Importing Libraries

In [2]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

In [3]:
```
from scipy.stats import chi2 # Distribution (cdf etc.)
from scipy.stats import chisquare # Statistical test (chistat, pvalue)
from scipy.stats import chi2_contingency # Categorical Vs Categorical
from scipy.stats import ttest_rel,ttest_1samp,ttest_ind
from scipy.stats import binom,tiecorrect
from scipy.stats import f,f_oneway
from scipy.stats import f,f_oneway,kruskal,ttest_ind,levene,shapiro,kstest,norm
from statsmodels.distributions.empirical_distribution import ECDF
from statsmodels.graphics.gofplots import qqplot
import stats
```

In [4]:
```
df=pd.read_csv("loan.csv")
df
```

Out[4]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y
...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N

614 rows × 13 columns

In [ ]:

In [ ]:

In [5]:
```
df
```

Out[5]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y
...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N

614 rows × 13 columns

In [6]:
```
df["total_household_income"]=df["ApplicantIncome"]+df["CoapplicantIncome"]
```

In [7]:
```
df
```

Out[7]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y	5849.0
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N	6091.0
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y	3000.0
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y	4941.0
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y	6000.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y	2900.0
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y	4106.0
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y	8312.0
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y	7583.0
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N	4583.0

614 rows × 14 columns

In [10]:
```
df_acc_total=df.loc[df["Loan_Status"]=="Y"]["total_household_income"]
df_rej_total=df.loc[df["Loan_Status"]=="N"]["total_household_income"]
```

In [11]:
```
ttest_ind(df_acc_total,df_rej_total)
```

Out[11]: Ttest_indResult(statistic=-0.773974858431208, pvalue=0.4392445339235994)

In [12]:
```
df_acc_total.mean()
```

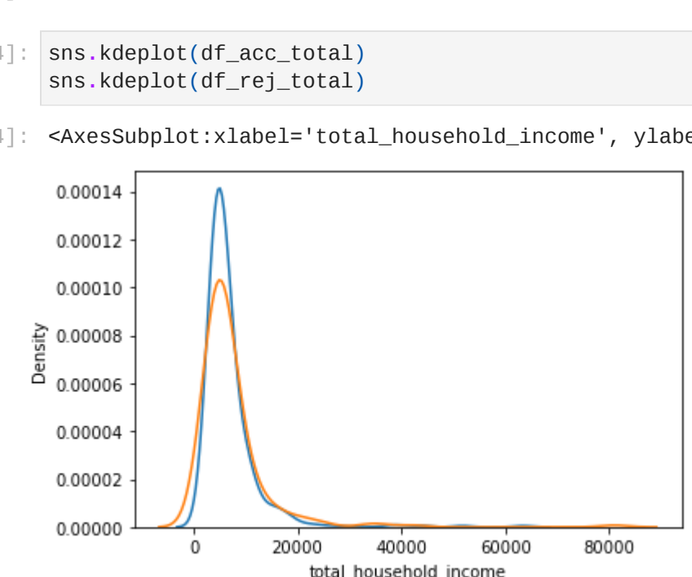
Out[12]: 6888.585118456492

In [13]:
```
df_rej_total.mean()
```

Out[13]: 7323.885416666667

In [14]:
```
sns.kdeplot(df_acc_total)
sns.kdeplot(df_rej_total)
```

Out[14]: <AxesSubplot:xlabel='total_household_income', ylabel='Density'>



In [15]:
```
kstest(df_acc_total,df_rej_total)
```

Out[15]: KstestResult(statistic=0.0832099131121643, pvalue=0.2992103834451707)

In [16]:
```
bins=[0, 2500, 4000, 6000, 8000, 10000, 81000]
labels=['Low','Average','medium', 'h1', 'h2', 'Very high']
df["total_income_bins"]=pd.cut(df["total_household_income"],bins=bins,labels=labels)
df
```

Out[16]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y	5849.0	medium
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N	6091.0	h1
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y	3000.0	Average
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y	4941.0	medium
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y	6000.0	medium
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y	2900.0	Average
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y	4106.0	medium
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y	8312.0	h2
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y	7583.0	h1
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N	4583.0	medium

614 rows × 15 columns

In [17]:
```
pd.crosstab(df["Loan_Status"],df["total_income_bins"])
```

Out[17]:

total_income_bins	Low	Average	medium	h1	h2	Very high
Loan_Status						
N	14	32	65	39	13	29
Y	10	87	159	76	32	58

In [18]:
```
chi2_contingency(pd.crosstab(df["Loan_Status"],df["total_income_bins"]))
```

Out[18]:
```
(10.434284908336592,
 0.06382460733584135,
 5,
 array([[  7.50488599,  37.21172638,  70.04560261,  35.96091205,
         14.07166124,  27.20521173],
       [ 16.49511401,  81.78827362, 153.95439739,  79.03908795,
         30.92833876,  59.79478827]]))
```

In [ ]:

Ability to pay EMI

In [19]:
```
df
```

Out[19]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y	5849.0	medium
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N	6091.0	h1
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y	3000.0	Average
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y	4941.0	medium
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y	6000.0	medium
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y	2900.0	Average
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y	4106.0	medium
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y	8312.0	h2
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y	7583.0	h1
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N	4583.0	medium

614 rows × 15 columns

In [21]:
```
df["monthly_emi"]=(df["LoanAmount"]*1000)/df["Loan_Amount_Term"]
df["monthly_emi"]
```

Out[21]:
```
0             NaN
1      355.555556
2      183.333333
3      333.333333
4      391.666667
          ...
609    197.222222
610    222.222222
611    702.777778
612    519.444444
613    369.444444
Name: monthly_emi, Length: 614, dtype: float64
```

In [24]:
```
df["ability_to_pay_emi_10"]=((df["total_household_income"]*0.1)>df["monthly_emi"]).astype("int")
```

In [25]:
```
df
```

Out[25]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins	monthly_emi	ability_to_pay_emi_10
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y	5849.0	medium	NaN	0
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N	6091.0	h1	355.555556	1
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y	3000.0	Average	183.333333	1
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y	4941.0	medium	333.333333	1
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y	6000.0	medium	391.666667	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y	2900.0	Average	197.222222	1
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y	4106.0	medium	222.222222	1
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y	8312.0	h2	702.777778	1
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y	7583.0	h1	519.444444	1
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N	4583.0	medium	369.444444	1

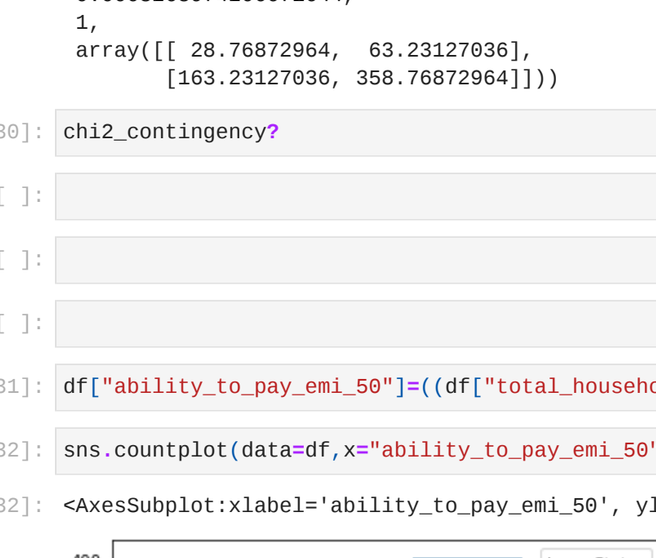
614 rows × 17 columns

In [26]:
```
df["ability_to_pay_emi_10"].value_counts()
```

Out[26]:
```
1    522
0     92
Name: ability_to_pay_emi_10, dtype: int64
```

In [27]:
```
sns.countplot(data=df,x="ability_to_pay_emi_10",hue="Loan_Status")
```

Out[27]: <AxesSubplot:xlabel='ability_to_pay_emi_10', ylabel='count'>



In [28]:
```
pd.crosstab(df["ability_to_pay_emi_10"],df["Loan_Status"])
```

Out[28]:

Loan_Status	N	Y
ability_to_pay_emi_10		
0	44	48
1	148	374

In [29]:
```
chi2_contingency(pd.crosstab(df["ability_to_pay_emi_10"],df["Loan_Status"]))
```

Out[29]:
```
(12.909621328812786,
 0.0003268974206671644,
 1,
 array([[ 28.76872964,  63.23127036],
        [163.23127036, 358.76872964]]))
```

In [30]:
```
chi2_contingency?
```

In [ ]:

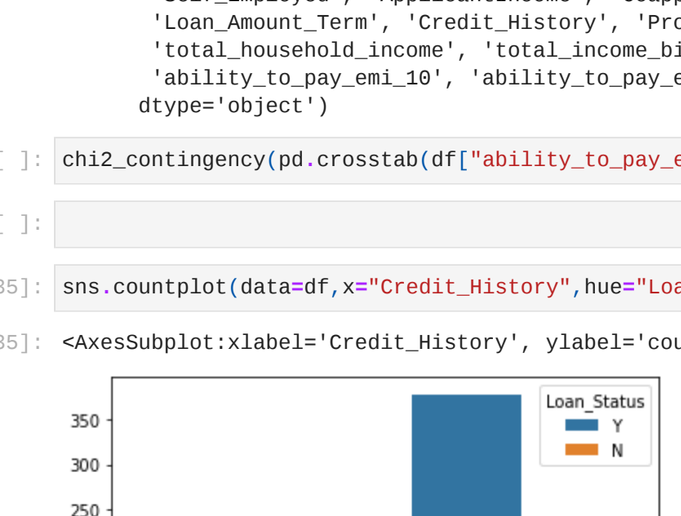
In [ ]:

In [ ]:

In [31]:
```
df["ability_to_pay_emi_50"]=((df["total_household_income"]*0.5)>df["monthly_emi"]).astype("int")
```

In [32]:
```
sns.countplot(data=df,x="ability_to_pay_emi_50",hue="Loan_Status")
```

Out[32]: <AxesSubplot:xlabel='ability_to_pay_emi_50', ylabel='count'>



In [33]:
```
chi2_contingency(pd.crosstab(df["ability_to_pay_emi_50"],df["Loan_Status"]))
```

Out[33]:
```
(5.06370716479013,
 0.02443192257832814 4,
 1,
 array([[ 12.19543974,  26.80456026],
        [179.80456026, 395.19543974]]))
```

In [34]:
```
df.columns
```

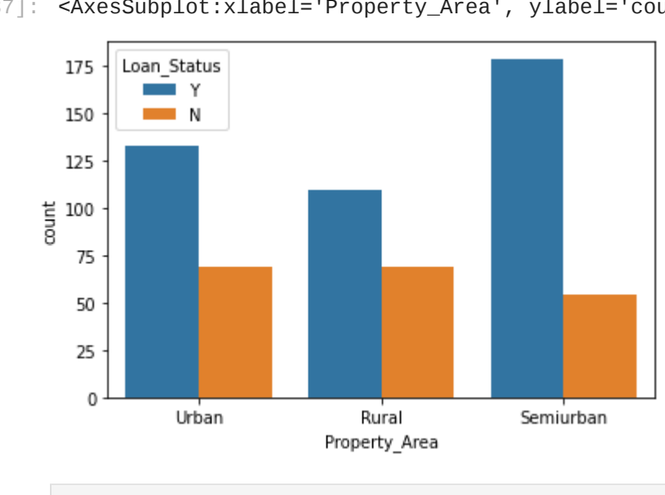
Out[34]:
```
Index(['Loan_ID', 'Gender', 'Married', 'Dependents', 'Education',
       'Self_Employed', 'ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
       'Loan_Amount_Term', 'Credit_History', 'Property_Area', 'Loan_Status',
       'total_household_income', 'total_income_bins', 'monthly_emi',
       'ability_to_pay_emi_10', 'ability_to_pay_emi_50'],
      dtype='object')
```

In [ ]:
```
chi2_contingency(pd.crosstab(df["ability_to_pay_emi_50"],df["Loan_Status"]))
```

In [ ]:

In [35]:
```
sns.countplot(data=df,x="Credit_History",hue="Loan_Status")
```

Out[35]: <AxesSubplot:xlabel='Credit_History', ylabel='count'>

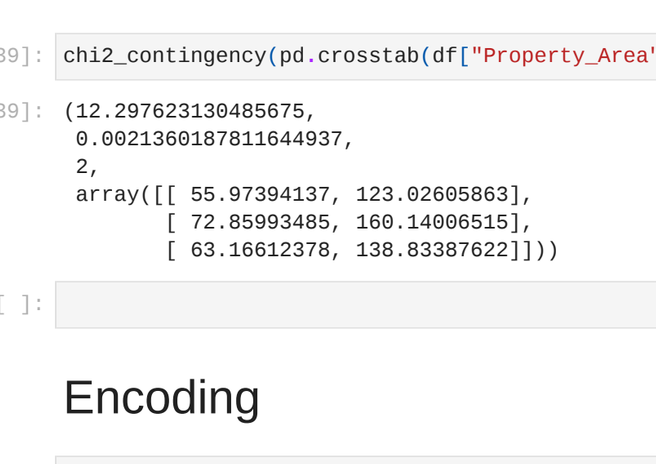


In [36]:
```
chi2_contingency(pd.crosstab(df["Credit_History"],df["Loan_Status"]))
```

