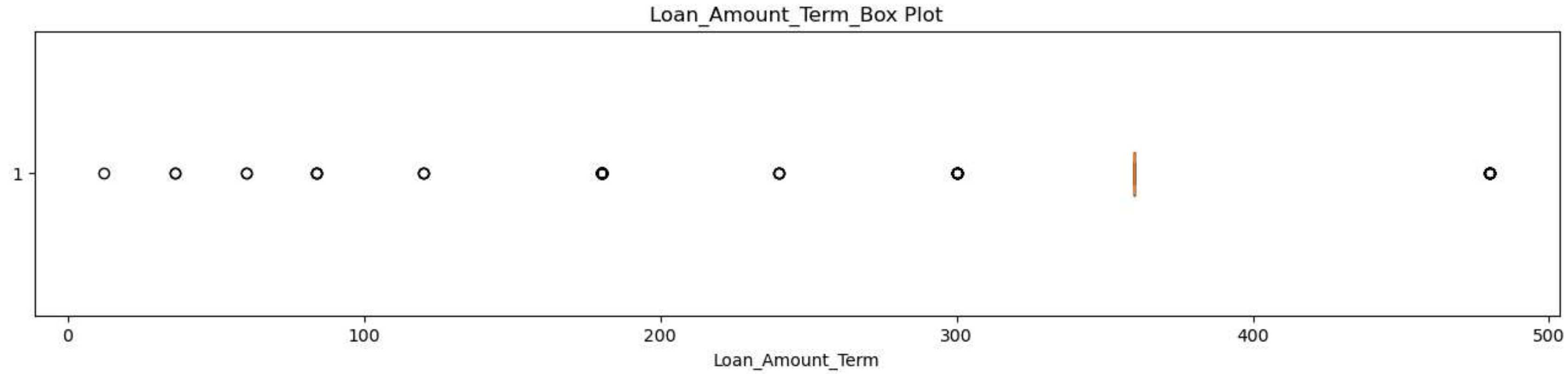
```
for i in numerical:
    plt.figure(figsize=(16,3))
    plt.boxplot(loan_df[i],vert = False)
    plt.xlabel(i)
    plt.title(f"{i}_Box Plot")
    plt.show()
```

