Importing The Libraries

In [11...

```
import numpy as np
import pandas as pd
import pickle
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import sklearn
from sklearn.preprocessing import LabelEncoder
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import GradientBoostingClassifier,RandomForestClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import RandomizedSearchCV
from xgboost import XGBClassifier
from sklearn.ensemble import RandomForestClassifier
import imblearn
from imblearn.under_sampling import RandomUnderSampler
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import scale
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score,classification_report,confusion_matrix,f1_sc
```

Reading The Dataset

In [118]:

```
df=pd.read_csv('Loan_dataset.csv')
df
```

Ou...

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

614 rows × 13 columns

In [119]:

```
df.head()
```

Ou...

Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	Loa

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	Loa
0	LP001002	Male	No	0	Graduate	No	5849	0.0	
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	
4	LP001008	Male	No	0	Graduate	No	6000	0.0	

In [120]:

```
df.info()
```

```
RangeIndex: 614 entries, 0 to 613
Data columns (total 13 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Loan_ID            614 non-null    object 
 1   Gender             601 non-null    object 
 2   Married            611 non-null    object 
 3   Dependents         599 non-null    object 
 4   Education          614 non-null    object 
 5   Self_Employed      582 non-null    object 
 6   ApplicantIncome    614 non-null    int64  
 7   CoapplicantIncome  614 non-null    float64
 8   LoanAmount         592 non-null    float64
 9   Loan_Amount_Term   600 non-null    float64
 10  Credit_History     564 non-null    float64
 11  Property_Area      614 non-null    object 
 12  Loan_Status        614 non-null    object 
dtypes: float64(4), int64(1), object(8)
memory usage: 62.5+ KB
```

In [121]:

```
df.shape
```

Out[121]:

```
(614, 13)
```

In [122]:

```
df=df.drop(columns=["Loan_ID"],axis=1)
```

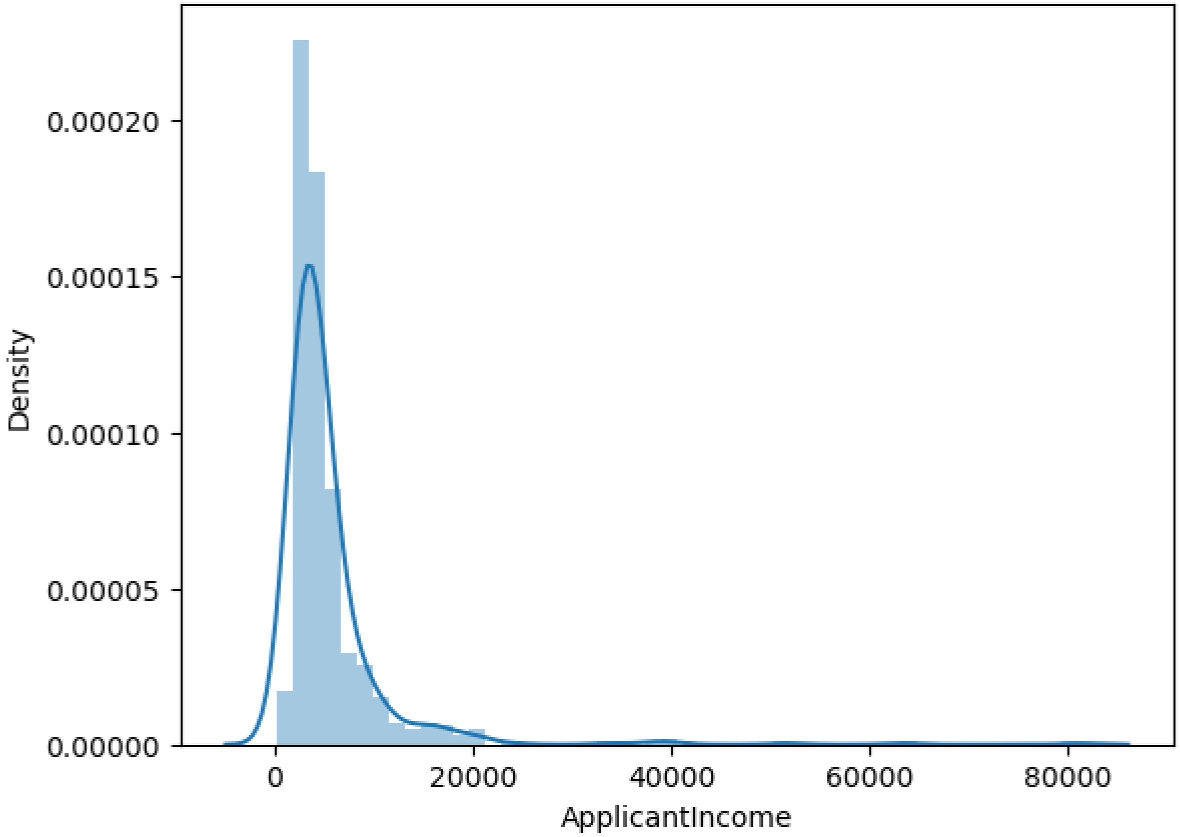
Uni-Variate Analysis

In [42]:

```
sns.distplot(df.ApplicantIncome)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `dist
plot` is a deprecated function and will be removed in a future version. Please adapt your code
to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an a
xes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[42]:

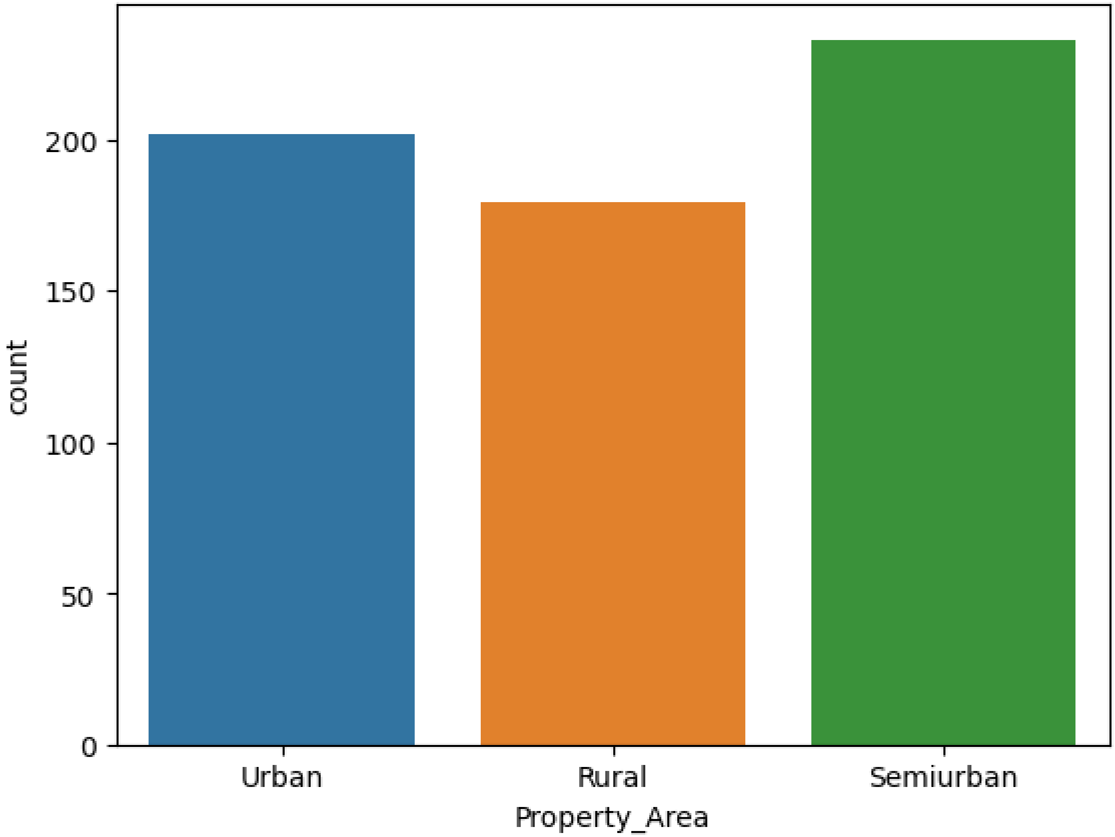


In [43]:

```
sns.countplot(df.Property_Area)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[43]:

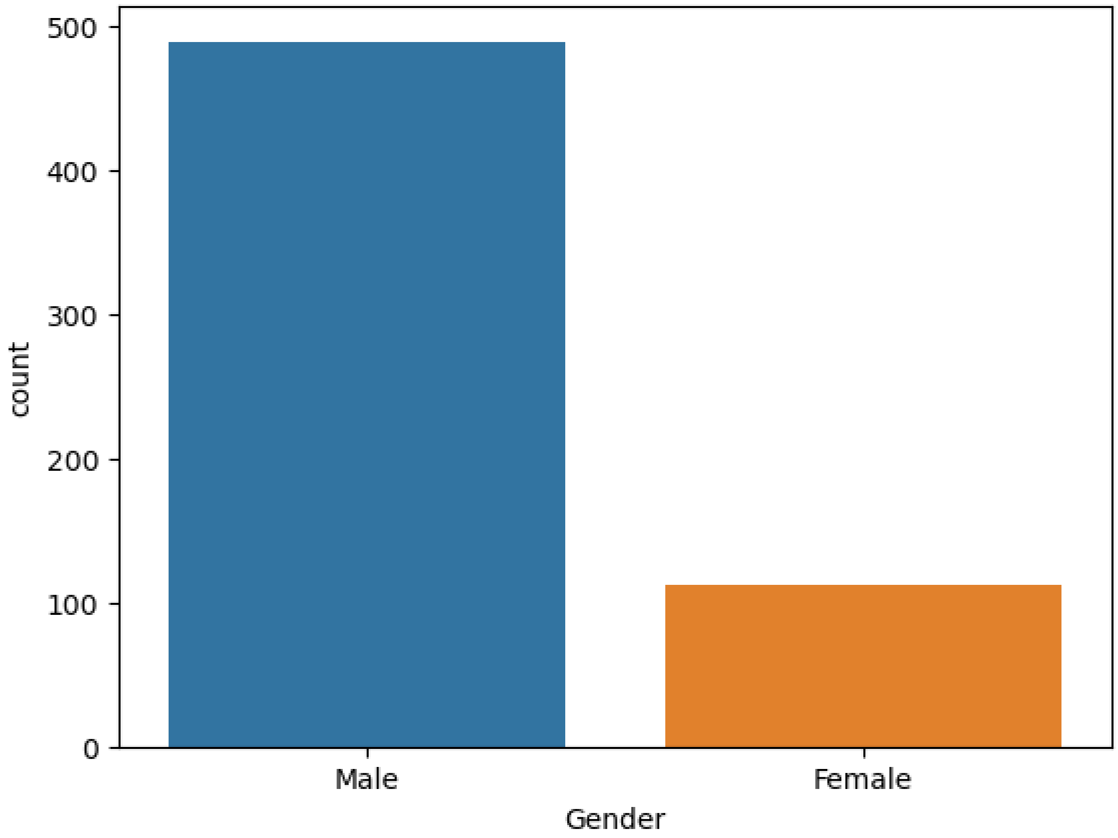


In [44]:

```
sns.countplot(df.Gender)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[44]:

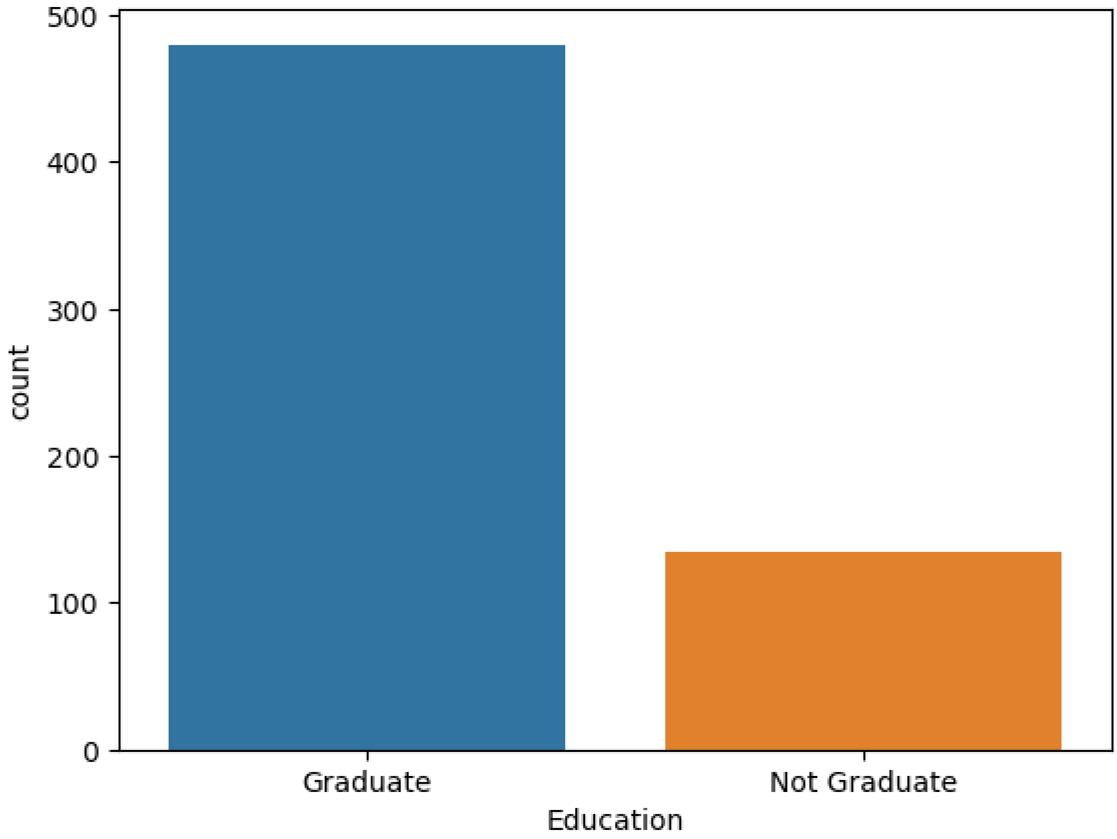


In [45]:

```
sns.countplot(df.Education)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[45]:

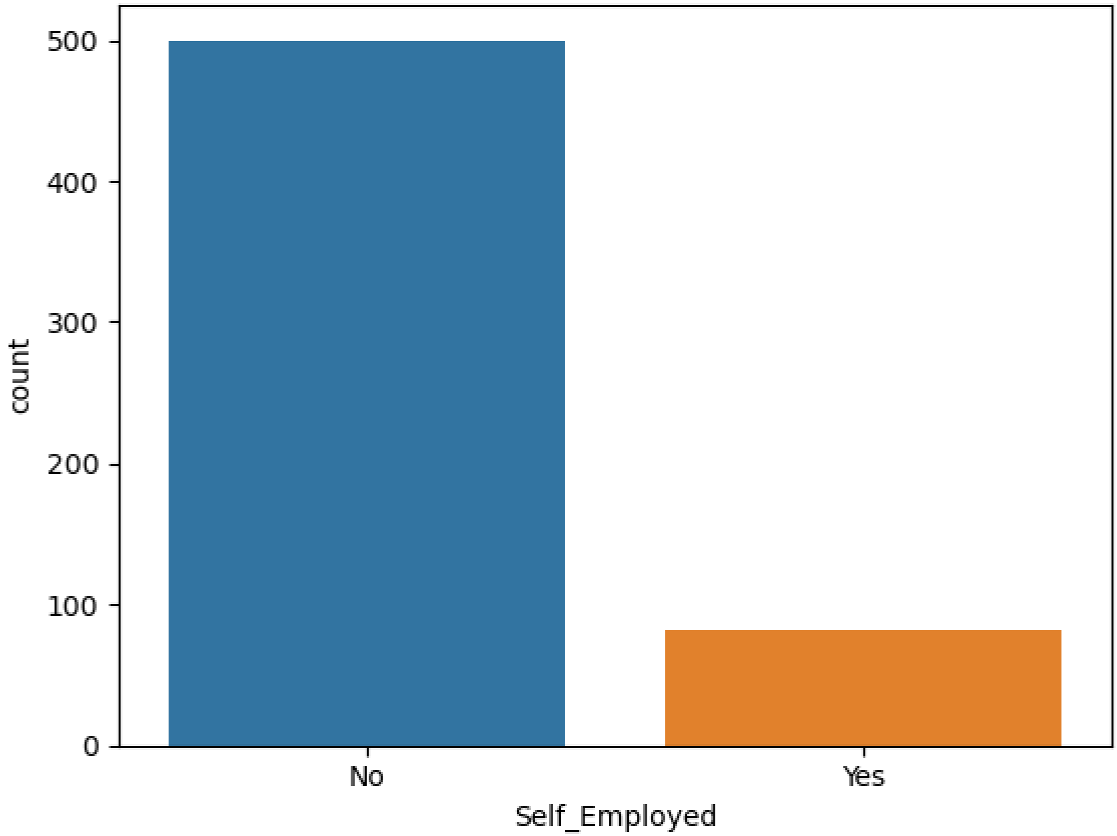


In [46]:

```
sns.countplot(df.Self_Employed)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[46]:

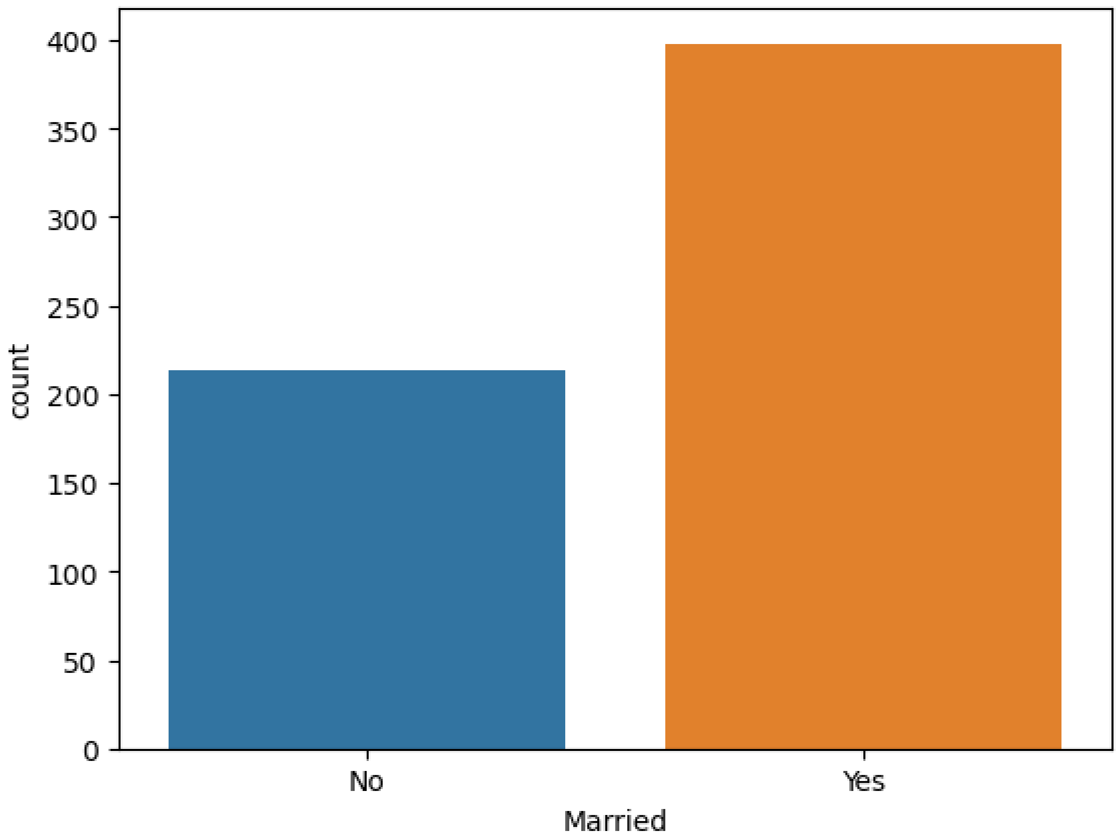


In [47]:

```
sns.countplot(df.Married)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

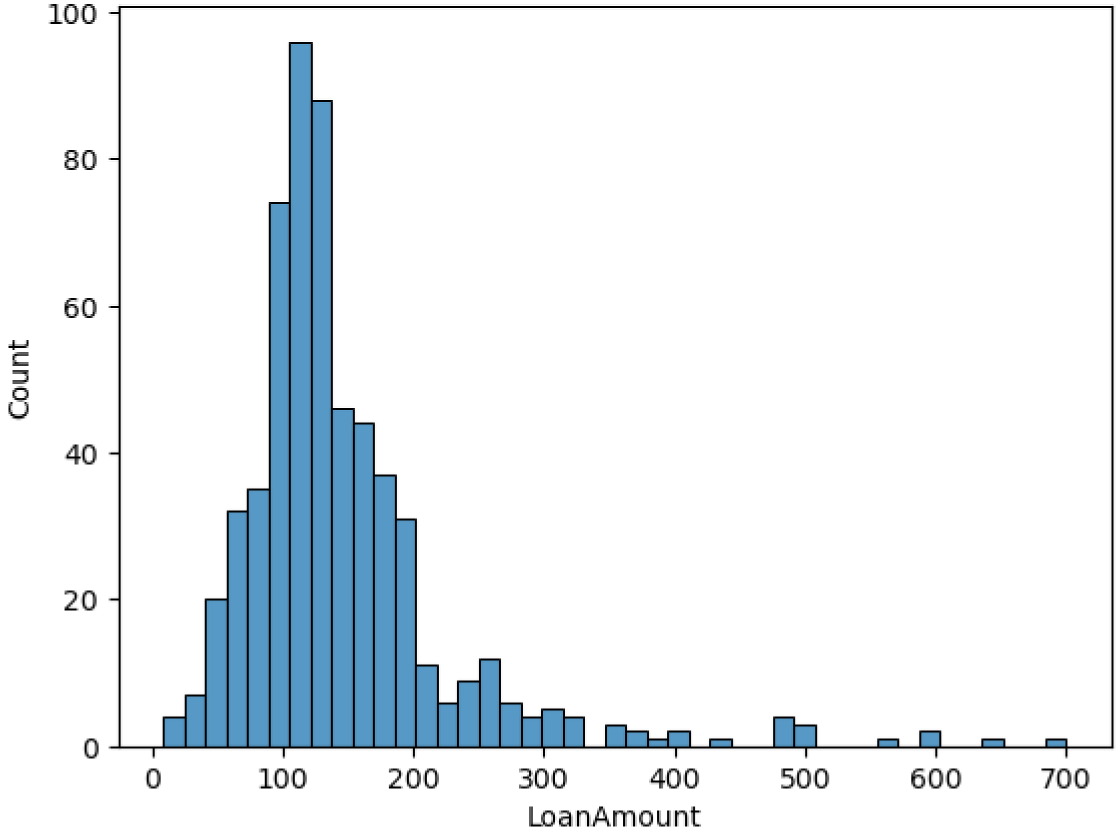
Out[47]:



In [48]:

```
sns.histplot(df.LoanAmount)
```

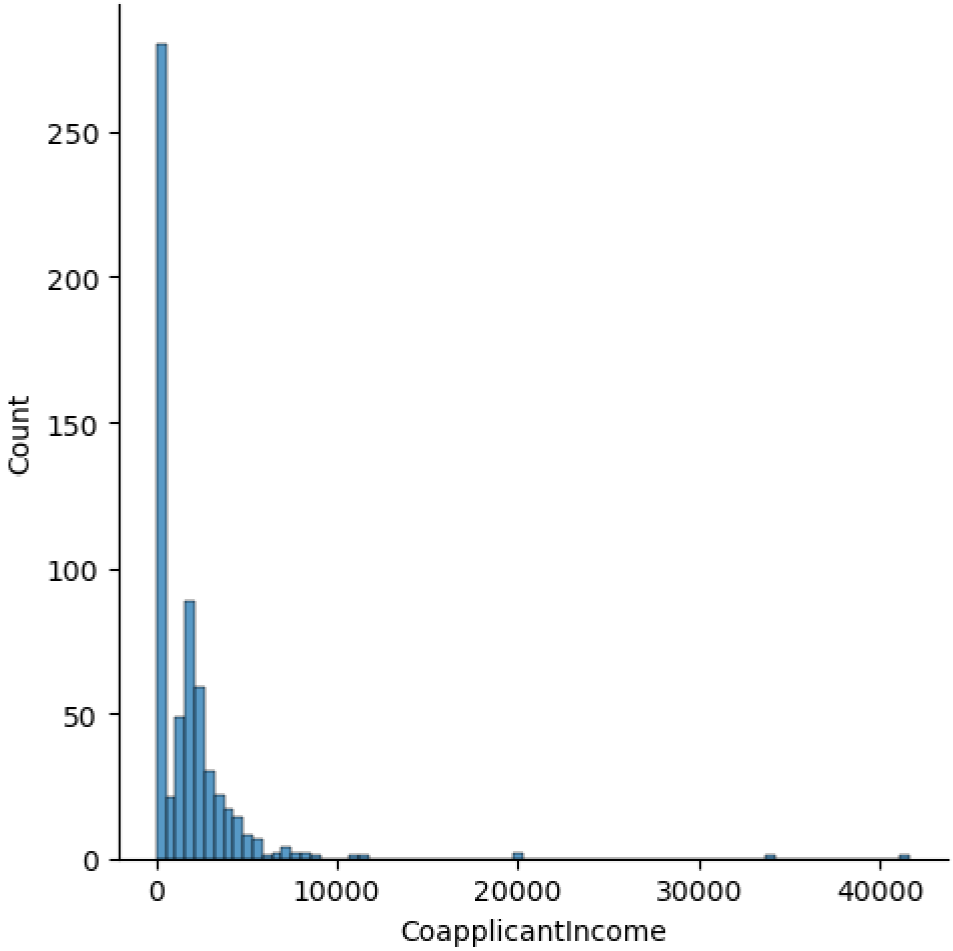
Out[48]:



In [49]:

```
sns.displot(df.CoapplicantIncome)
```

Out[49]:

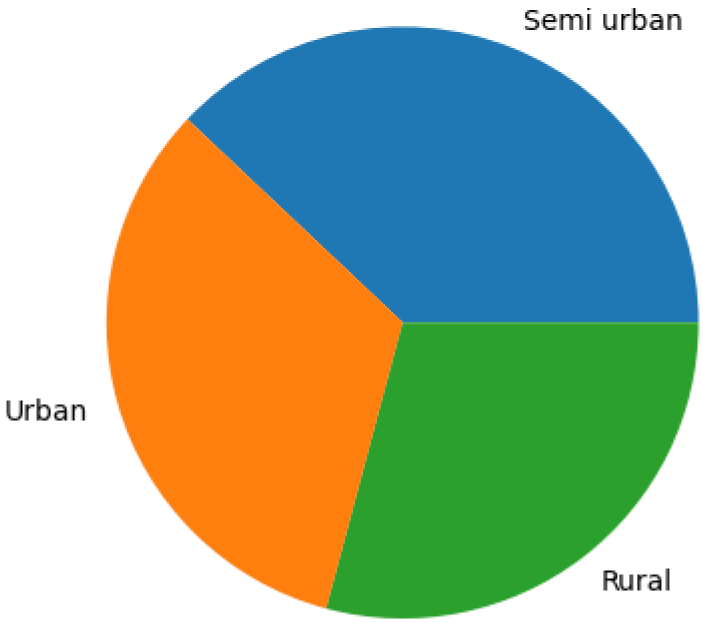


In [50]:

```
plt.pie(df.Property_Area.value_counts(),[0,0,0],labels=['Semi urban','Urban','Rural'])
```

Out[50]:

```
([,
  ,
  ],
 [Text(0.40661098511372595, 1.0220897743275028, 'Semi urban'),
  Text(-1.0582795633383781, -0.3000739339235115, 'Urban'),
  Text(0.67000963198199, -0.8724030565348555, 'Rural')])
```



In [123]:

```
df.Loan_Status.value_counts()
```

Out[123]:

```
Y    422
N    192
Name: Loan_Status, dtype: int64
```

In [124]:

```
df.Credit_History.value_counts()
```

Out[124]:

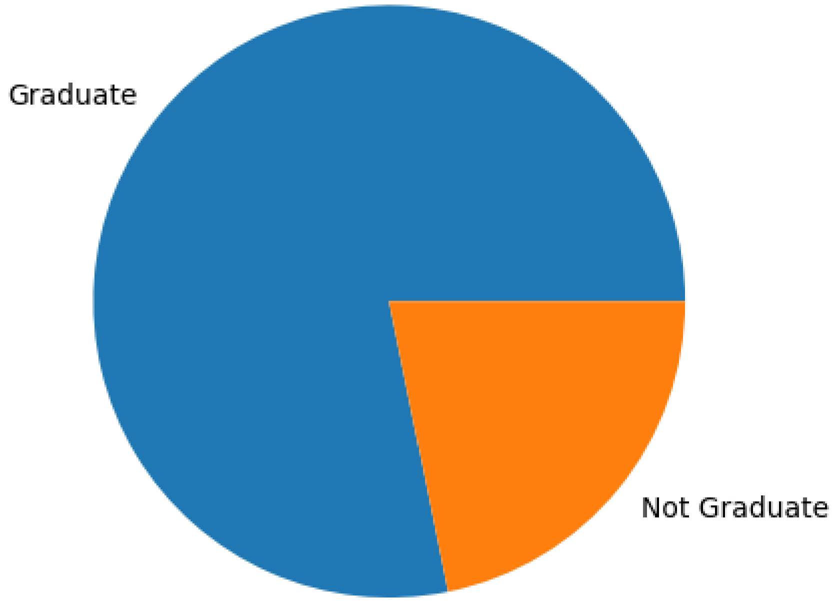
```
1.0    475
0.0     89
Name: Credit_History, dtype: int64
```

In [125]:

```
plt.pie(df.Education.value_counts(),[0,0],labels=['Graduate','Not Graduate'])
```

Out[125]:

```
([,
  ],
 [Text(-0.8514262161117528, 0.6964721089301588, 'Graduate'),
  Text(0.8514262161117524, -0.6964721089301593, 'Not Graduate')])
```



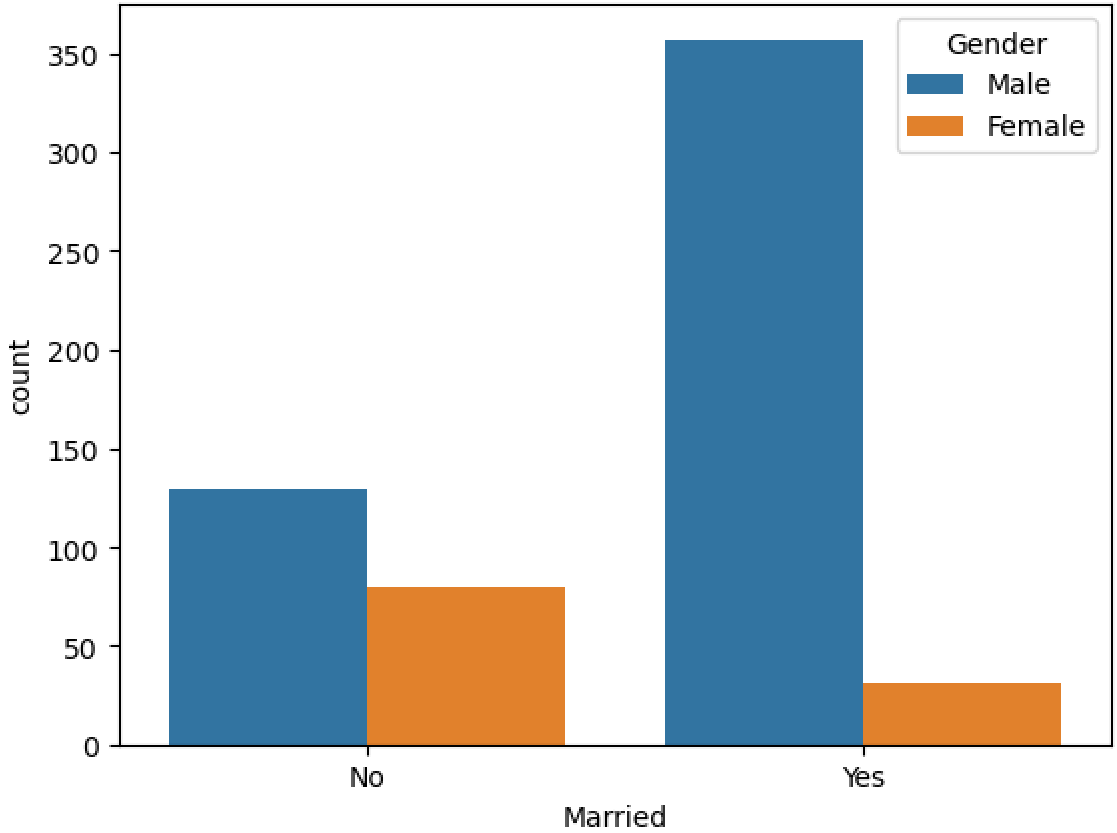
Bivariate Analysis

In [51]:

```
sns.countplot(df['Married'],hue=df['Gender'])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[51]:

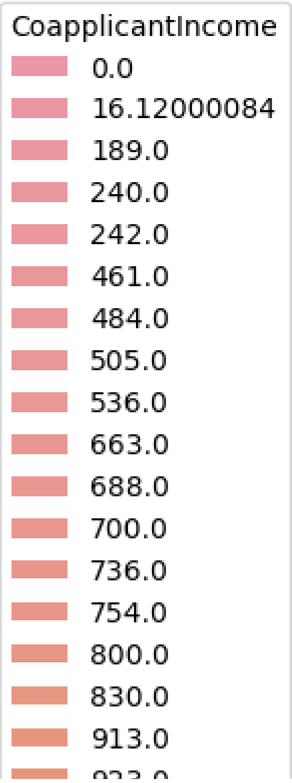


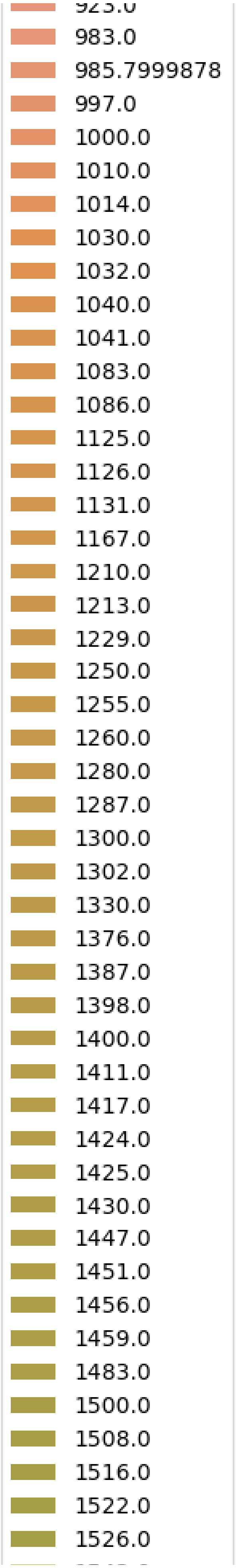
In [52]:

```
sns.countplot(df['ApplicantIncome'],hue=df['CoapplicantIncome'])
```

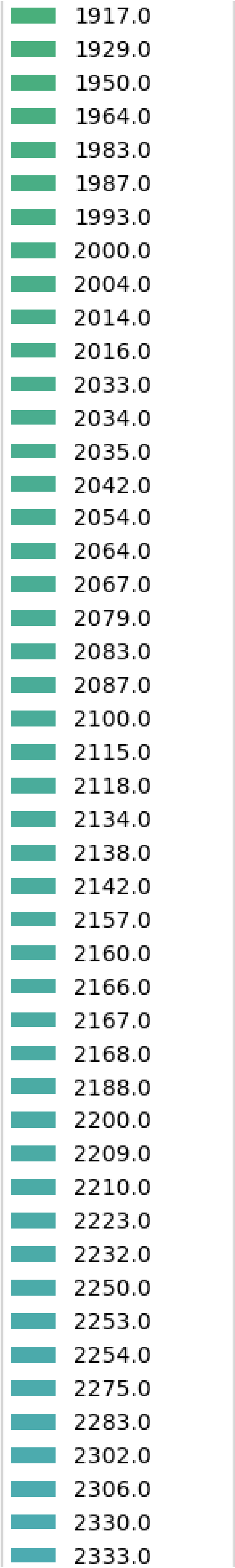
```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

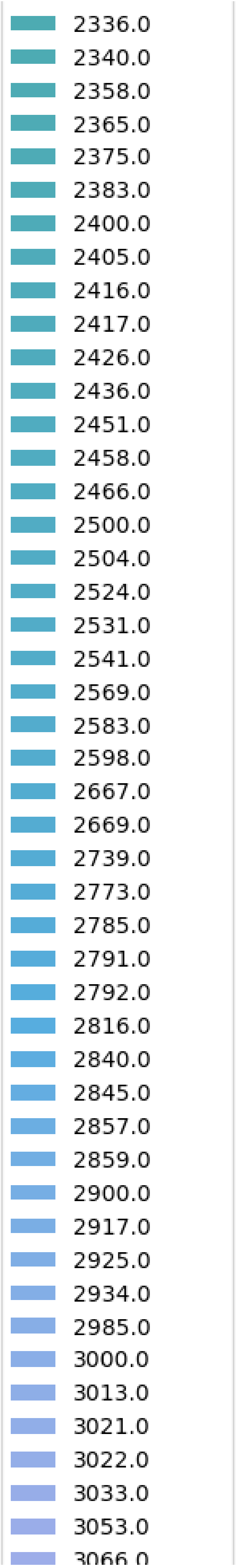
Out[52]:

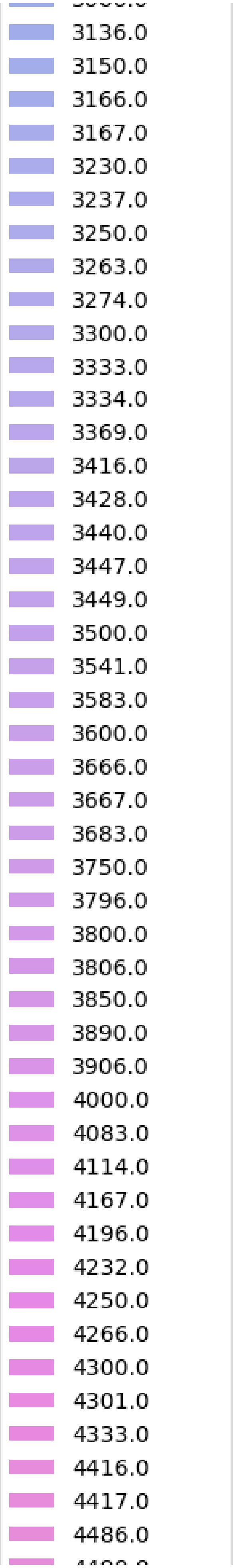


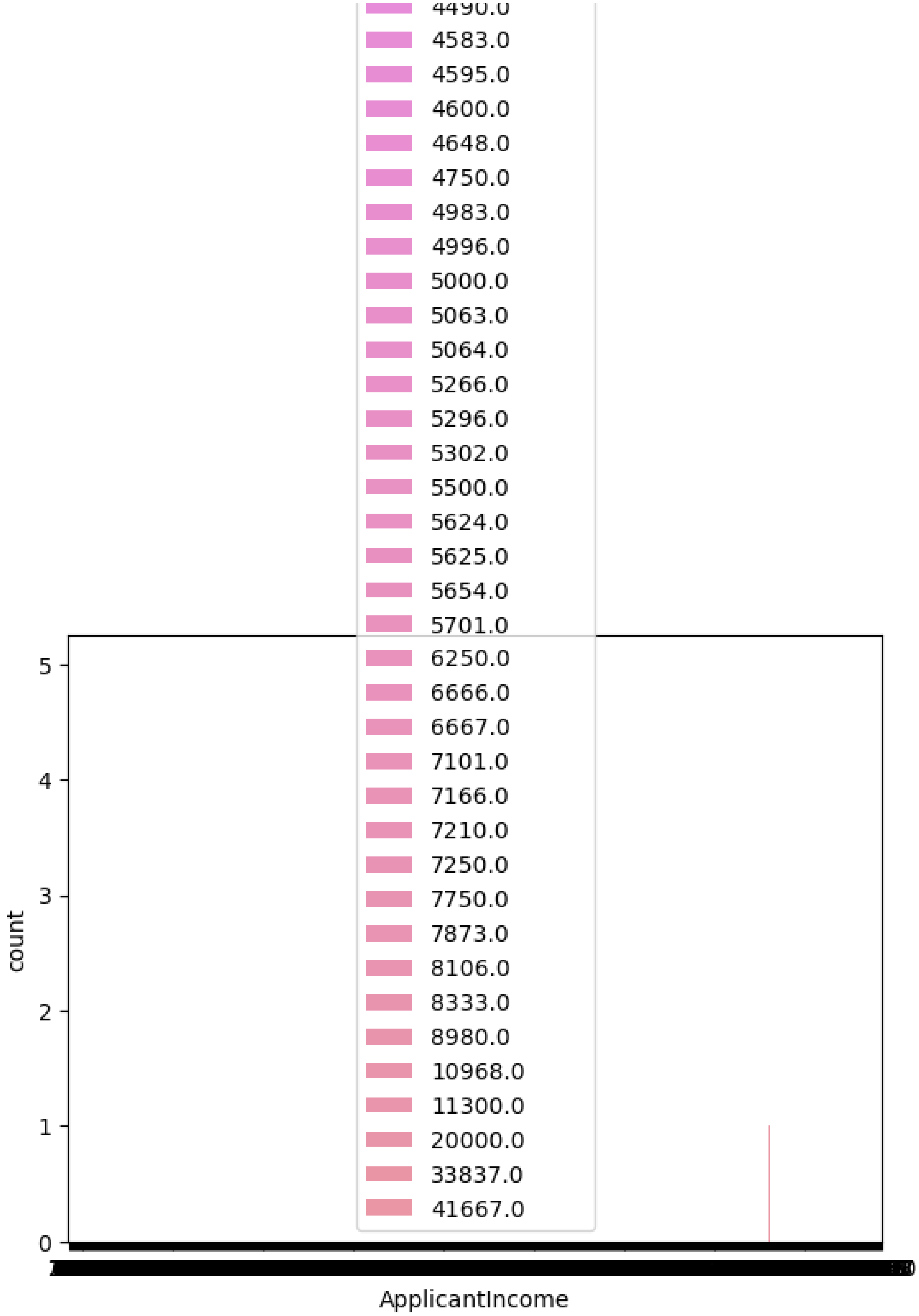

983.0
985.7999878
997.0
1000.0
1010.0
1014.0
1030.0
1032.0
1040.0
1041.0
1083.0
1086.0
1125.0
1126.0
1131.0
1167.0
1210.0
1213.0
1229.0
1250.0
1255.0
1260.0
1280.0
1287.0
1300.0
1302.0
1330.0
1376.0
1387.0
1398.0
1400.0
1411.0
1417.0
1424.0
1425.0
1430.0
1447.0
1451.0
1456.0
1459.0
1483.0
1500.0
1508.0
1516.0
1522.0
1526.0

🟩	1542.0
🟩	1560.0
🟩	1587.0
🟩	1590.0
🟩	1591.0
🟩	1600.0
🟩	1603.0
🟩	1619.0
🟩	1625.0
🟩	1632.0
🟩	1640.0
🟩	1644.0
🟩	1664.0
🟩	1666.0
🟩	1667.0
🟩	1668.0
🟩	1695.0
🟩	1700.0
🟩	1710.0
🟩	1717.0
🟩	1719.0
🟩	1733.0
🟩	1742.0
🟩	1750.0
🟩	1769.0
🟩	1774.0
🟩	1775.0
🟩	1779.0
🟩	1783.0
🟩	1793.0
🟩	1800.0
🟩	1803.0
🟩	1811.0
🟩	1820.0
🟩	1833.0
🟩	1840.0
🟩	1842.0
🟩	1843.0
🟩	1851.0
🟩	1857.0
🟩	1863.0
🟩	1868.0
🟩	1872.0
🟩	1875.0
🟩	1881.0
🟩	1911.0
🟩	1915.0


1917.0
1929.0
1950.0
1964.0
1983.0
1987.0
1993.0
2000.0
2004.0
2014.0
2016.0
2033.0
2034.0
2035.0
2042.0
2054.0
2064.0
2067.0
2079.0
2083.0
2087.0
2100.0
2115.0
2118.0
2134.0
2138.0
2142.0
2157.0
2160.0
2166.0
2167.0
2168.0
2188.0
2200.0
2209.0
2210.0
2223.0
2232.0
2250.0
2253.0
2254.0
2275.0
2283.0
2302.0
2306.0
2330.0
2333.0


2336.0
2340.0
2358.0
2365.0
2375.0
2383.0
2400.0
2405.0
2416.0
2417.0
2426.0
2436.0
2451.0
2458.0
2466.0
2500.0
2504.0
2524.0
2531.0
2541.0
2569.0
2583.0
2598.0
2667.0
2669.0
2739.0
2773.0
2785.0
2791.0
2792.0
2816.0
2840.0
2845.0
2857.0
2859.0
2900.0
2917.0
2925.0
2934.0
2985.0
3000.0
3013.0
3021.0
3022.0
3033.0
3053.0
3066.0


3136.0
3150.0
3166.0
3167.0
3230.0
3237.0
3250.0
3263.0
3274.0
3300.0
3333.0
3334.0
3369.0
3416.0
3428.0
3440.0
3447.0
3449.0
3500.0
3541.0
3583.0
3600.0
3666.0
3667.0
3683.0
3750.0
3796.0
3800.0
3806.0
3850.0
3890.0
3906.0
4000.0
4083.0
4114.0
4167.0
4196.0
4232.0
4250.0
4266.0
4300.0
4301.0
4333.0
4416.0
4417.0
4486.0