Out[36]:
```
(174.63729658142535,
 7.184759548750746e-40,
 1,
 array([[ 28.2464539,  60.7535461],
        [150.7535461, 324.2464539]]))
```

In [37]:
```
sns.countplot(data=df,x="Property_Area",hue="Loan_Status")
```

Out[37]: <AxesSubplot:xlabel='Property_Area', ylabel='count'>



In [38]:
```
pd.crosstab(df["Property_Area"],df["Loan_Status"])
```

Out[38]:

Loan_Status	N	Y
Property_Area		
Rural	69	110
Semiurban	54	179
Urban	69	133

In [39]:
```
chi2_contingency(pd.crosstab(df["Property_Area"],df["Loan_Status"]))
```

Out[39]:
```
(12.297623130485675,
 0.0021360187811644937,
 2,
 array([[ 55.97394137, 123.02605863],
        [ 72.85993485, 160.14006515],
        [ 63.16612378, 138.83387622]]))
```

In [ ]:

Encoding

In [40]:
```
df
```

Out[40]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins	monthly_emi	ability_to_pay_emi_10	ability_to_pay_emi_50
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y	5849.0	medium	NaN	0	0
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N	6091.0	h1	355.555556	1	1
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y	3000.0	Average	183.333333	1	1
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y	4941.0	medium	333.333333	1	1
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y	6000.0	medium	391.666667	1	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	Female	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y	2900.0	Average	197.222222	1	1
610	LP002979	Male	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y	4106.0	medium	222.222222	1	1
611	LP002983	Male	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y	8312.0	h2	702.777778	1	1
612	LP002984	Male	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y	7583.0	h1	519.444444	1	1
613	LP002990	Female	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N	4583.0	medium	369.444444	1	1

614 rows × 18 columns

In [41]:
```
from sklearn.preprocessing import LabelEncoder
from category_encoders import TargetEncoder
```

In [45]:
```
df[col]
```

Out[45]:
```
0        Male
1        Male
2        Male
3        Male
4        Male
        ...
609    Female
610      Male
611      Male
612      Male
613    Female
Name: Gender, Length: 614, dtype: object
```

In [46]:
```
label_encoder=LabelEncoder()
col="Gender"
df[col]=label_encoder.fit_transform(df[col])
df
```

Out[46]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins	monthly_emi	ability_to_pay_emi_10	ability_to_pay_emi_50
0	LP001002	1	No	0	Graduate	No	5849	0.0	NaN	360.0	1.0	Urban	Y	5849.0	medium	NaN	0	0
1	LP001003	1	Yes	1	Graduate	No	4583	1508.0	128.0	360.0	1.0	Rural	N	6091.0	h1	355.555556	1	1
2	LP001005	1	Yes	0	Graduate	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y	3000.0	Average	183.333333	1	1
3	LP001006	1	Yes	0	Not Graduate	No	2583	2358.0	120.0	360.0	1.0	Urban	Y	4941.0	medium	333.333333	1	1
4	LP001008	1	No	0	Graduate	No	6000	0.0	141.0	360.0	1.0	Urban	Y	6000.0	medium	391.666667	1	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	0	No	0	Graduate	No	2900	0.0	71.0	360.0	1.0	Rural	Y	2900.0	Average	197.222222	1	1
610	LP002979	1	Yes	3+	Graduate	No	4106	0.0	40.0	180.0	1.0	Rural	Y	4106.0	medium	222.222222	1	1
611	LP002983	1	Yes	1	Graduate	No	8072	240.0	253.0	360.0	1.0	Urban	Y	8312.0	h2	702.777778	1	1
612	LP002984	1	Yes	2	Graduate	No	7583	0.0	187.0	360.0	1.0	Urban	Y	7583.0	h1	519.444444	1	1
613	LP002990	0	No	0	Graduate	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N	4583.0	medium	369.444444	1	1

614 rows × 18 columns

In [47]:
```
df["Gender"].value_counts()
```

Out[47]:
```
1    489
0    112
2     13
Name: Gender, dtype: int64
```

In [49]:
```
df["Education"].value_counts()
```

Out[49]:
```
Graduate        480
Not Graduate    134
Name: Education, dtype: int64
```

In [50]:
```
label_encoder=LabelEncoder()
col="Education"
df[col]=label_encoder.fit_transform(df[col])
df
```

Out[50]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins	monthly_emi	ability_to_pay_emi_10	ability_to_pay_emi_50
0	LP001002	1	No	0	0	No	5849	0.0	NaN	360.0	1.0	Urban	Y	5849.0	medium	NaN	0	0
1	LP001003	1	Yes	1	0	No	4583	1508.0	128.0	360.0	1.0	Rural	N	6091.0	h1	355.555556	1	1
2	LP001005	1	Yes	0	0	Yes	3000	0.0	66.0	360.0	1.0	Urban	Y	3000.0	Average	183.333333	1	1
3	LP001006	1	Yes	0	1	No	2583	2358.0	120.0	360.0	1.0	Urban	Y	4941.0	medium	333.333333	1	1
4	LP001008	1	No	0	0	No	6000	0.0	141.0	360.0	1.0	Urban	Y	6000.0	medium	391.666667	1	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	0	No	0	0	No	2900	0.0	71.0	360.0	1.0	Rural	Y	2900.0	Average	197.222222	1	1
610	LP002979	1	Yes	3+	0	No	4106	0.0	40.0	180.0	1.0	Rural	Y	4106.0	medium	222.222222	1	1
611	LP002983	1	Yes	1	0	No	8072	240.0	253.0	360.0	1.0	Urban	Y	8312.0	h2	702.777778	1	1
612	LP002984	1	Yes	2	0	No	7583	0.0	187.0	360.0	1.0	Urban	Y	7583.0	h1	519.444444	1	1
613	LP002990	0	No	0	0	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	N	4583.0	medium	369.444444	1	1

614 rows × 18 columns

In [51]:
```
label_encoder=LabelEncoder()
col="Loan_Status"
df[col]=label_encoder.fit_transform(df[col])
df
```

Out[51]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins	monthly_emi	ability_to_pay_emi_10	ability_to_pay_emi_50
0	LP001002	1	No	0	0	No	5849	0.0	NaN	360.0	1.0	Urban	1	5849.0	medium	NaN	0	0
1	LP001003	1	Yes	1	0	No	4583	1508.0	128.0	360.0	1.0	Rural	0	6091.0	h1	355.555556	1	1
2	LP001005	1	Yes	0	0	Yes	3000	0.0	66.0	360.0	1.0	Urban	1	3000.0	Average	183.333333	1	1
3	LP001006	1	Yes	0	1	No	2583	2358.0	120.0	360.0	1.0	Urban	1	4941.0	medium	333.333333	1	1
4	LP001008	1	No	0	0	No	6000	0.0	141.0	360.0	1.0	Urban	1	6000.0	medium	391.666667	1	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	0	No	0	0	No	2900	0.0	71.0	360.0	1.0	Rural	1	2900.0	Average	197.222222	1	1
610	LP002979	1	Yes	3+	0	No	4106	0.0	40.0	180.0	1.0	Rural	1	4106.0	medium	222.222222	1	1
611	LP002983	1	Yes	1	0	No	8072	240.0	253.0	360.0	1.0	Urban	1	8312.0	h2	702.777778	1	1
612	LP002984	1	Yes	2	0	No	7583	0.0	187.0	360.0	1.0	Urban	1	7583.0	h1	519.444444	1	1
613	LP002990	0	No	0	0	Yes	4583	0.0	133.0	360.0	0.0	Semiurban	0	4583.0	medium	369.444444	1	1

614 rows × 18 columns

In [52]:
```
df.groupby(["Property_Area"])["Loan_Status"].mean()
```

Out[52]:
```
Property_Area
Rural        0.614525
Semiurban    0.768240
Urban        0.658416
Name: Loan_Status, dtype: float64
```

In [53]:
```
df["Property_Area"].value_counts()
```

Out[53]:
```
Semiurban    233
Urban        202
Rural        179
Name: Property_Area, dtype: int64
```

In [57]:
```
df["Property_Area"].value_counts()
```

Out[57]:
```
0.768240    233
0.658416    202
0.614525    179
Name: Property_Area, dtype: int64
```

In [54]:
```
target_encoder=TargetEncoder()
col= "Property_Area"
df[col]=target_encoder.fit_transform(df[col],df["Loan_Status"])
df
```

Out[54]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History	Property_Area	Loan_Status	total_household_income	total_income_bins	monthly_emi	ability_to_pay_emi_10	ability_to_pay_emi_50
0	LP001002	1	No	0	0	No	5849	0.0	NaN	360.0	1.0	0.658416	1	5849.0	medium	NaN	0	0
1	LP001003	1	Yes	1	0	No	4583	1508.0	128.0	360.0	1.0	0.614525	0	6091.0	h1	355.555556	1	1
2	LP001005	1	Yes	0	0	Yes	3000	0.0	66.0	360.0	1.0	0.658416	1	3000.0	Average	183.333333	1	1
3	LP001006	1	Yes	0	1	No	2583	2358.0	120.0	360.0	1.0	0.658416	1	4941.0	medium	333.333333	1	1
4	LP001008	1	No	0	0	No	6000	0.0	141.0	360.0	1.0	0.658416	1	6000.0	medium	391.666667	1	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
609	LP002978	0	No	0	0	No	2900	0.0	71.0	360.0	1.0	0.614525	1	2900.0	Average	197.222222	1	1
610	LP002979	1	Yes	3+	0	No	4106	0.0	40.0	180.0	1.0	0.614525	1	4106.0	medium	222.222222	1	1
611	LP002983	1	Yes	1	0	No	8072	240.0	253.0	360.0	1.0	0.658416	1	8312.0	h2	702.777778	1	1
612	LP002984	1	Yes	2	0	No	7583	0.0	187.0	360.0	1.0	0.658416	1	7583.0	h1	519.444444	1	1
613	LP002990	0	No	0	0	Yes	4583	0.0	133.0	360.0	0.0	0.768240	0	4583.0	medium	369.444444	1	1

614 rows × 18 columns

In [56]:
```
df["Property_Area"].value_counts()
```

Out[56]:
```
0.768240    233
0.658416    202
0.614525    179
Name: Property_Area, dtype: int64
```

In [ ]:

In [60]:
```
df.groupby(["Loan_Status","Gender"])["ApplicantIncome"].mean().reset_index()
```

Out[60]:

	Loan_Status	Gender	ApplicantIncome
0	0	0	4091.351351
1	0	1	5859.240000
2	0	2	3076.200000
3	1	0	4915.853333
4	1	1	5263.814159
5	1	2	14869.375000

In [61]:
```
# df.groupby(["Loan_Status","Gender"])[["c1","c2","c3"]].agg({"c1":"f1","c2":"f2","c3":["f3","f4"]})
```

In [ ]:
```
We believe that the loan.csv data shows that
unmarried men are in a different income group than
both married and unmarried women.
To prove this, would a t-test be more appropriate
or a chi-square test? Carry out the test on the
'ApplicantIncome' column for the two groups and
report the p-value. Also report your interpretation.
Note: Assume a confidence level of 5% and round
    off the p-value to 2 decimal places.
```

In [62]:
```
df.loc[(df["Gender"]==1) & (df["Married"]=="No")]["ApplicantIncome"]
```

Out[62]:
```
0      5849
4      6000
13     1853
15     4950
16     3596
       ...
579    3182
581    1836
595    3833
597    2987
603    3676
Name: ApplicantIncome, Length: 130, dtype: int64
```

In [ ]:
```
df.loc[(df["Gender"]==0)]["ApplicantIncome"]
```

In [ ]:

In [63]:
```
# iloc works on implicit indexes
# loc works on explicit indexes
```

```
  File "/var/folders/hd/9z4dczb56dj54lb7q8w7s4zw0000gn/T/ipykernel_93164/4070168354.py", line 1
    iloc works on implicit indexes
         ^
SyntaxError: invalid syntax
```

In [67]:
```
a=pd.Series(["a","b","c"],index=[1,2,3])
```

In [68]:
```
a
```

Out[68]:
```
1    a
2    b
3    c
dtype: object
```

In [70]:
```
a.loc[2]
```

Out[70]: 'b'

In [71]:
```
a.iloc[2]
```

Out[71]: 'c'

In [72]:
```
a.iloc[0:2]
```

Out[72]:
```
1    a
2    b
dtype: object
```

In [73]:
```
a.loc[1:3]
```

Out[73]:
```
1    a
2    b
3    c
dtype: object
```