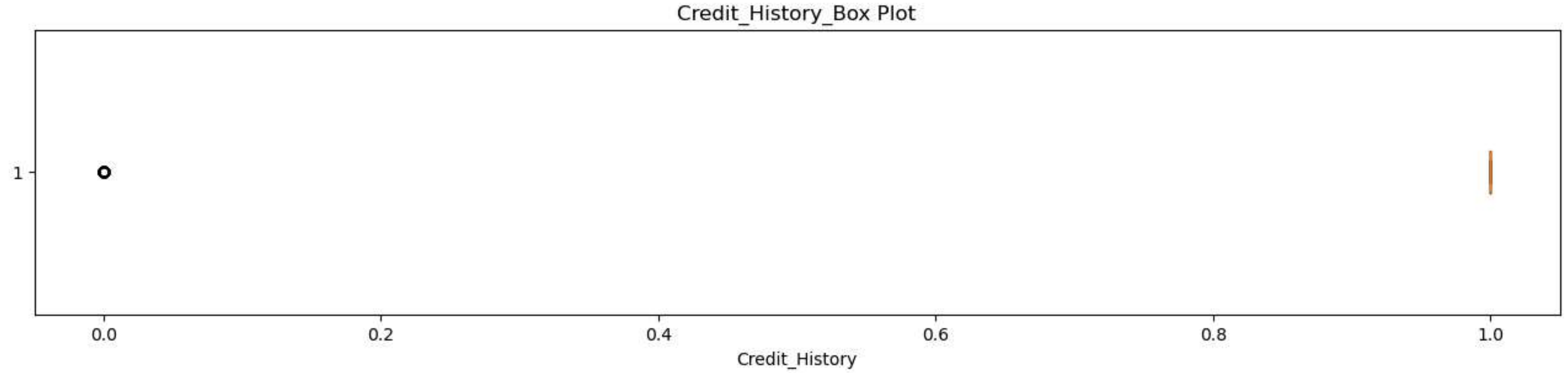


ApplicantIncome_Box Plot

CoapplicantIncome_Box Plot

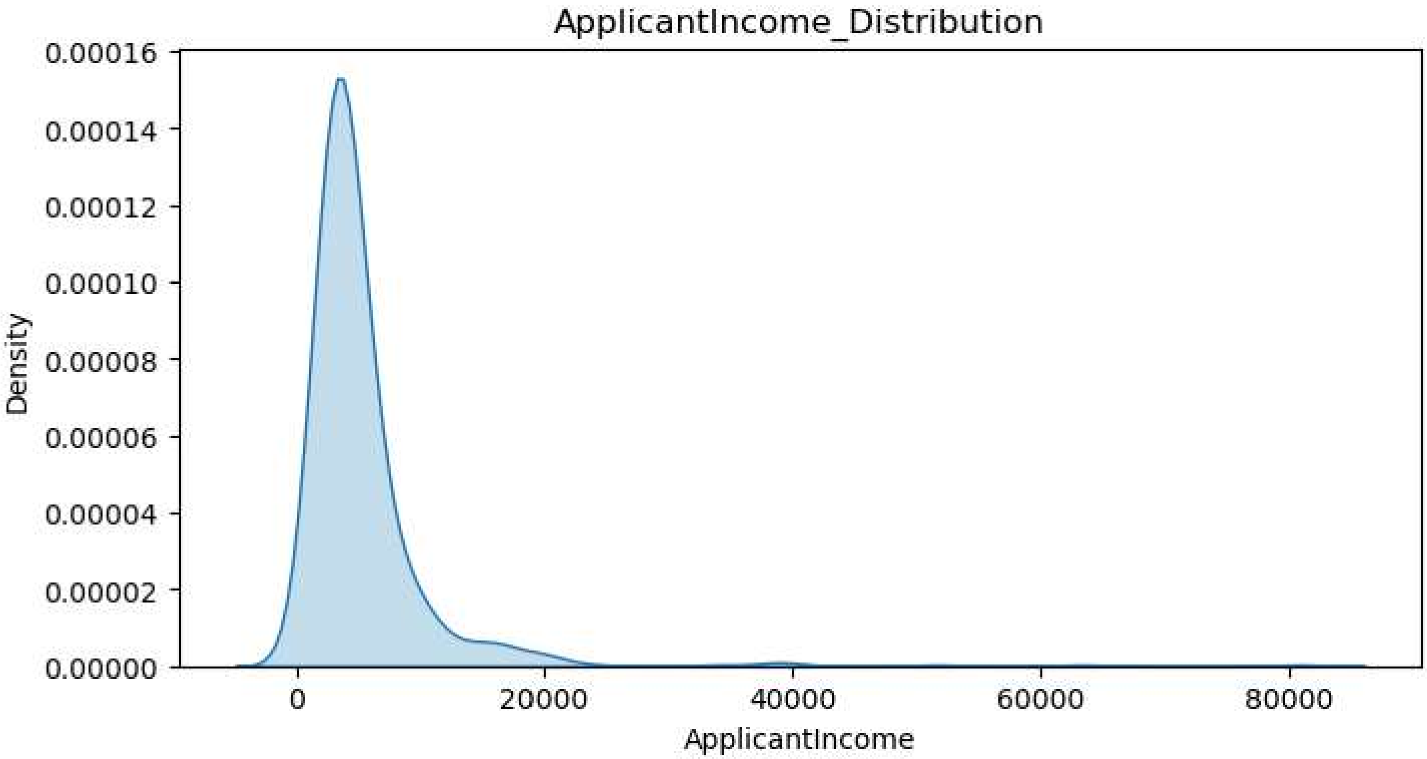
LoanAmount_Box Plot

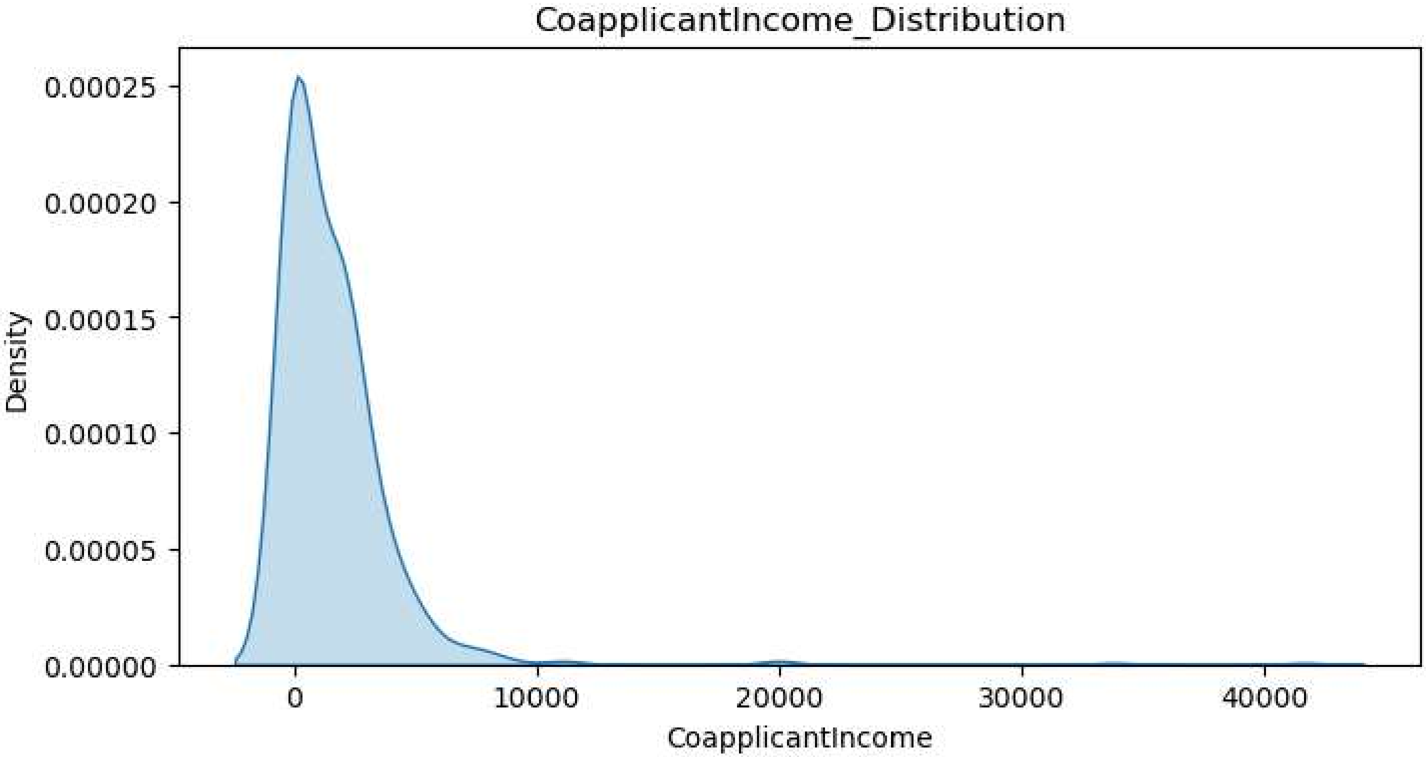


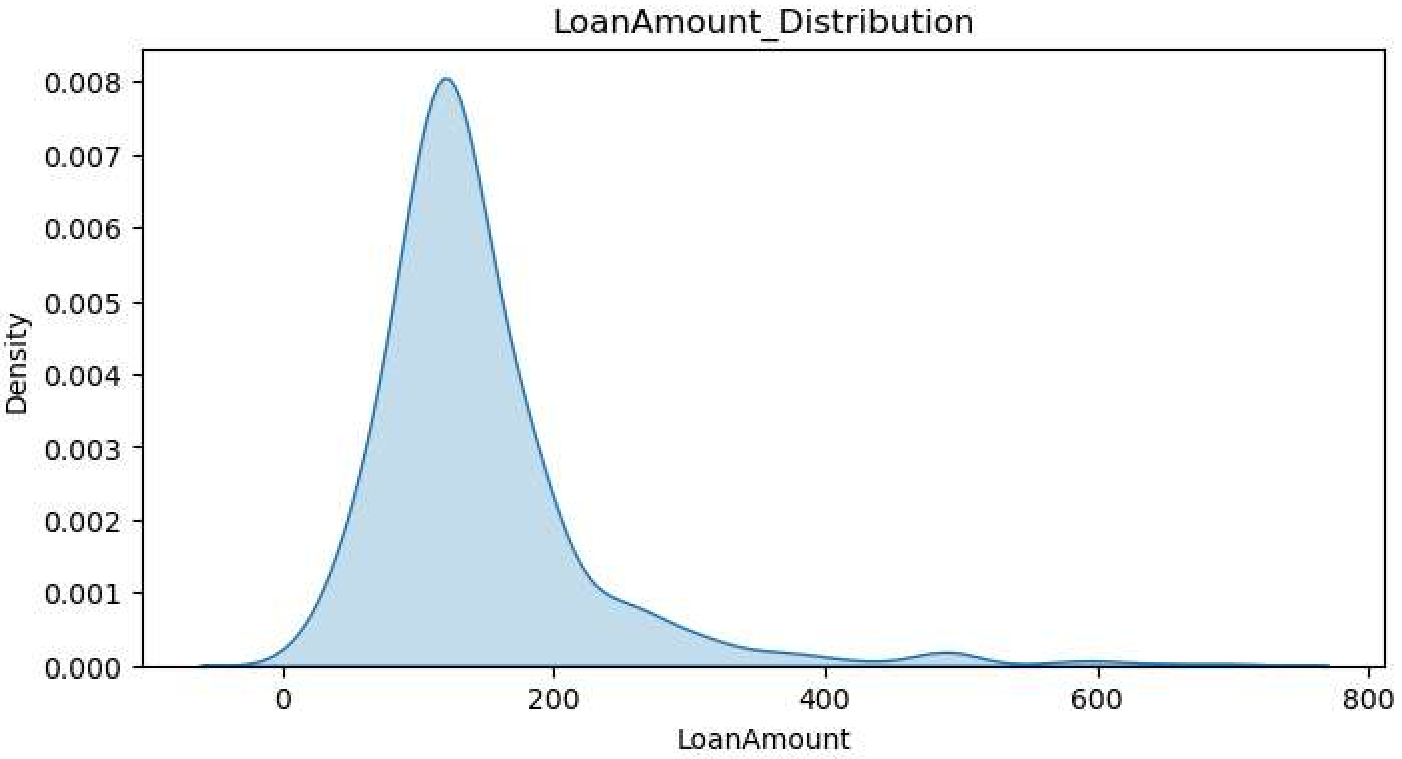


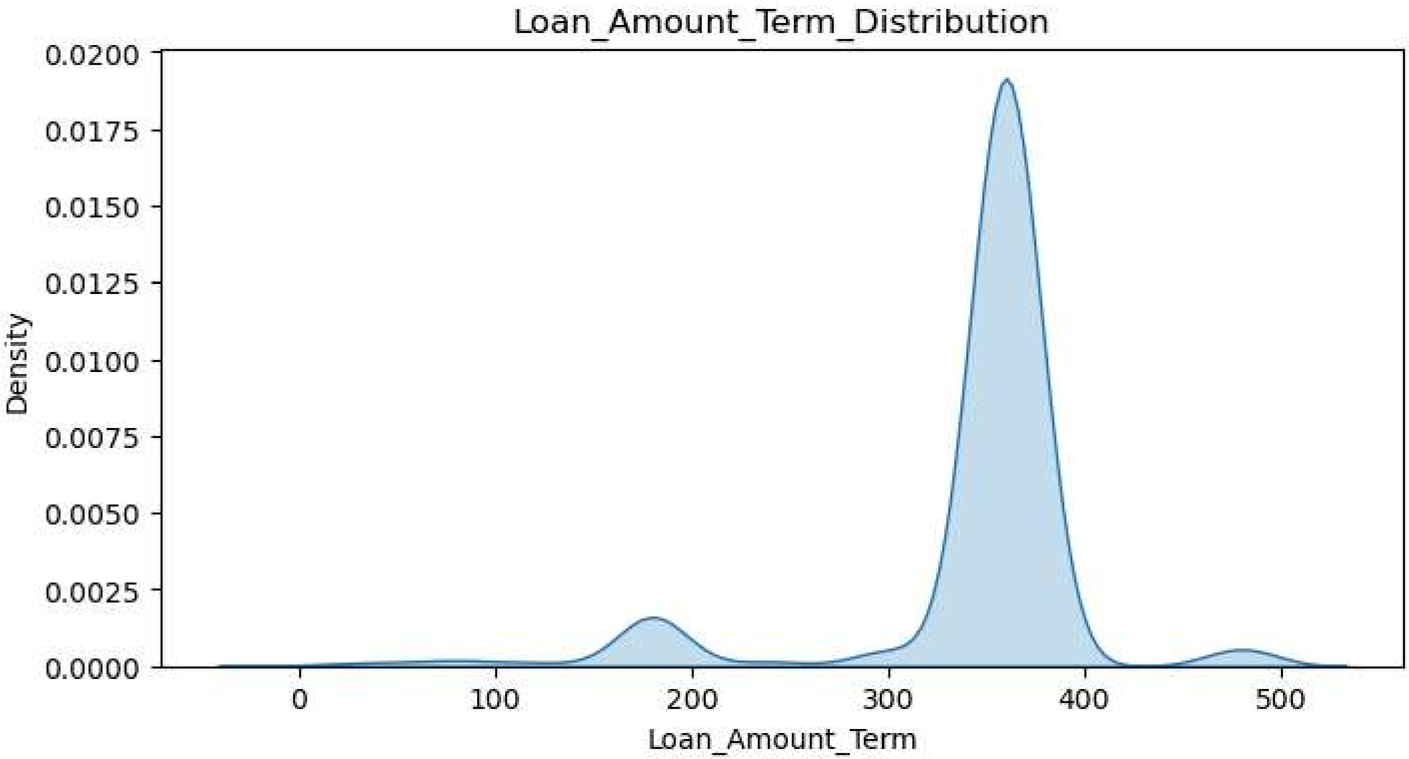
In [177…

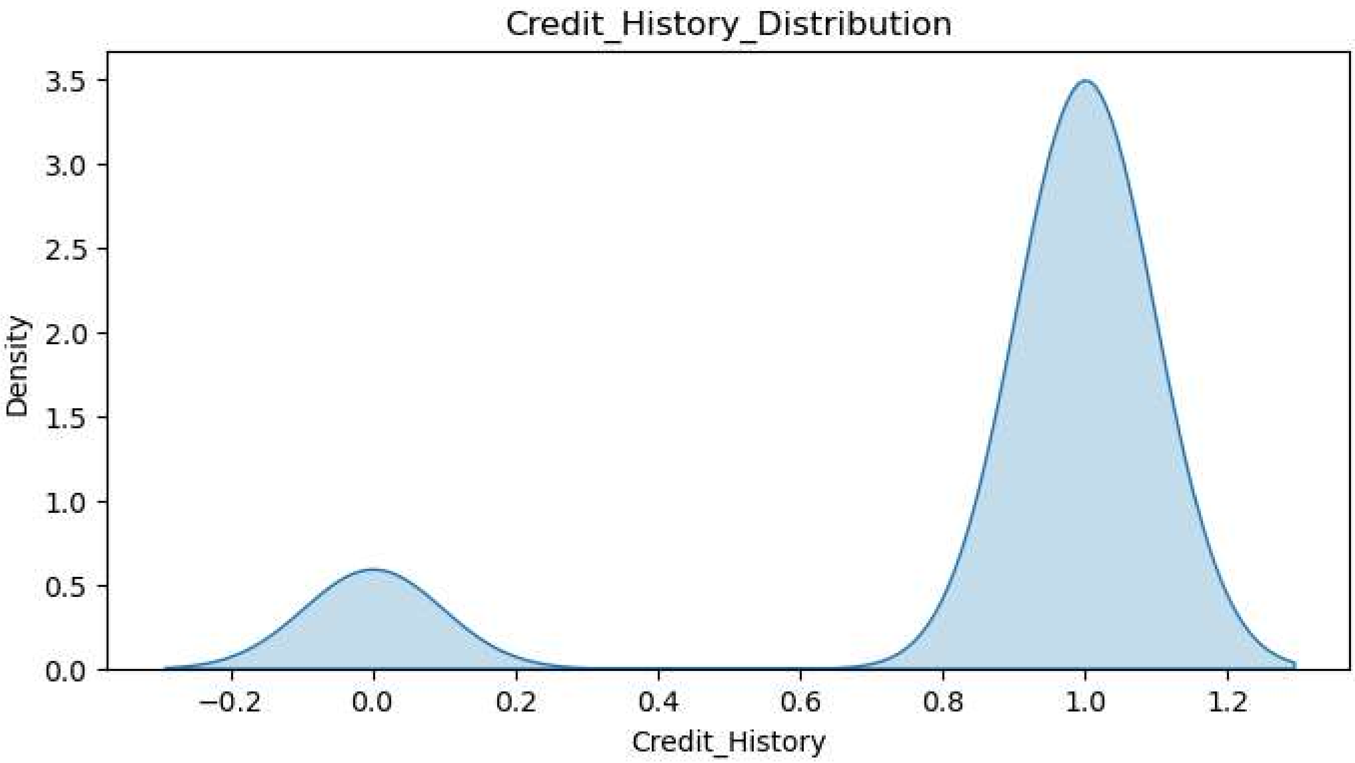
```
for i in numerical:
    plt.figure(figsize=(8,4))
    sns.kdeplot(loan_df[i], fill = True)
    plt.xlabel(i)
    plt.ylabel("Density")
    plt.title(f"{i}_Distribution")
    plt.show()
```


ApplicantIncome_Distribution
Density
0.00016
0.00014
0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
0
20000
40000
60000
80000
ApplicantIncome


CoapplicantIncome_Distribution
Density
0.00025
0.00020
0.00015
0.00010
0.00005
0.00000
0
10000
20000
30000
40000
CoapplicantIncome


LoanAmount_Distribution
Density
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0
200
400
600
800
LoanAmount


Loan_Amount_Term_Distribution
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
Density
0
100
200
300
400
500
Loan_Amount_Term



In [178…

```
loan_df_clean = loan_df.copy()
for i in numerical:
    series = loan_df_clean[i]
    q1 = np.quantile(series,0.25)
    q2 = np.quantile(series,0.50)
    q3 = np.quantile(series,0.75)
    IQR = q3 - q1
    lower = q1 - 1.5 * IQR
    upper = q3 + 1.5 * IQR
    con1 = series > lower
    con2 = series > upper
    outliers = con1 | con2
    print(f"{i} : {outliers.sum()} Outliers detected")
    series[outliers] = q2
    loan_df_clean[i] = series
```

```
ApplicantIncome : 614 Outliers detected
CoapplicantIncome : 614 Outliers detected
LoanAmount : 614 Outliers detected
Loan_Amount_Term : 15 Outliers detected
Credit_History : 0 Outliers detected
```

In [179…

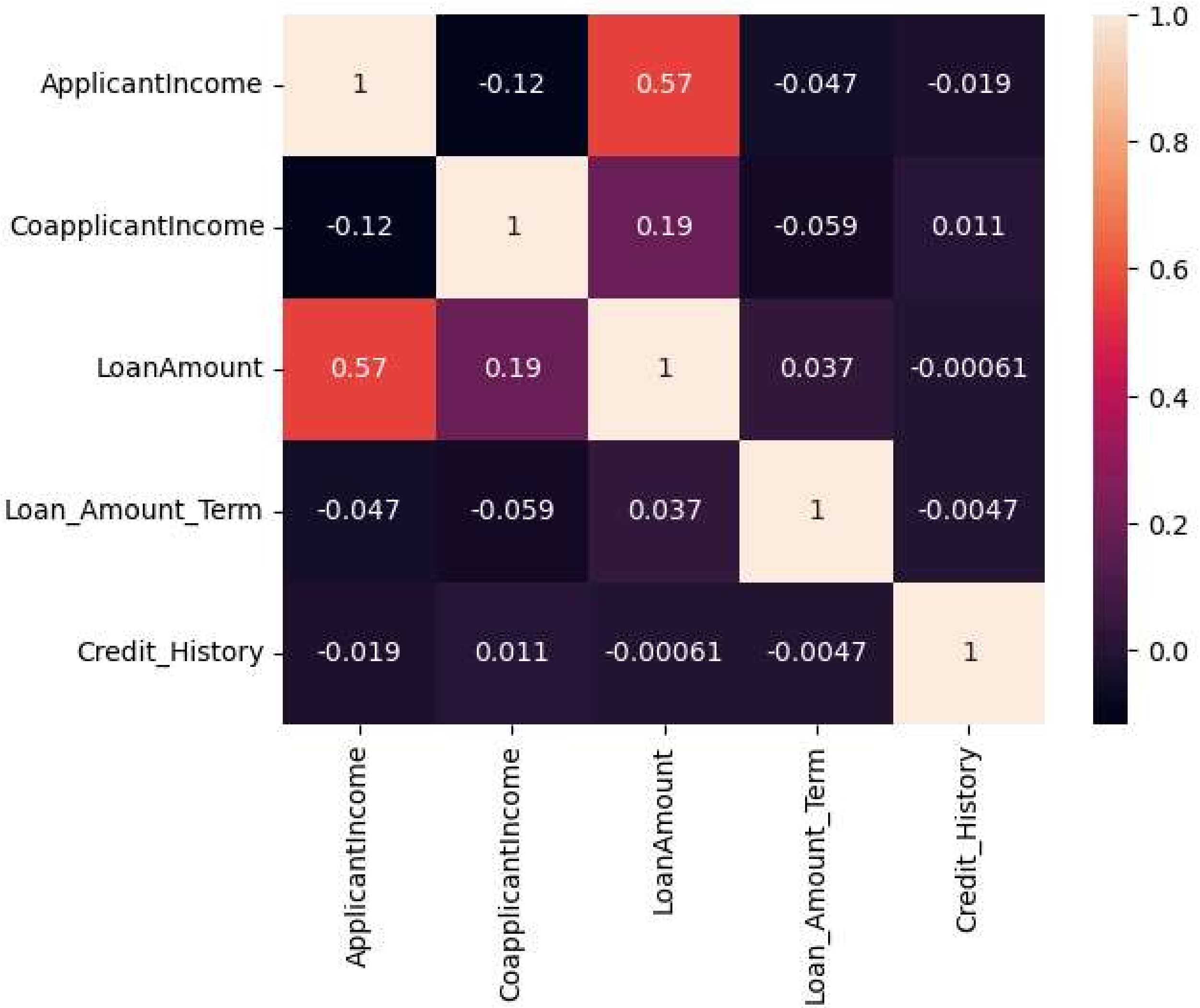
```
loan_df_winso = loan_df.copy()
for i in numerical:
    series = loan_df_winso[i]
    q1 = np.percentile(series,25)
    q2 = np.percentile(series,50)
    q3 = np.percentile(series,75)
    IQR = q3-q1
    lower = q1 - 1.5 * IQR
    upper = q3 + 1.5 * IQR
    series_clip = np.clip(series, lower, upper)
    loan_df_winso[i] = series
```

In [180…

```
loan_df_corr = loan_df.corr(numeric_only = True)
sns.heatmap(loan_df_corr,annot = True)
```

Out[180…

```
<Axes: >
```



In [181…

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
for i in categorical[1:]:
    loan_df[i] = le.fit_transform(loan_df[i])
loan_df
```

Out[181…

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amour
0	Male	0	0	0	0	5849	0.0	128.0	
1	Male	1	1	0	0	4583	1508.0	128.0	
2	Male	1	0	0	1	3000	0.0	66.0	
3	Male	1	0	1	0	2583	2358.0	120.0	
4	Male	0	0	0	0	6000	0.0	141.0	
...	...	...	...	...	...	...	...	...	
609	Female	0	0	0	0	2900	0.0	71.0	
610	Male	1	3	0	0	4106	0.0	40.0	
611	Male	1	1	0	0	8072	240.0	253.0	
612	Male	1	2	0	0	7583	0.0	187.0	
613	Female	0	0	0	1	4583	0.0	133.0	

614 rows × 12 columns

In [182…

```
for i in categorical[1:]:
    pd.get_dummies(loan_df[i],dtype = int)
loan_df
```

Out[182…

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amour
0	Male	0	0	0	0	5849	0.0	128.0	
1	Male	1	1	0	0	4583	1508.0	128.0	
2	Male	1	0	0	1	3000	0.0	66.0	
3	Male	1	0	1	0	2583	2358.0	120.0	
4	Male	0	0	0	0	6000	0.0	141.0	
...	...	...	...	...	...	...	...	...	
609	Female	0	0	0	0	2900	0.0	71.0	
610	Male	1	3	0	0	4106	0.0	40.0	
611	Male	1	1	0	0	8072	240.0	253.0	
612	Male	1	2	0	0	7583	0.0	187.0	
613	Female	0	0	0	1	4583	0.0	133.0	

614 rows × 12 columns

In [ ]:

In [189…

```
from sklearn.preprocessing import StandardScaler

ss = StandardScaler()

loan_df_z = loan_df.copy()
loan_df_z[numerical] = ss.fit_transform(loan_df[numerical])

loan_df_z.head()
```

Out[189…

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_
0	Male	0	0	0	0	0.072991	-0.554487	-0.211241	0.27
1	Male	1	1	0	0	-0.134412	-0.038732	-0.211241	0.27
2	Male	1	0	0	1	-0.393747	-0.554487	-0.948996	0.27
3	Male	1	0	1	0	-0.462062	0.251980	-0.306435	0.27
4	Male	0	0	0	0	0.097728	-0.554487	-0.056551	0.27

In [190…

```python
from sklearn.preprocessing import MinMaxScaler

mm = MinMaxScaler()

loan_df_norm = loan_df.copy()
loan_df_norm[numerical] = mm.fit_transform(loan_df[numerical])

loan_df_norm.head()
```

Out[190…

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_
0	Male	0	0	0	0	0.070489	0.000000	0.172214	0.7
1	Male	1	1	0	0	0.054830	0.036192	0.172214	0.7
2	Male	1	0	0	1	0.035250	0.000000	0.082489	0.7
3	Male	1	0	1	0	0.030093	0.056592	0.160637	0.7
4	Male	0	0	0	0	0.072356	0.000000	0.191027	0.7