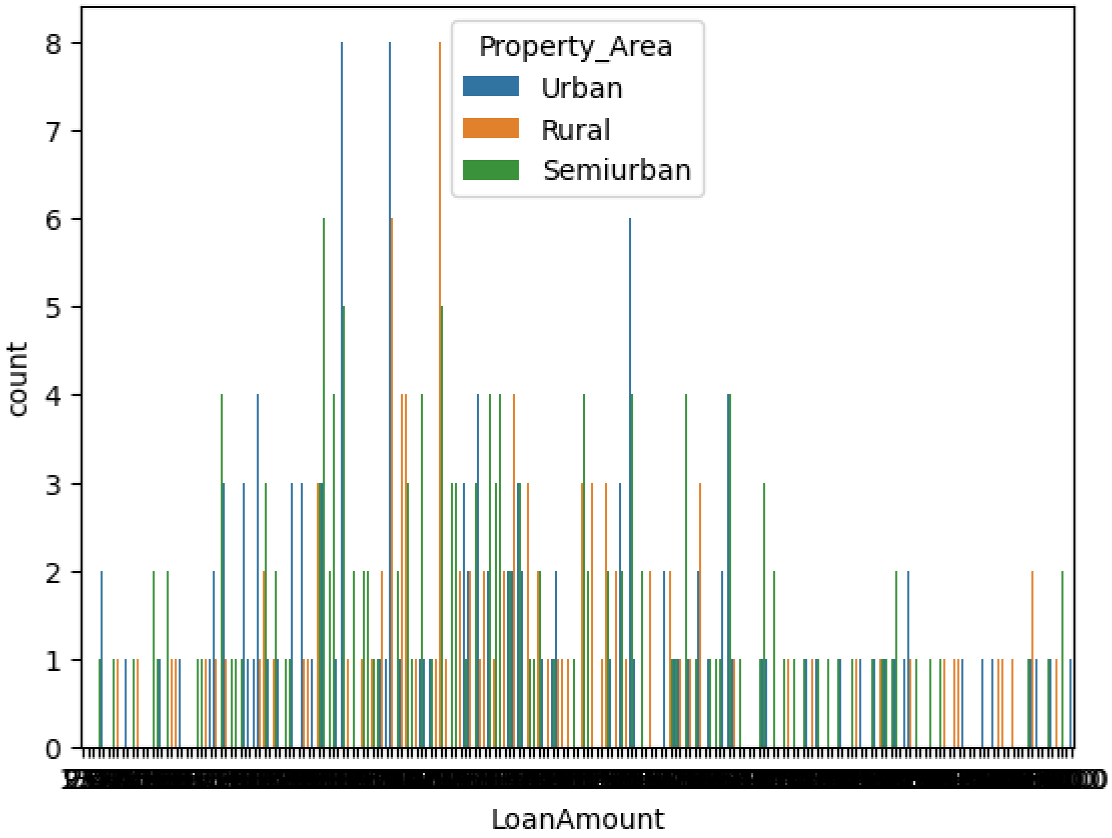


In [53]:

```
sns.countplot(df['LoanAmount'],hue=df['Property_Area'])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[53]:

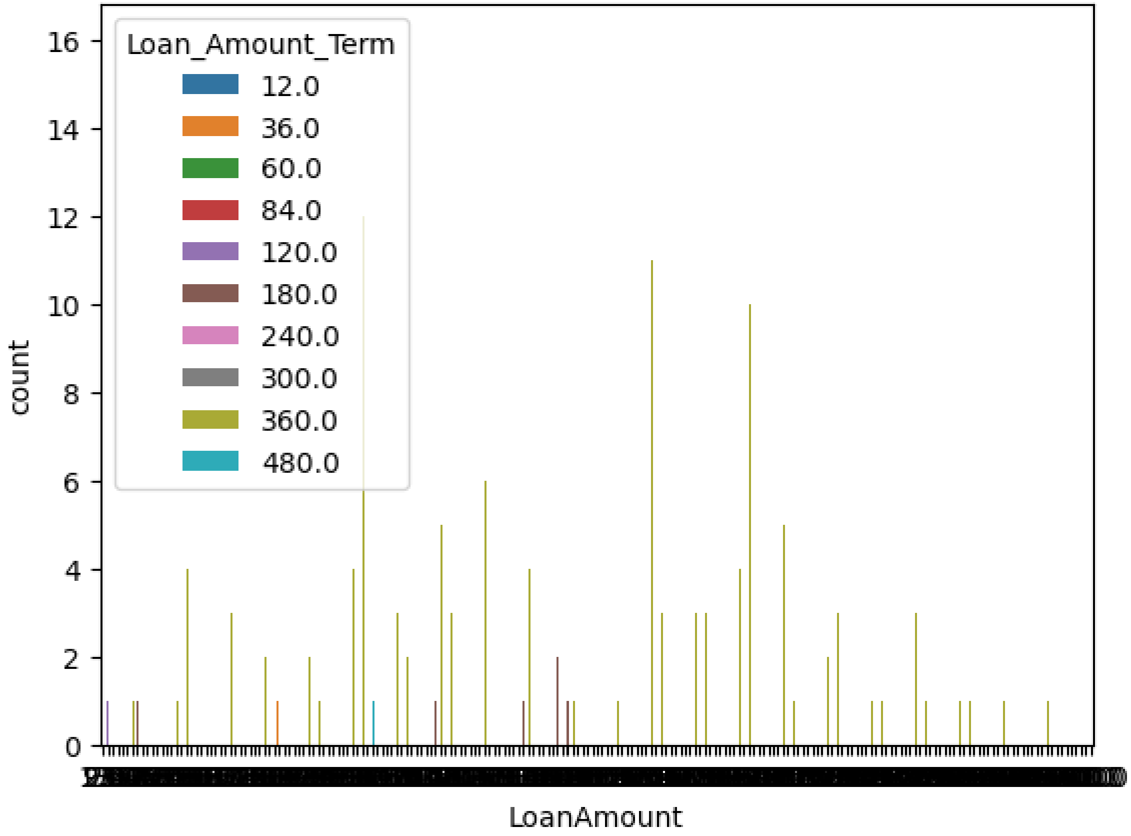


In [126]:

```
sns.countplot(df['LoanAmount'],hue=df['Loan_Amount_Term'])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[126]:

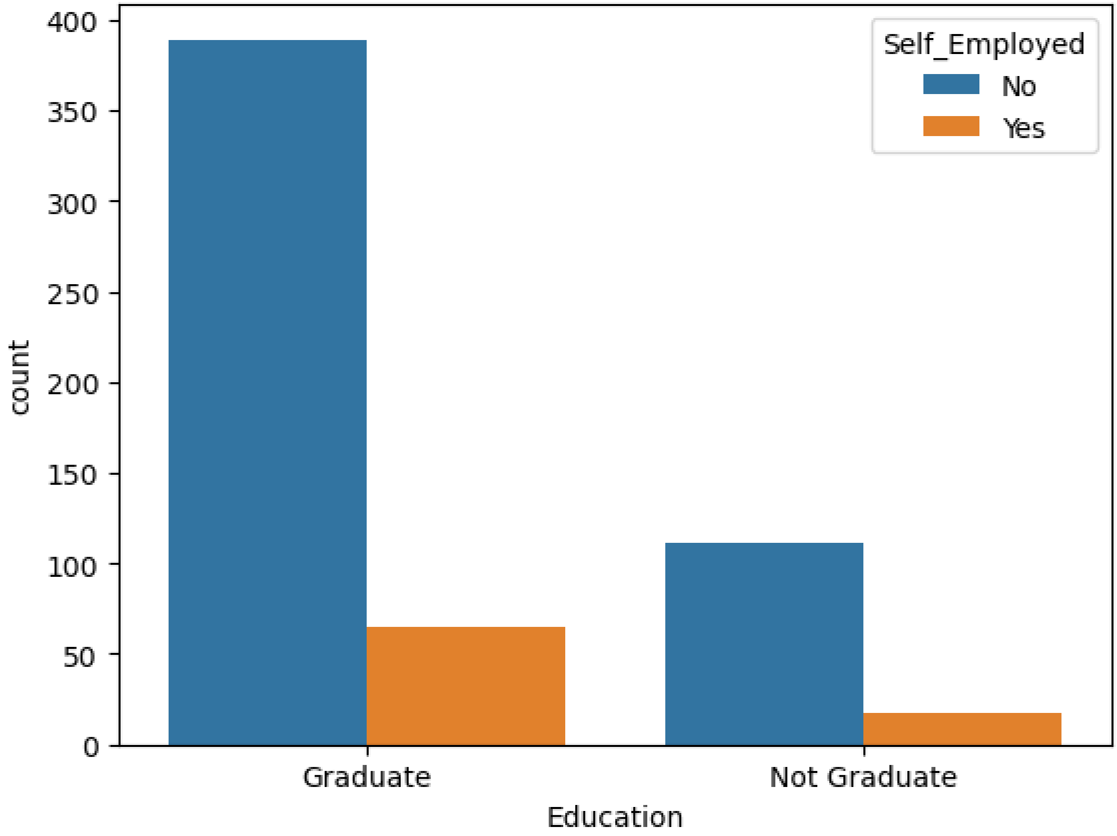


In [127]:

```
sns.countplot(df['Education'],hue=df['Self_Employed'])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[127]:

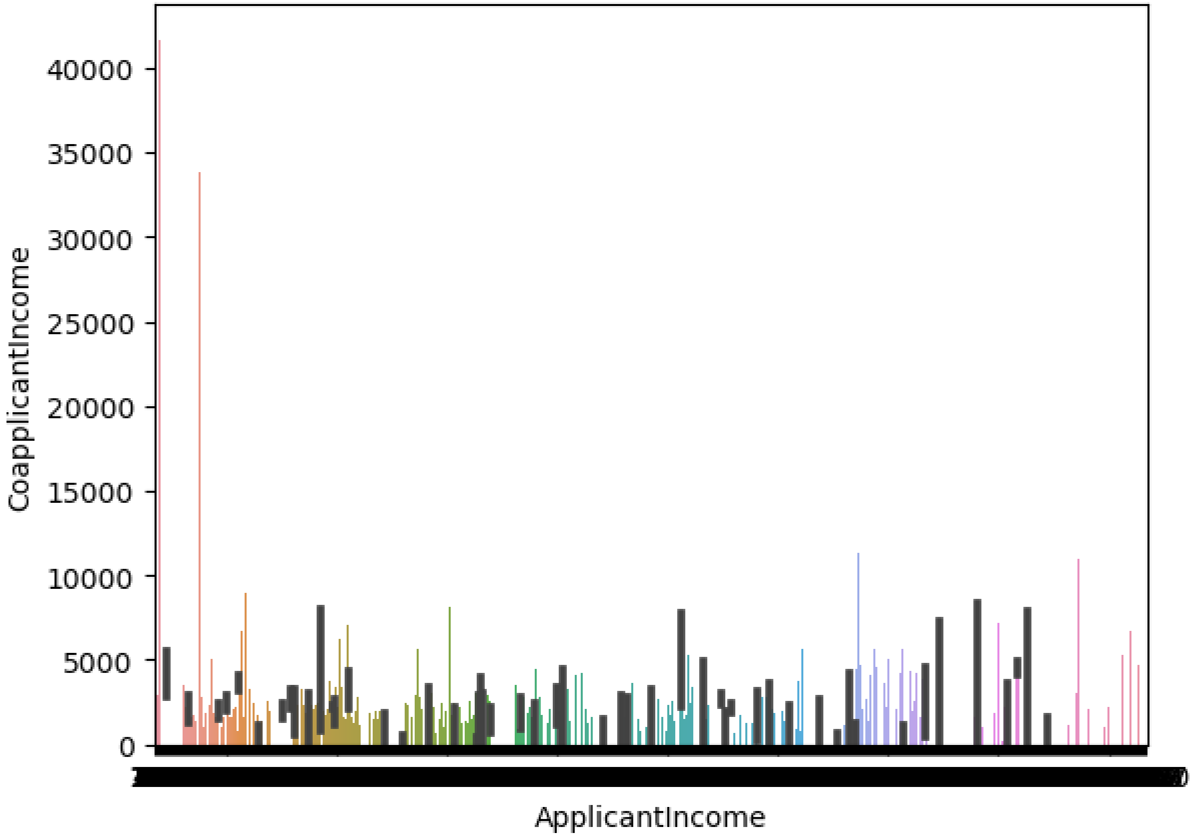


In [128]:

```
sns.barplot(df.ApplicantIncome,df.CoapplicantIncome)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variables as keyword args: x, y. From version 0.12, the only valid positional argume
nt will be `data`, and passing other arguments without an explicit keyword will result in an e
rror or misinterpretation.
  warnings.warn(
```

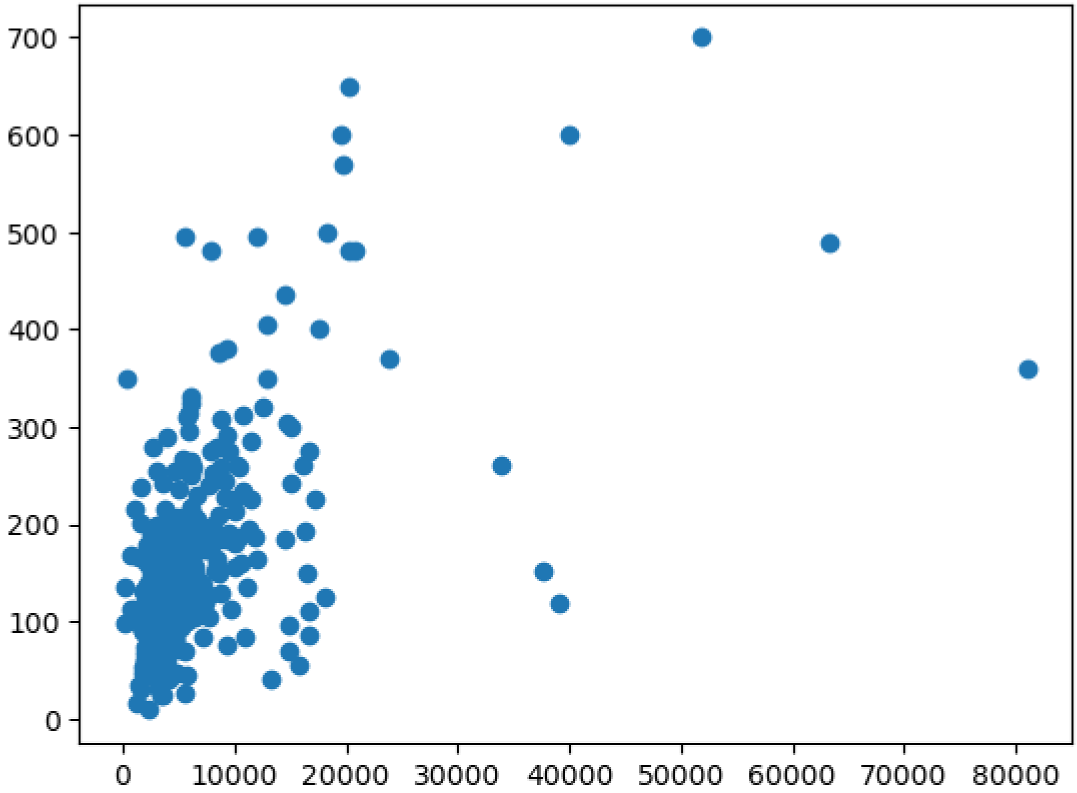
Out[128]:



In [129]:

```
plt.scatter(df.ApplicantIncome,df.LoanAmount)
```

Out[129]:



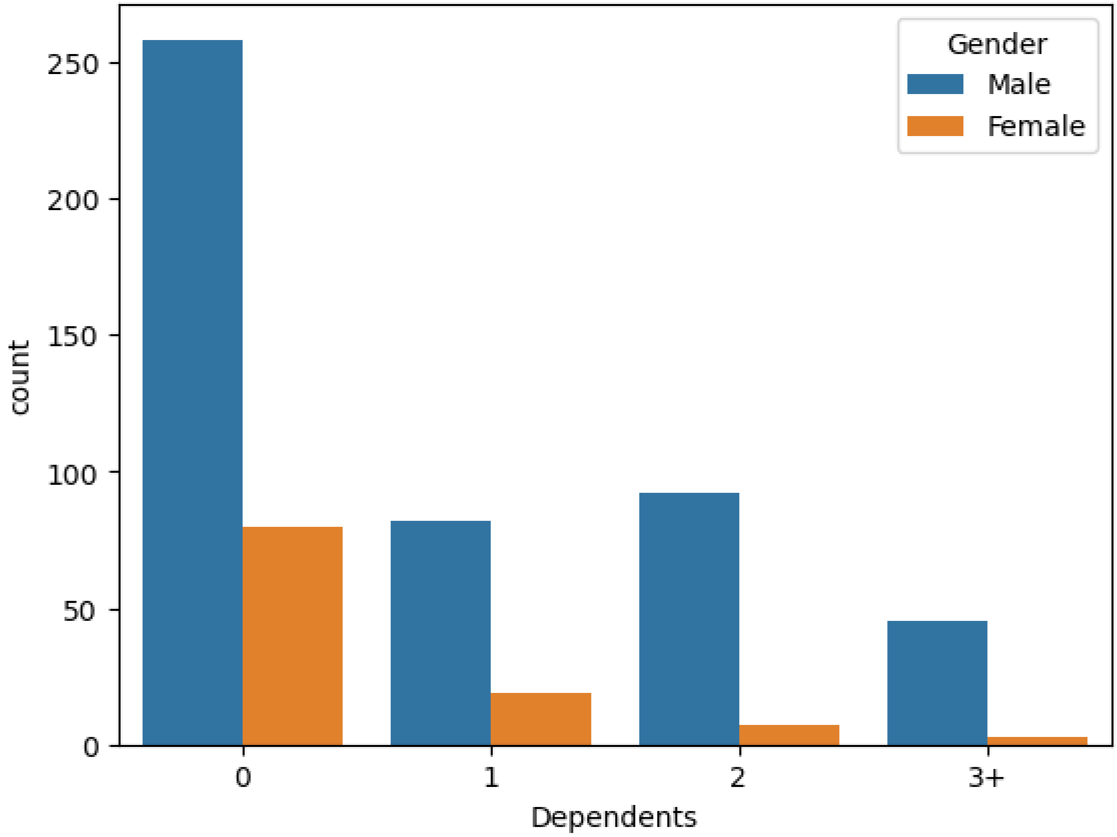
In [130]:

```
sns.countplot(df['Dependents'],hue=df['Gender'])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
```

```
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[130]:

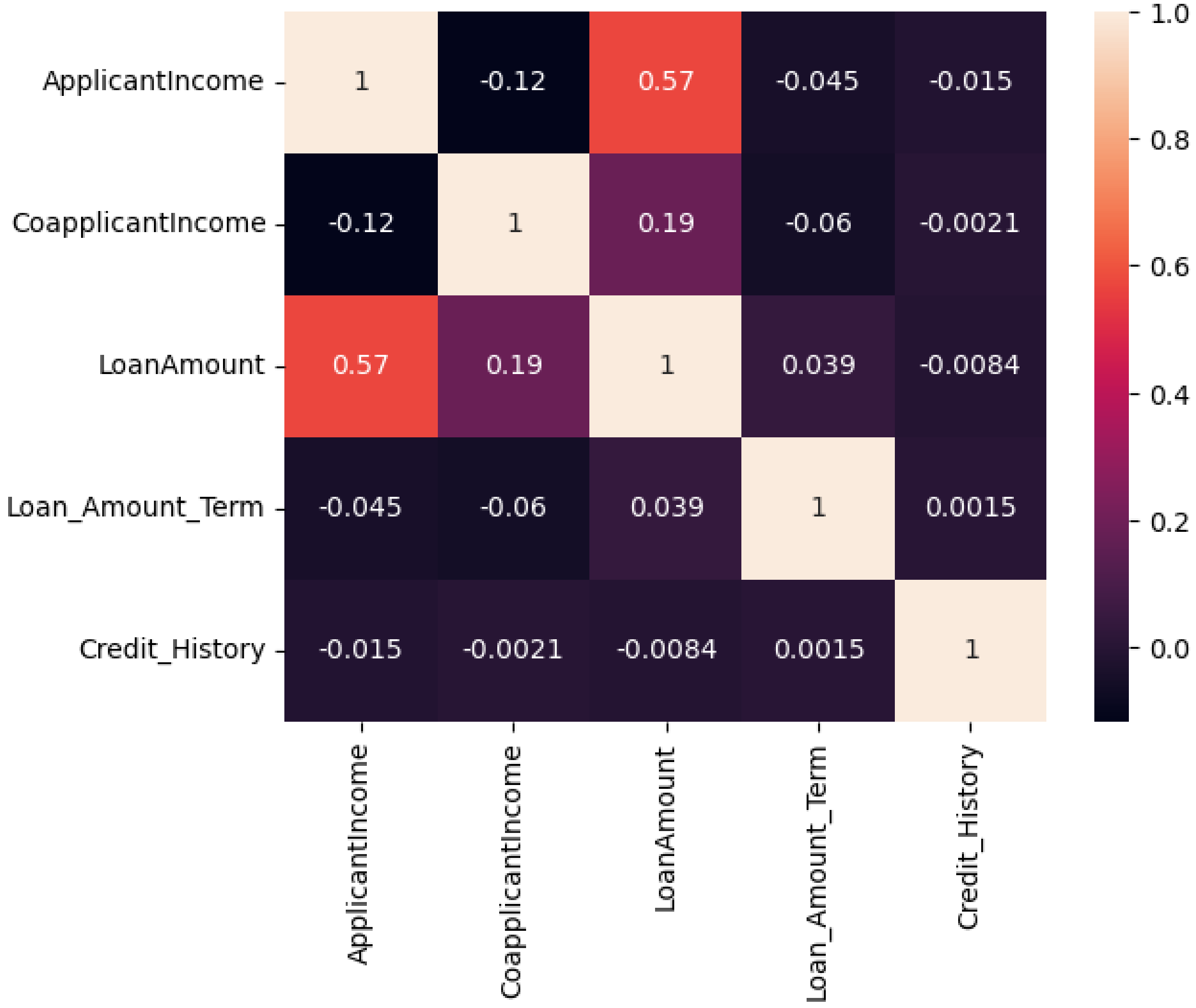


Multi variate Analysis

In [54]:

```
sns.heatmap(df.corr(),annot=True)
```

Out[54]:

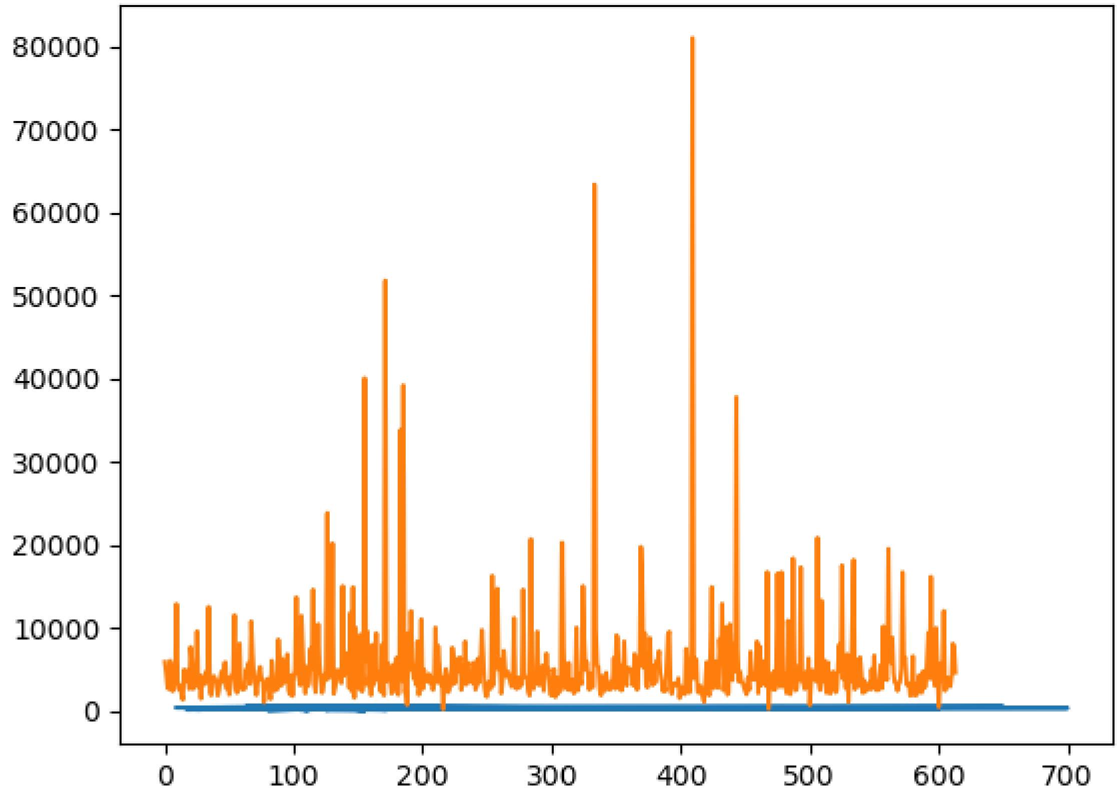


In [55]:

```
plt.plot(df.LoanAmount,df.Loan_Amount_Term,df.ApplicantIncome)
```

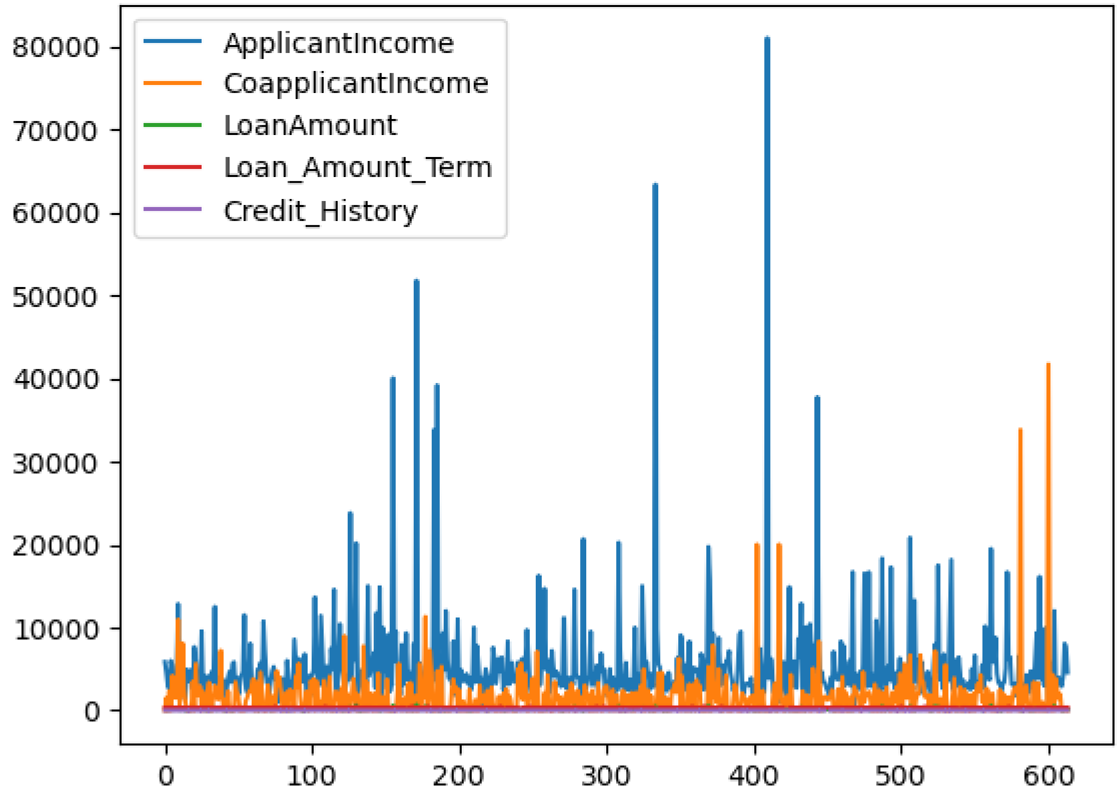
Out[55]:

```
[,
 ]
```



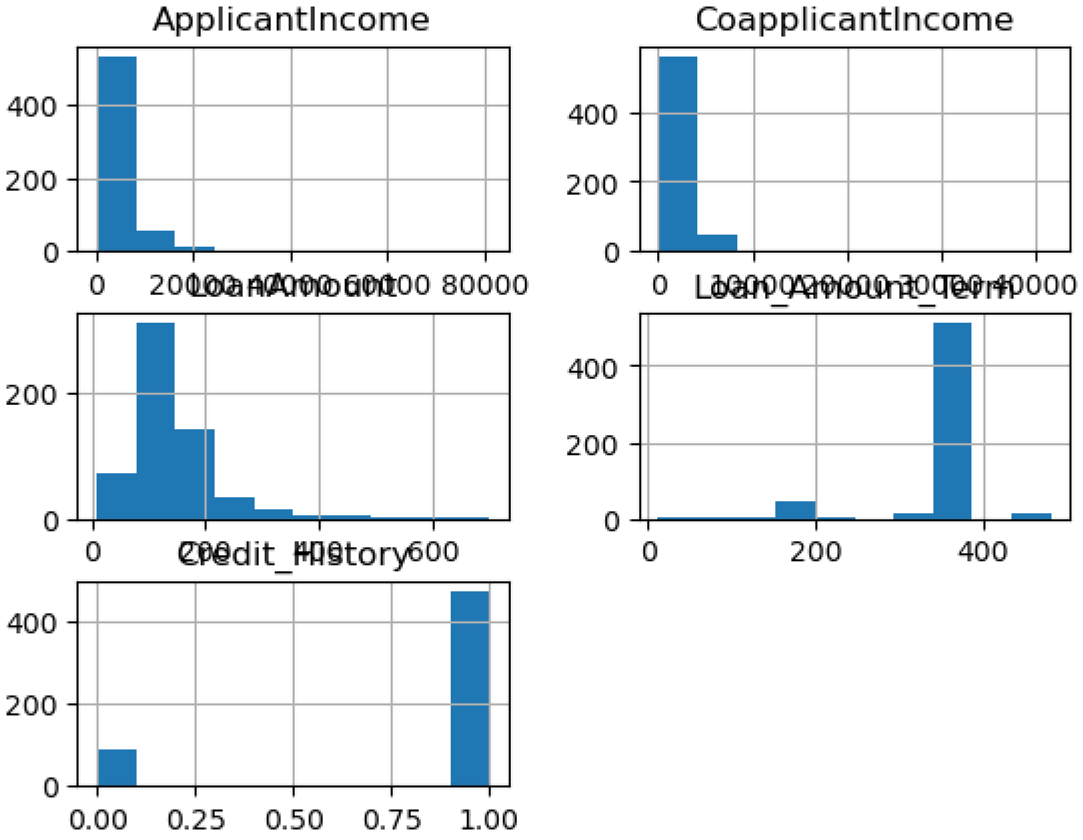
In [56]:
```
df.plot.line()
```

Out[56]:



In [57]:
```
df.hist()
```

Out[57]:
```
array([[,
        ],
 [,
  ],
 [, ]],
dtype=object)
```

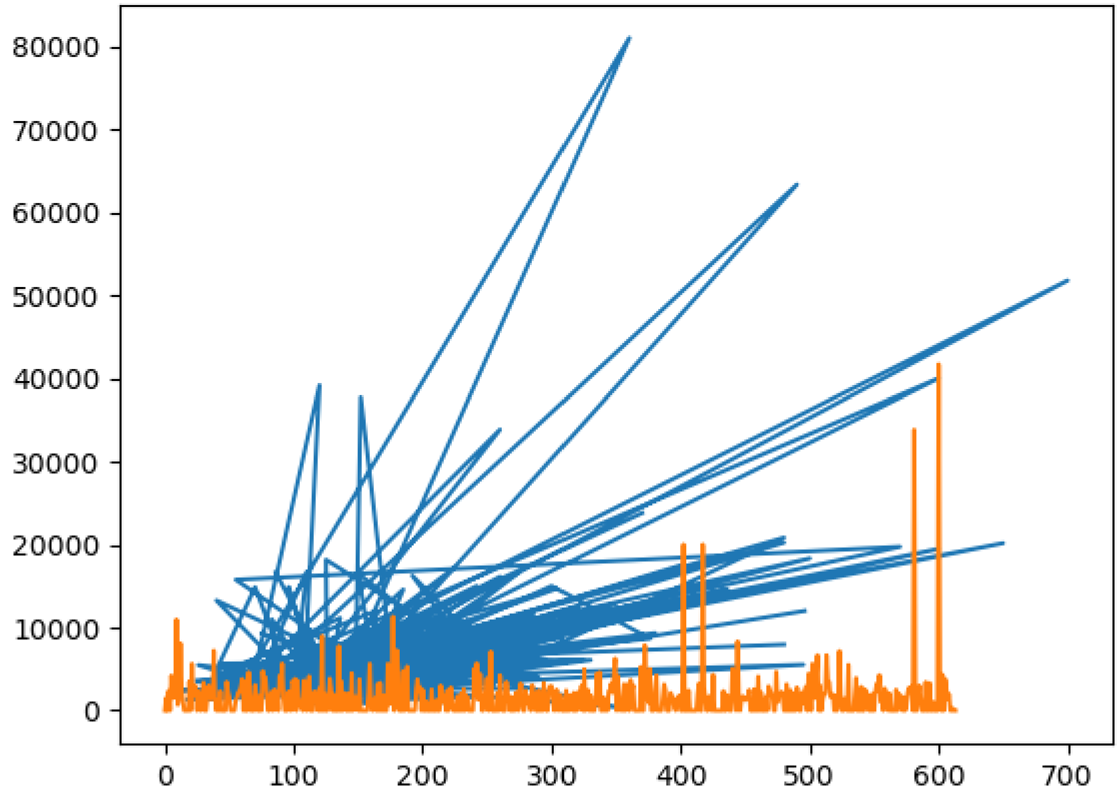


In [131]:

```
plt.plot(df.LoanAmount,df.ApplicantIncome,df.CoapplicantIncome)
```

Out[131]:

```
[,
 ]
```

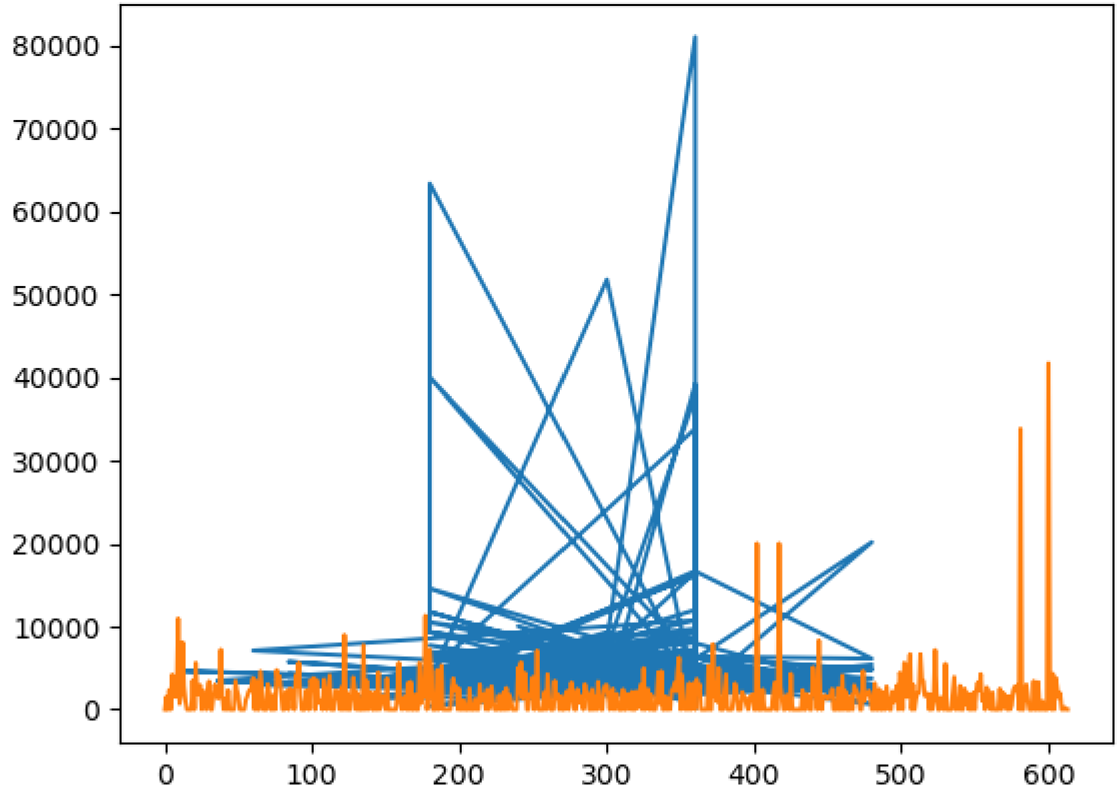


In [132]:

```
plt.plot(df.Loan_Amount_Term,df.ApplicantIncome,df.CoapplicantIncome)
```

Out[132]:

```
[,
 ]
```



Descriptive Analysis¶

In [58]:

```
df.describe()
```

Out[58]:

	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History
count	614.000000	614.000000	592.000000	600.00000	564.000000
mean	5403.459283	1621.245798	146.412162	342.00000	0.842199
std	6109.041673	2926.248369	85.587325	65.12041	0.364878
min	150.000000	0.000000	9.000000	12.00000	0.000000
25%	2877.500000	0.000000	100.000000	360.00000	1.000000
50%	3812.500000	1188.500000	128.000000	360.00000	1.000000
75%	5795.000000	2297.250000	168.000000	360.00000	1.000000
max	81000.000000	41667.000000	700.000000	480.00000	1.000000

In [133]:

```
df.mean()
```

```
C:\Users\Aishwarya\AppData\Local\Temp\ipykernel_6568\3698961737.py:1: FutureWarning: Dropping
of nuisance columns in DataFrame reductions (with 'numeric_only=None') is deprecated; in a fut
ure version this will raise TypeError.  Select only valid columns before calling the reductio
n.
  df.mean()
```

Out[133]:

```
ApplicantIncome      5403.459283
CoapplicantIncome    1621.245798
LoanAmount            146.412162
Loan_Amount_Term      342.000000
Credit_History          0.842199
dtype: float64
```

In [134]:

```
df.mode()
```

Out...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount
0	Male	Yes	0	Graduate	No	2500	0.0	120.0

In [135]:

```
df.std()
```

```
C:\Users\Aishwarya\AppData\Local\Temp\ipykernel_6568\3390915376.py:1: FutureWarning: Dropping
of nuisance columns in DataFrame reductions (with 'numeric_only=None') is deprecated; in a fut
ure version this will raise TypeError.  Select only valid columns before calling the reductio
n.
  df.std()
```

Out[135]:

```
ApplicantIncome      6109.041673
CoapplicantIncome    2926.248369
LoanAmount             85.587325
Loan_Amount_Term       65.120410
Credit_History          0.364878
dtype: float64
```

In [136]:

```
df.count()
```

Out[136]:

```
Gender               601
Married              611
Dependents           599
Education            614
```

```
Self_Employed        582
ApplicantIncome      614
CoapplicantIncome    614
LoanAmount           592
Loan_Amount_Term     600
Credit_History       564
Property_Area        614
Loan_Status          614
dtype: int64
```

Data Pre-Processing

Check for Null Values

In [137]:

```
df.isnull().any()
```

Out[137]:

```
Gender                True
Married               True
Dependents            True
Education            False
Self_Employed         True
ApplicantIncome      False
CoapplicantIncome    False
LoanAmount            True
Loan_Amount_Term      True
Credit_History        True
Property_Area        False
Loan_Status          False
dtype: bool
```

In [138]:

```
df.isnull().sum()
```

Out[138]:

```
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 [139]:

```
df['LoanAmount']=df['LoanAmount'].fillna(df['LoanAmount'].mean())
df['Loan_Amount_Term']=df['Loan_Amount_Term'].fillna(df['Loan_Amount_Term'].mean())
df['Credit_History']=df['Credit_History'].fillna(df['Credit_History'].mean())
```

In [140]:

```
df['Gender']=df['Gender'].fillna(df['Gender'].mode()[0])
df['Married']=df['Married'].fillna(df['Married'].mode()[0])
df['Dependents']=df['Dependents'].fillna(df['Dependents'].mode()[0])
df['Self_Employed']=df['Self_Employed'].fillna(df['Self_Employed'].mode()[0])
```

In [141]:

```
df.isnull().any()
```

Out[141]:

```
Gender               False
Married              False
Dependents           False
```

```
Education            False
Self_Employed        False
ApplicantIncome      False
CoapplicantIncome    False
LoanAmount           False
Loan_Amount_Term     False
Credit_History       False
Property_Area        False
Loan_Status          False
dtype: bool
```

In [142]:

```
df.isnull().sum()
```

Out[142]:

```
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
```

Handling Categorical Values

In [143]:

```
df.head()
```

Out...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount
0	Male	No	0	Graduate	No	5849	0.0	146.412162
1	Male	Yes	1	Graduate	No	4583	1508.0	128.000000
2	Male	Yes	0	Graduate	Yes	3000	0.0	66.000000
3	Male	Yes	0	Not Graduate	No	2583	2358.0	120.000000
4	Male	No	0	Graduate	No	6000	0.0	141.000000

In [144]:

```
le=LabelEncoder()
```

In [145]:

```
df.Gender=le.fit_transform(df.Gender)
df.Married=le.fit_transform(df.Married)
df.Education=le.fit_transform(df.Education)
df.Self_Employed=le.fit_transform(df.Self_Employed)
df.Property_Area=le.fit_transform(df.Property_Area)
df.Loan_Status=le.fit_transform(df.Loan_Status)
df.Dependents=le.fit_transform(df.Dependents)
```

In [146]:

```
df.head()
```

Out...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount
0	1	0	0	0	0	5849	0.0	146.412162
1	1	1	1	0	0	4583	1508.0	128.000000
2	1	1	0	0	1	3000	0.0	66.000000
3	1	1	0	1	0	2583	2358.0	120.000000
4	1	0	0	0	0	6000	0.0	141.000000

Spliting into dependent and independent data

In [147]:

```
df.head()
```

Out...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount
0	1	0	0	0	0	5849	0.0	146.412162
1	1	1	1	0	0	4583	1508.0	128.000000
2	1	1	0	0	1	3000	0.0	66.000000
3	1	1	0	1	0	2583	2358.0	120.000000
4	1	0	0	0	0	6000	0.0	141.000000

In [148]:

```
x=df.iloc[:,:-1]
y=df.Loan_Status
```

In [149]:

```
x.head()
```

Out[...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount
0	1	0	0	0	0	5849	0.0	146.412162
1	1	1	1	0	0	4583	1508.0	128.000000
2	1	1	0	0	1	3000	0.0	66.000000
3	1	1	0	1	0	2583	2358.0	120.000000
4	1	0	0	0	0	6000	0.0	141.000000

In [150]:

```
y.head()
```

Out[150]:

```
0    1
1    0
2    1
3    1
4    1
Name: Loan_Status, dtype: int32
```

Scaling The Data

In [151]:

```
x_scale=pd.DataFrame(scale(x),columns=x.columns)
```

```
x_scale.head()
```

Out[...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmou
0	0.472343	-1.372089	-0.737806	-0.528362	-0.392601	0.072991	-0.554487	0.00000
1	0.472343	0.728816	0.253470	-0.528362	-0.392601	-0.134412	-0.038732	-0.21927
2	0.472343	0.728816	-0.737806	-0.528362	2.547117	-0.393747	-0.554487	-0.95764
3	0.472343	0.728816	-0.737806	1.892641	-0.392601	-0.462062	0.251980	-0.31454
4	0.472343	-1.372089	-0.737806	-0.528362	-0.392601	0.097728	-0.554487	-0.06445

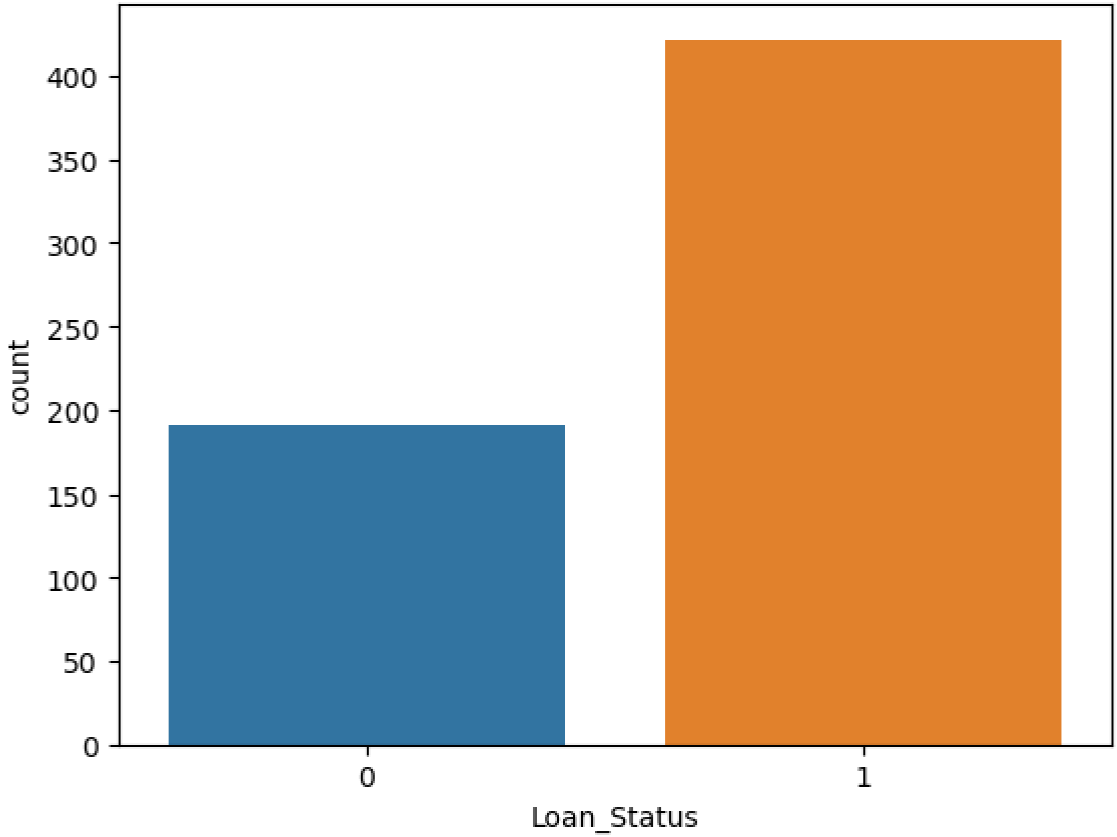
Balancing The Dataset

In [163]:

```
sns.countplot(df.Loan_Status)
```

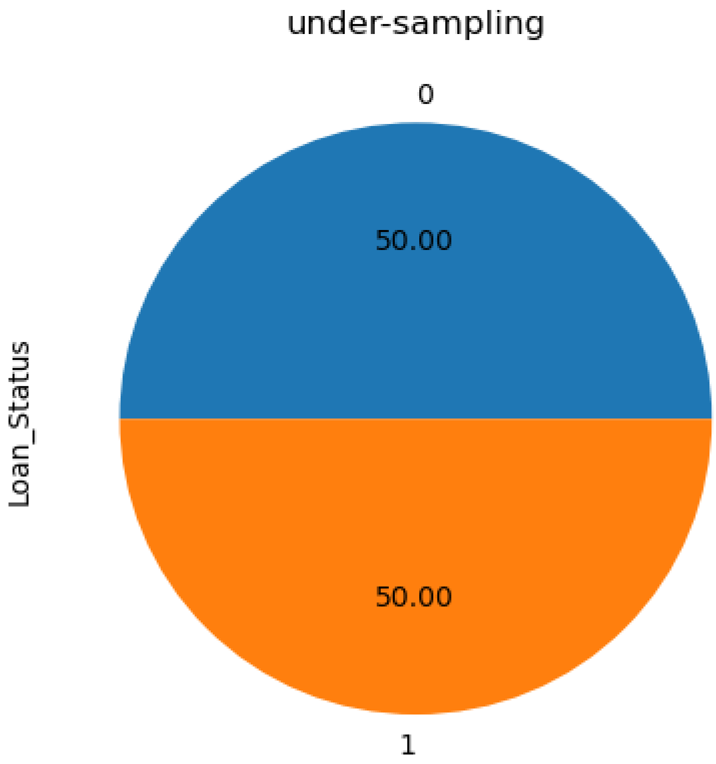
```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the
following variable as a keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an erro
r or misinterpretation.
  warnings.warn(
```

Out[163]:



In [164]:

```
rus=RandomUnderSampler(sampling_strategy=1)
x_res,y_res=rus.fit_resample(x,y)
ax=y_res.value_counts().plot.pie(autopct='%.2f')
_=ax.set_title("under-sampling")
```



Splitting Data Into Train and Test

In [165]:

```
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.3,random_state=10)
```

In [166]:

```
xtrain.head()
```

Out[...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmour
245	1	0	0	0	1	6050	4333.0	120
413	1	1	0	1	0	2253	2033.0	110
126	1	1	3	0	0	23803	0.0	370
531	1	1	3	0	0	4281	0.0	100
188	1	1	0	0	1	674	5296.0	168

In [167]:

```
xtest.head()
```

Out[...

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmour
285	1	0	0	0	0	3158	3053.0	89
323	0	0	0	0	0	3166	2985.0	132
482	1	1	0	0	0	2083	3150.0	128
173	1	1	0	0	0	5708	5625.0	187
518	1	0	0	0	0	4683	1915.0	185

In [168]:

```
ytrain.head()
```

Out[168]:

```
245    0
413    1
126    1
531    1
188    1
Name: Loan_Status, dtype: int32
```

In [169]:

```
ytest.head()
```

Out[169]:

```
285    1
323    1
482    1
173    1
518    0
Name: Loan_Status, dtype: int32
```

In [170]:

```
xtrain.shape
```

Out[170]:

```
(429, 11)
```

In [171]:

```
xtest.shape
```

Out[171]:

```
(185, 11)
```

In [172]:

```
ytrain.shape
```

Out[172]:

```
(429,)
```

In [173]:

```
ytest.shape
```

Out[173]:

```
(185,)
```

Model Building

Decision Tree Model

In [174]:

```
dmodel=DecisionTreeClassifier(random_state=100)
```

In [175]:

```
dmodel.fit(x_res,y_res)
```

Out[17...DecisionTreeClassifier(random_state=100)

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [176]:

```
ypredd=dmodel.predict(xtest)
```

In [177]:

```
ypred2d=dmodel.predict(xtrain)
```

Random Forest Model

In [212]:

```
Rmodel=RandomForestClassifier(n_estimators=100)
```

In [213]:

```
Rmodel.fit(x_res,y_res)
```

Out[21...RandomForestClassifier()

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [214]:

```
ypredR=Rmodel.predict(xtest)
```

In [215]:

```
ypred2R=Rmodel.predict(xtrain)
```

KNN Model

In [182]:

```
kmodel=KNeighborsClassifier()
```

In [183]:

```
kmodel.fit(x_res,y_res)
```

Out[18...KNeighborsClassifier()

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [184]:

```
ypredk=kmodel.predict(xtest)
```

In [185]:

```
ypred2k=kmodel.predict(xtrain)
```

Xgboost Model

In [186]:

```
xmodel=XGBClassifier(eval_metric='mlogloss',n_estimators=100,random_state=100)
```

In [187]:

```
xmodel.fit(x_res,y_res)
```

Out[18...

```
XGBClassifier(base_score=0.5, booster='gbtree', callbacks=None,
              colsample_bylevel=1, colsample_bynode=1, colsample_bytree=1,
              early_stopping_rounds=None, enable_categorical=False,
              eval_metric='mlogloss', gamma=0, gpu_id=-1,
              grow_policy='depthwise', importance_type=None,
              interaction_constraints='', learning_rate=0.300000012,
              max_bin=256, max_cat_to_onehot=4, max_delta_step=0, max_depth=6,
              max_leaves=0, min_child_weight=1, missing=nan,
              monotone_constraints='()', n_estimators=100, n_jobs=0,
              num_parallel_tree=1, predictor='auto', random_state=100,
              reg_alpha=0, reg_lambda=1, ...)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [188]:

```
ypredx=xmodel.predict(xtest)
```

In [189]:

```
ypred2x=xmodel.predict(xtrain)
```

Compare The Model

In [190]:

```
print("Decision Tree Model Testing Accuracy")
print(accuracy_score(ytest,ypredd))
print("Decision Tree Model Training Accuracy")
print(accuracy_score(ytrain,ypred2d))
```

```
Decision Tree Model Testing Accuracy
0.8594594594594595
Decision Tree Model Training Accuracy
0.8741258741258742
```

In [216]:

```
print("Random Forest Model Testing Accuracy")
print(accuracy_score(ytest,ypredR))
print("Random Forest Model Training Accuracy")
print(accuracy_score(ytrain,ypred2R))
```

```
Random Forest Model Testing Accuracy
0.9243243243243243
Random Forest Model Training Accuracy
0.9300699300699301
```

In [192]:

```
print("KNN Model Testing Accuracy")
print(accuracy_score(ytest,ypredk))
print("KNN Model Training Accuracy")
print(accuracy_score(ytrain,ypred2k))
```

```
KNN Model Testing Accuracy
0.6054054054054054
KNN Model Training Accuracy
0.6503496503496503
```

In [218]:

```
print("Xgboost Model Testing Accuracy")
print(accuracy_score(ytest,ypredx))
print("Xgboost Model Training Accuracy")
print(accuracy_score(ytrain,ypred2x))
```

```
Xgboost Model Testing Accuracy
0.9135135135135135
Xgboost Model Training Accuracy
0.9020979020979021
```

In [ ]: