

Bivariate Analysis

It is a statistical method used to determine the relationship between two variables. It helps to understand how one variable is affected by changes in another.

Bivariate analysis can be applied to:

- Numerical vs. Numerical: Correlation and scatter plots.
- Numerical vs. Categorical: Box plots, violin plots, and t-tests.
- Categorical vs. Categorical: Contingency tables and chi-square tests.

Features of Bivariate Analysis:

- Correlation: Measures the strength and direction of the linear relationship between two numerical variables.
- Scatter Plots: Visual representation of the relationship between two numerical variables.
- Box Plots: Shows the distribution of a numerical variable across the categories of a categorical variable.
- Violin Plots: Similar to box plots but also show the kernel density of the data.
- Contingency Tables: Display the frequency distribution of categorical variables.
- Chi-Square Tests: Test the association between two categorical variables.

```
# installing libraries

%pip install pandas
%pip install numpy
%pip install matplotlib
%pip install seaborn
%pip install scipy

Requirement already satisfied: pandas in
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pandas) (2.0.0)
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pandas) (2024.1)
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Note: you may need to restart the kernel to use updated packages.  
Requirement already satisfied: numpy in  
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/Users/anushkajain/micromamba/lib/python3.12/site-packages (from
scipy) (2.0.0)
Note: you may need to restart the kernel to use updated packages.
```

```
# importing libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats
from scipy.stats import chi2_contingency, pearsonr

# Load the data
file_path = 'processed_loan_data.csv'
```

```

data = pd.read_csv(file_path)

# Display the first few rows of the data
print("First few rows of the dataset:")
print(data.head())

First few rows of the dataset:
Customer ID           Name Gender Age Income (USD) Income Stability \
0      C-36995  Frederica Shealy     F   56    1933.05
Low
1      C-23855  Nathalie Olivier     M   43    2361.56
Low
2      C-24944    Barbie Goetsch     M   18    1546.17
Low
3      C-40801    Laree Staton     M   18    2416.86
Low
4      C-30073      Brinda Vaz     F   48     777.25
Low

Profession Type of Employment Location Loan Amount Request
(USD) \
0      Working       Sales staff  Semi-Urban 72809.58
1      Working        Laborers  Semi-Urban 152561.34
2      Working        Laborers    Rural 42091.29
3 State servant      Core staff  Semi-Urban 25765.72
4      Working        Laborers  Semi-Urban 96080.60

... Credit Score No. of Defaults Has Active Credit Card Property
ID \
0 ...      809.44          0             Active
746
1 ...      637.29          0            Unpossessed
227
2 ...      613.24          0            Unpossessed
883
3 ...      652.41          0             Active
325
4 ...      764.11          0             Active
678

Property Age Property Type Property Location Co-Applicant \
0      1933.05          4          Rural           1
1      2361.56          1      Semi-Urban           1
2      1546.17          2          Urban           1

```

3	2416.86	2	Rural	1
4	777.25	1	Semi-Urban	1

	Property Price	Loan Sanction Amount (USD)
0	119933.46	54607.18
1	221050.80	0.00
2	67993.43	0.00
3	32423.71	16747.72
4	146073.26	67256.42

[5 rows x 24 columns]

```
# Numerical vs. Numerical: Correlation and Scatter Plot
numerical_columns = data.select_dtypes(include=['float64',
'int64']).columns

print("\nCorrelation between Numerical Features:")
correlation_matrix = data[numerical_columns].corr()
print(correlation_matrix)
```

Correlation between Numerical Features:

	Age	Income (USD)	\
Age	1.000000	-0.026527	
Income (USD)	-0.026527	1.000000	
Loan Amount Request (USD)	0.003691	0.240544	
Current Loan Expenses (USD)	-0.007977	0.319590	
Dependents	-0.056981	-0.033185	
Credit Score	0.084496	0.021051	
No. of Defaults		NaN	NaN
Property ID	-0.012239	-0.014644	
Property Age	-0.026711	0.993999	
Property Type	-0.001978	-0.004515	
Co-Applicant		NaN	NaN
Property Price	0.004209	0.224053	
Loan Sanction Amount (USD)	0.006529	0.176932	

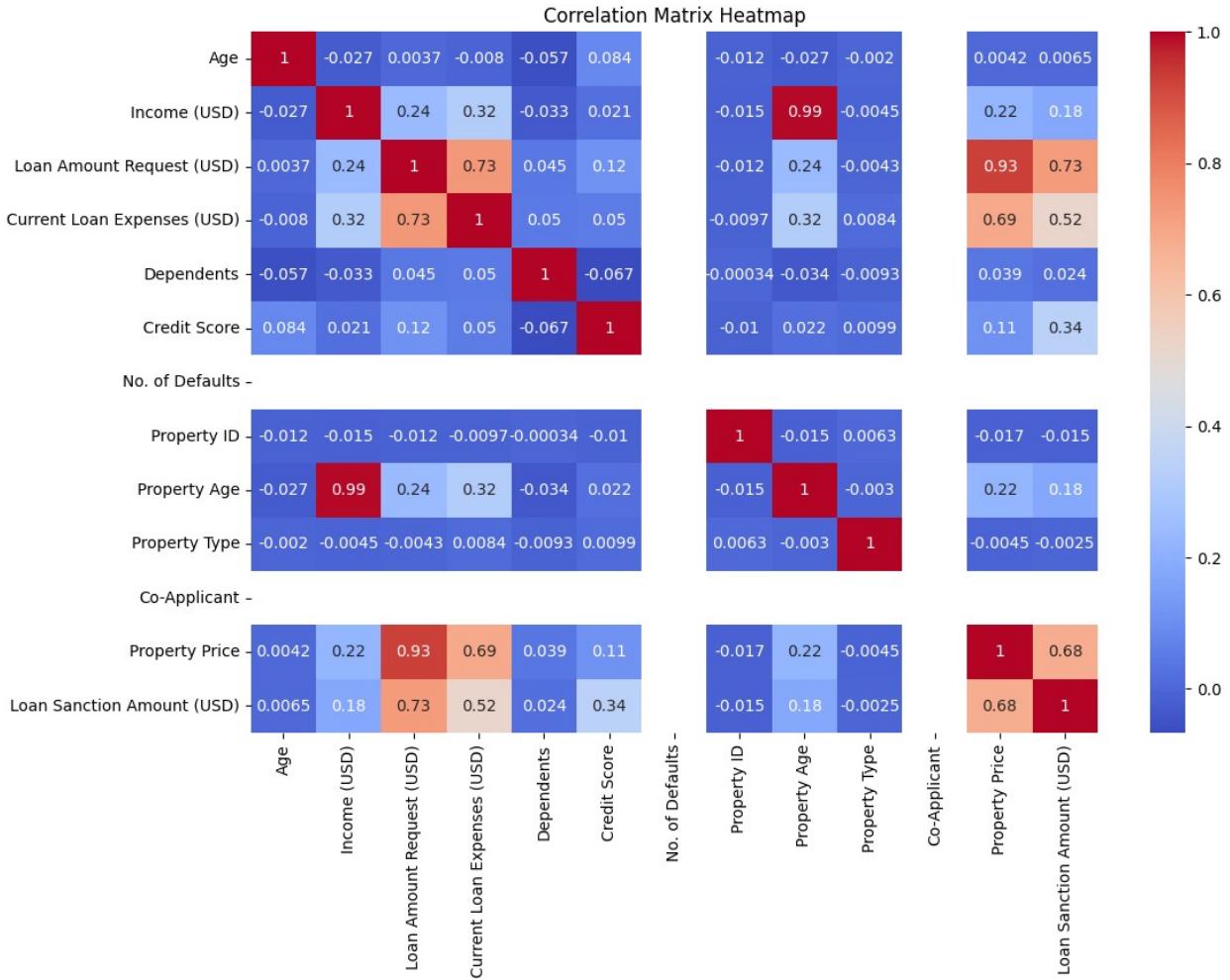
	Loan Amount Request (USD)	\
Age	0.003691	
Income (USD)	0.240544	
Loan Amount Request (USD)	1.000000	
Current Loan Expenses (USD)	0.734165	
Dependents	0.044845	
Credit Score	0.115891	
No. of Defaults		NaN
Property ID	-0.012065	
Property Age	0.238503	
Property Type	-0.004314	
Co-Applicant		NaN
Property Price	0.927475	

Loan Sanction Amount (USD)	0.728908	
Dependents \ Age	Current Loan Expenses (USD)	
Income (USD)	-0.007977	-0.056981
Loan Amount Request (USD)	0.319590	-0.033185
Current Loan Expenses (USD)	0.734165	0.044845
Dependents	1.000000	0.049681
Credit Score	0.049681	1.000000
No. of Defaults	0.050066	-0.066986
Property ID	NaN	NaN
Property Age	-0.009692	-0.000338
Property Type	0.317149	-0.034174
Co-Applicant	0.008420	-0.009304
Property Price	NaN	NaN
Loan Sanction Amount (USD)	0.689104	0.038639
	0.518257	0.024086
ID \ Age	Credit Score	No. of Defaults
0.012239	0.084496	Property
Income (USD)	0.021051	No. of Defaults
0.014644	NaN	-
Loan Amount Request (USD)	0.115891	No. of Defaults
0.012065	NaN	-
Current Loan Expenses (USD)	0.050066	No. of Defaults
0.009692	NaN	-
Dependents	-0.066986	No. of Defaults
0.000338	NaN	-
Credit Score	1.000000	No. of Defaults
0.010432	NaN	-
No. of Defaults	NaN	No. of Defaults
Nan	NaN	-
Property ID	-0.010432	No. of Defaults
1.000000	NaN	-
Property Age	0.021820	No. of Defaults
0.015065	NaN	-

Property Type	0.009948	NaN
0.006282		
Co-Applicant	NaN	NaN
Nan		
Property Price	0.109297	NaN -
0.016678		
Loan Sanction Amount (USD)	0.341492	NaN -
0.014856		
Property Age	Property Type	Co-Applicant
\		
Age	-0.026711	-0.001978
Income (USD)	0.993999	-0.004515
Loan Amount Request (USD)	0.238503	-0.004314
Current Loan Expenses (USD)	0.317149	0.008420
Dependents	-0.034174	-0.009304
Credit Score	0.021820	0.009948
No. of Defaults	NaN	NaN
Property ID	-0.015065	0.006282
Property Age	1.000000	-0.003009
Property Type	-0.003009	1.000000
Co-Applicant	NaN	NaN
Property Price	0.221754	-0.004485
Loan Sanction Amount (USD)	0.176245	-0.002520
Property Price	Loan Sanction Amount	
(USD)		
Age	0.004209	
0.006529		
Income (USD)	0.224053	
0.176932		
Loan Amount Request (USD)	0.927475	
0.728908		
Current Loan Expenses (USD)	0.689104	
0.518257		
Dependents	0.038639	
0.024086		
Credit Score	0.109297	

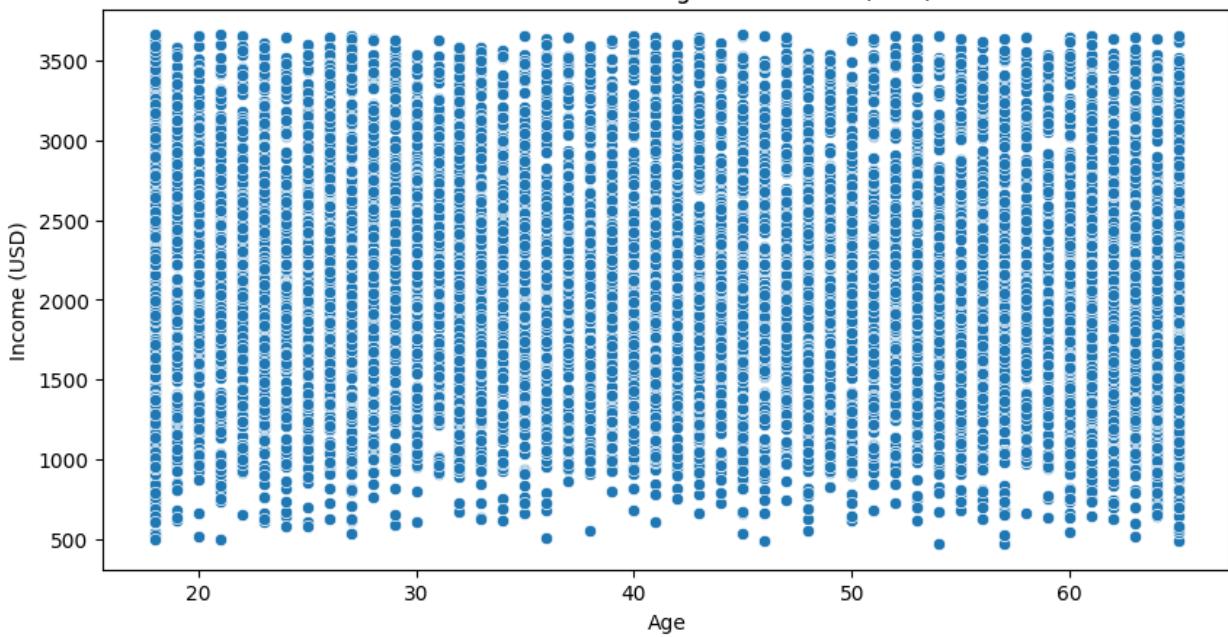
```
0.341492
No. of Defaults           NaN
NaN
Property ID                -0.016678
0.014856
Property Age                 0.221754
0.176245
Property Type                -0.004485
0.002520
Co-Applicant             NaN
NaN
Property Price              1.000000
0.675525
Loan Sanction Amount (USD) 0.675525
1.000000

# Heatmap for correlation matrix
plt.figure(figsize=(12, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm')
plt.title('Correlation Matrix Heatmap')
plt.show()
```

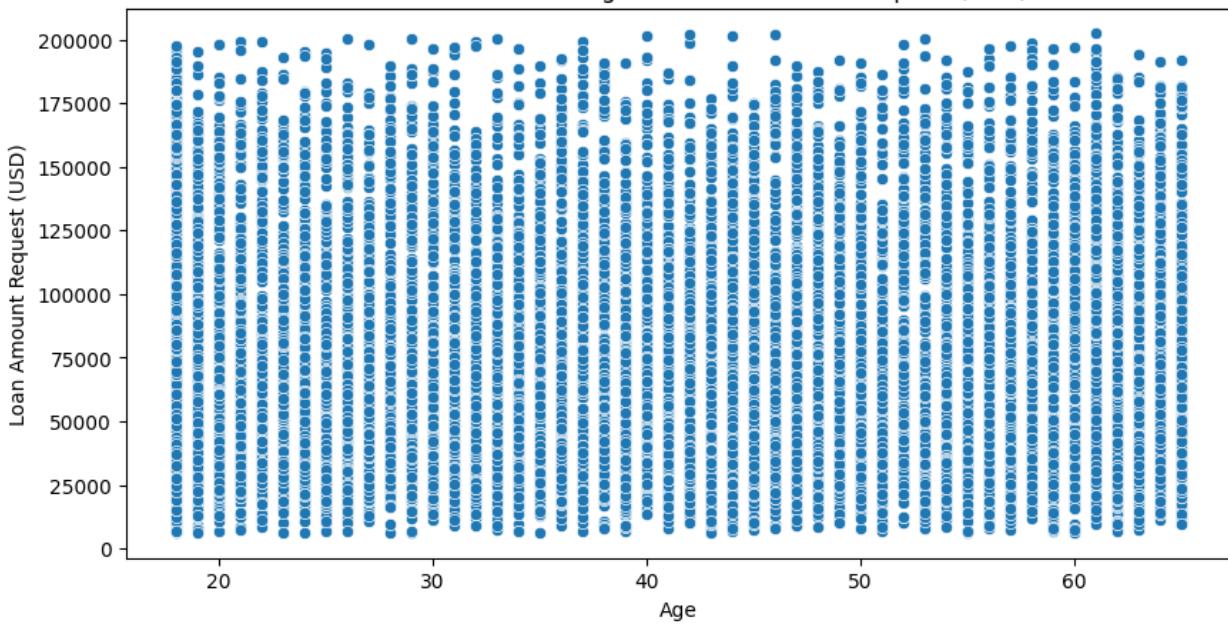


```
# Scatter plot for each pair of numerical features
for i, column1 in enumerate(numerical_columns):
    for column2 in numerical_columns[i+1:]:
        plt.figure(figsize=(10, 5))
        sns.scatterplot(x=column1, y=column2, data=data)
        plt.title(f'Scatter Plot between {column1} and {column2}')
        plt.xlabel(column1)
        plt.ylabel(column2)
        plt.show()
```

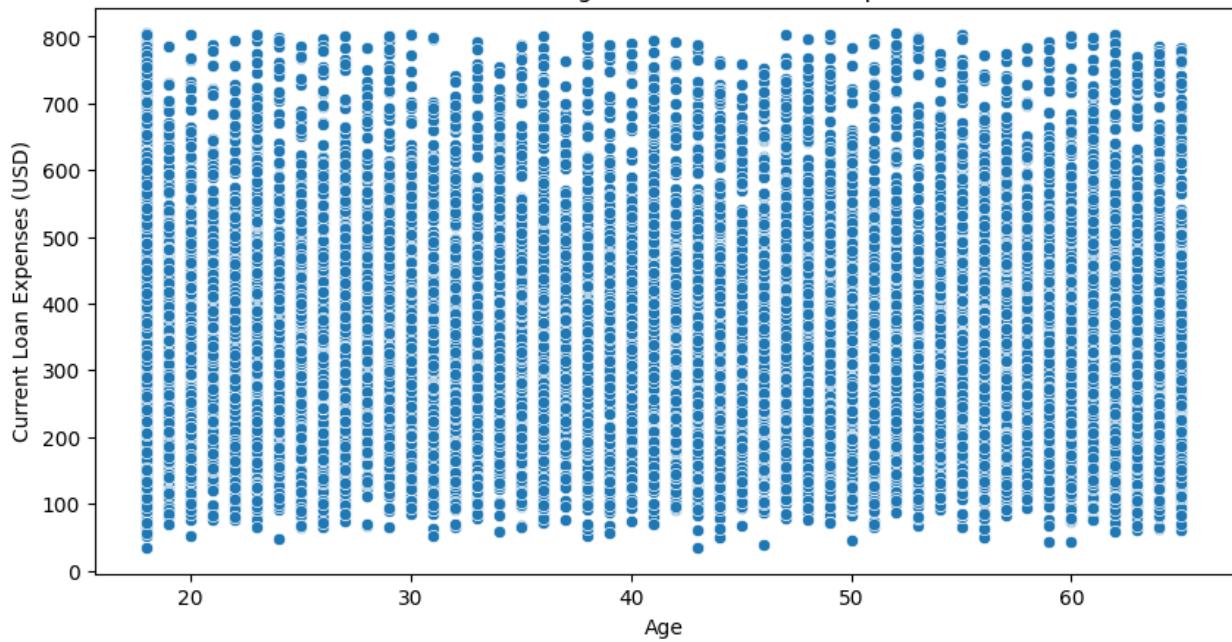
Scatter Plot between Age and Income (USD)



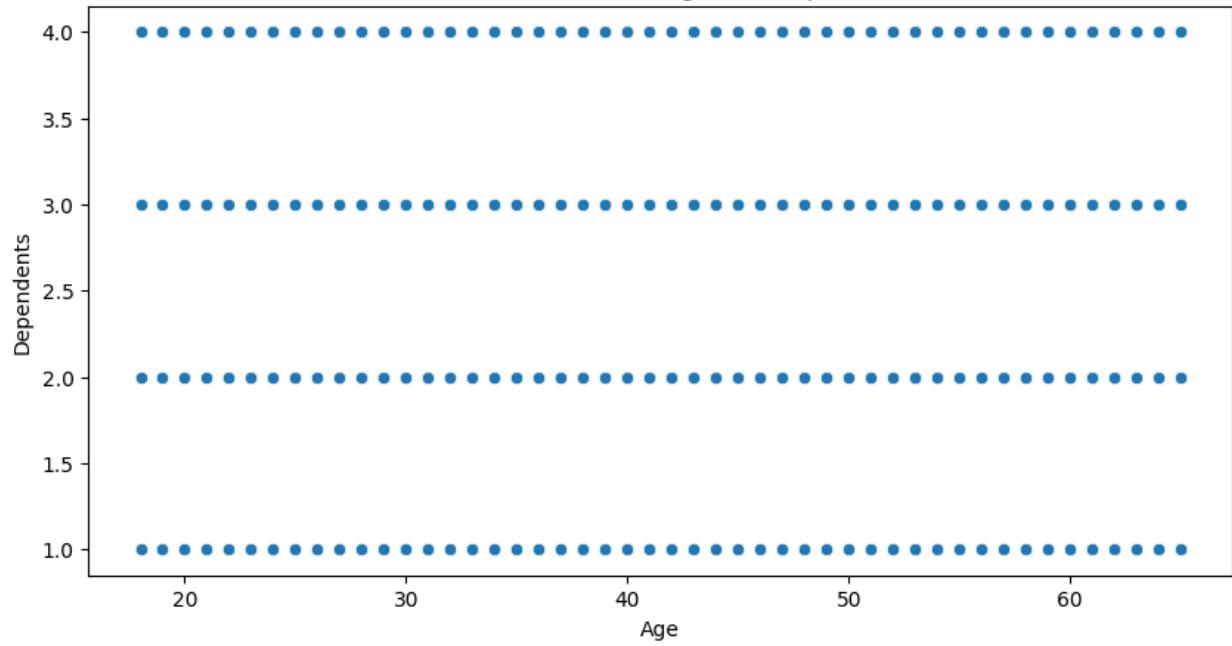
Scatter Plot between Age and Loan Amount Request (USD)



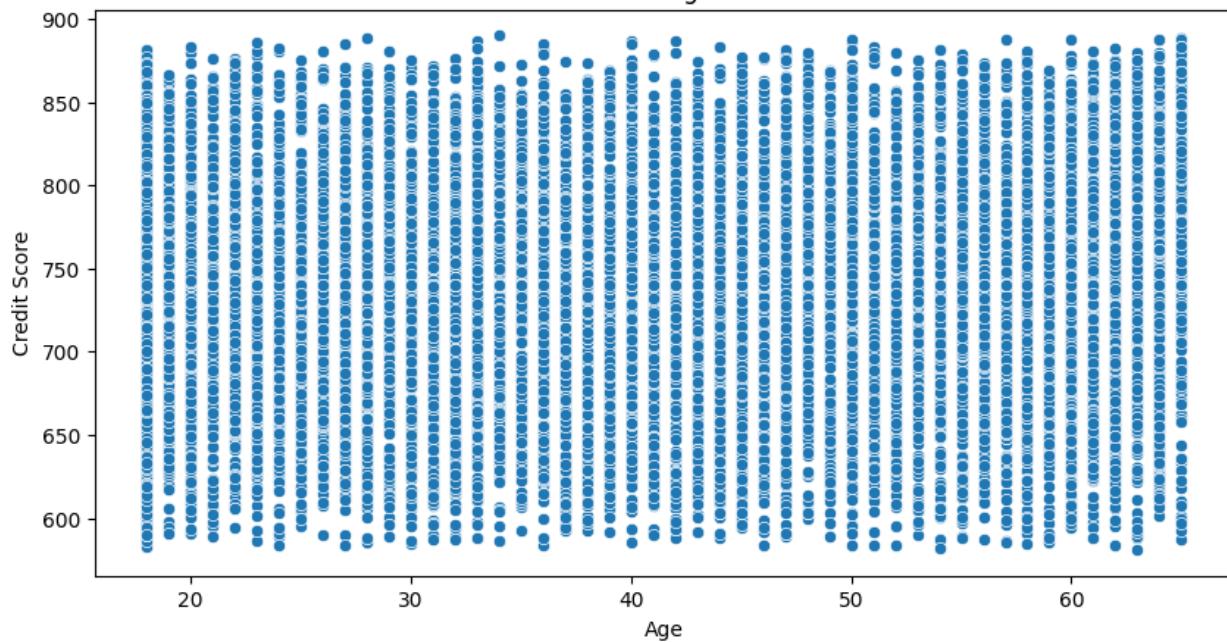
Scatter Plot between Age and Current Loan Expenses (USD)



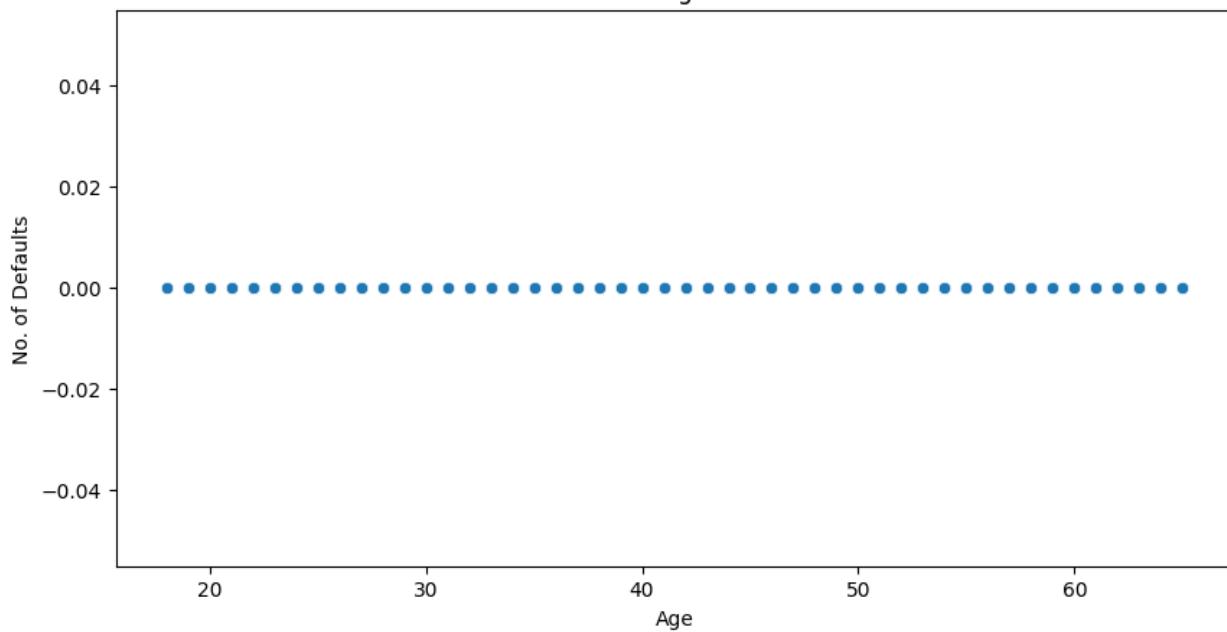
Scatter Plot between Age and Dependents



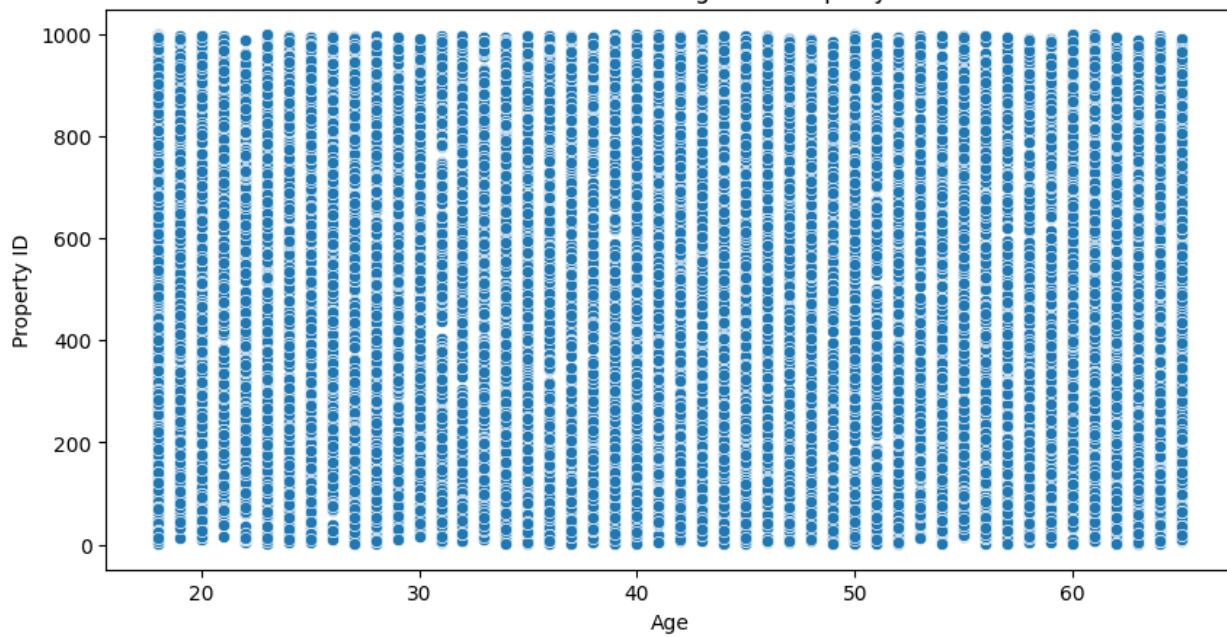
Scatter Plot between Age and Credit Score



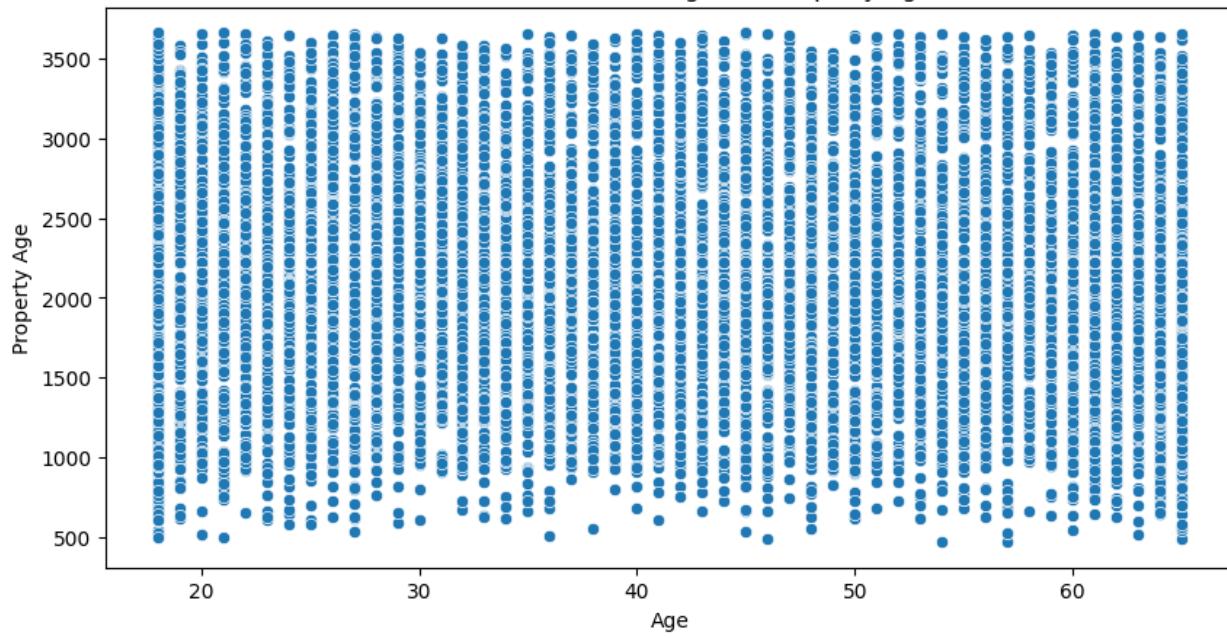
Scatter Plot between Age and No. of Defaults



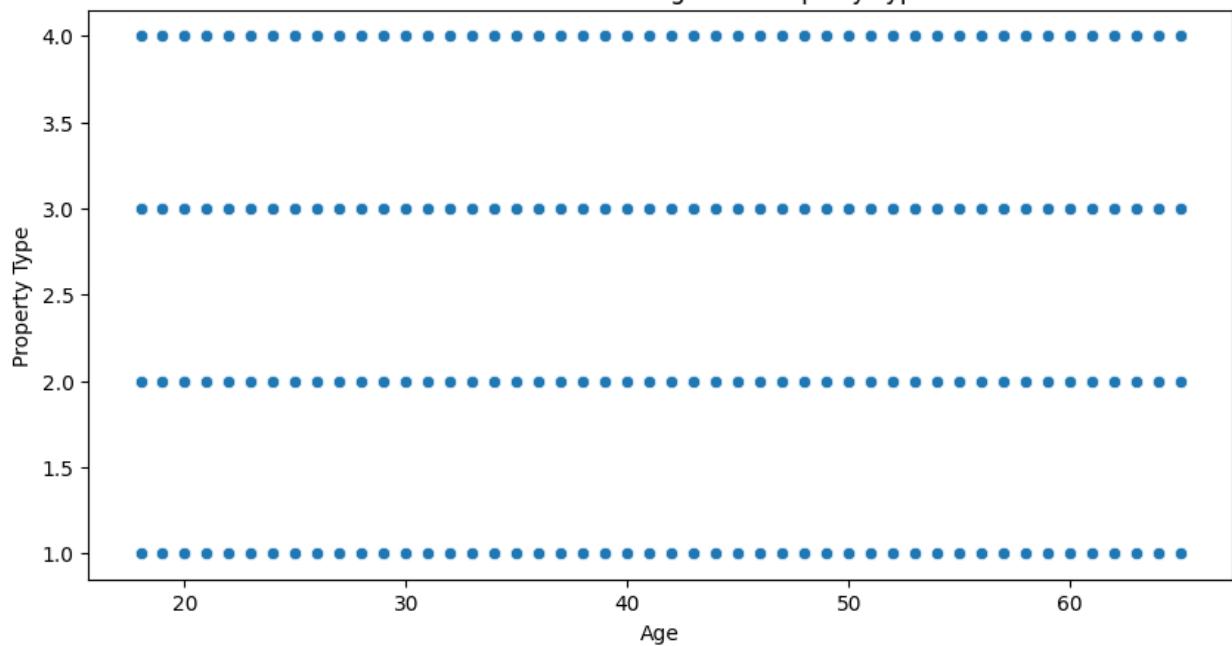
Scatter Plot between Age and Property ID



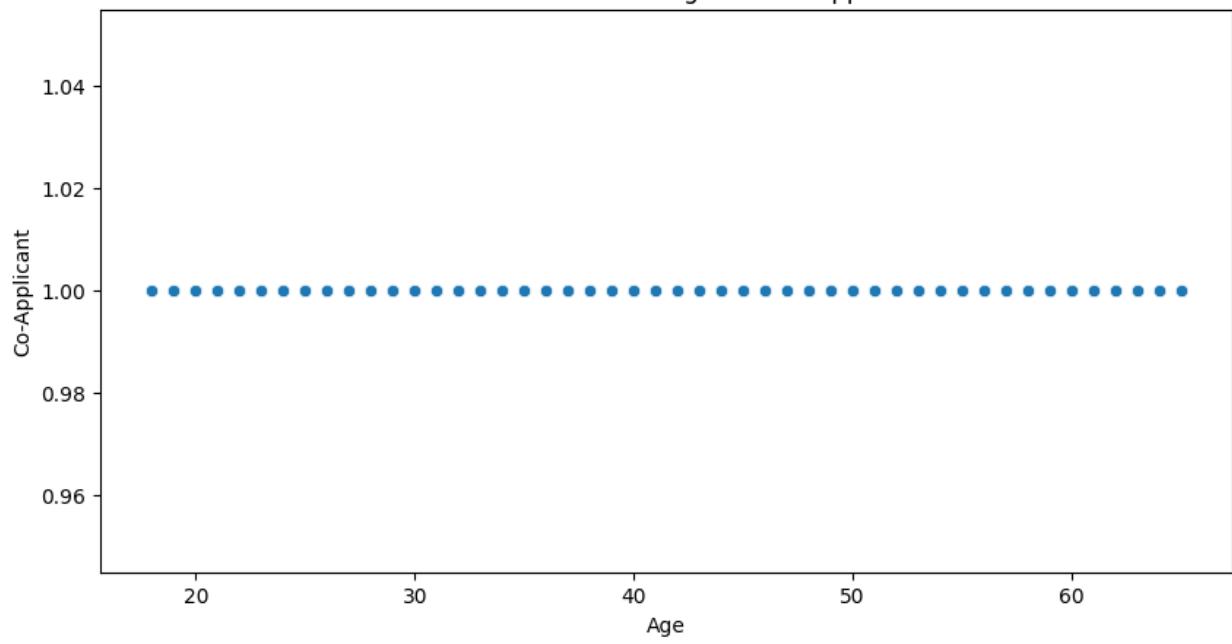
Scatter Plot between Age and Property Age



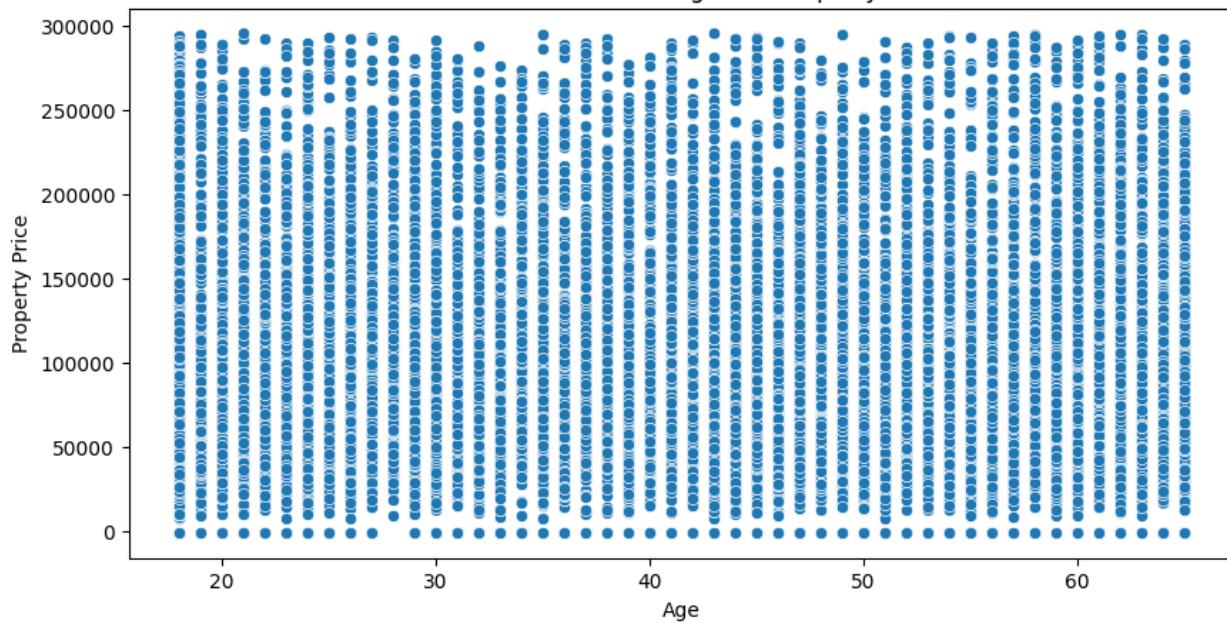
Scatter Plot between Age and Property Type



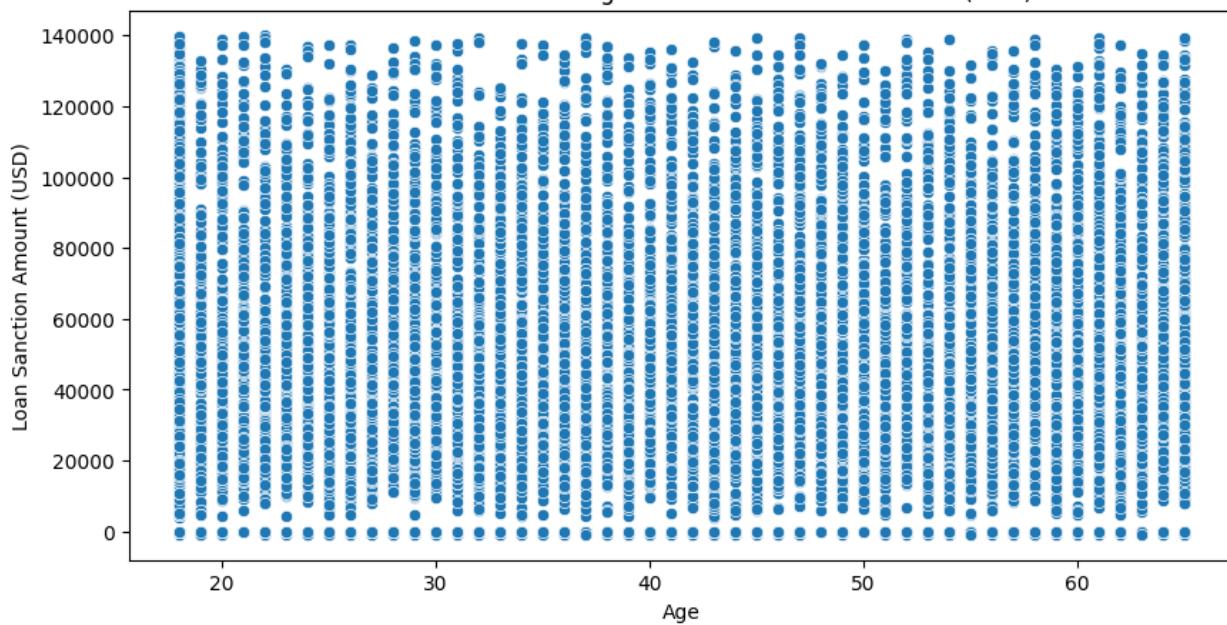
Scatter Plot between Age and Co-Applicant



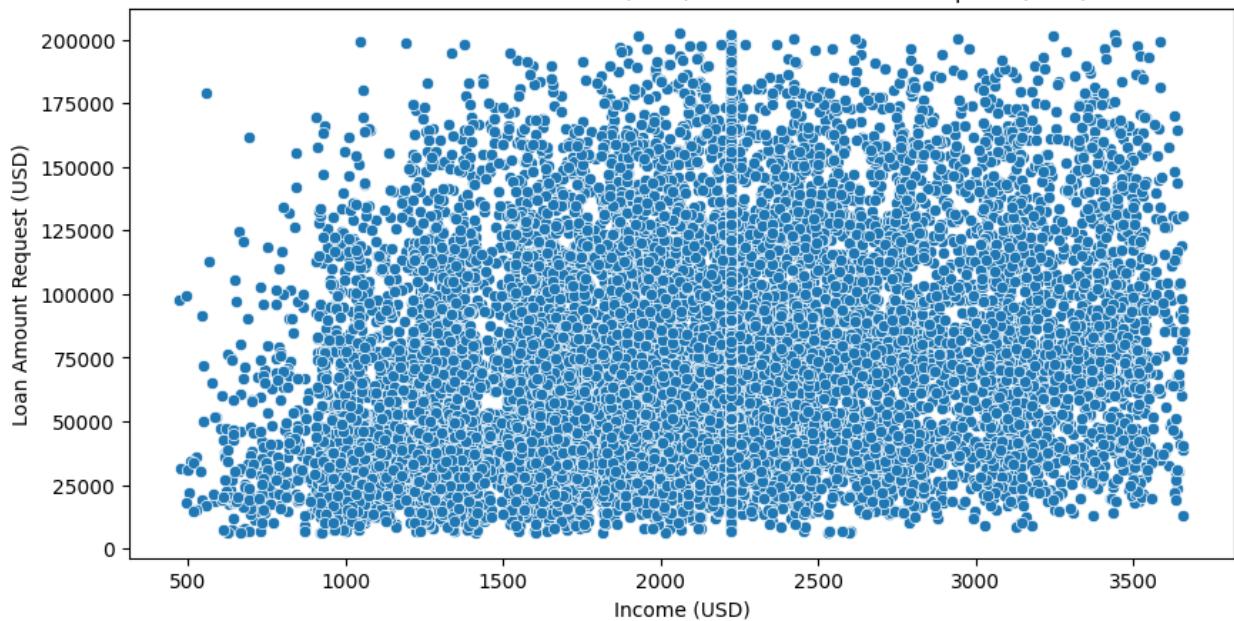
Scatter Plot between Age and Property Price



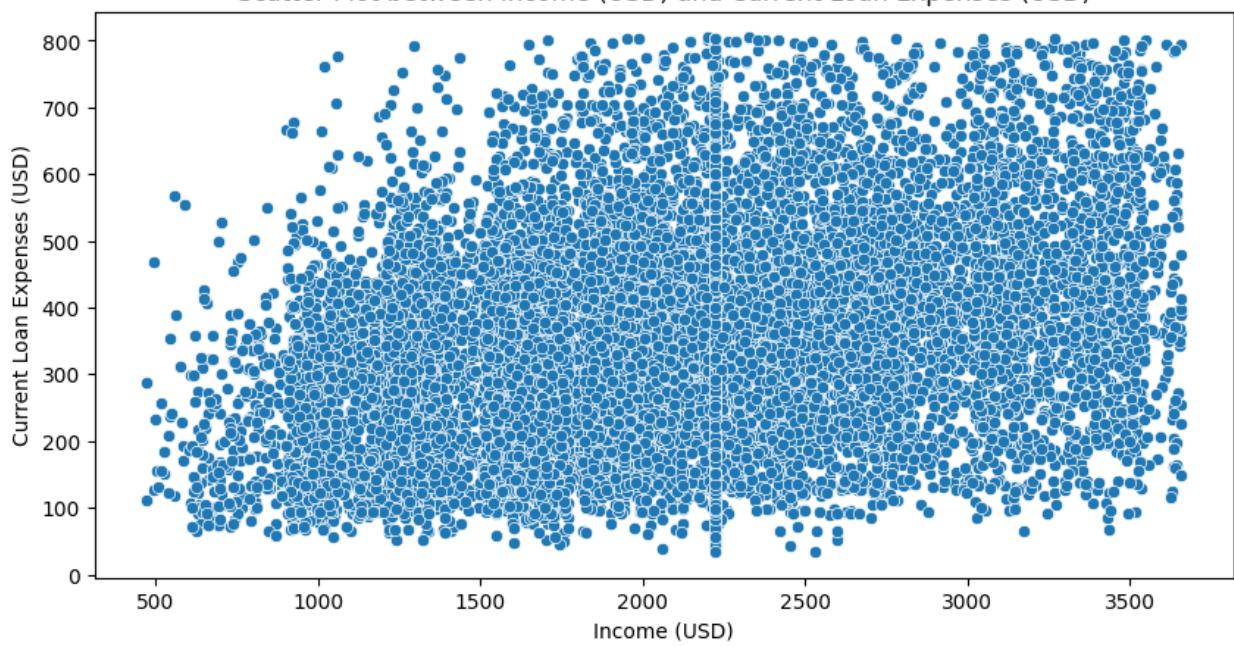
Scatter Plot between Age and Loan Sanction Amount (USD)



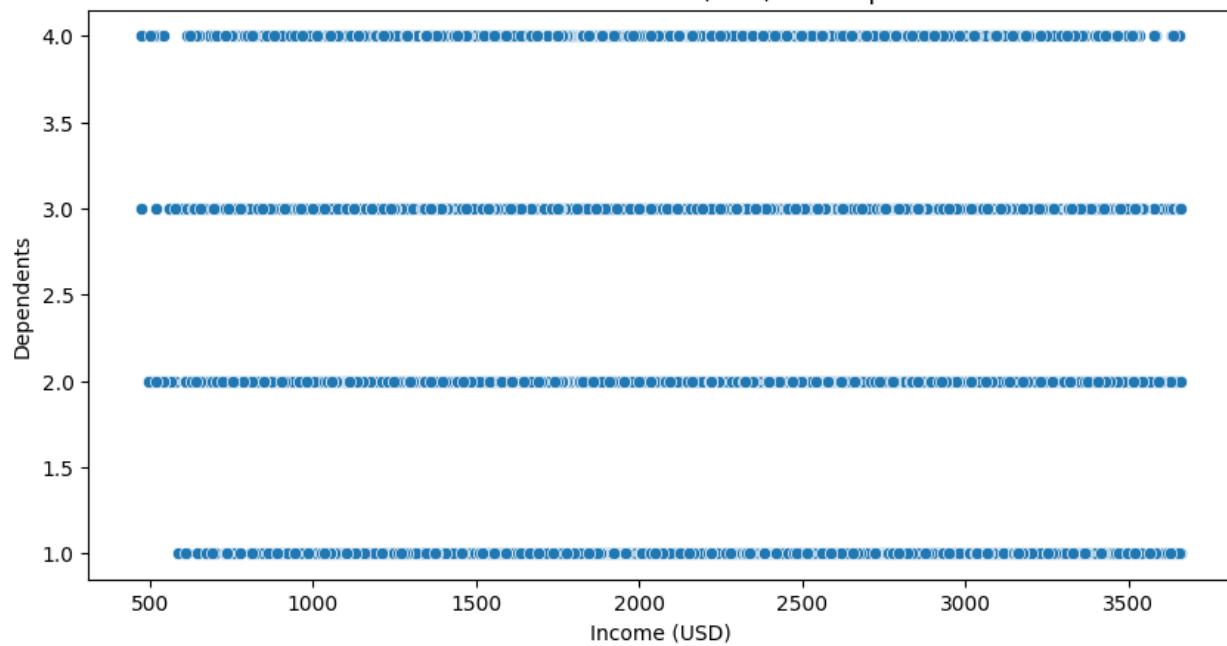
Scatter Plot between Income (USD) and Loan Amount Request (USD)



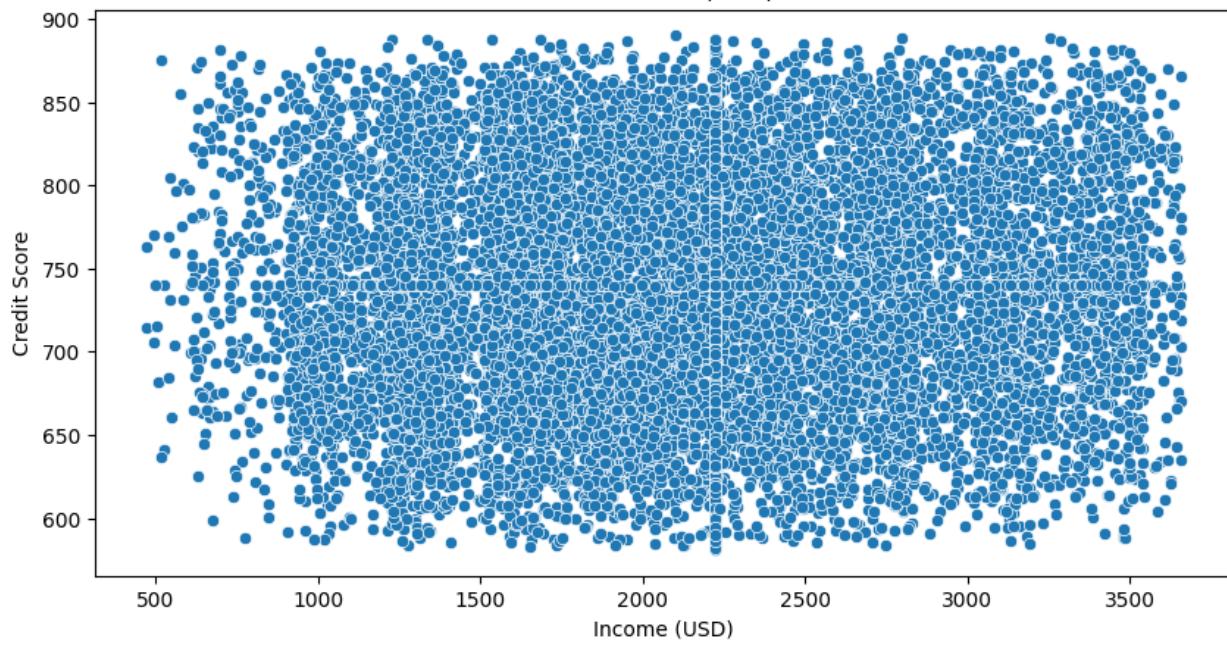
Scatter Plot between Income (USD) and Current Loan Expenses (USD)



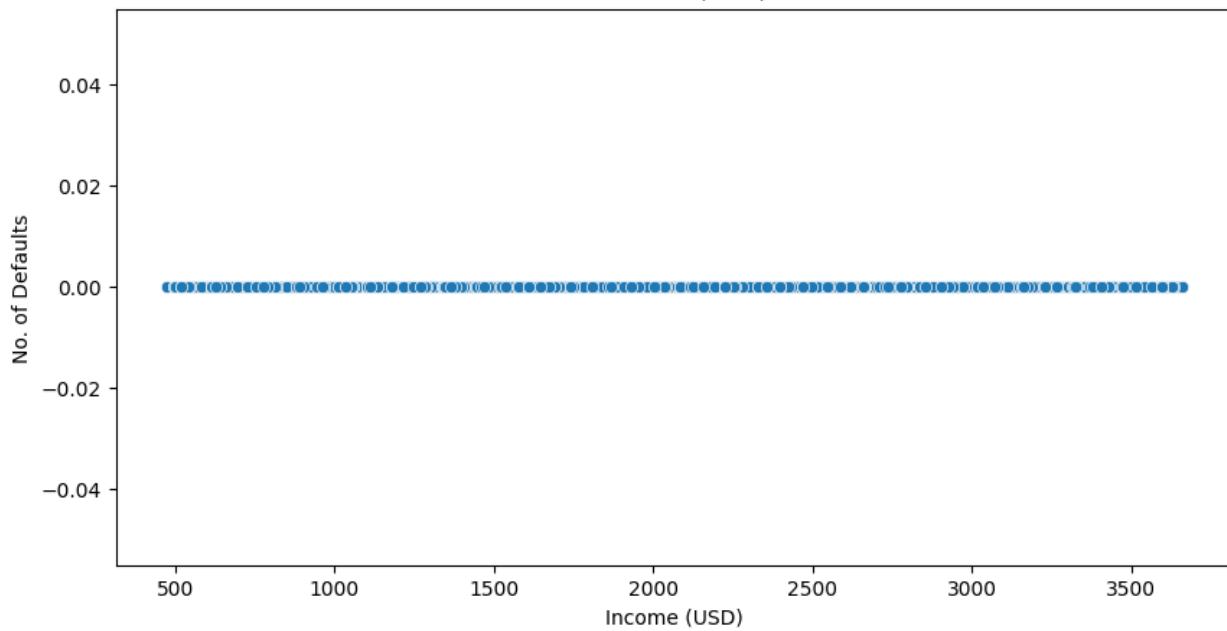
Scatter Plot between Income (USD) and Dependents



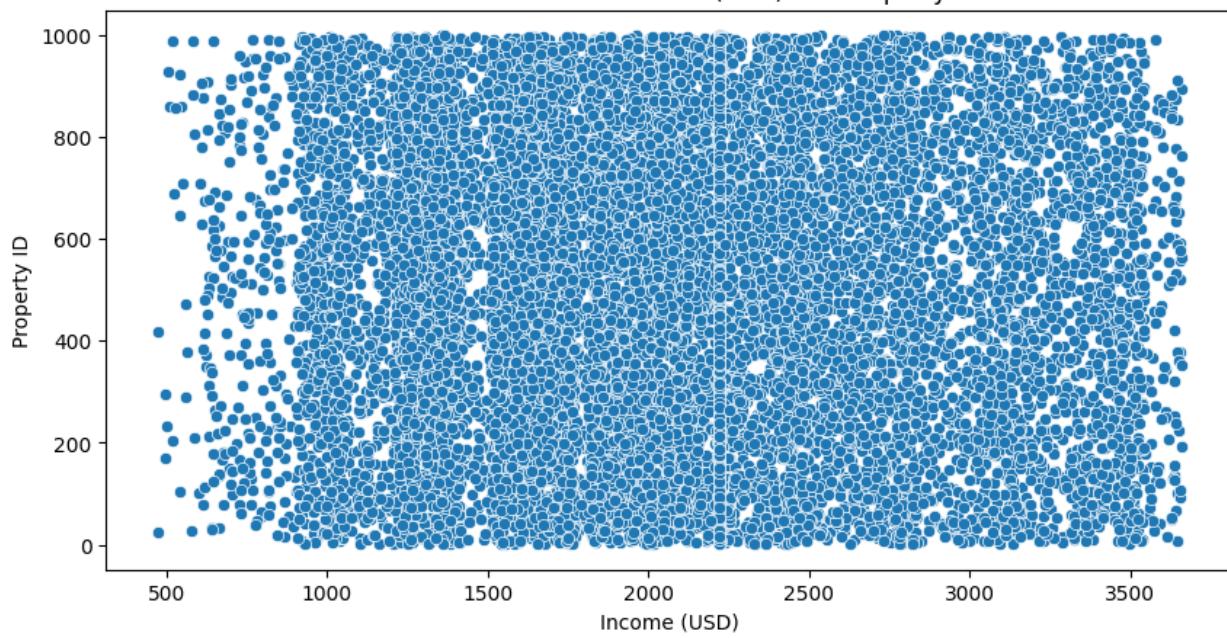
Scatter Plot between Income (USD) and Credit Score



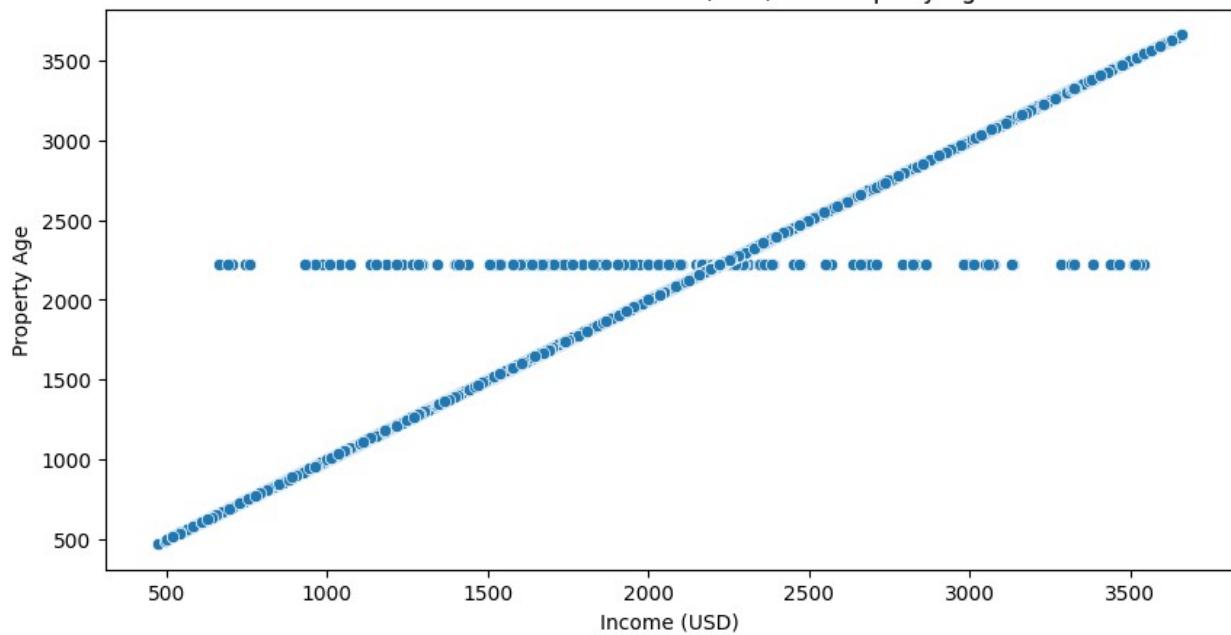
Scatter Plot between Income (USD) and No. of Defaults



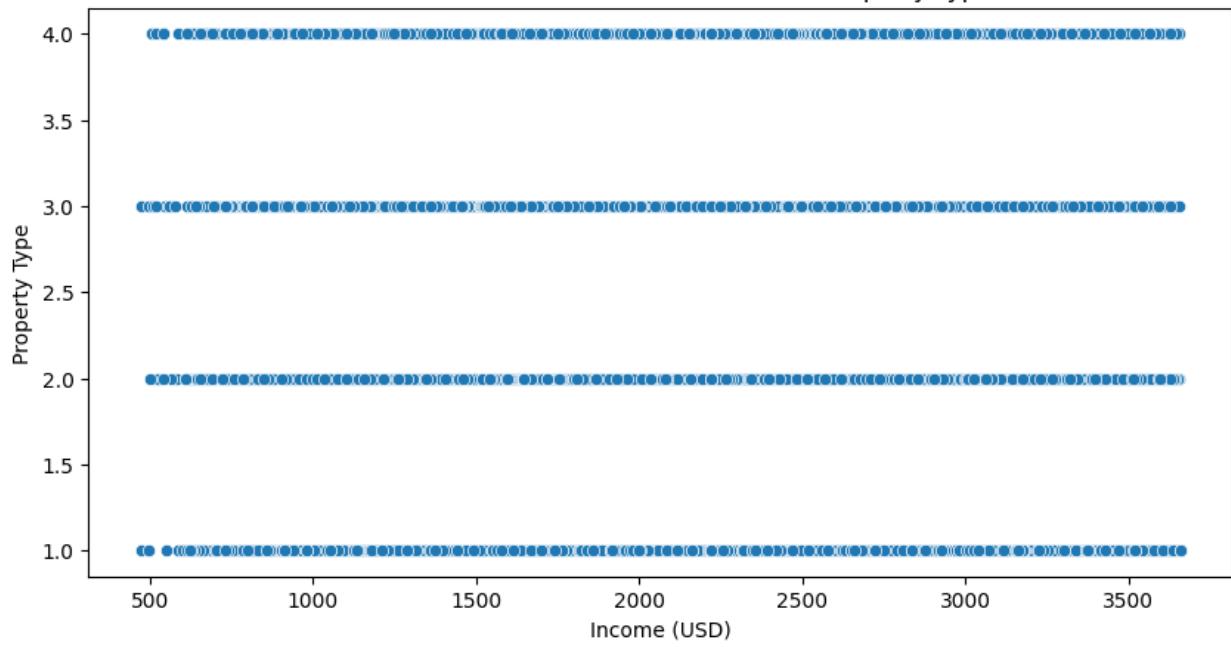
Scatter Plot between Income (USD) and Property ID



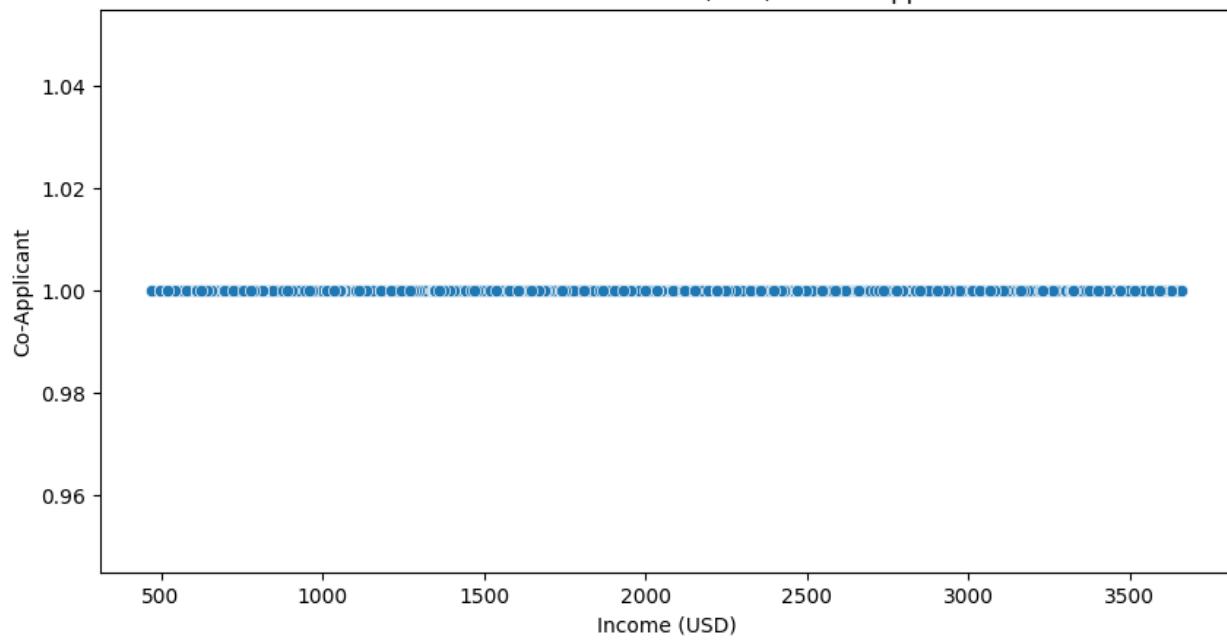
Scatter Plot between Income (USD) and Property Age



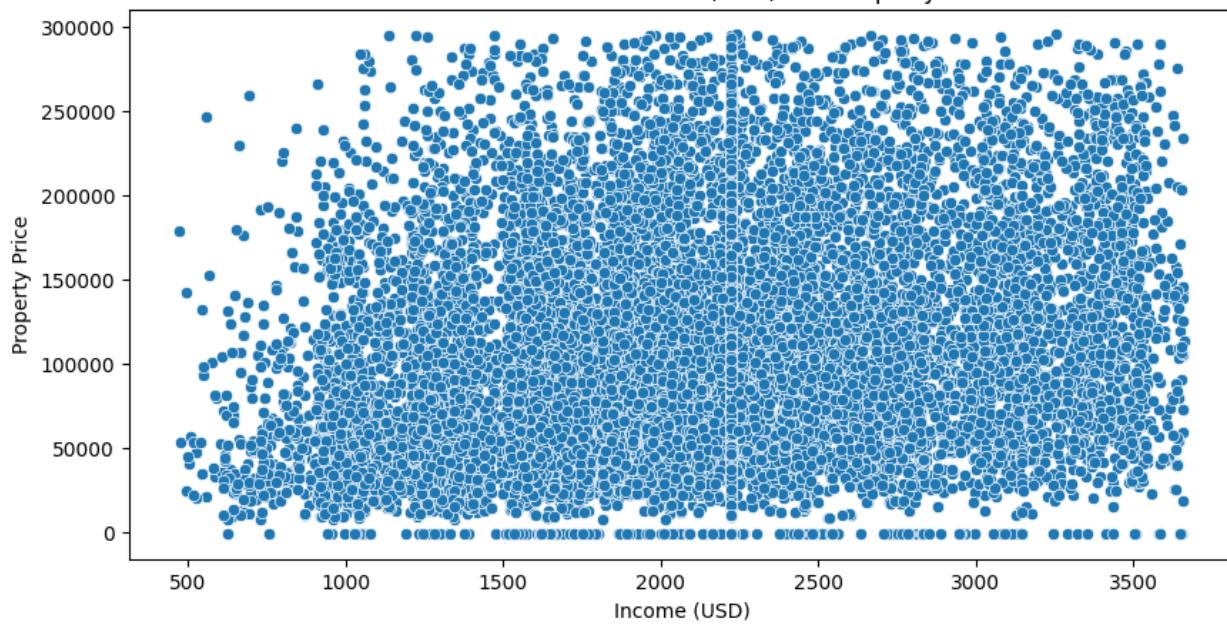
Scatter Plot between Income (USD) and Property Type



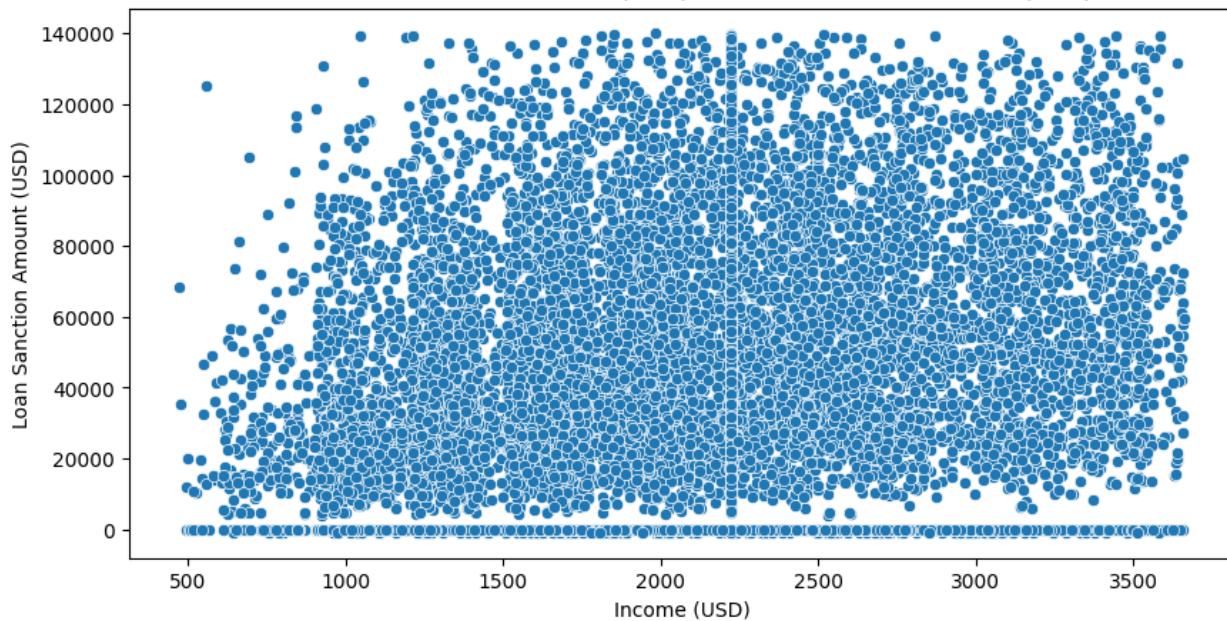
Scatter Plot between Income (USD) and Co-Applicant



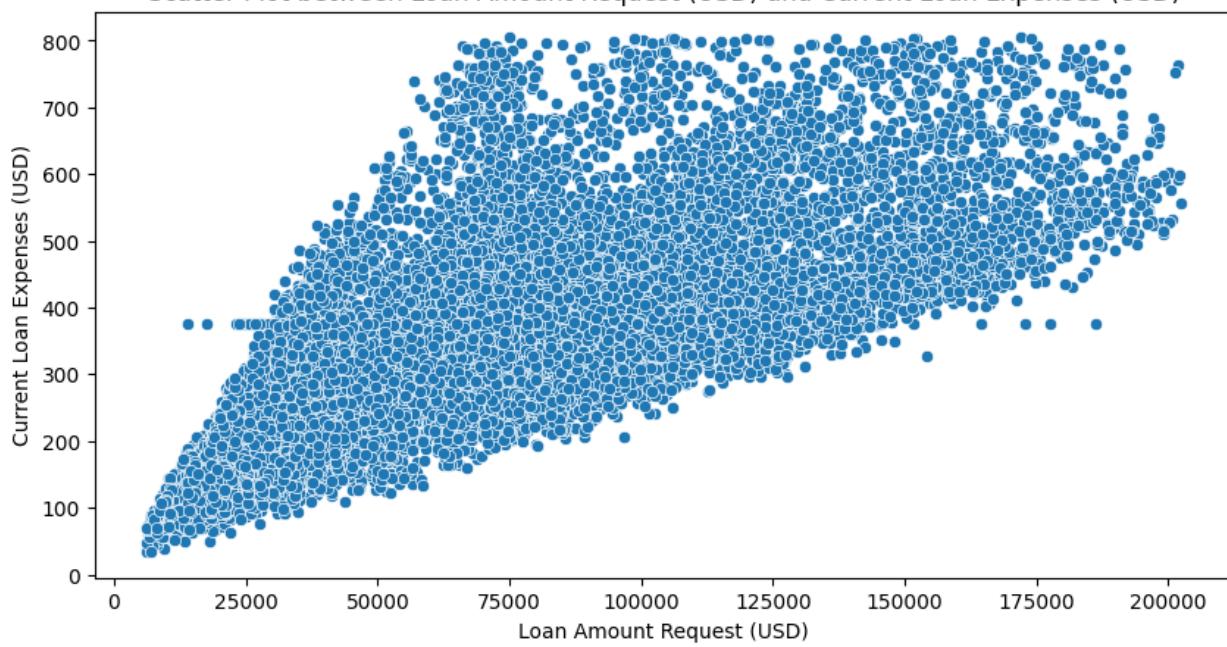
Scatter Plot between Income (USD) and Property Price



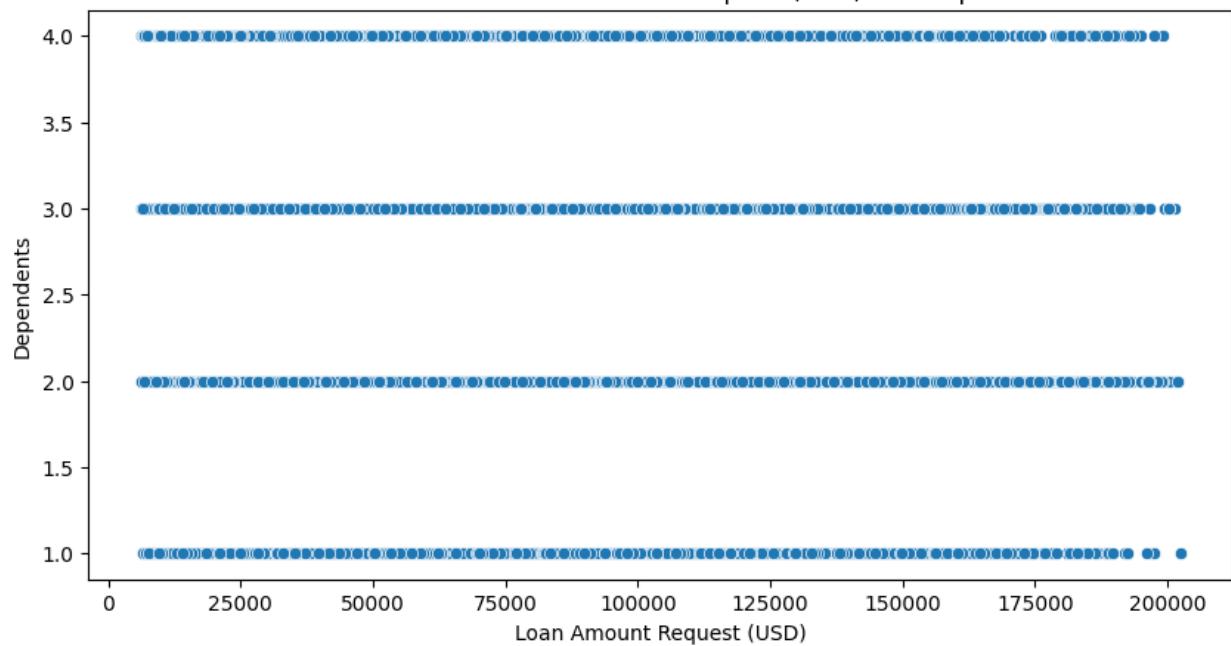
Scatter Plot between Income (USD) and Loan Sanction Amount (USD)



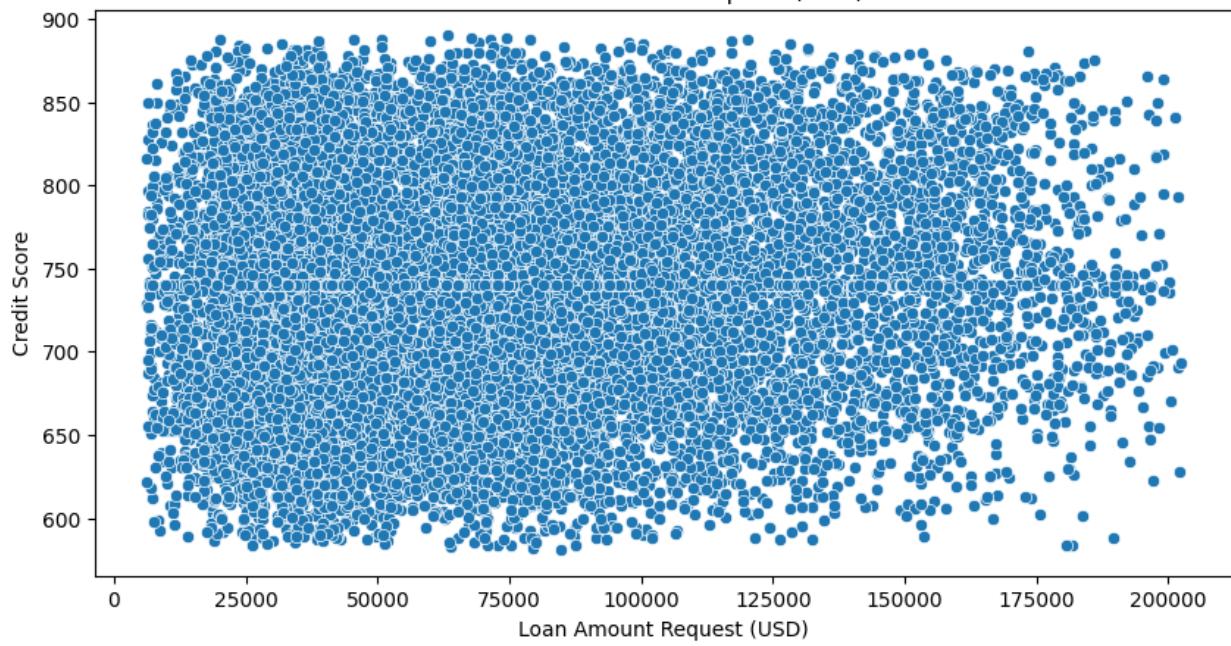
Scatter Plot between Loan Amount Request (USD) and Current Loan Expenses (USD)



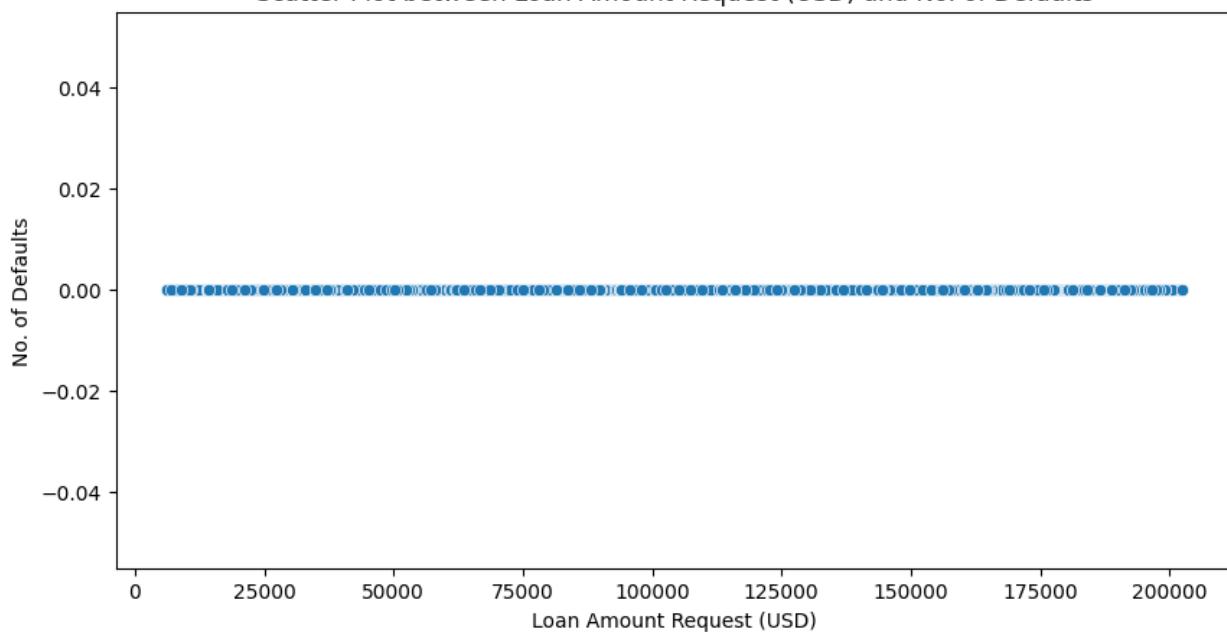
Scatter Plot between Loan Amount Request (USD) and Dependents



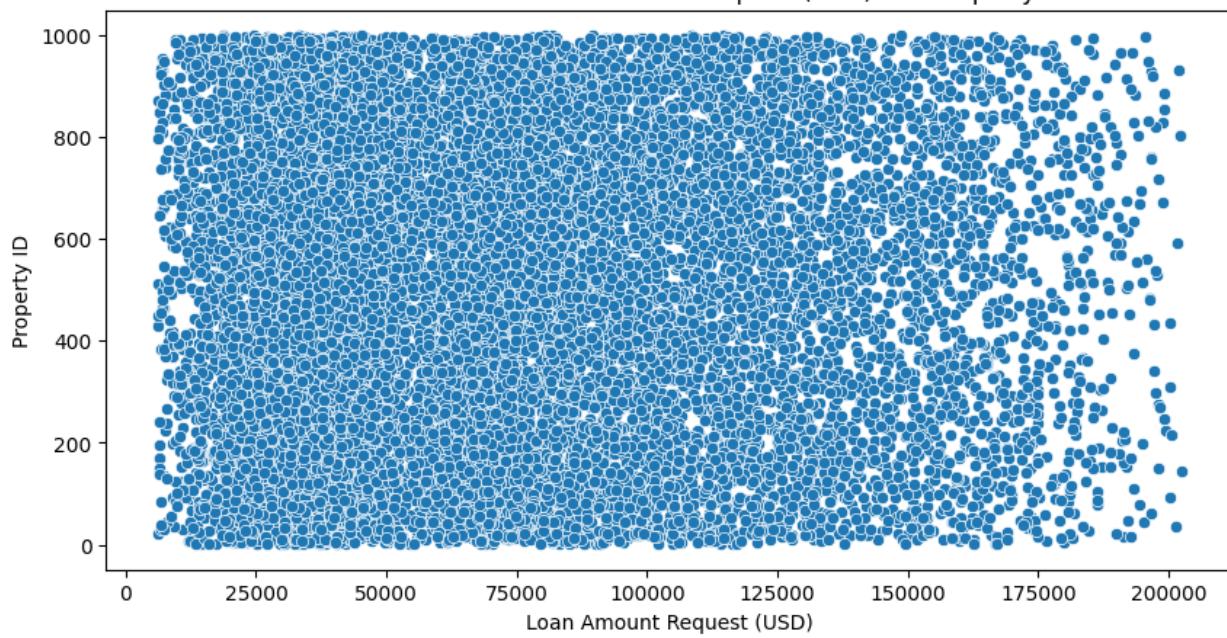
Scatter Plot between Loan Amount Request (USD) and Credit Score



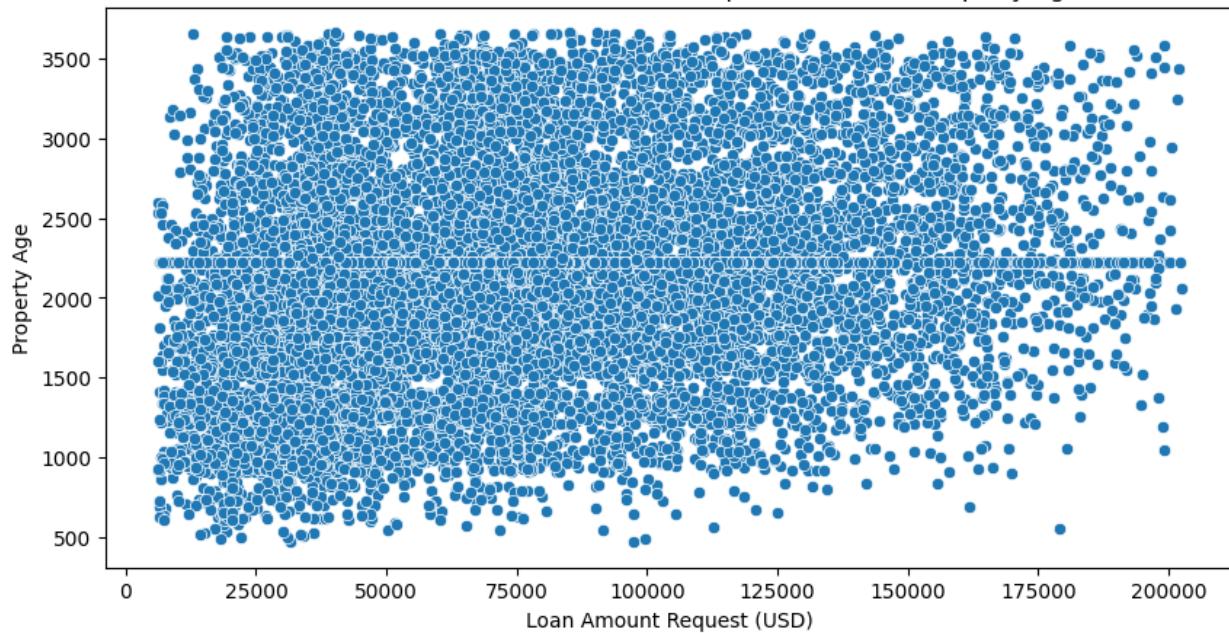
Scatter Plot between Loan Amount Request (USD) and No. of Defaults



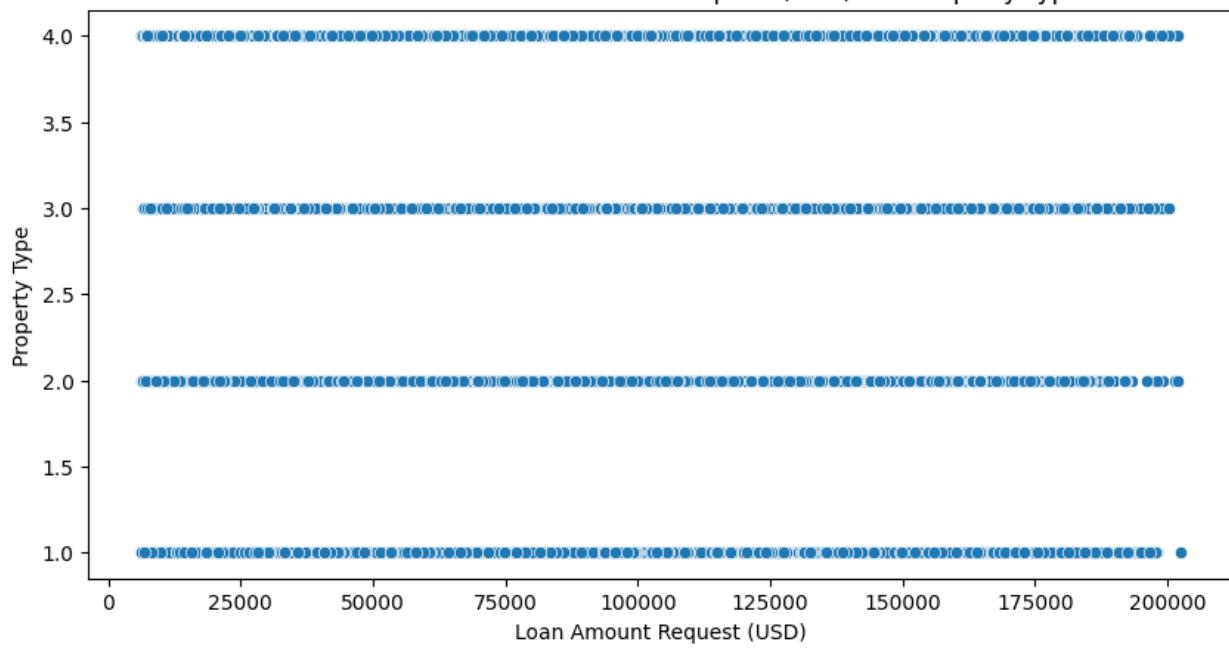
Scatter Plot between Loan Amount Request (USD) and Property ID



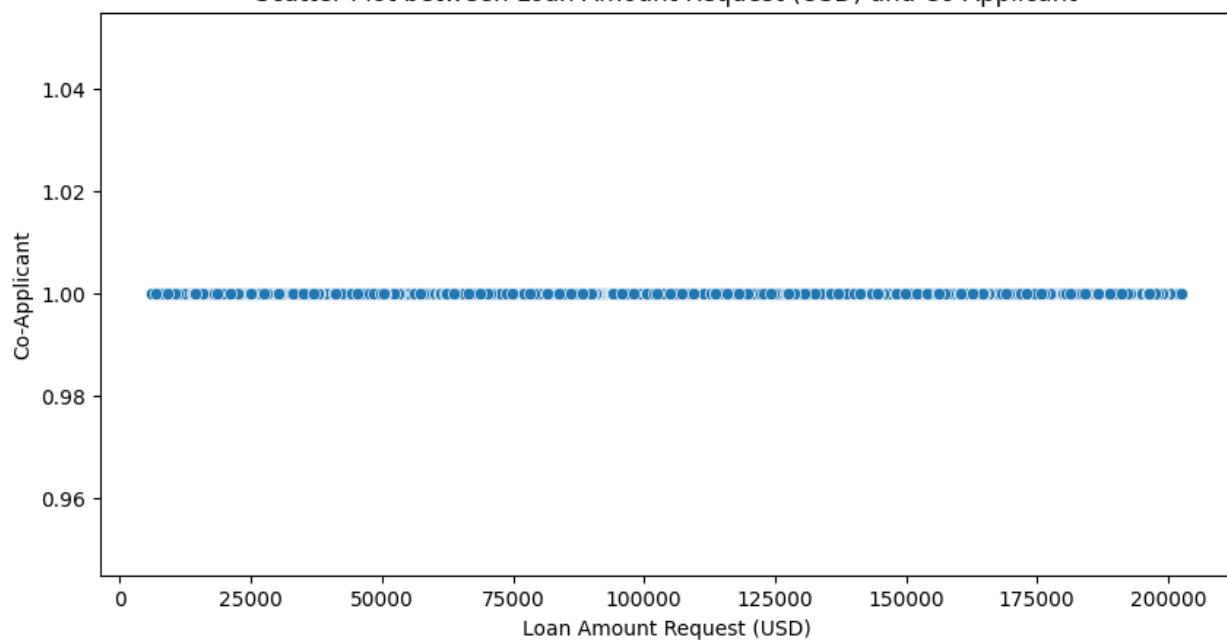
Scatter Plot between Loan Amount Request (USD) and Property Age



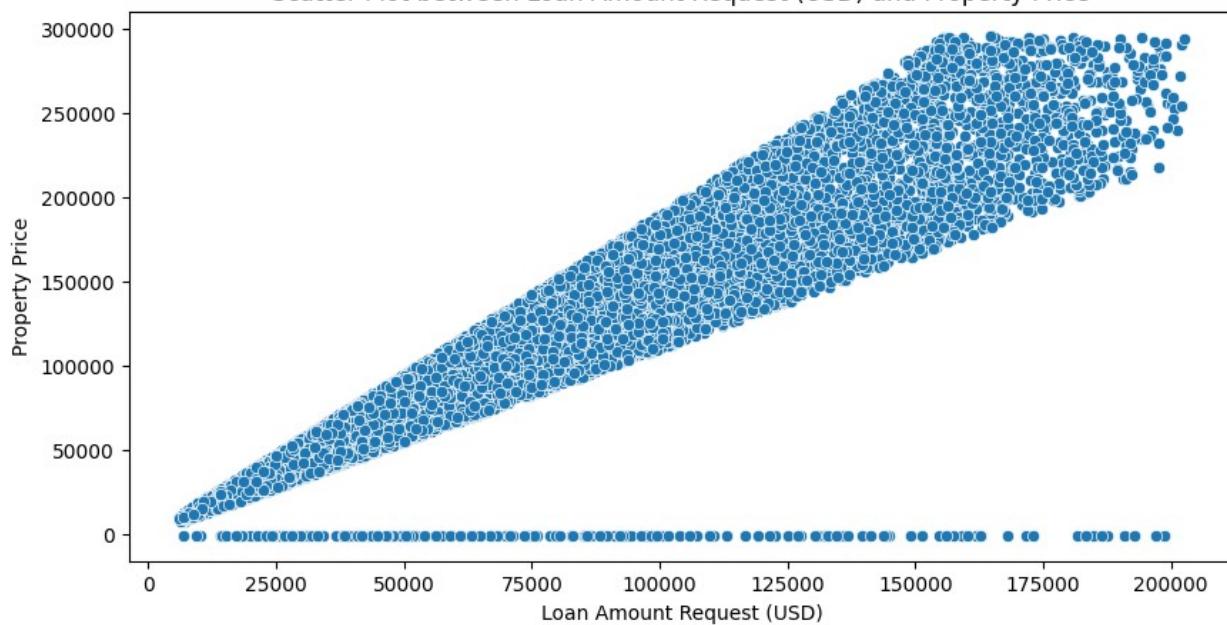
Scatter Plot between Loan Amount Request (USD) and Property Type



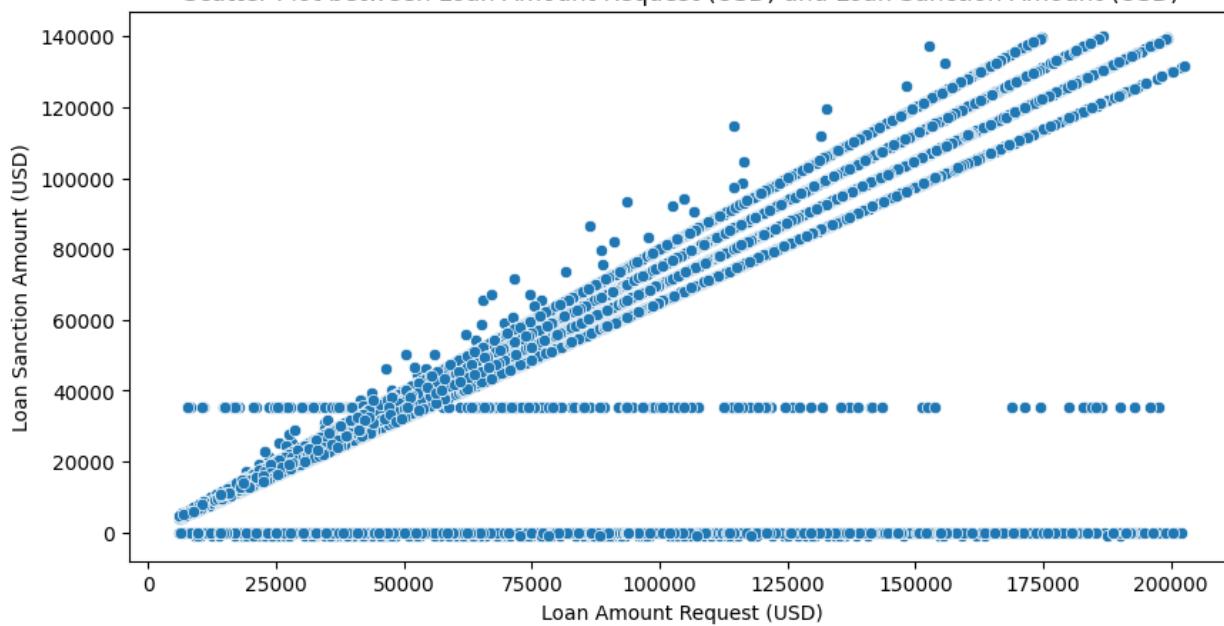
Scatter Plot between Loan Amount Request (USD) and Co-Applicant



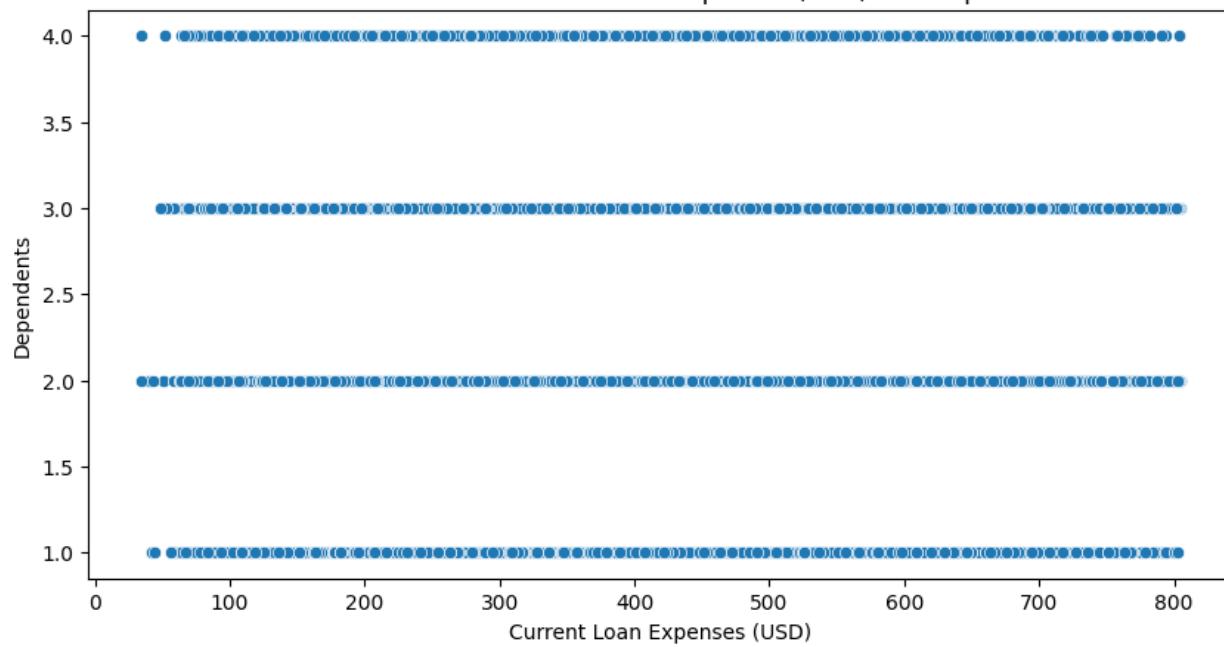
Scatter Plot between Loan Amount Request (USD) and Property Price

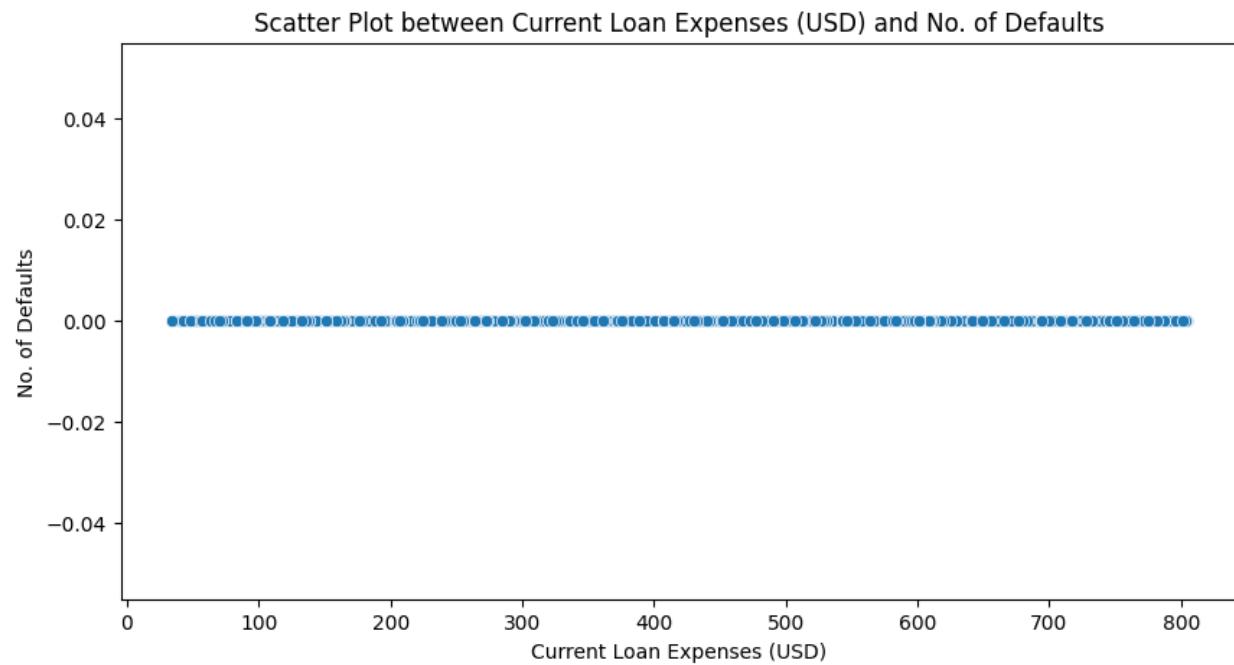
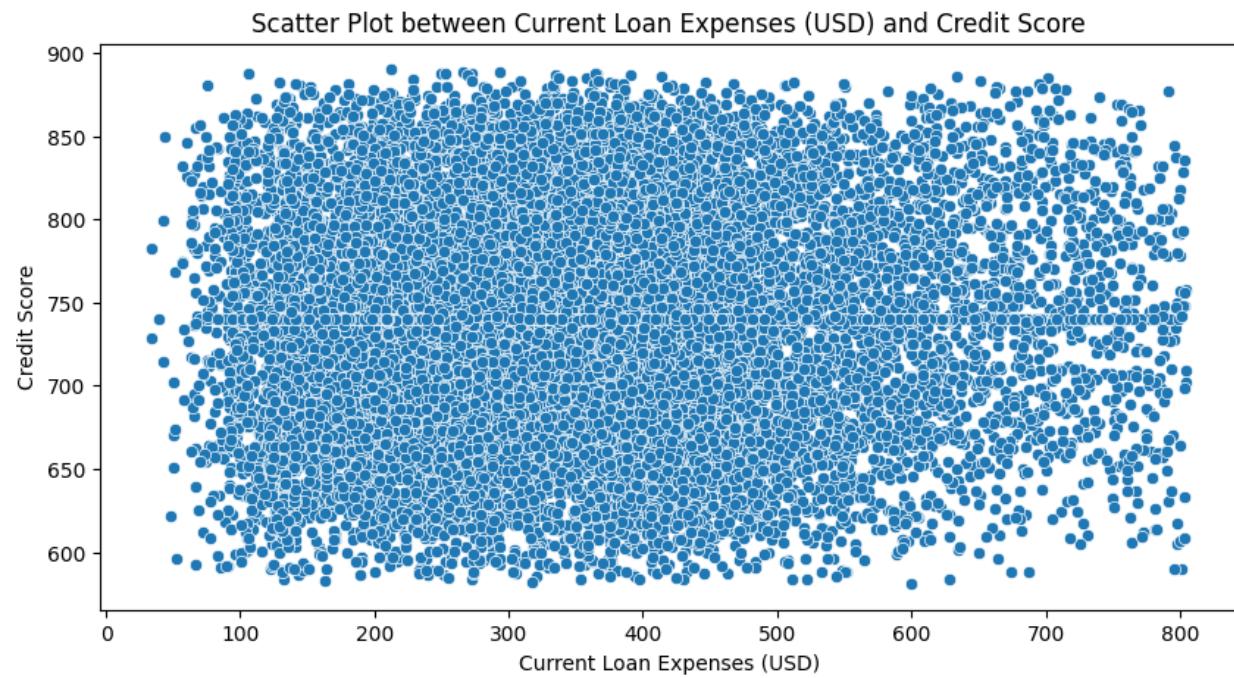


Scatter Plot between Loan Amount Request (USD) and Loan Sanction Amount (USD)

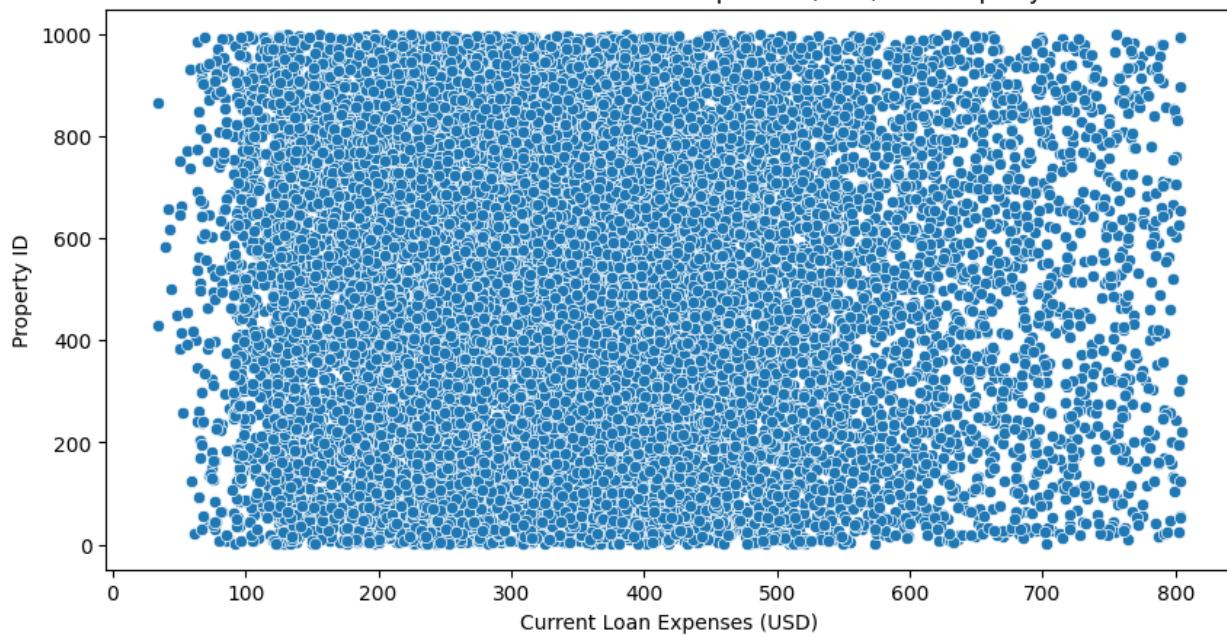


Scatter Plot between Current Loan Expenses (USD) and Dependents

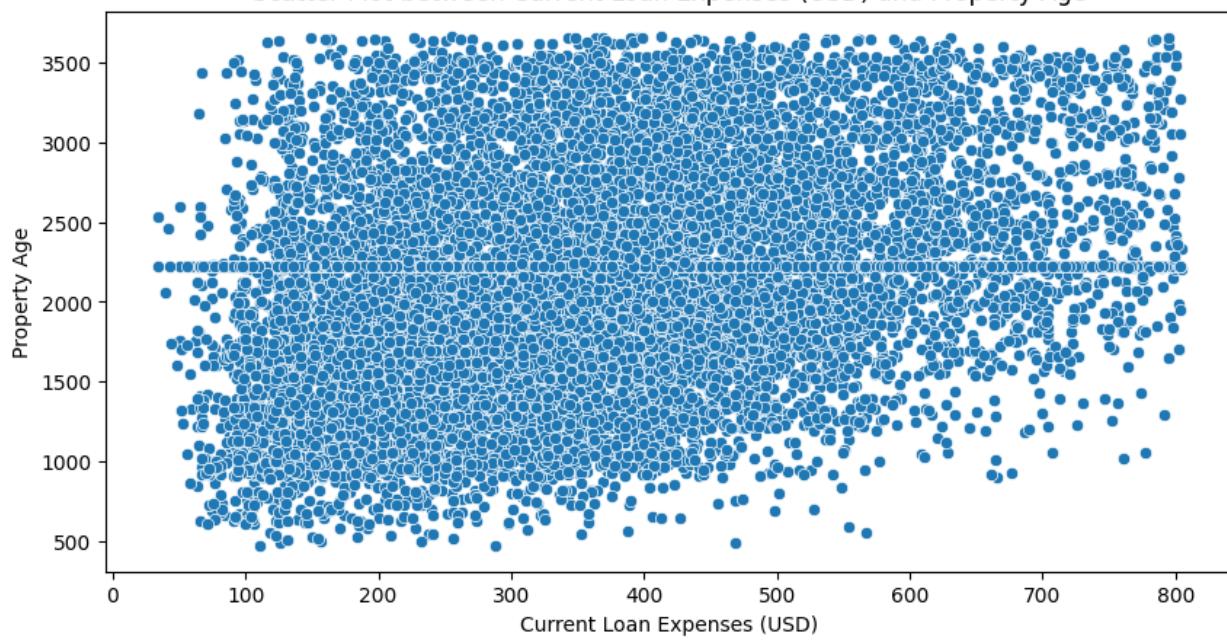




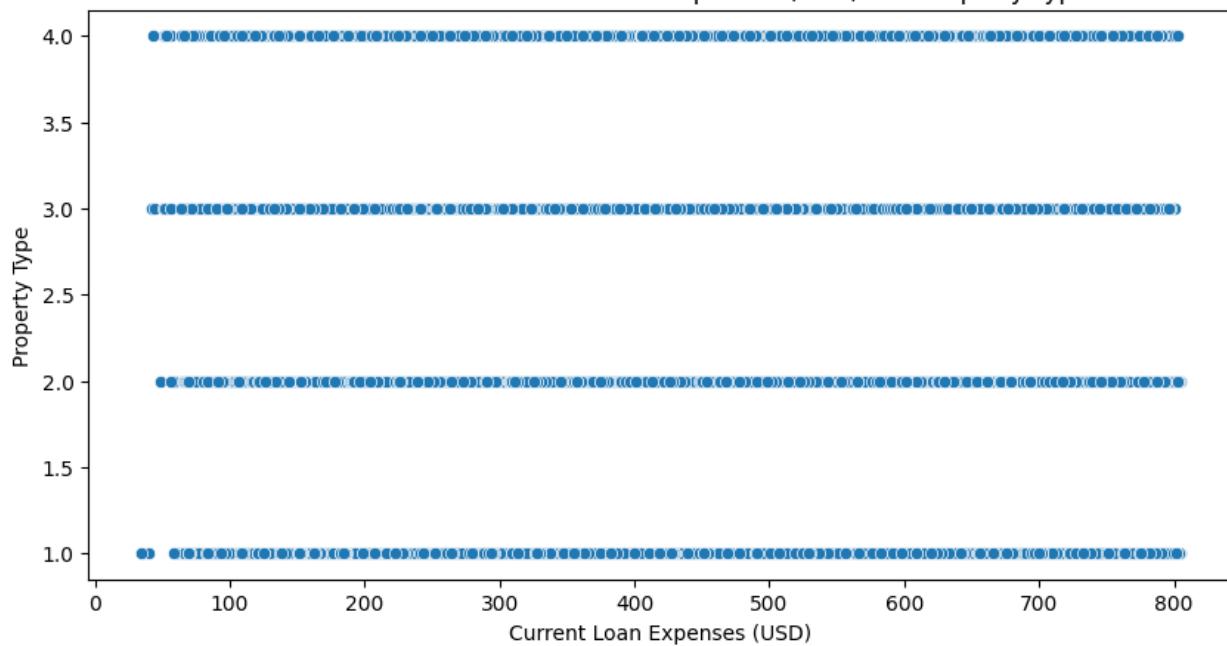
Scatter Plot between Current Loan Expenses (USD) and Property ID



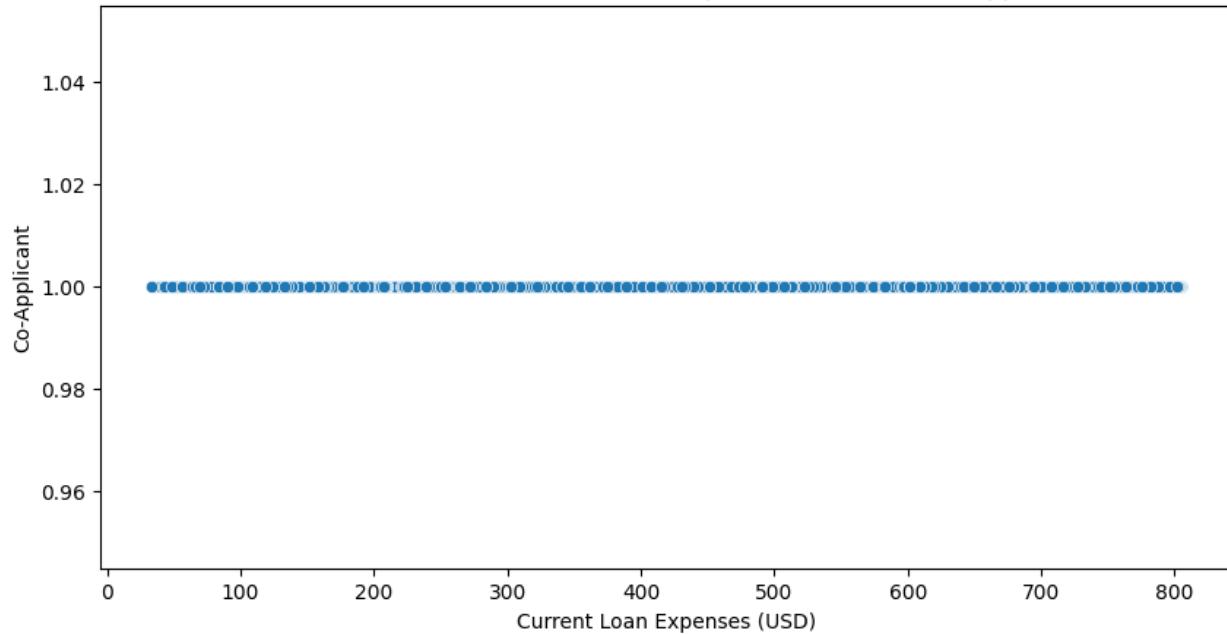
Scatter Plot between Current Loan Expenses (USD) and Property Age



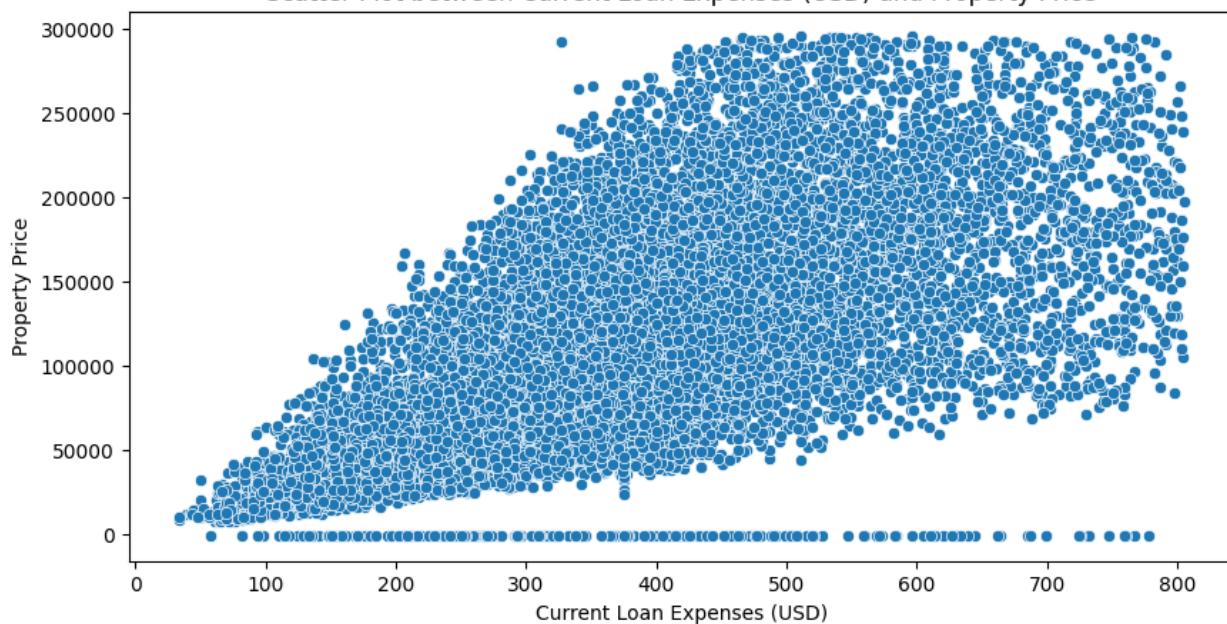
Scatter Plot between Current Loan Expenses (USD) and Property Type



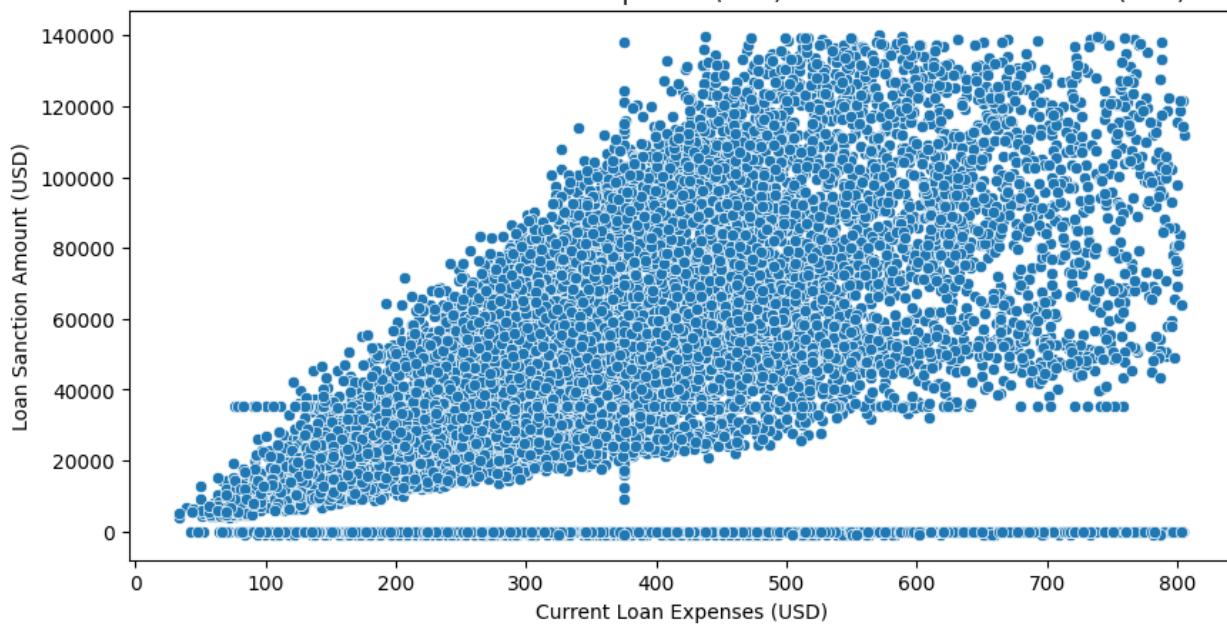
Scatter Plot between Current Loan Expenses (USD) and Co-Applicant



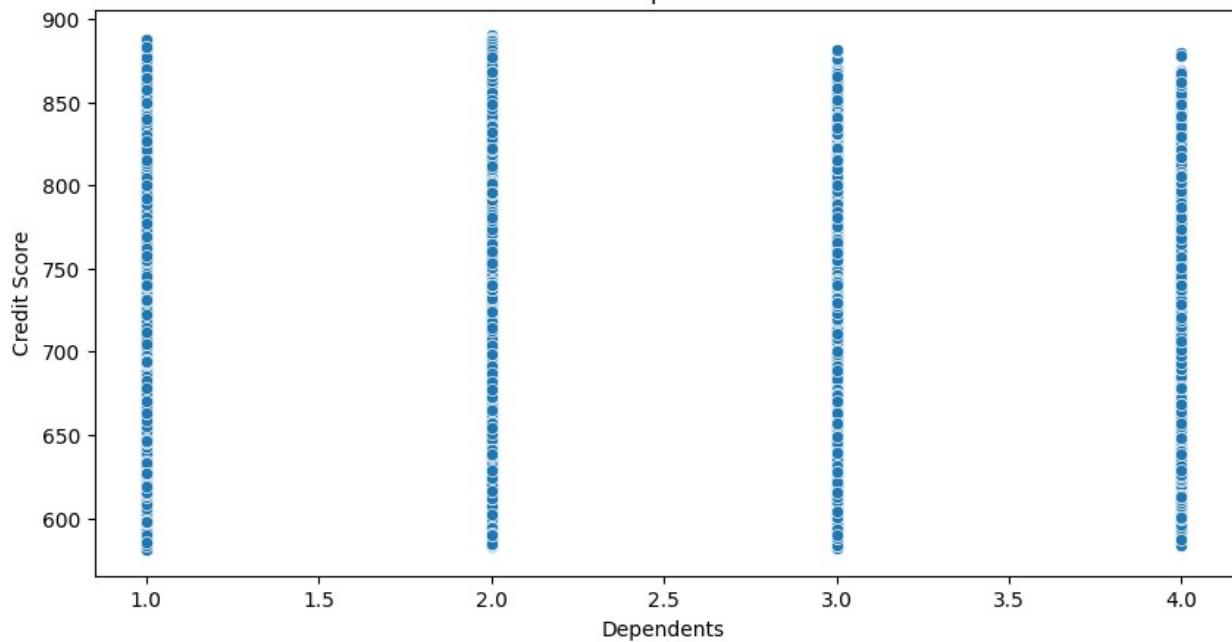
Scatter Plot between Current Loan Expenses (USD) and Property Price



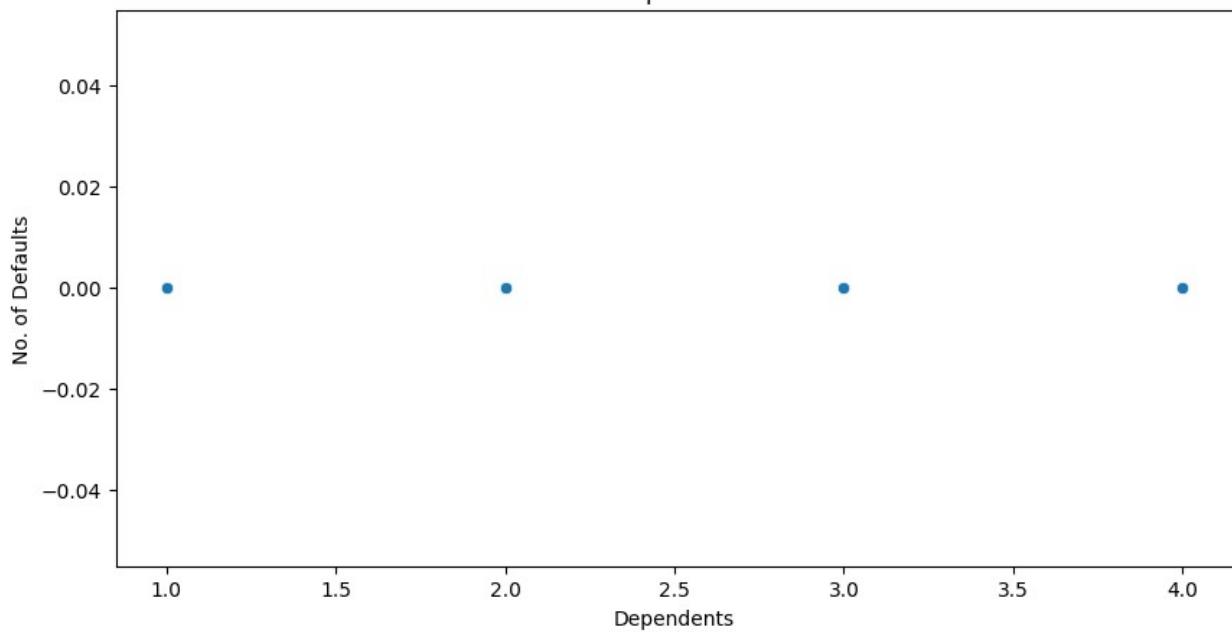
Scatter Plot between Current Loan Expenses (USD) and Loan Sanction Amount (USD)



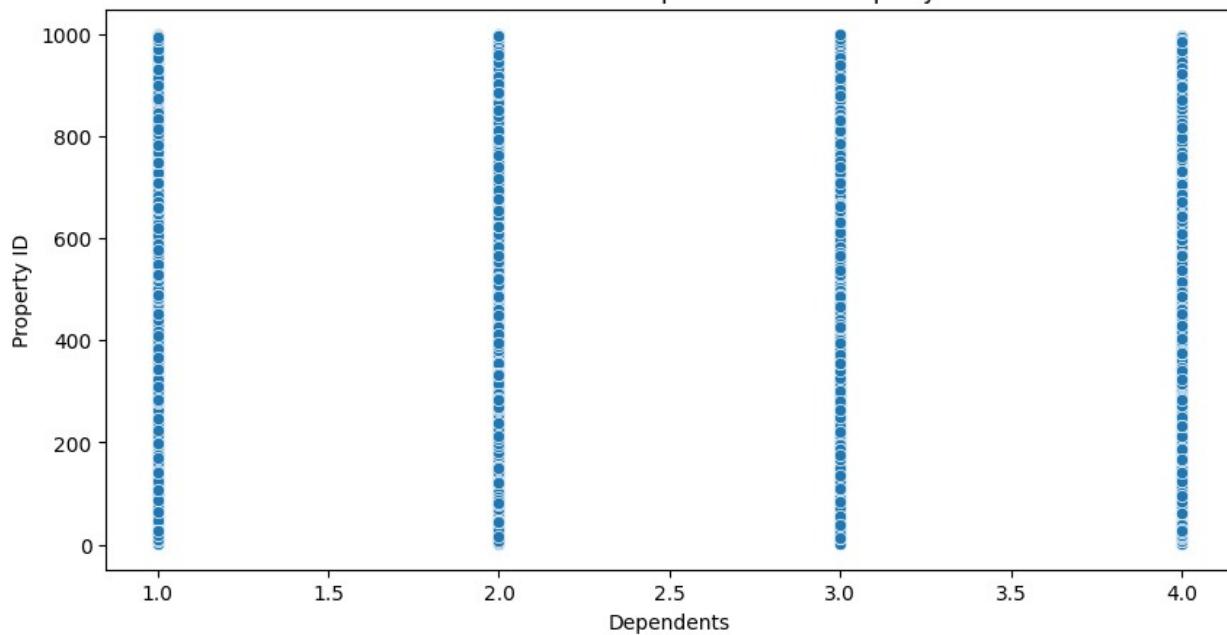
Scatter Plot between Dependents and Credit Score



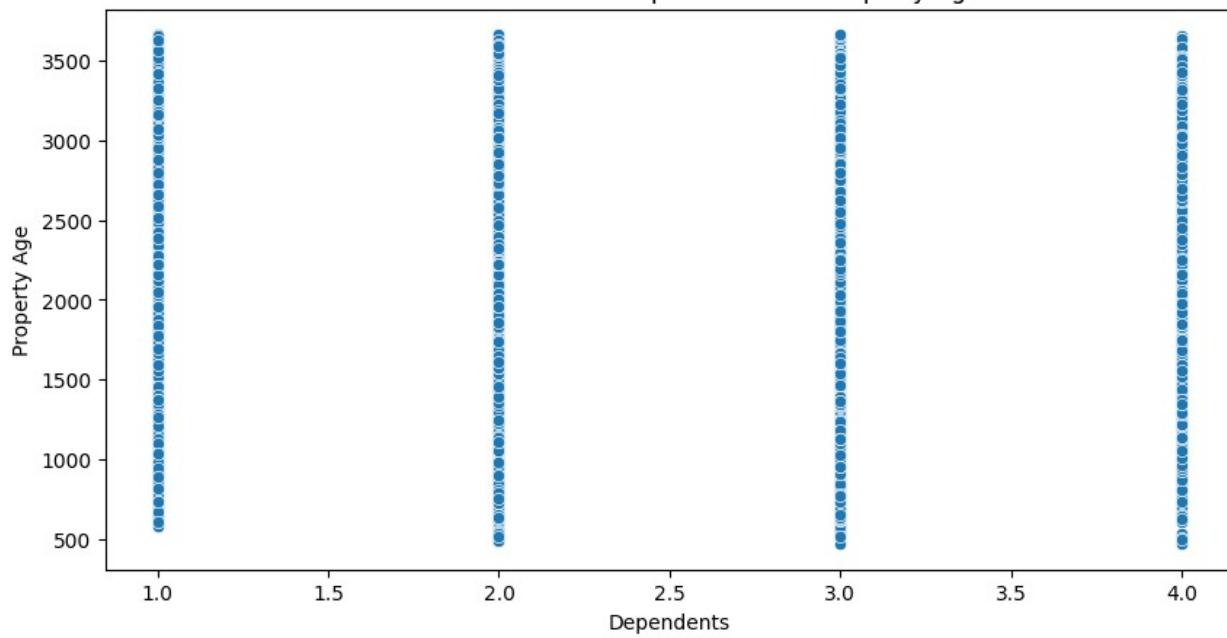
Scatter Plot between Dependents and No. of Defaults



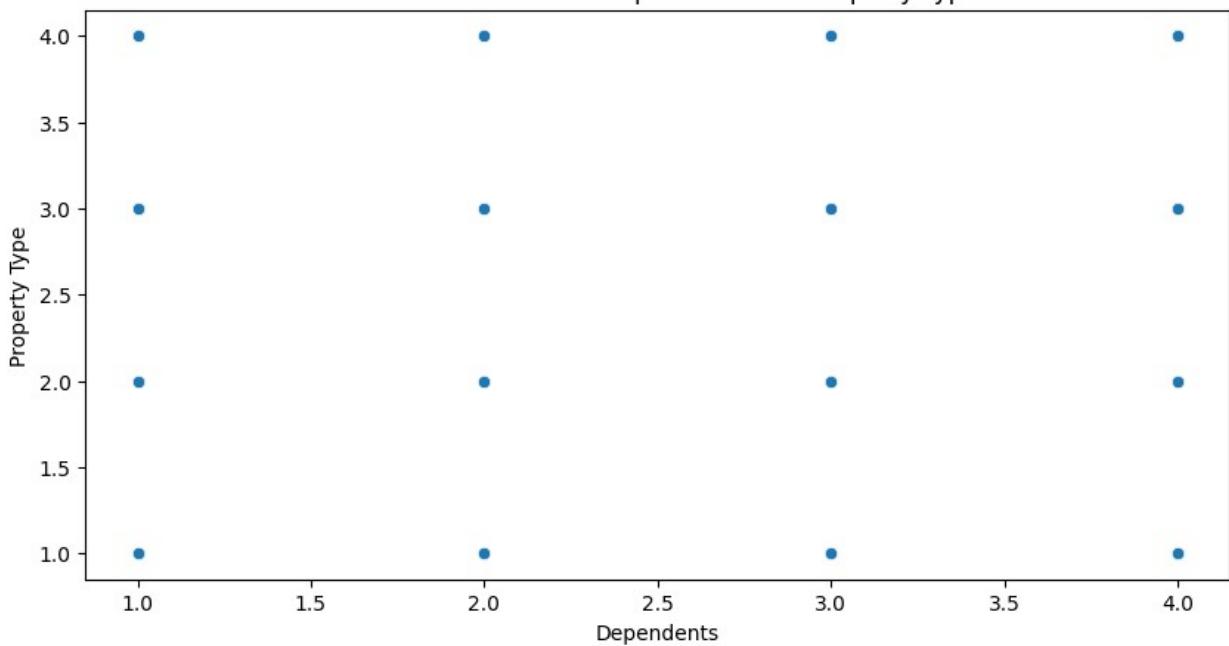
Scatter Plot between Dependents and Property ID



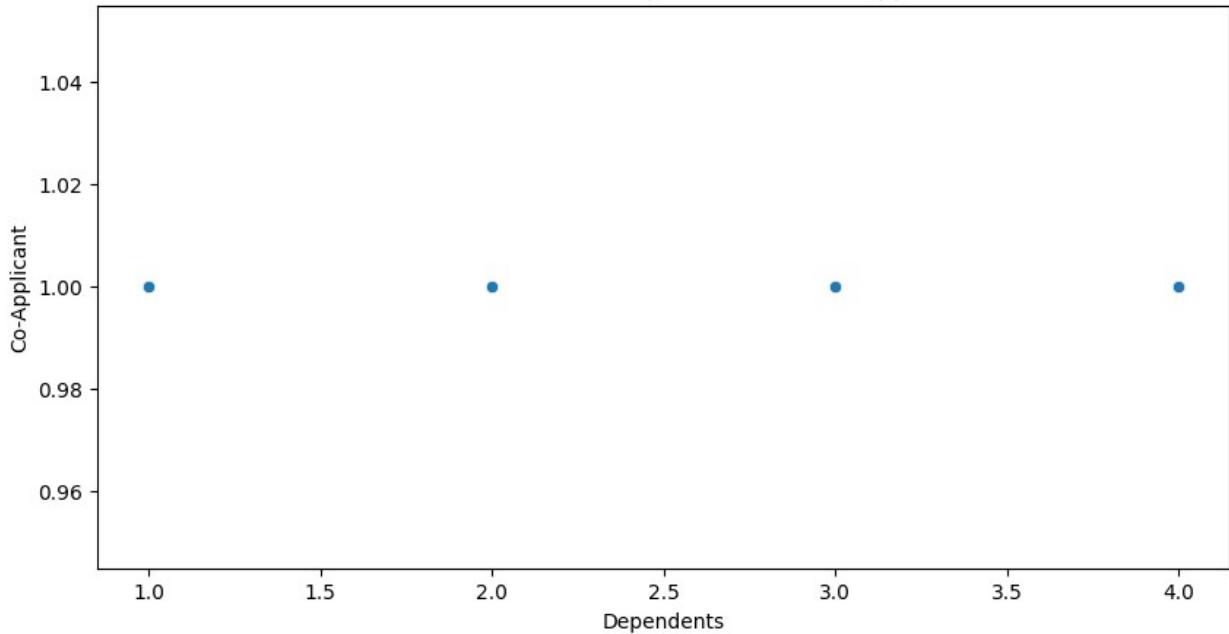
Scatter Plot between Dependents and Property Age



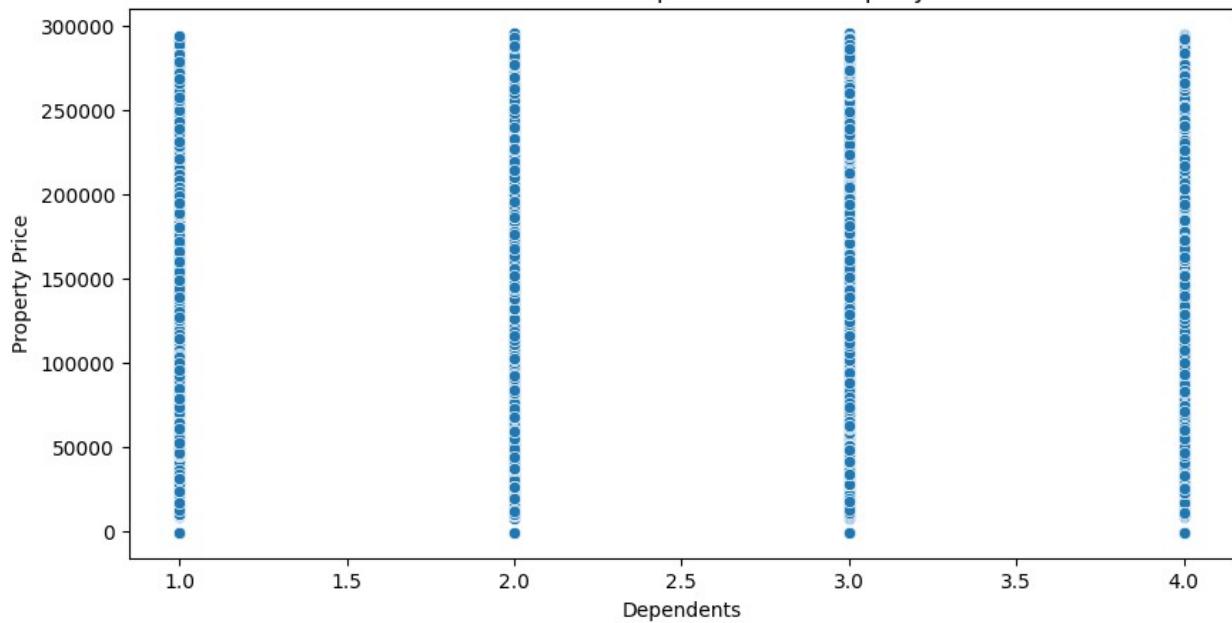
Scatter Plot between Dependents and Property Type



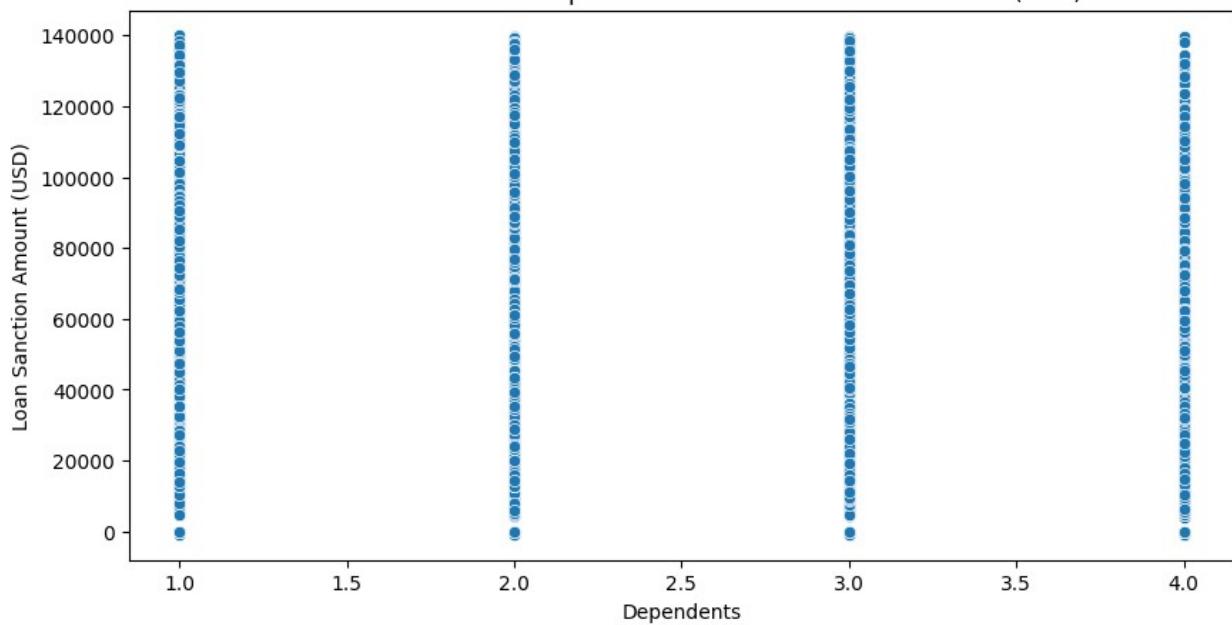
Scatter Plot between Dependents and Co-Applicant



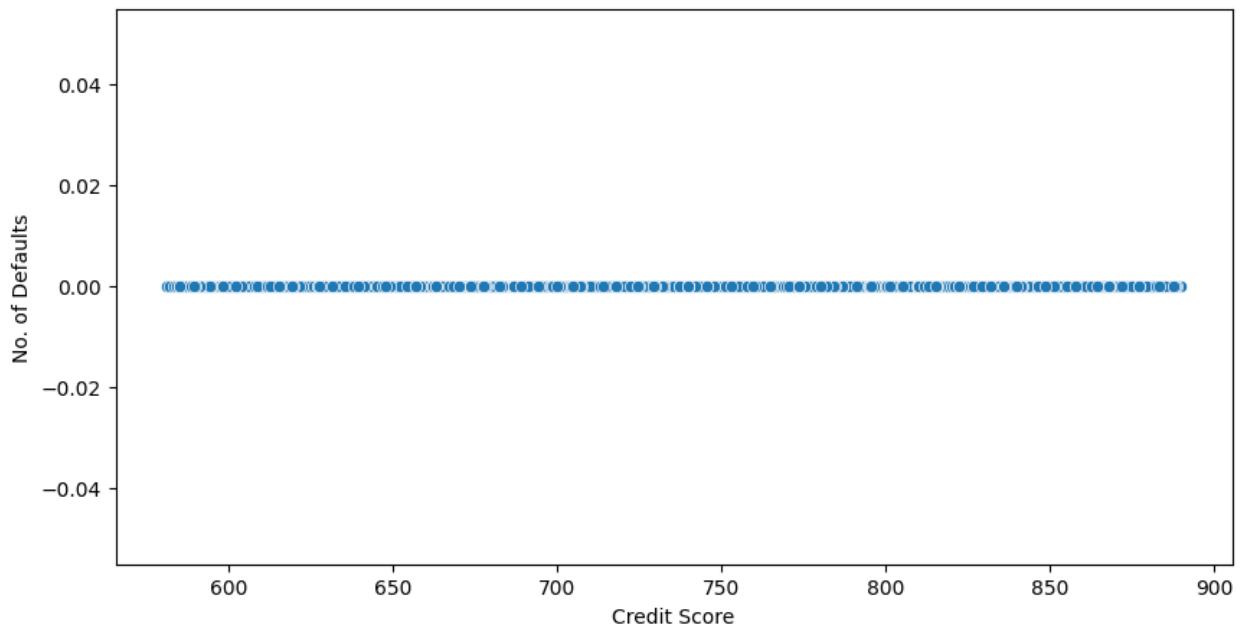
Scatter Plot between Dependents and Property Price



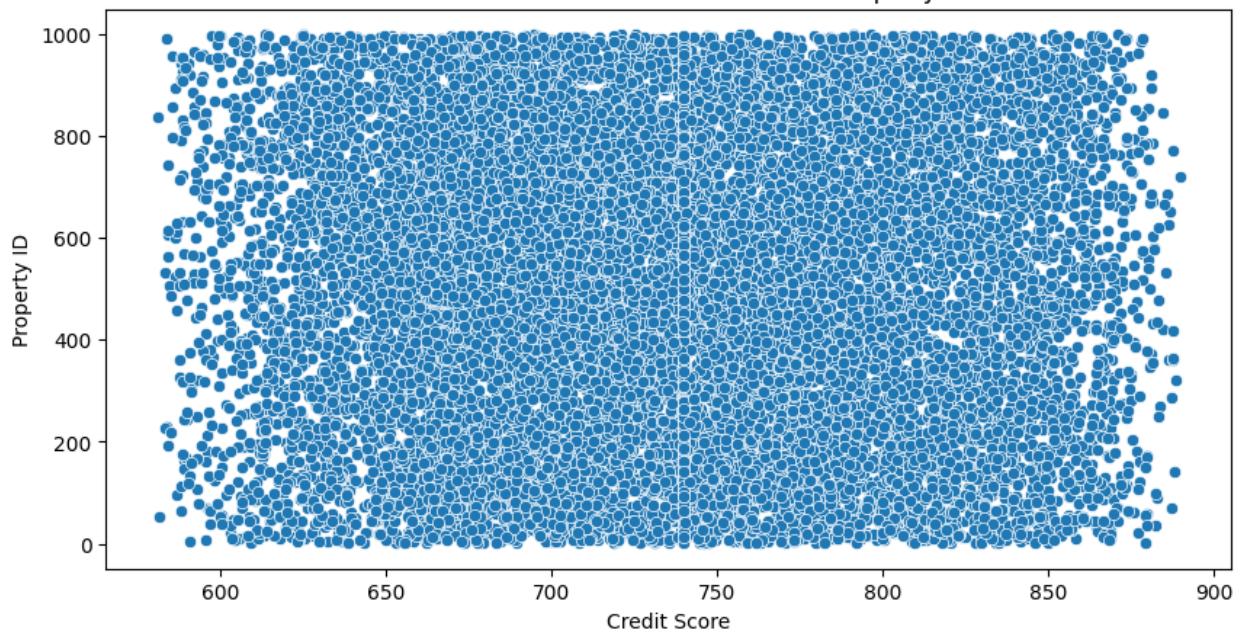
Scatter Plot between Dependents and Loan Sanction Amount (USD)



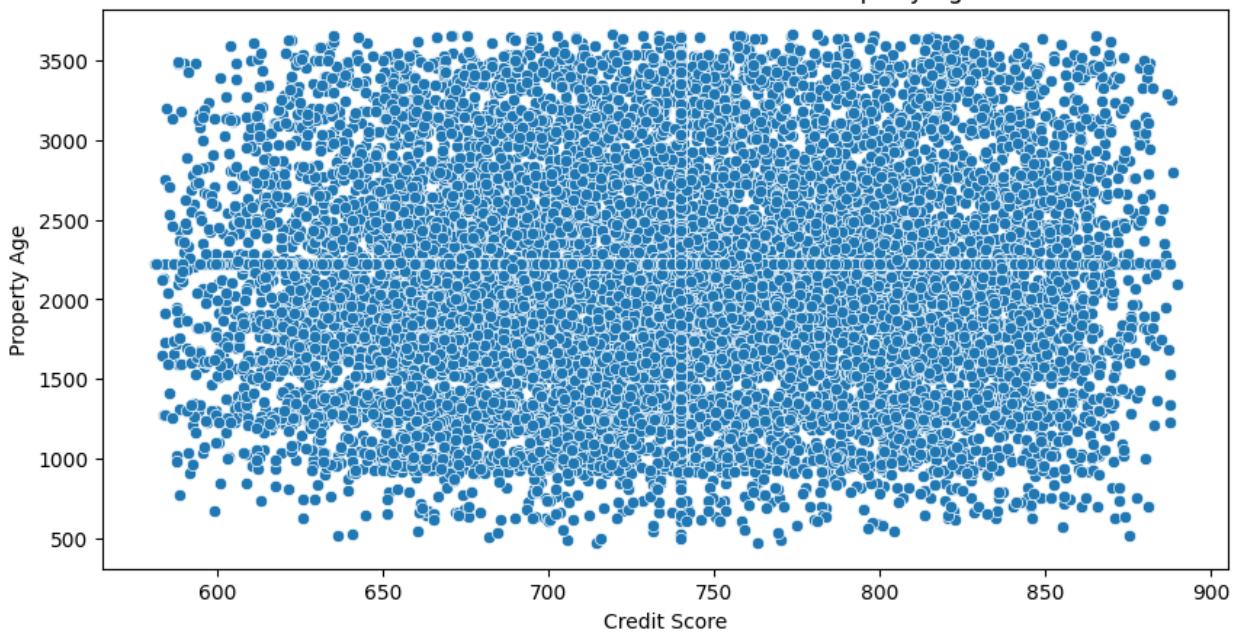
Scatter Plot between Credit Score and No. of Defaults



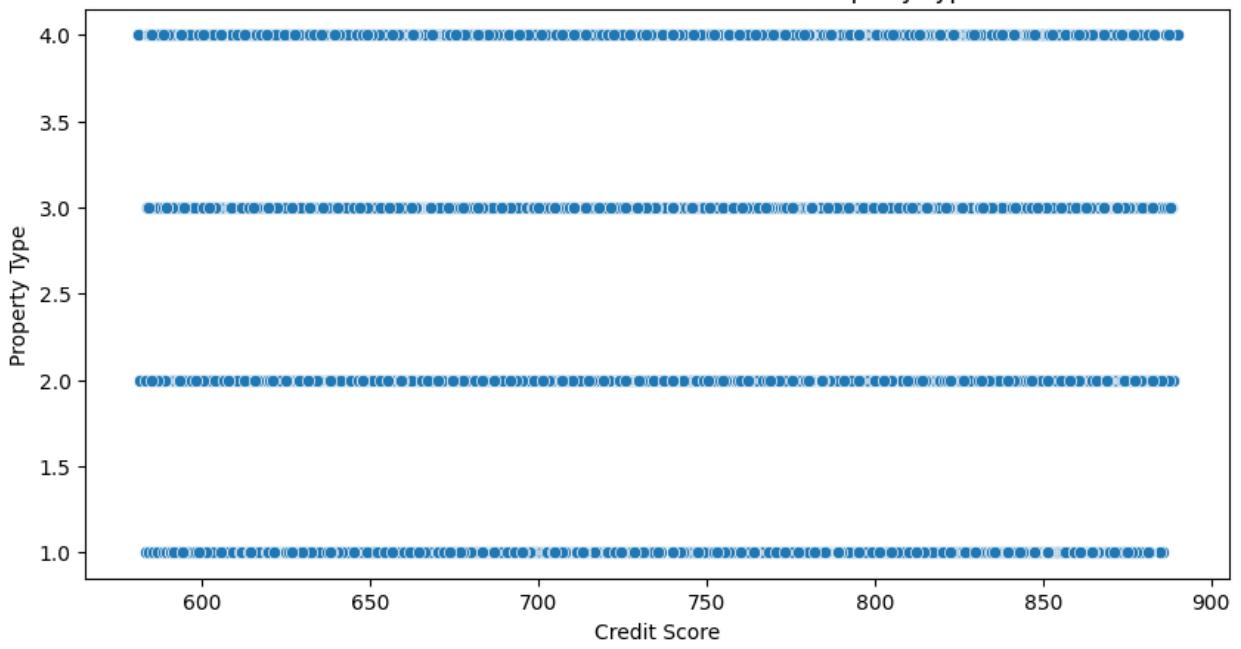
Scatter Plot between Credit Score and Property ID



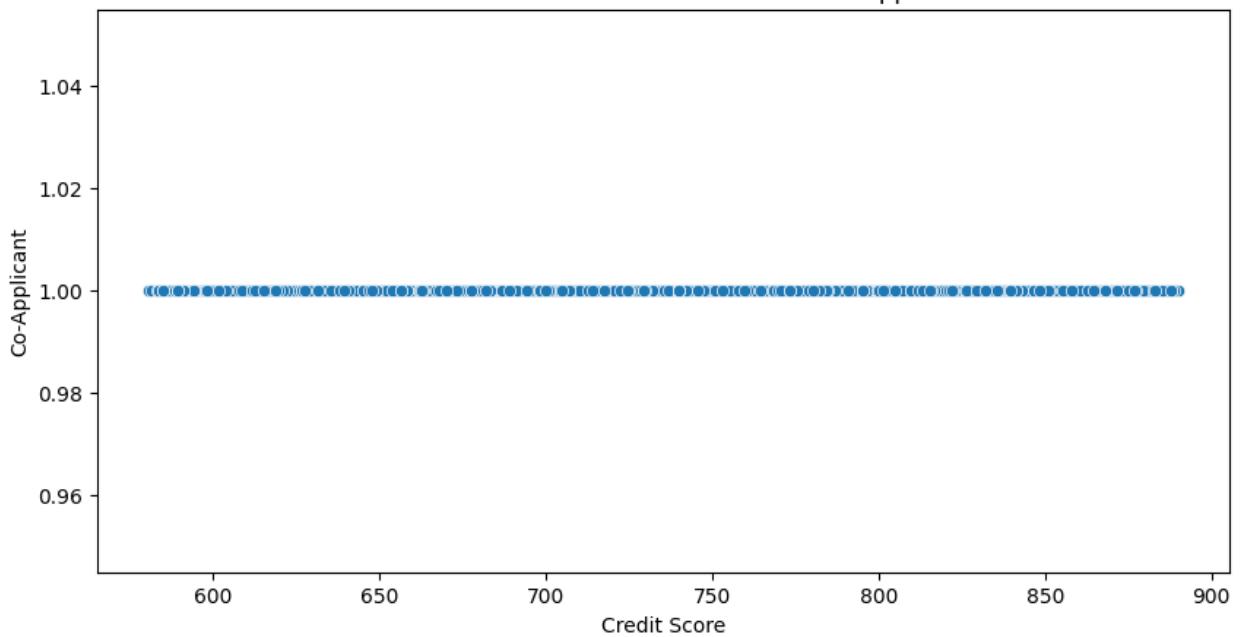
Scatter Plot between Credit Score and Property Age



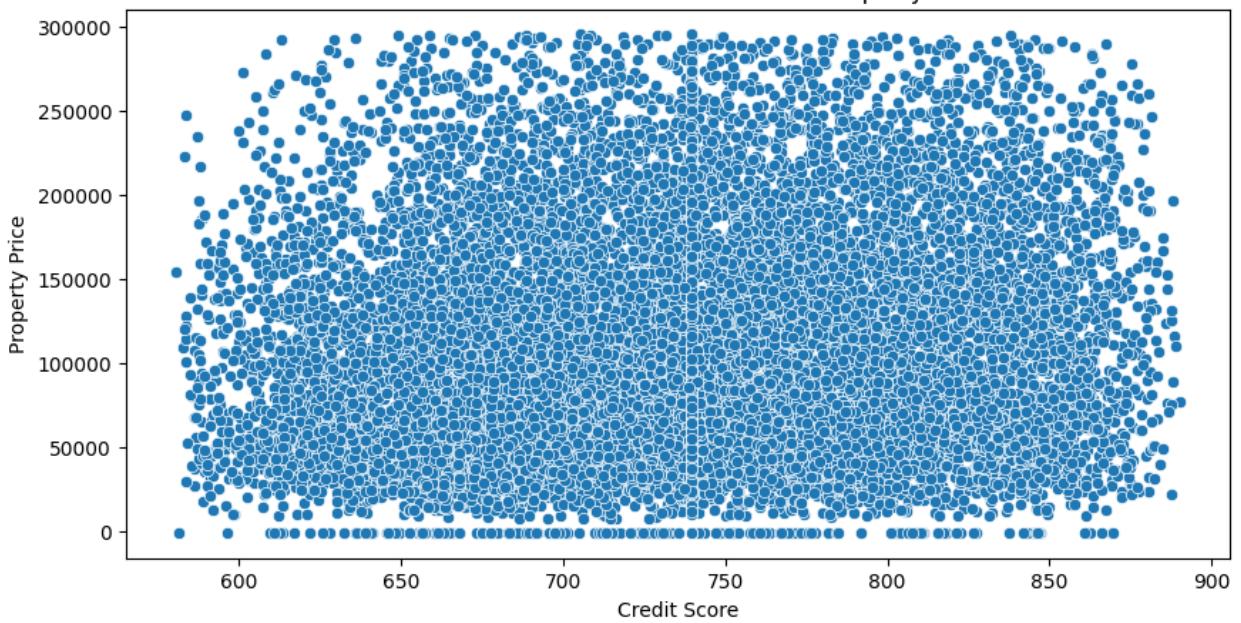
Scatter Plot between Credit Score and Property Type

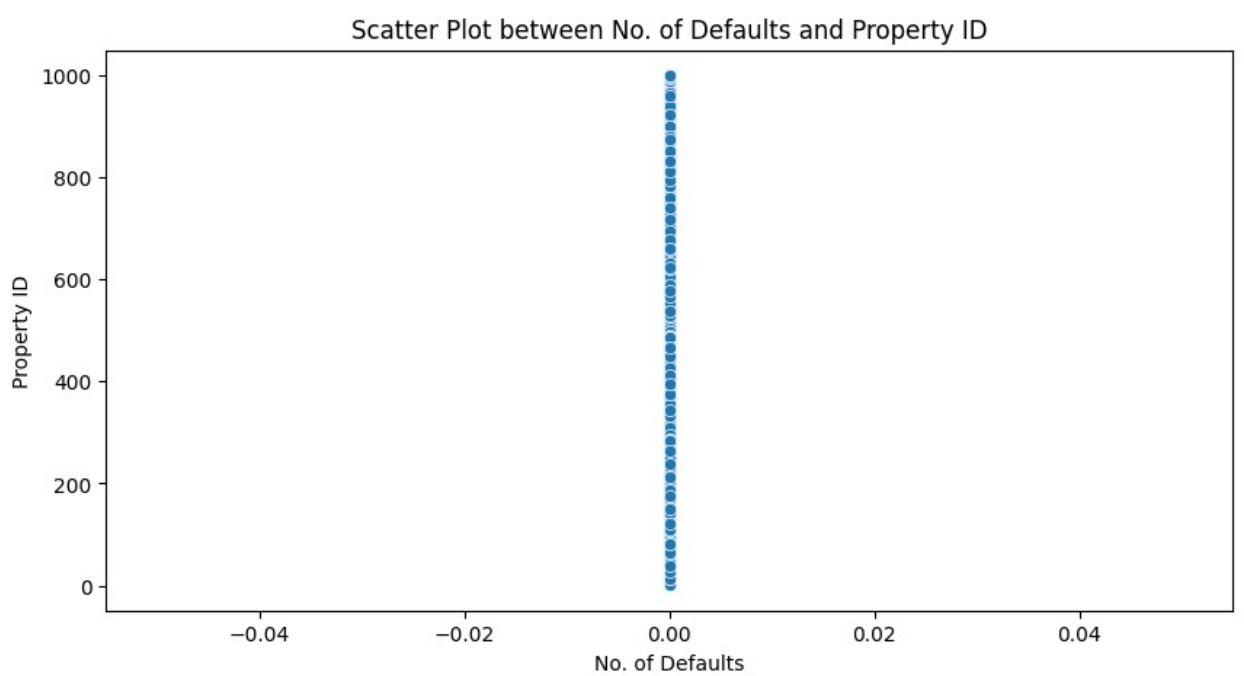
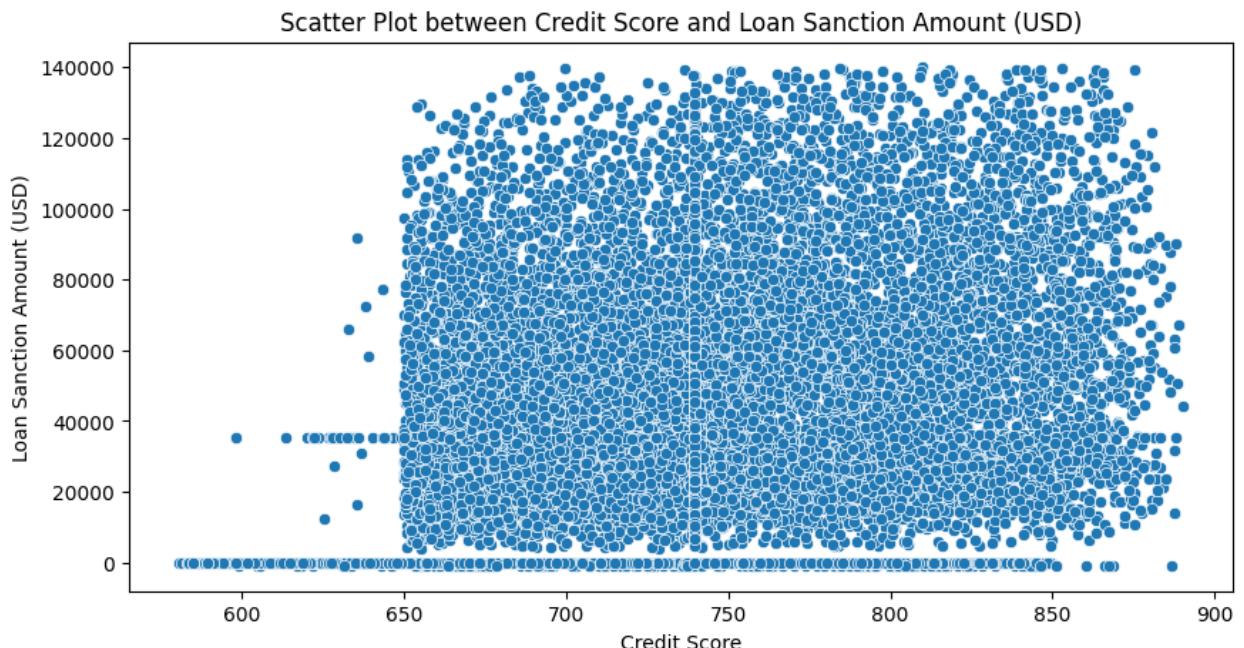


Scatter Plot between Credit Score and Co-Applicant

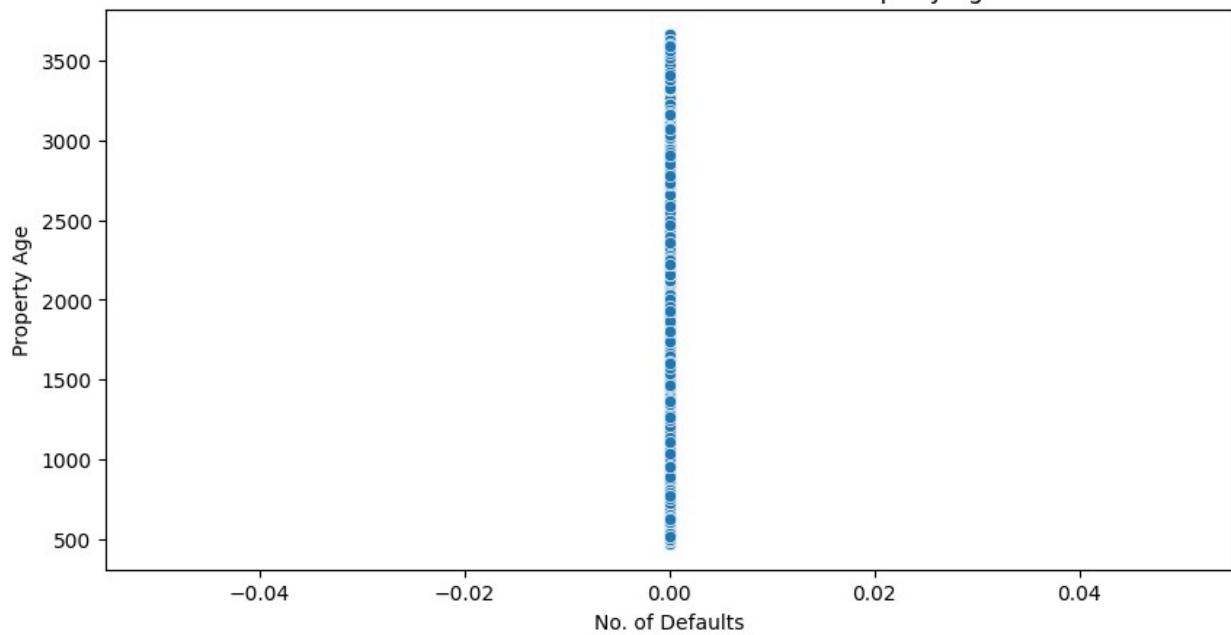


Scatter Plot between Credit Score and Property Price

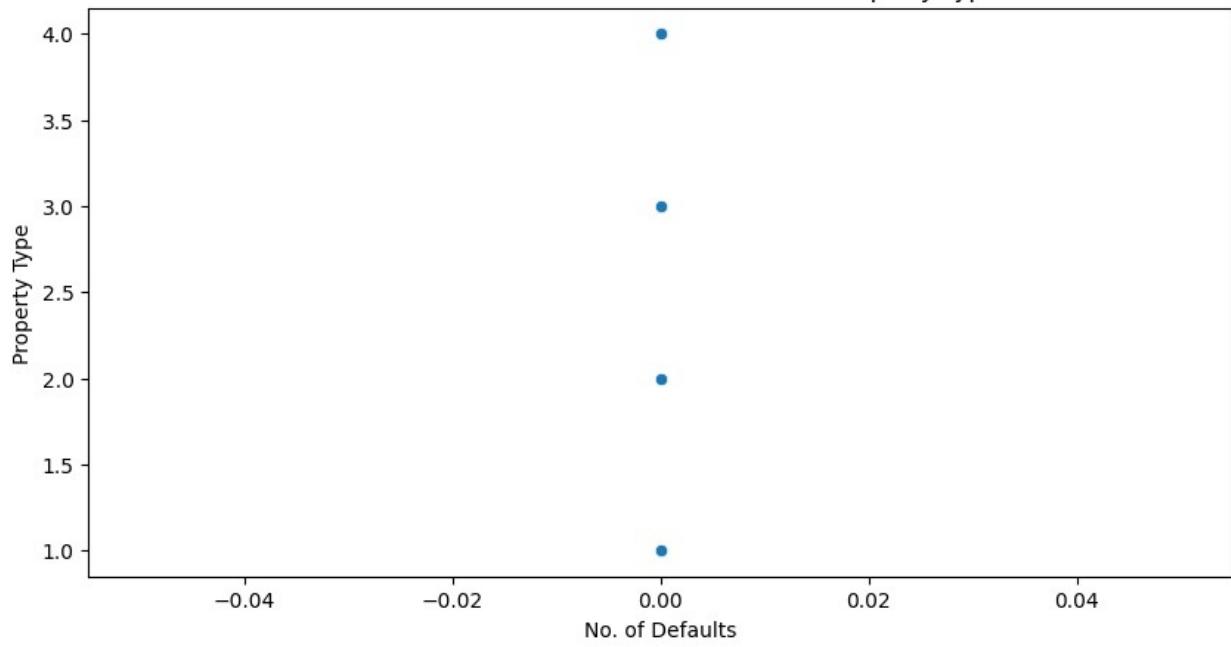




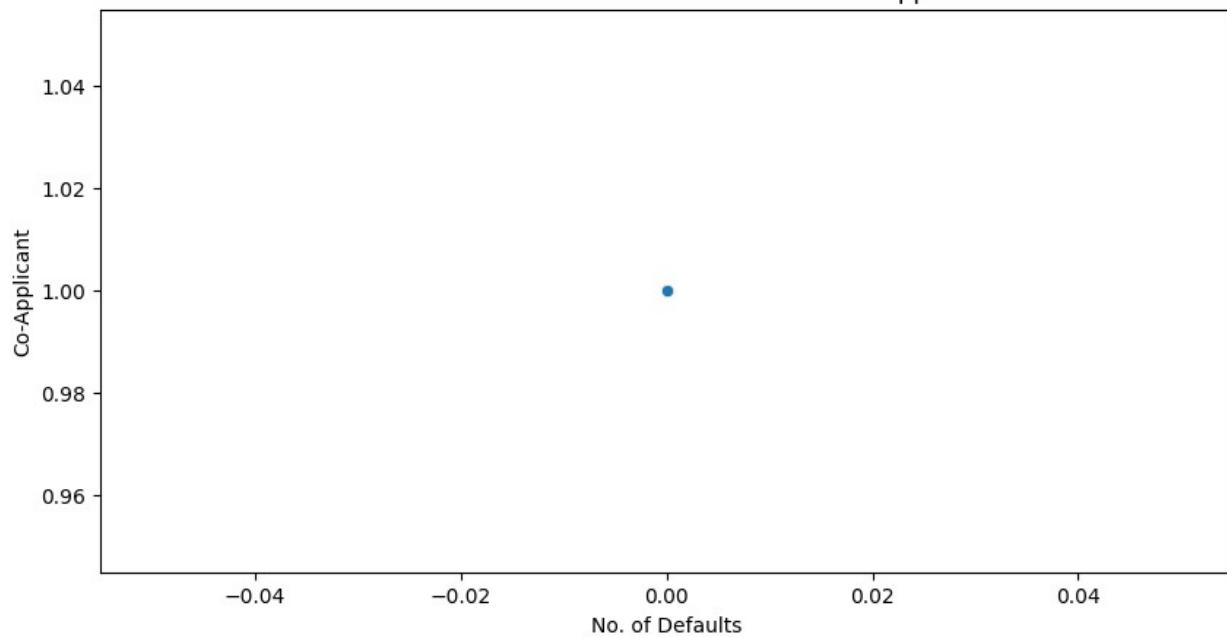
Scatter Plot between No. of Defaults and Property Age



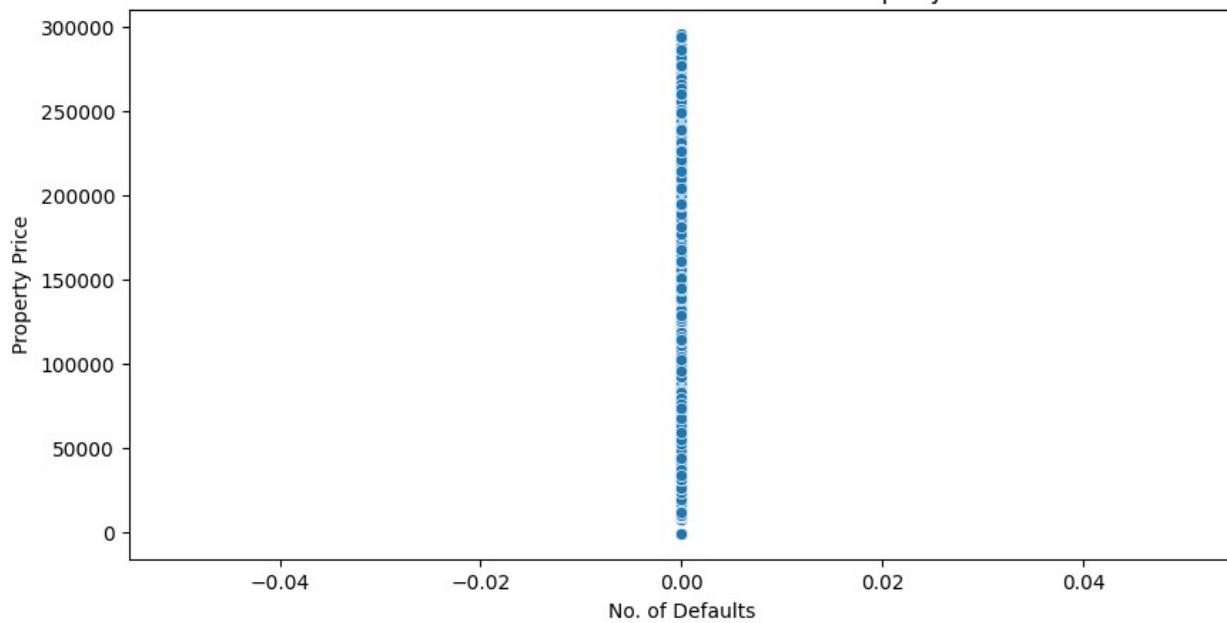
Scatter Plot between No. of Defaults and Property Type



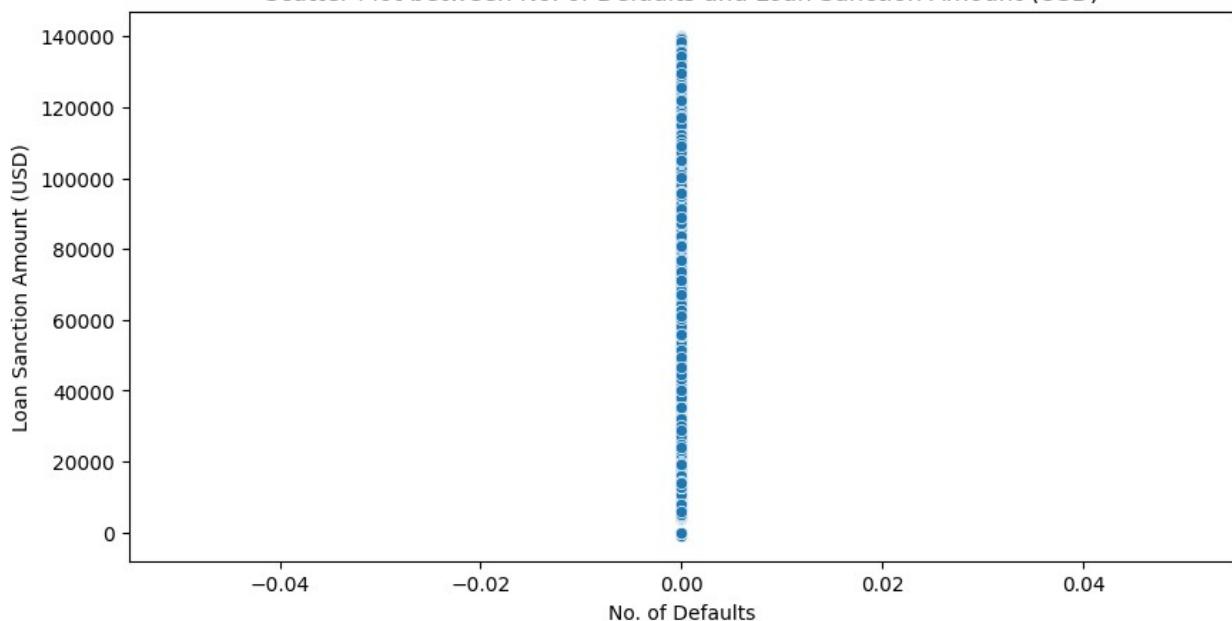
Scatter Plot between No. of Defaults and Co-Applicant



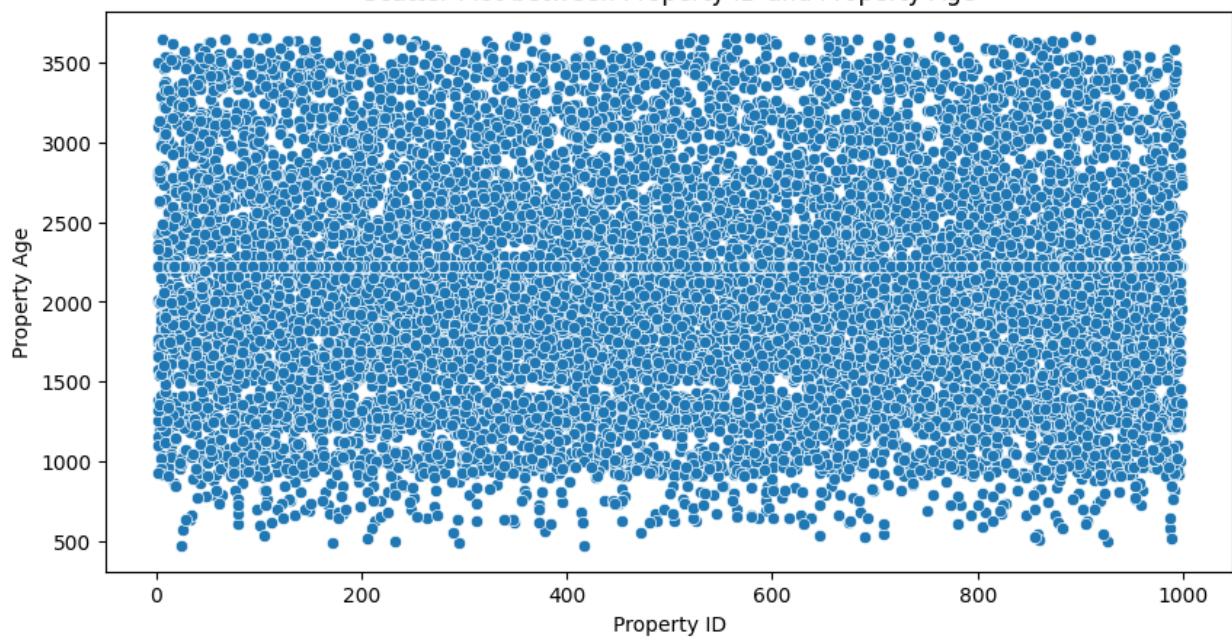
Scatter Plot between No. of Defaults and Property Price



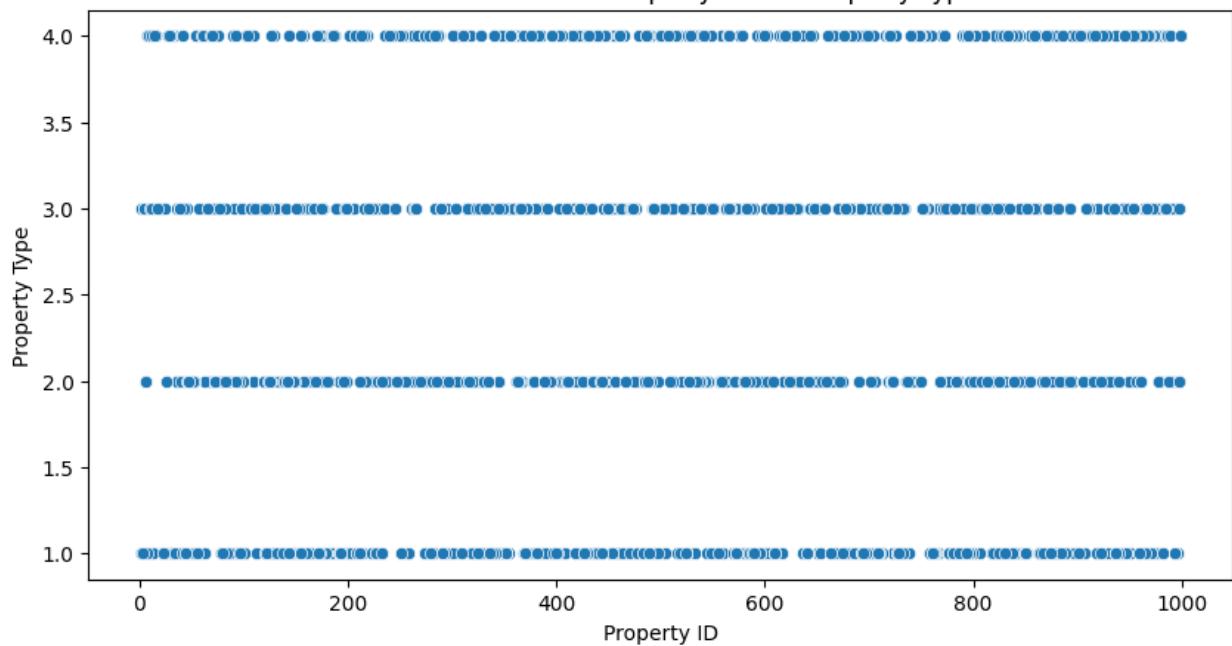
Scatter Plot between No. of Defaults and Loan Sanction Amount (USD)



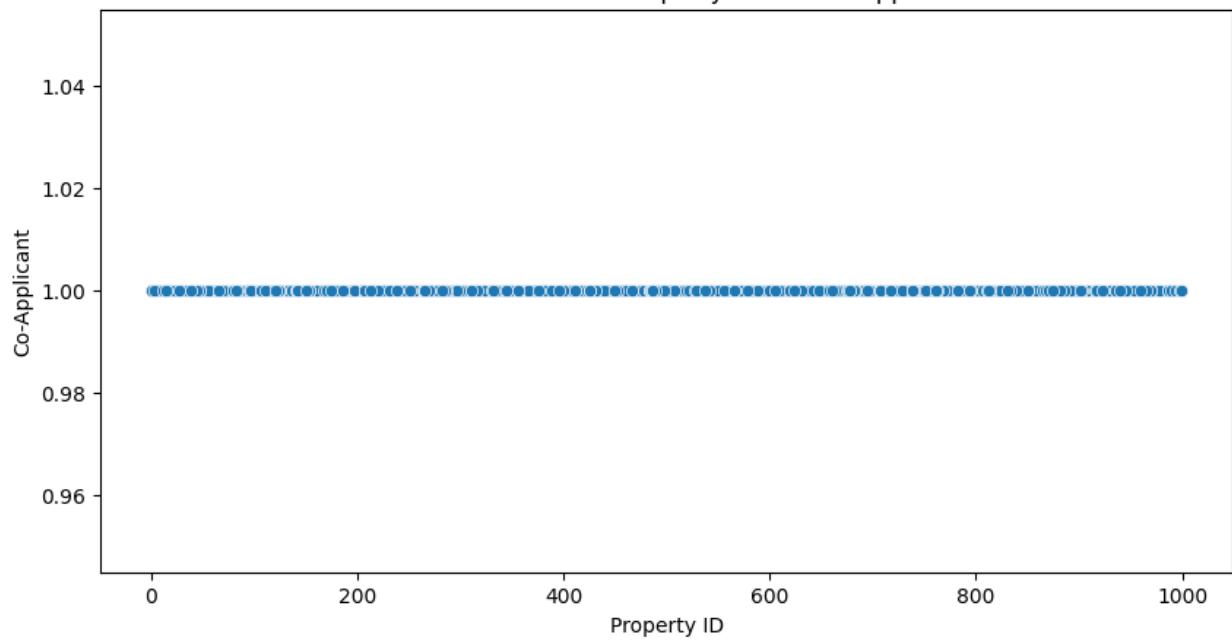
Scatter Plot between Property ID and Property Age



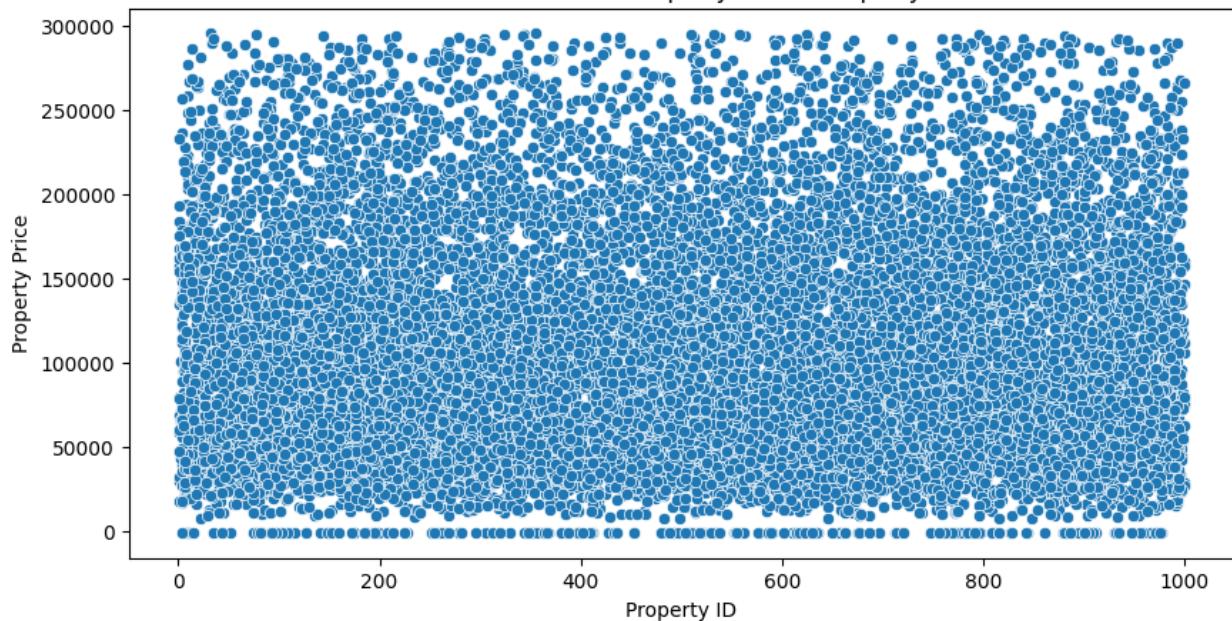
Scatter Plot between Property ID and Property Type



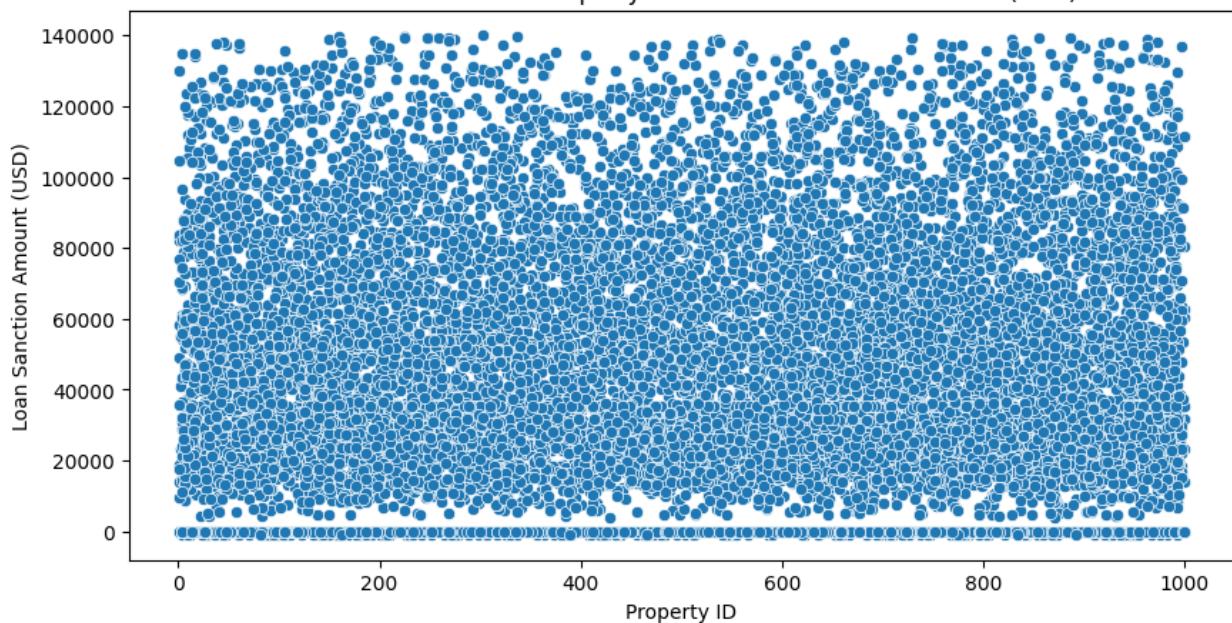
Scatter Plot between Property ID and Co-Applicant



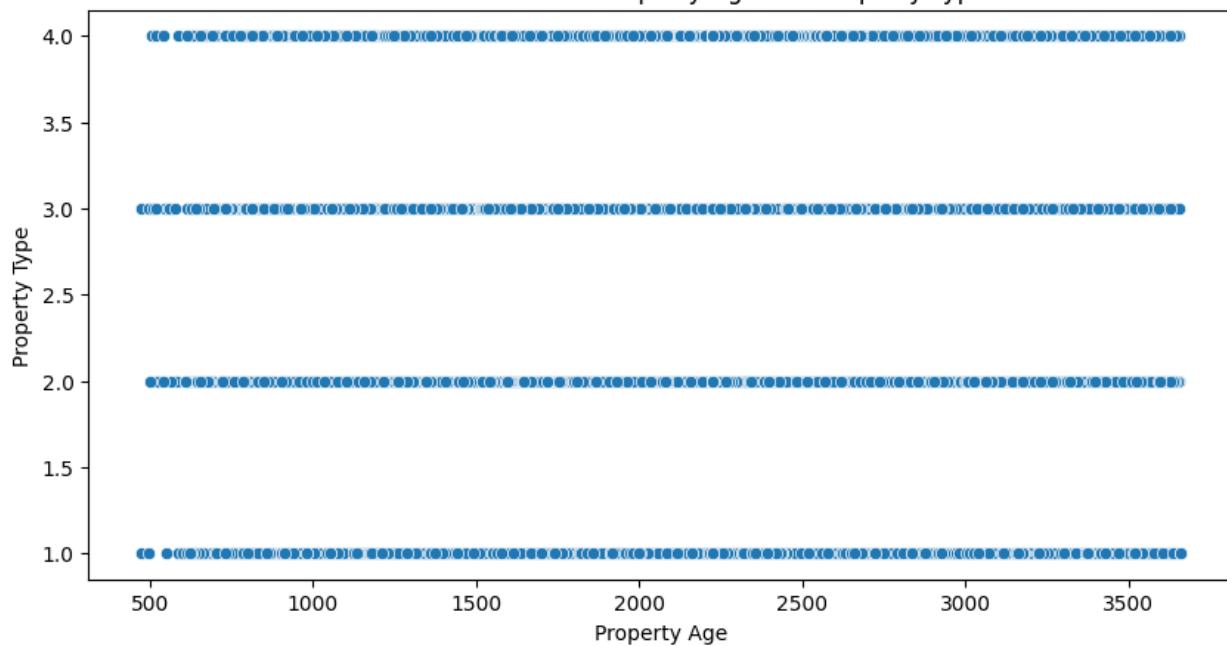
Scatter Plot between Property ID and Property Price



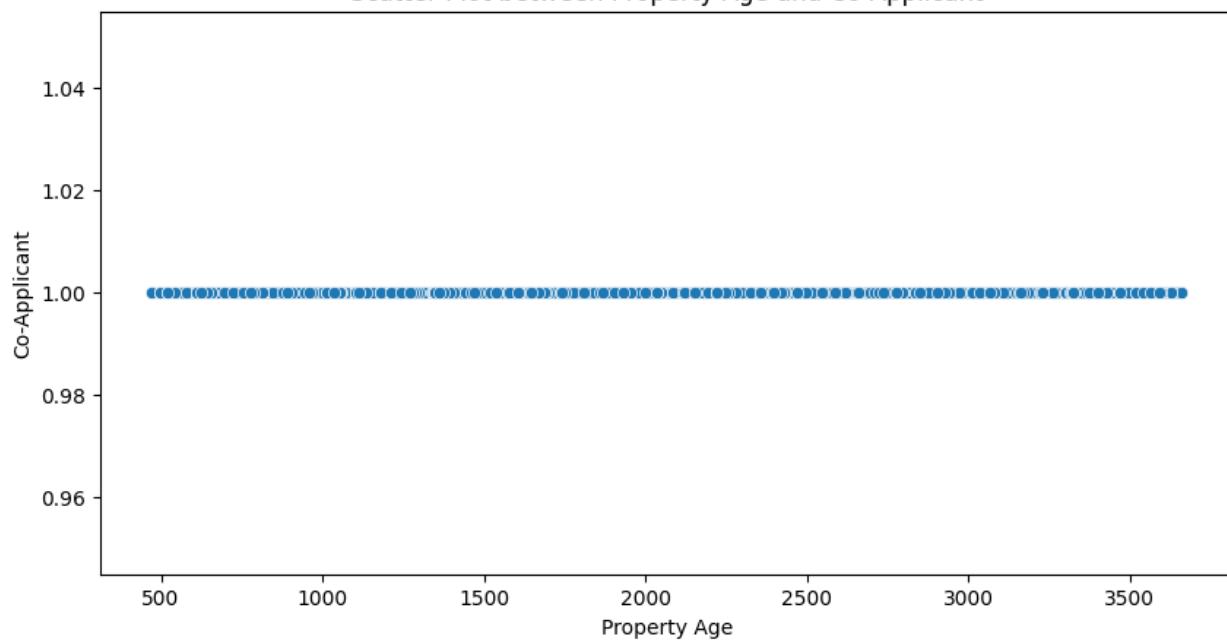
Scatter Plot between Property ID and Loan Sanction Amount (USD)



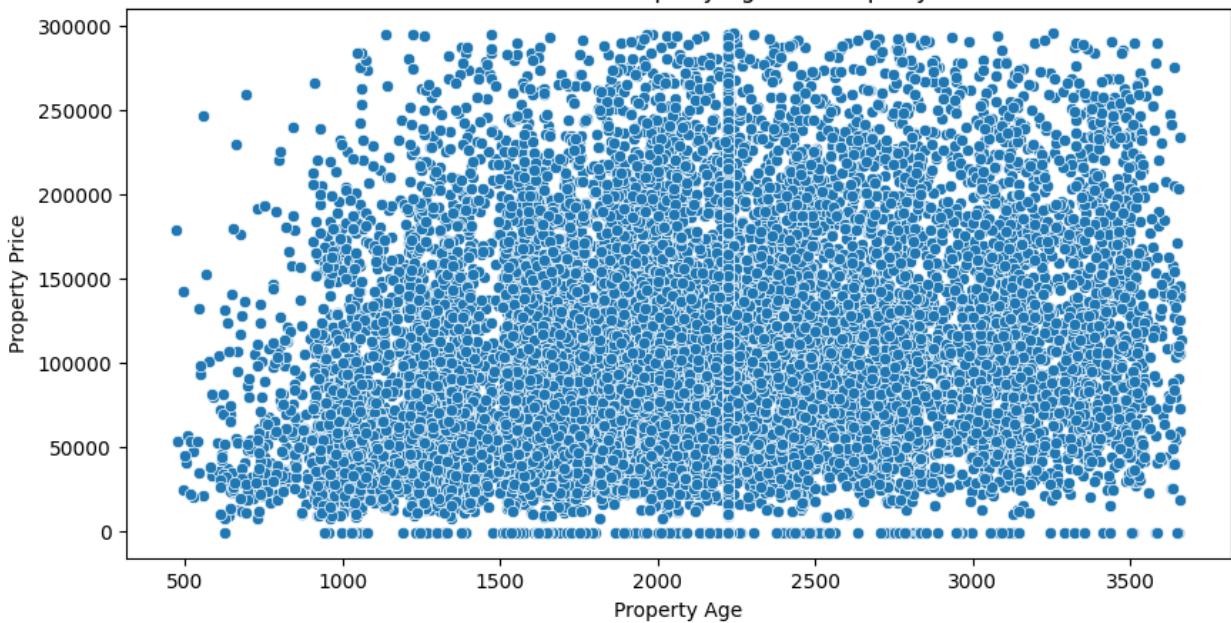
Scatter Plot between Property Age and Property Type



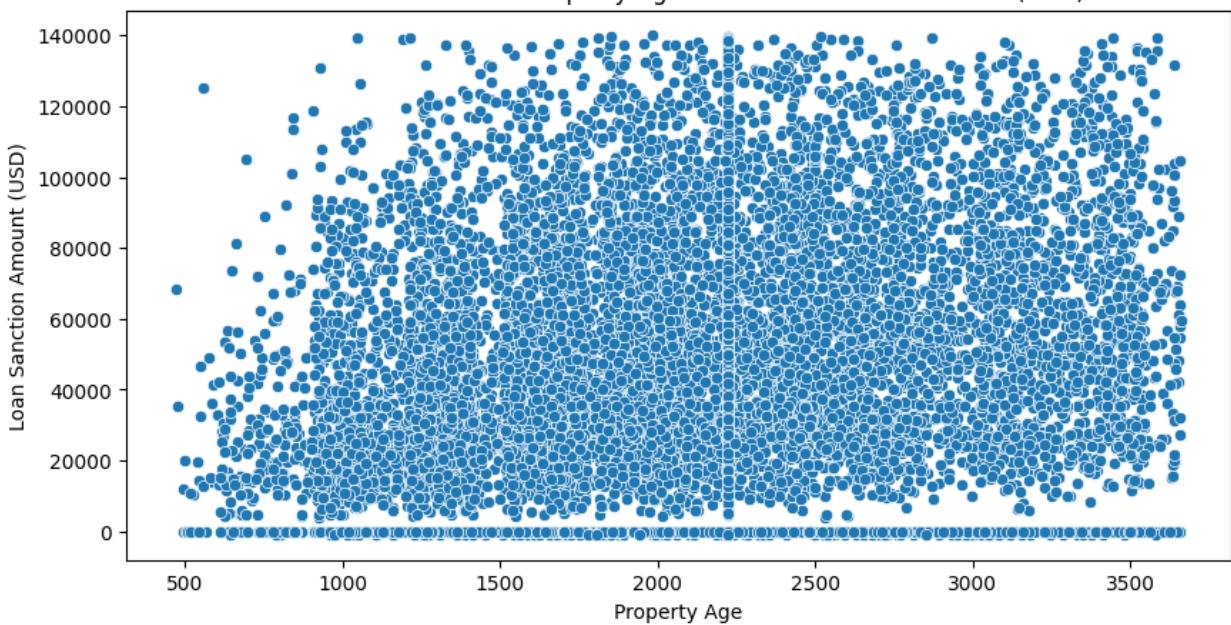
Scatter Plot between Property Age and Co-Applicant



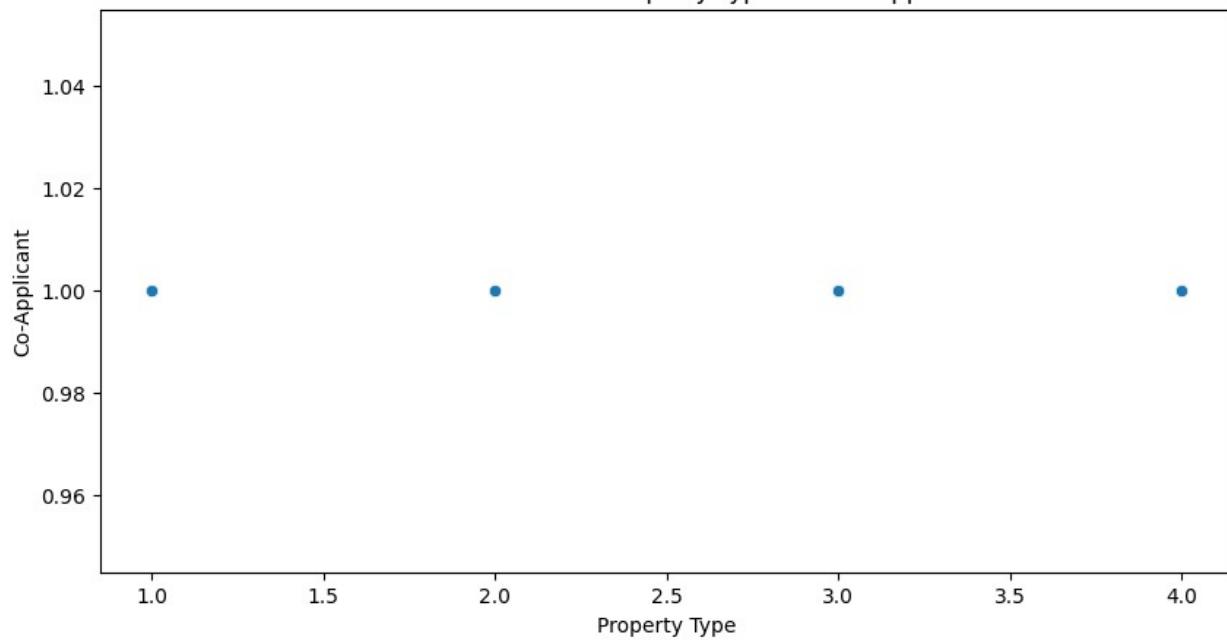
Scatter Plot between Property Age and Property Price



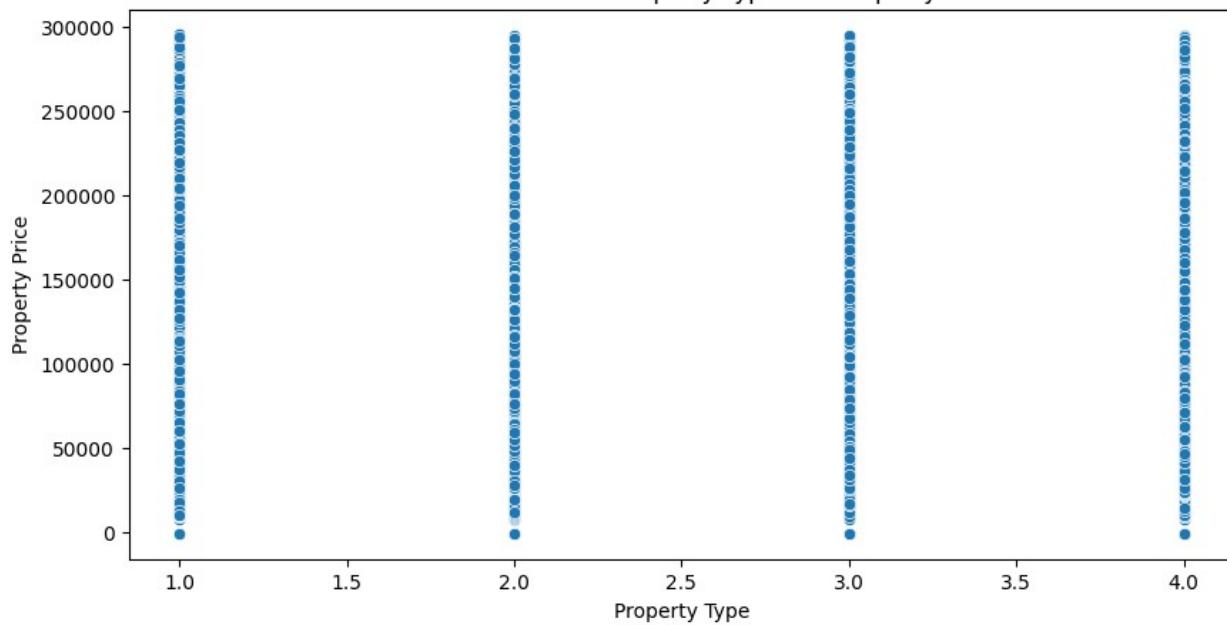
Scatter Plot between Property Age and Loan Sanction Amount (USD)



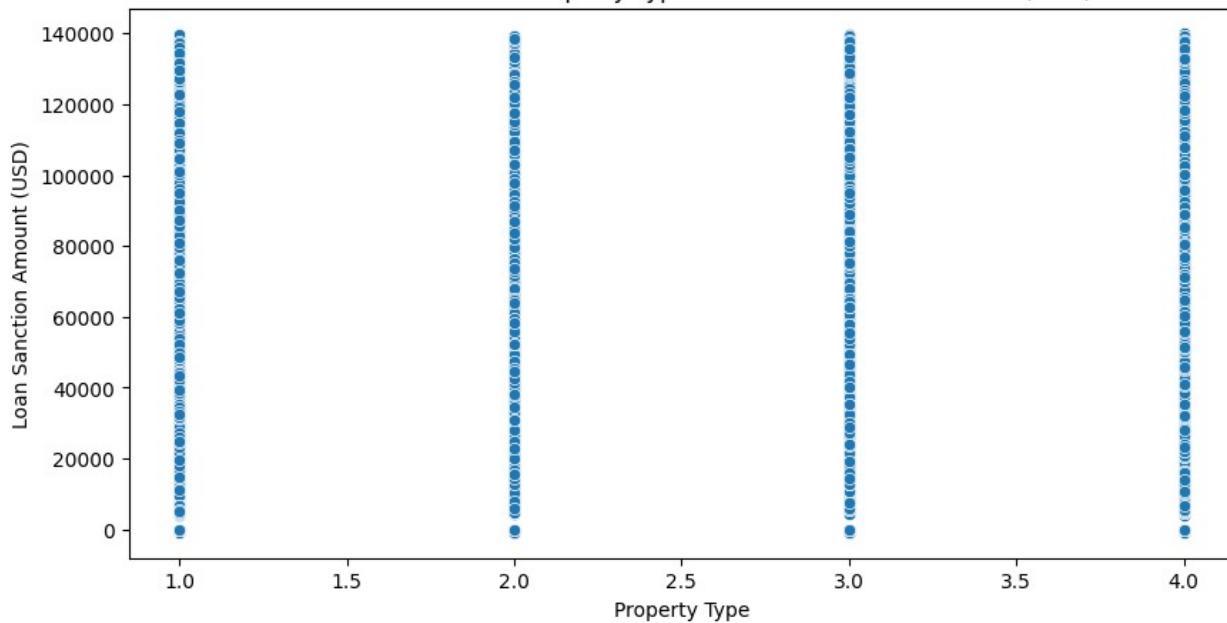
Scatter Plot between Property Type and Co-Applicant



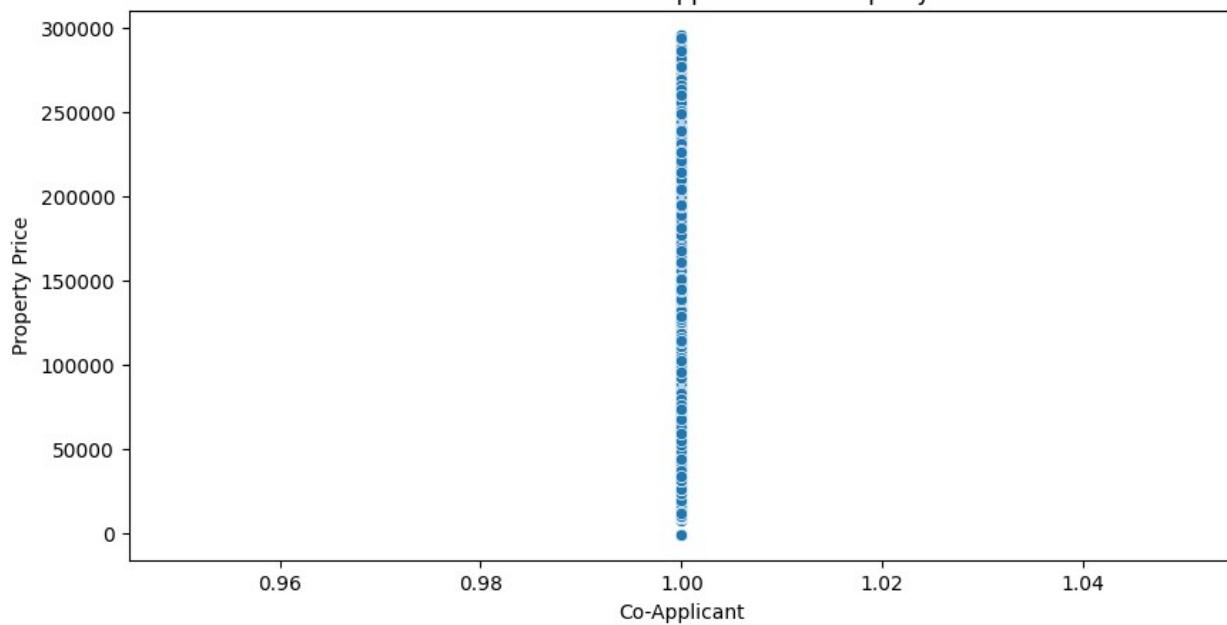
Scatter Plot between Property Type and Property Price

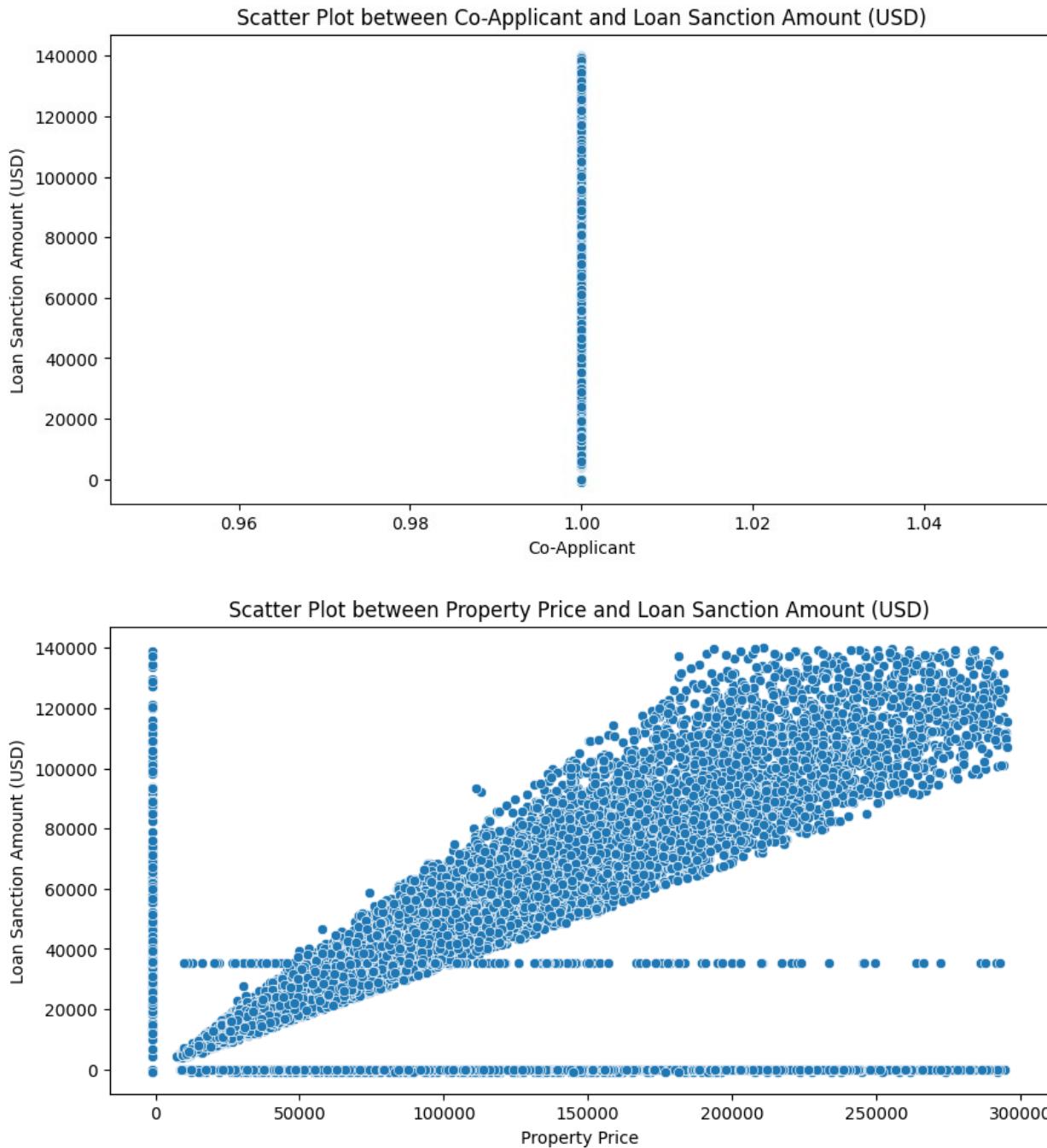


Scatter Plot between Property Type and Loan Sanction Amount (USD)



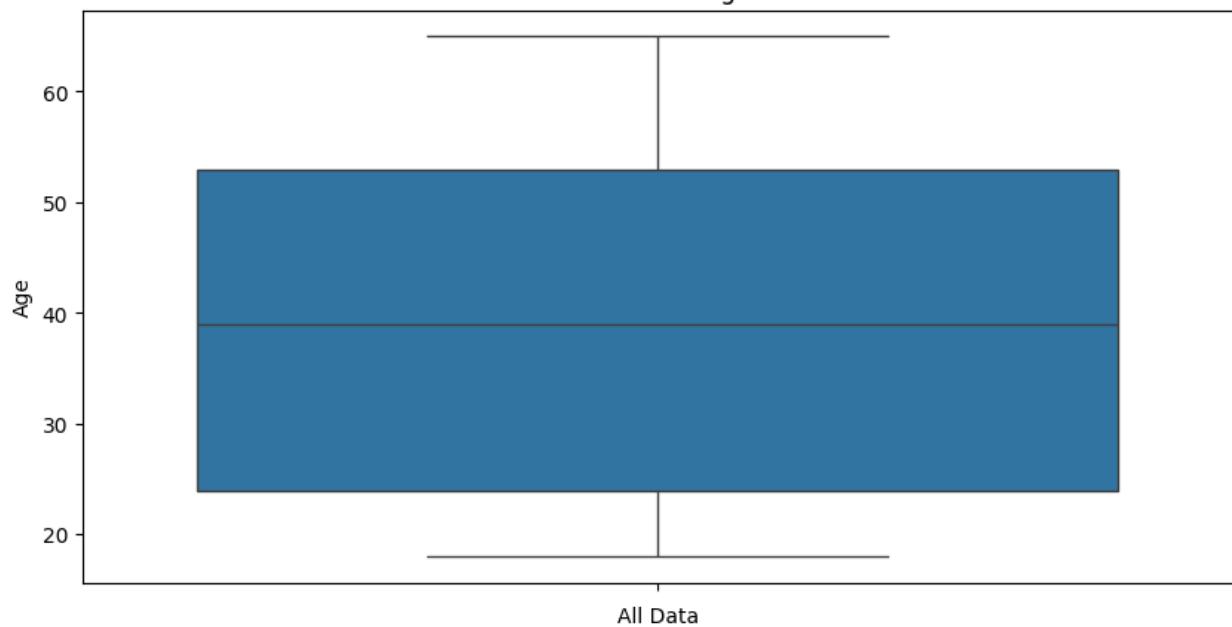
Scatter Plot between Co-Applicant and Property Price





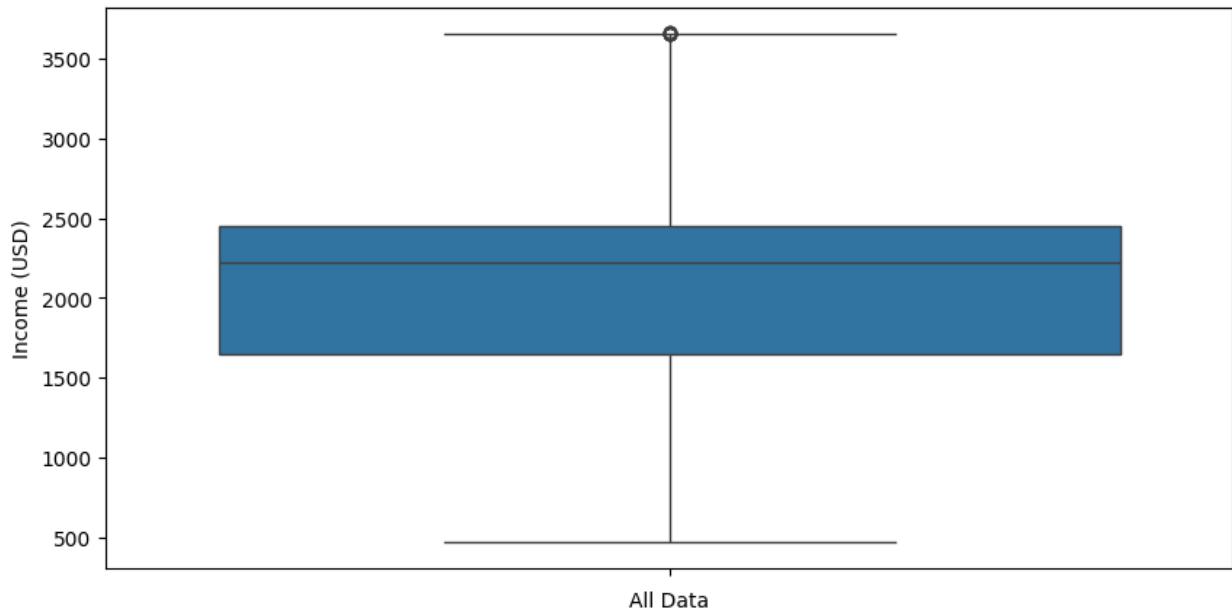
```
# Box Plots Numerical Data
for numerical_col in numerical_columns:
    plt.figure(figsize=(10, 5))
    sns.boxplot(y=numerical_col, data=data)
    plt.title(f'Box Plot of {numerical_col}')
    plt.xlabel('All Data')
    plt.ylabel(numerical_col)
    plt.show()
```

Box Plot of Age



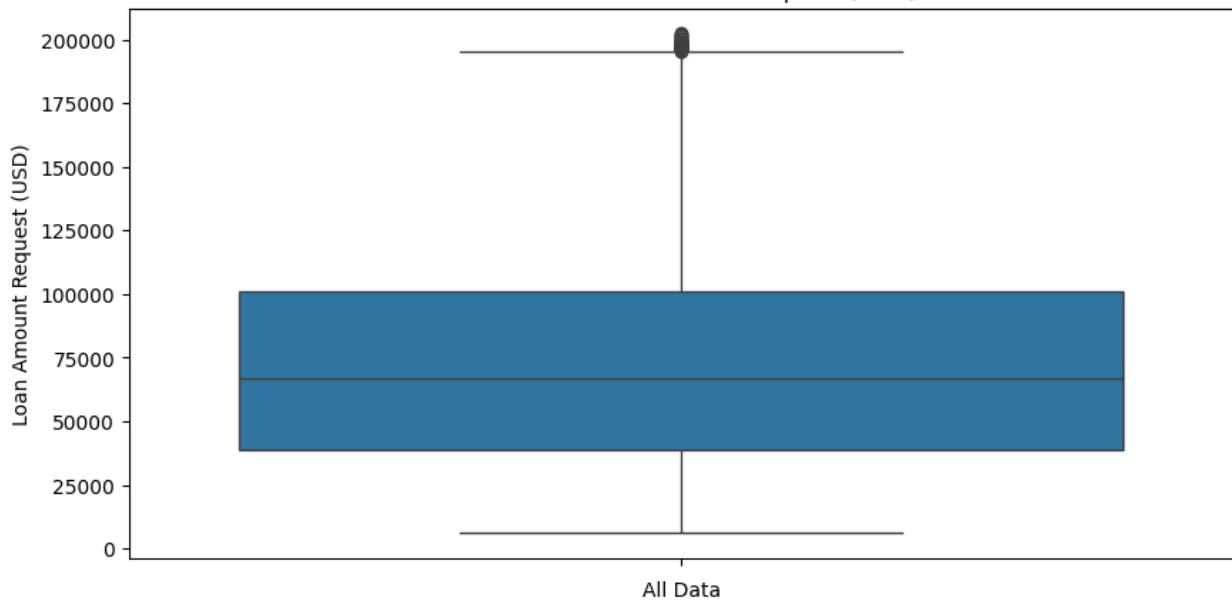
All Data

Box Plot of Income (USD)

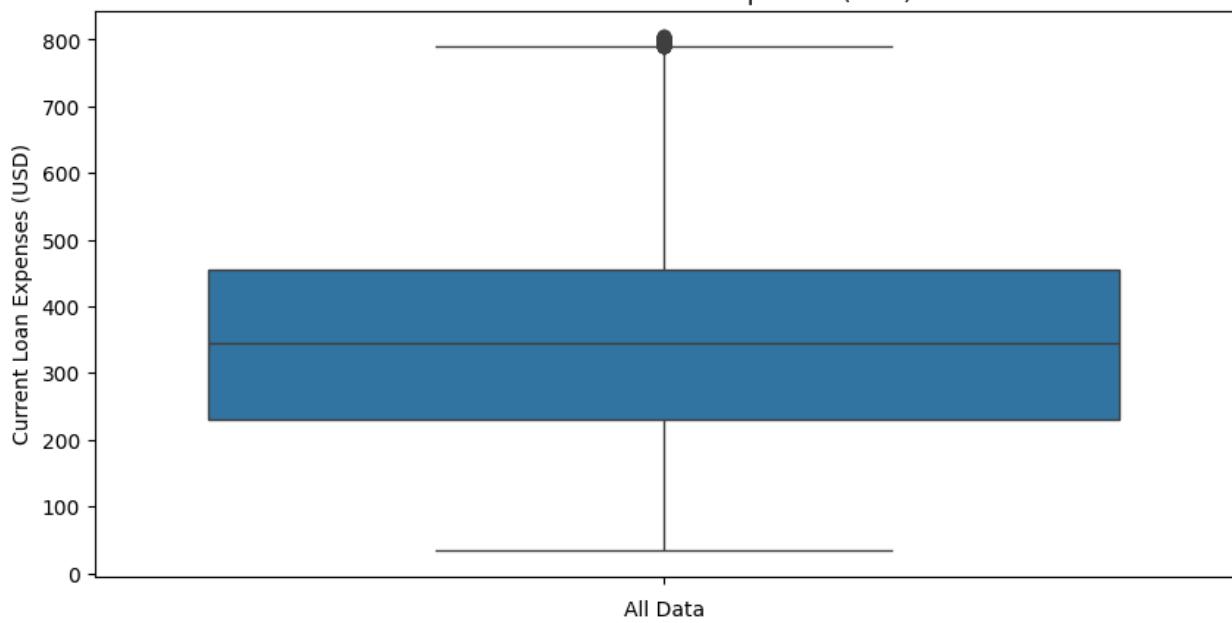


All Data

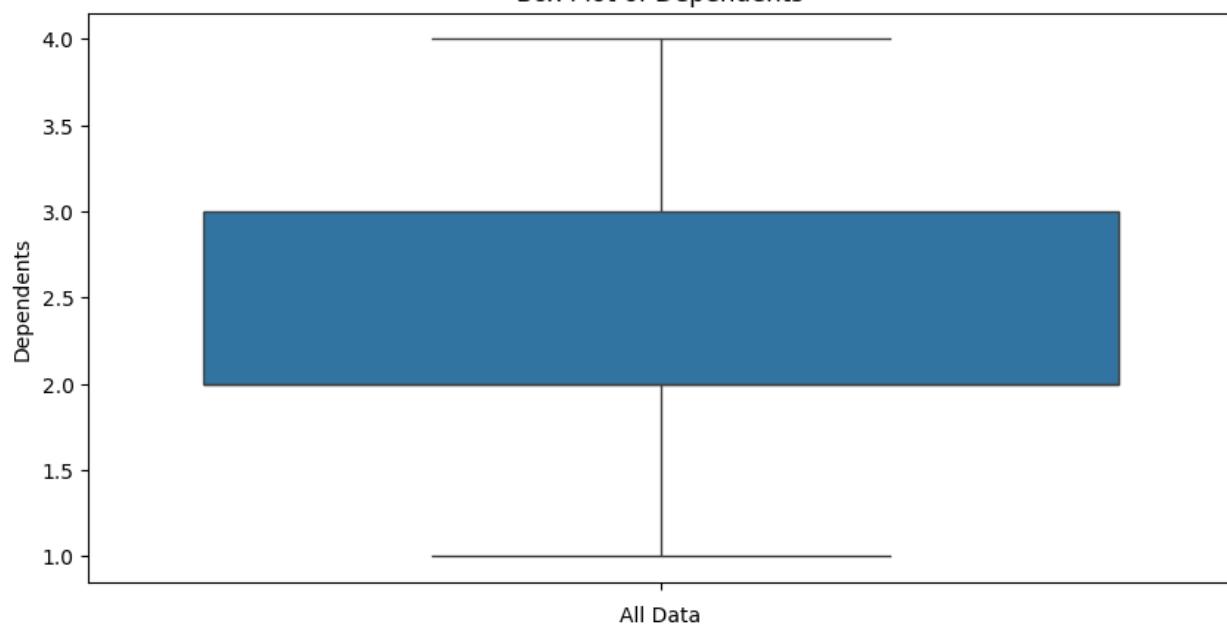
Box Plot of Loan Amount Request (USD)



Box Plot of Current Loan Expenses (USD)

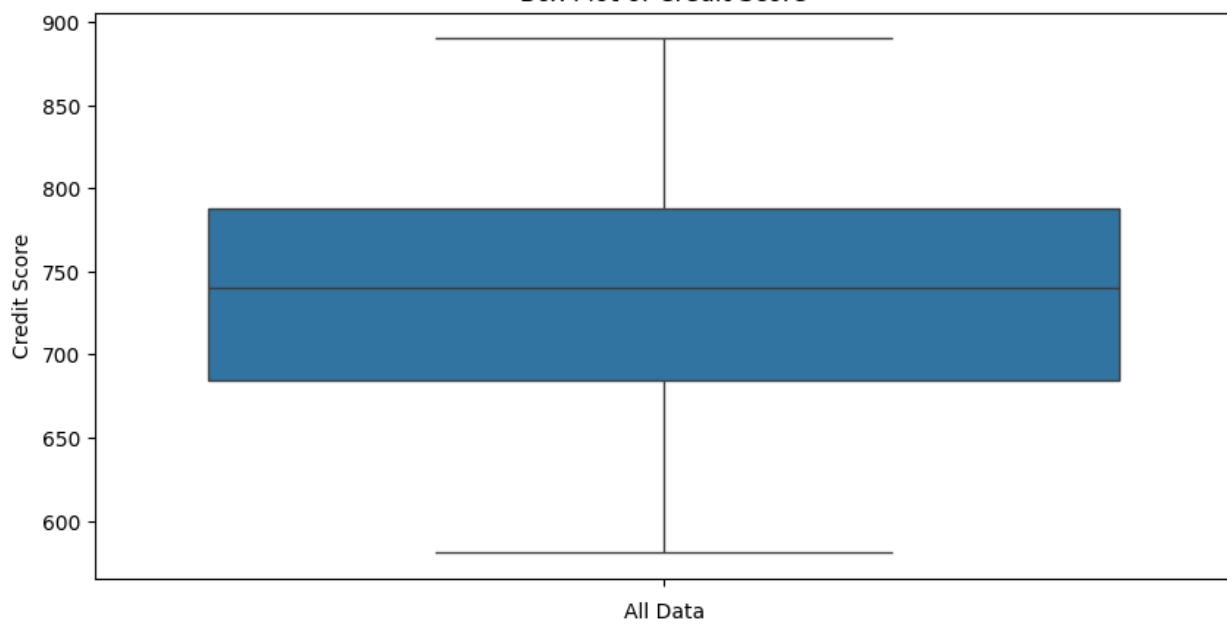


Box Plot of Dependents



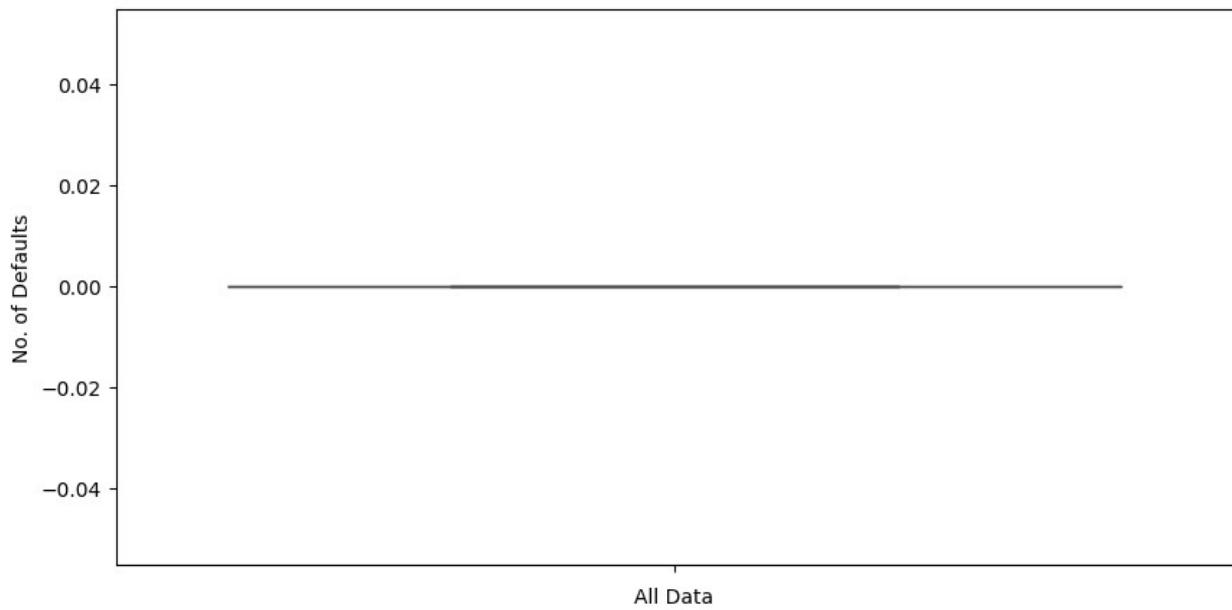
All Data

Box Plot of Credit Score

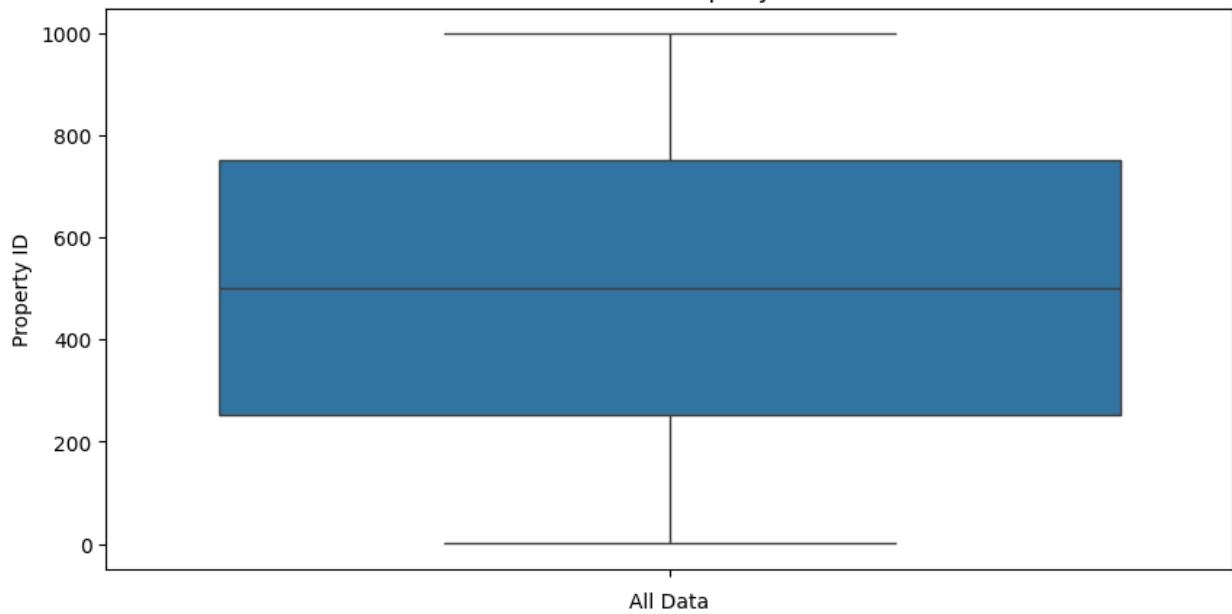


All Data

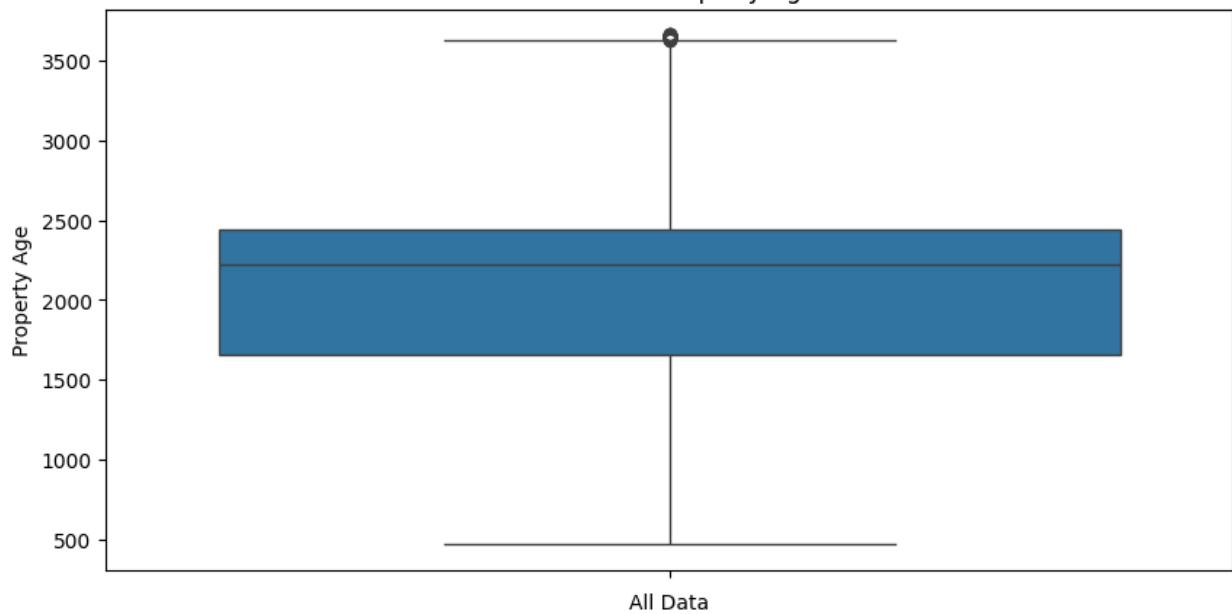
Box Plot of No. of Defaults



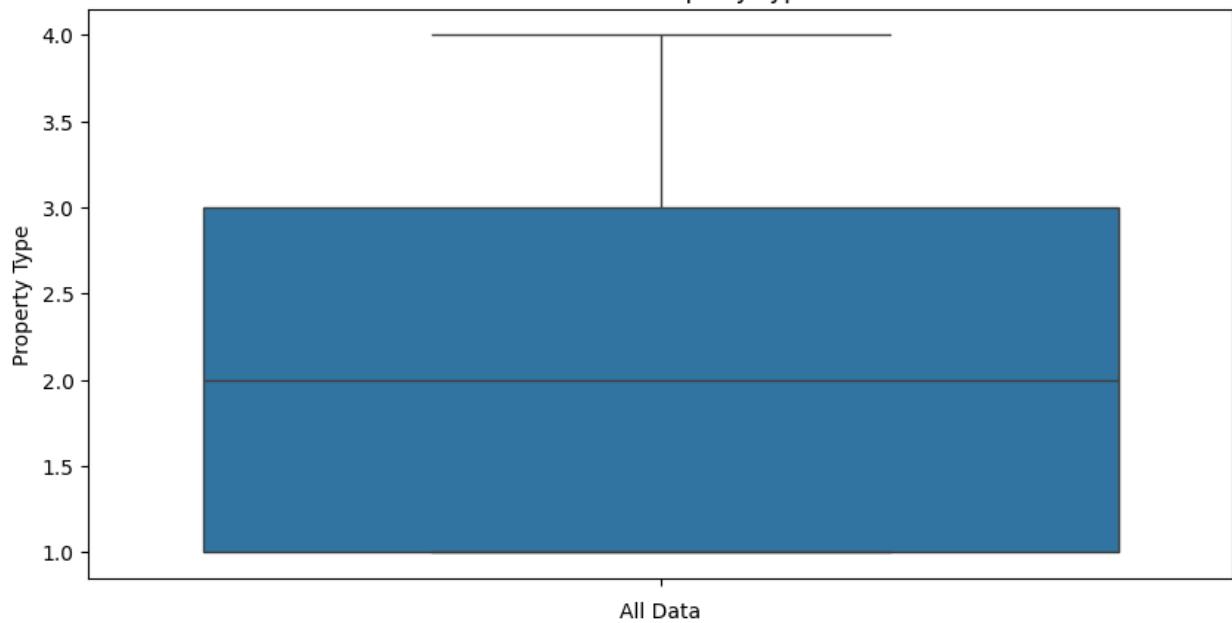
Box Plot of Property ID



Box Plot of Property Age



Box Plot of Property Type

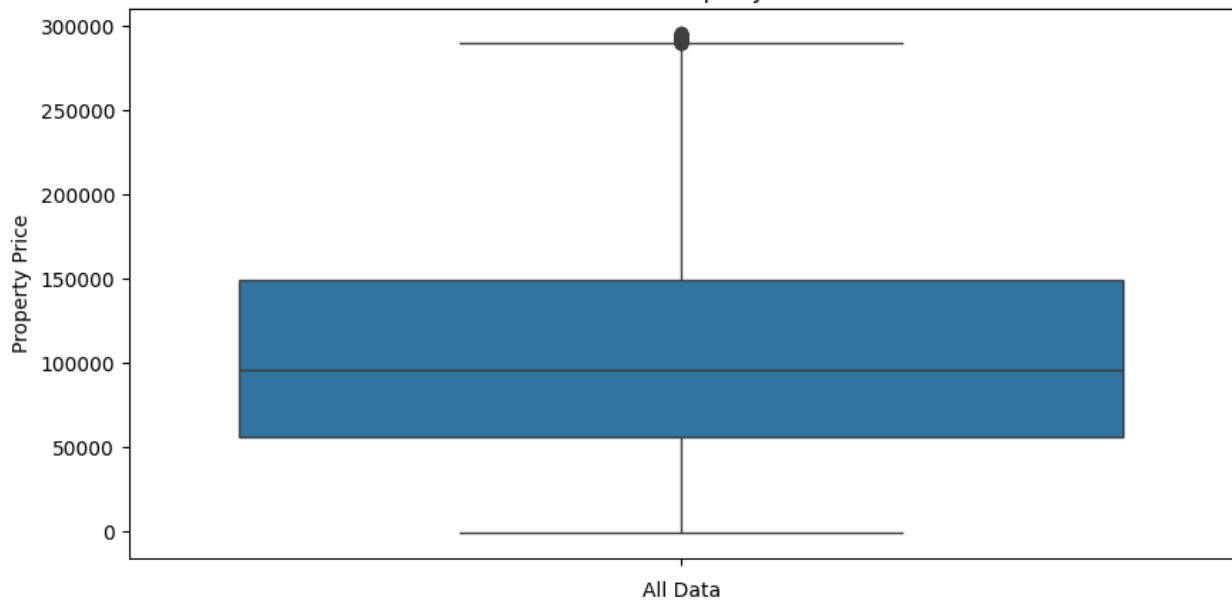


Box Plot of Co-Applicant

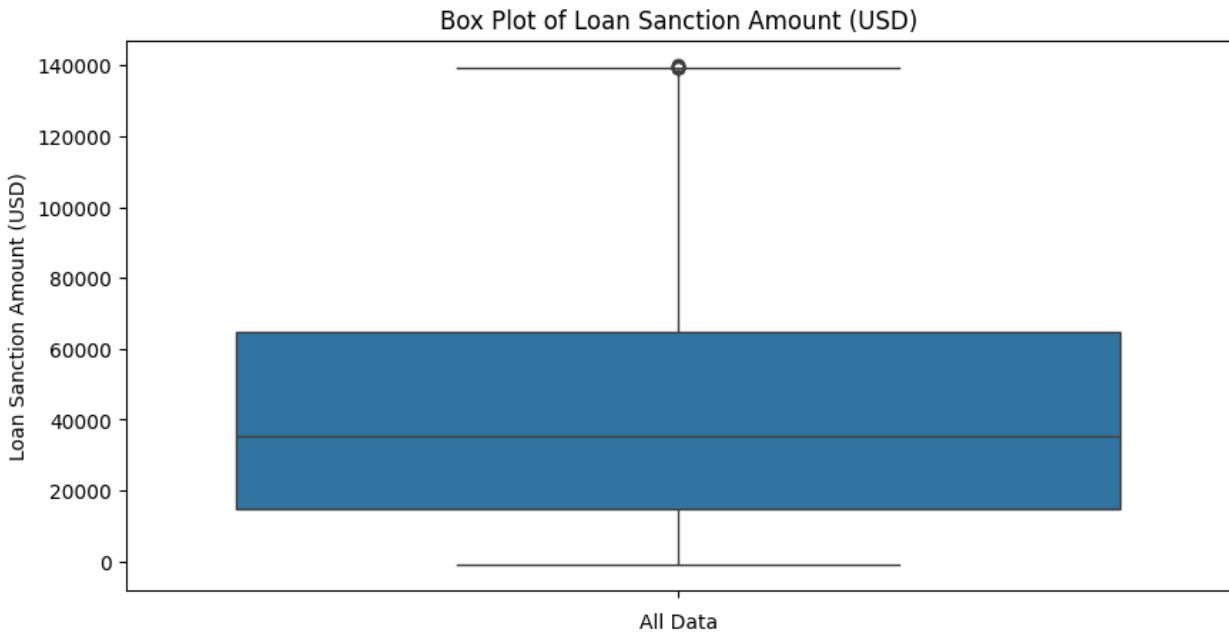


All Data

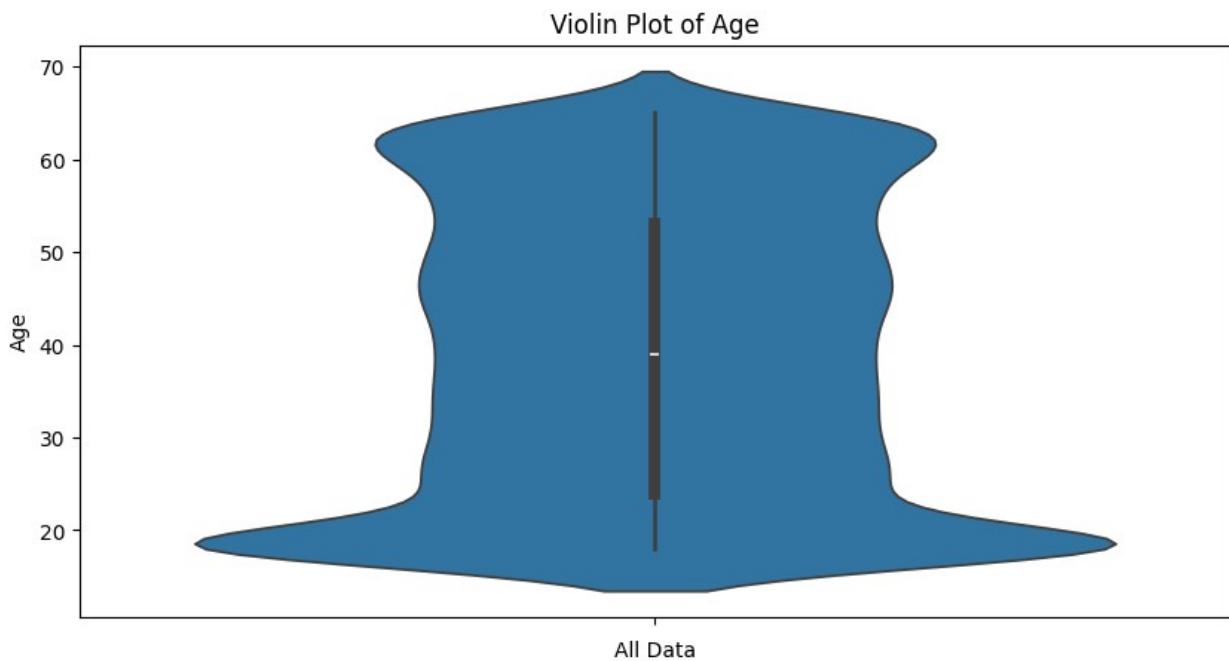
Box Plot of Property Price



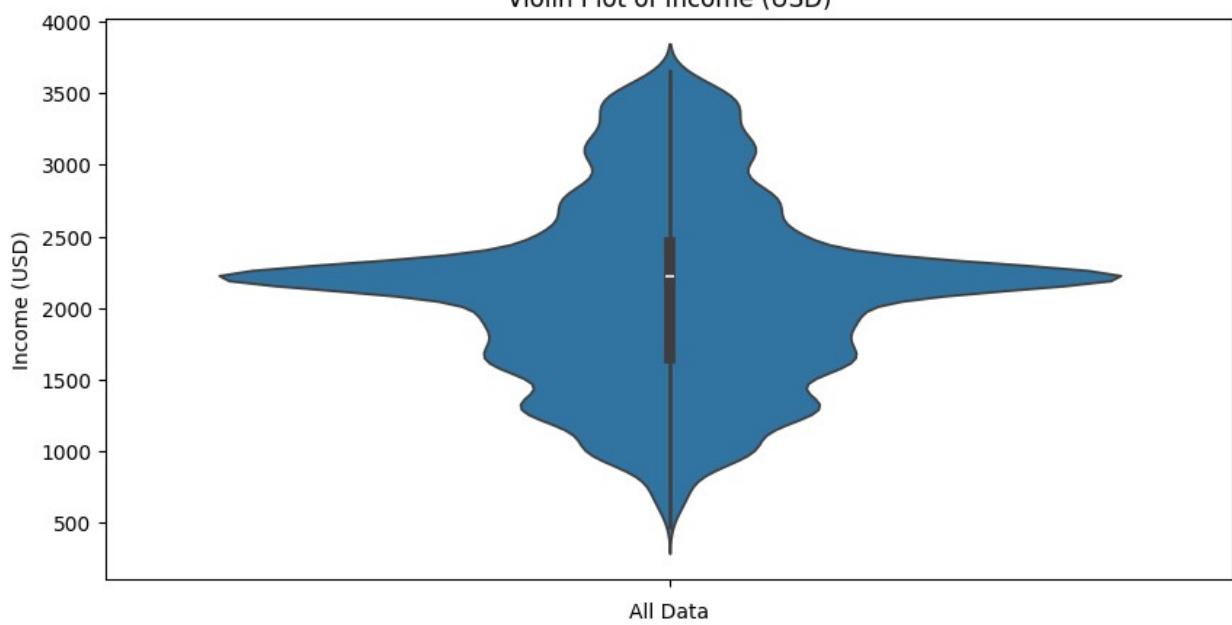
All Data



```
# Violin Plots for Numerical Data
for numerical_col in numerical_columns:
    plt.figure(figsize=(10, 5))
    sns.violinplot(y=numerical_col, data=data)
    plt.title(f'Violin Plot of {numerical_col}')
    plt.xlabel('All Data')
    plt.ylabel(numerical_col)
    plt.show()
```

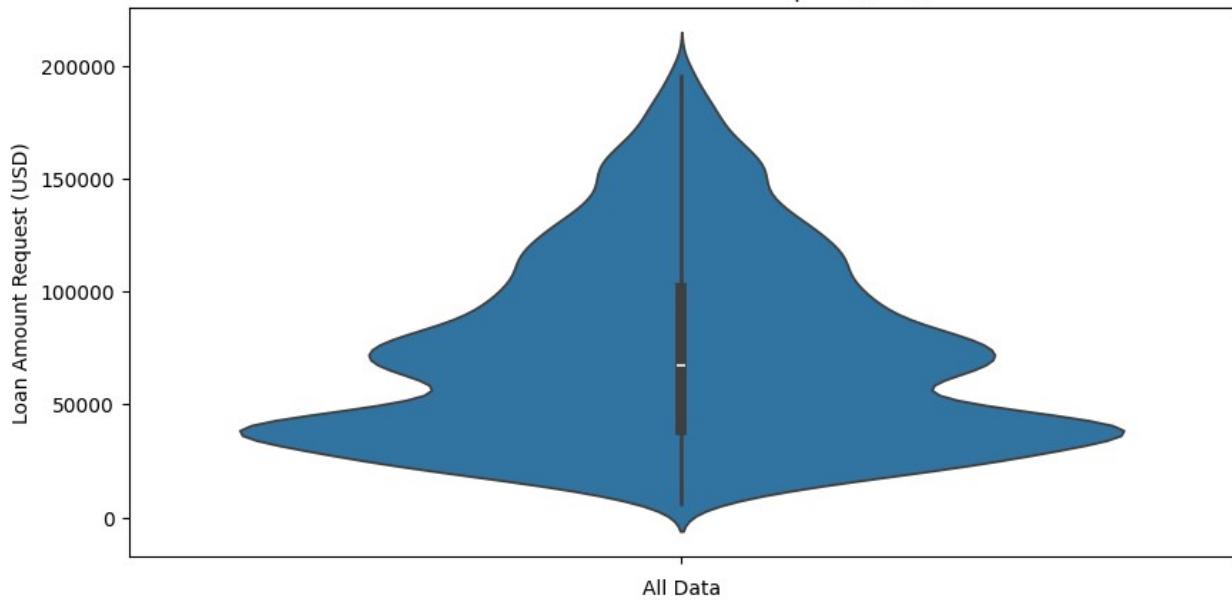


Violin Plot of Income (USD)



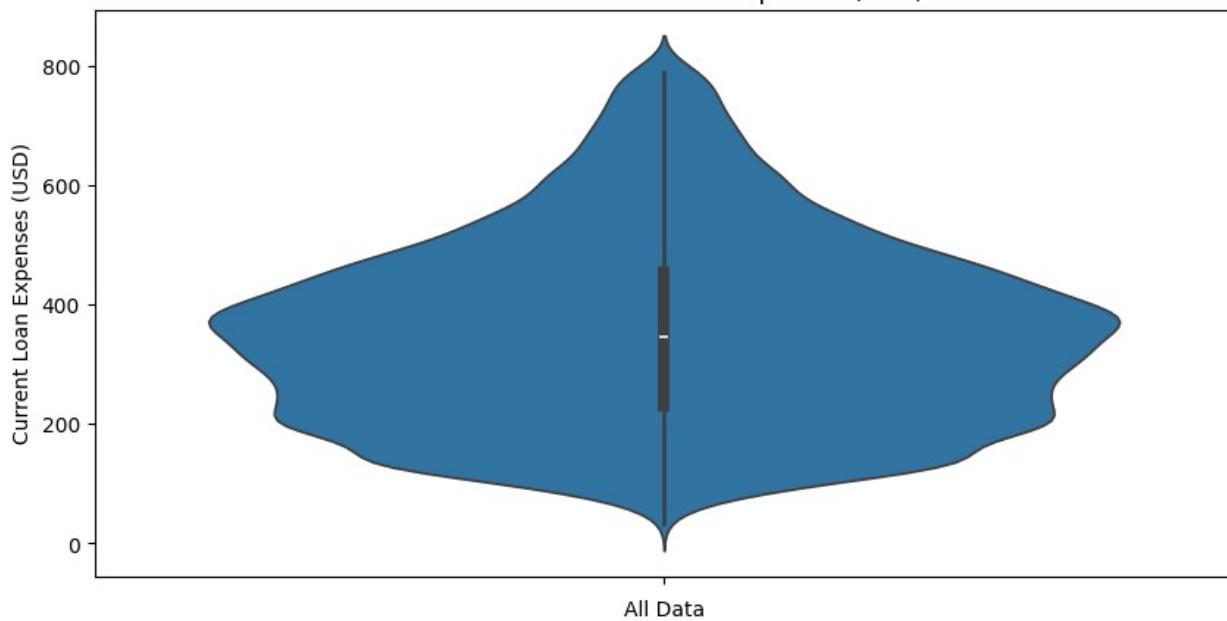
All Data

Violin Plot of Loan Amount Request (USD)

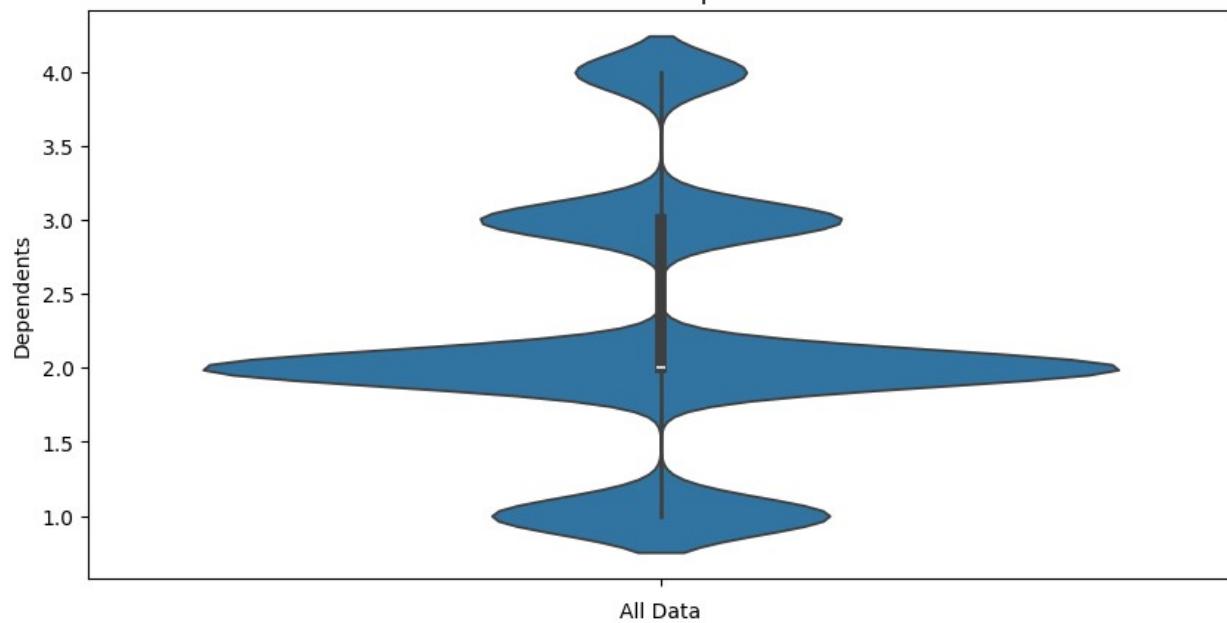


All Data

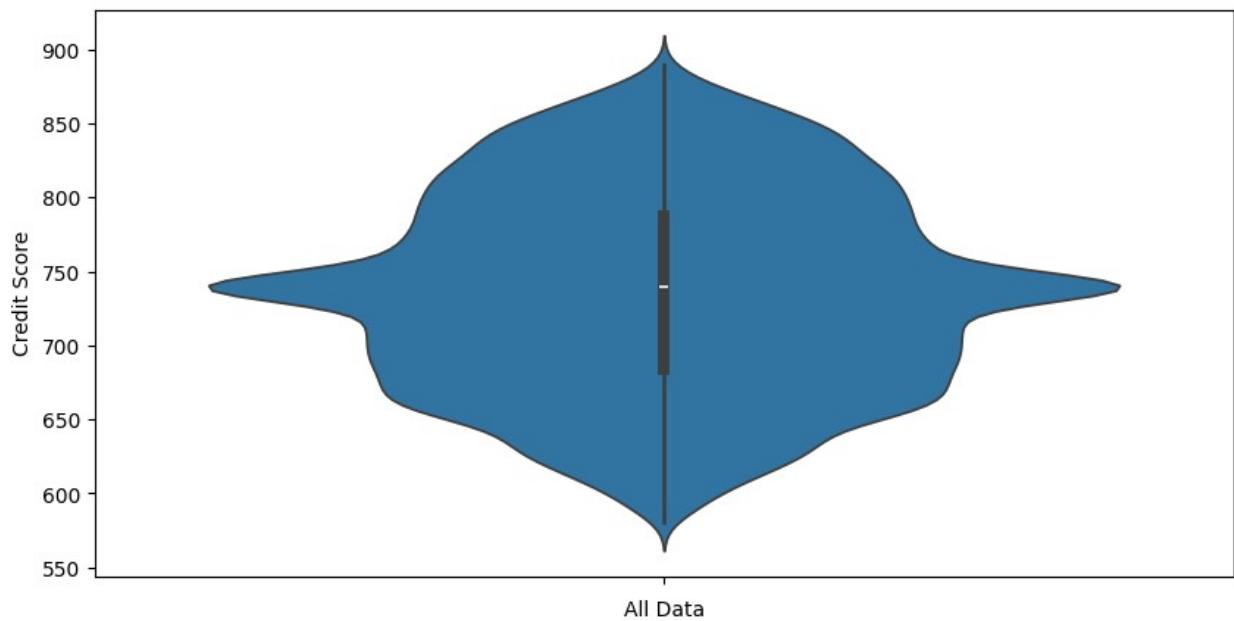
Violin Plot of Current Loan Expenses (USD)



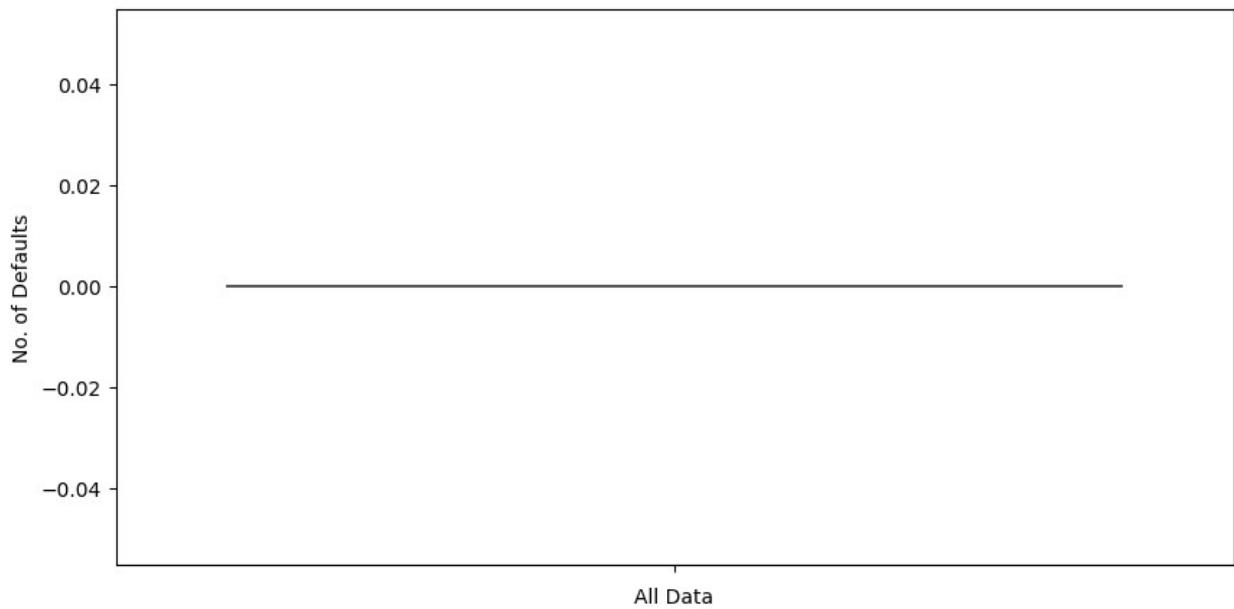
Violin Plot of Dependents



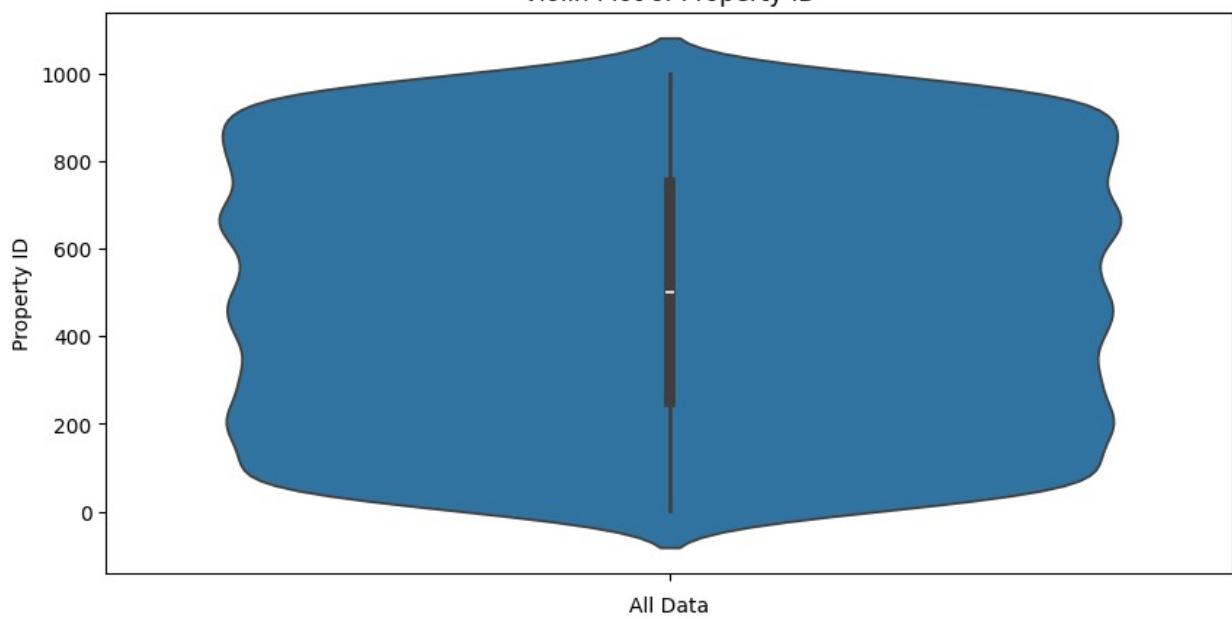
Violin Plot of Credit Score



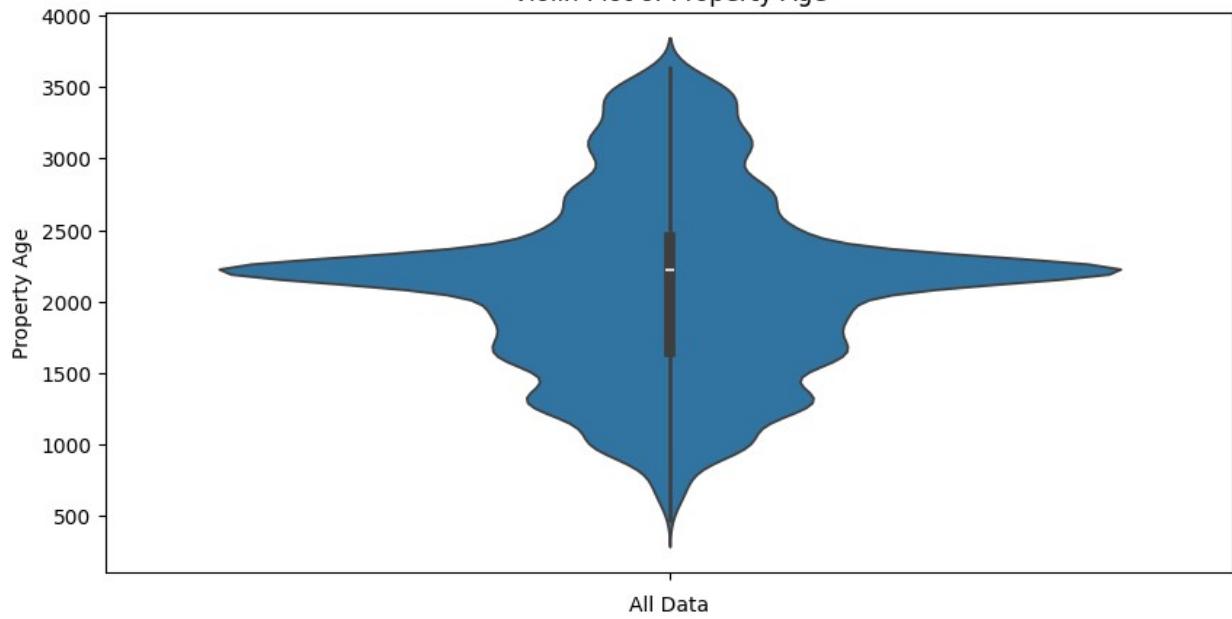
Violin Plot of No. of Defaults

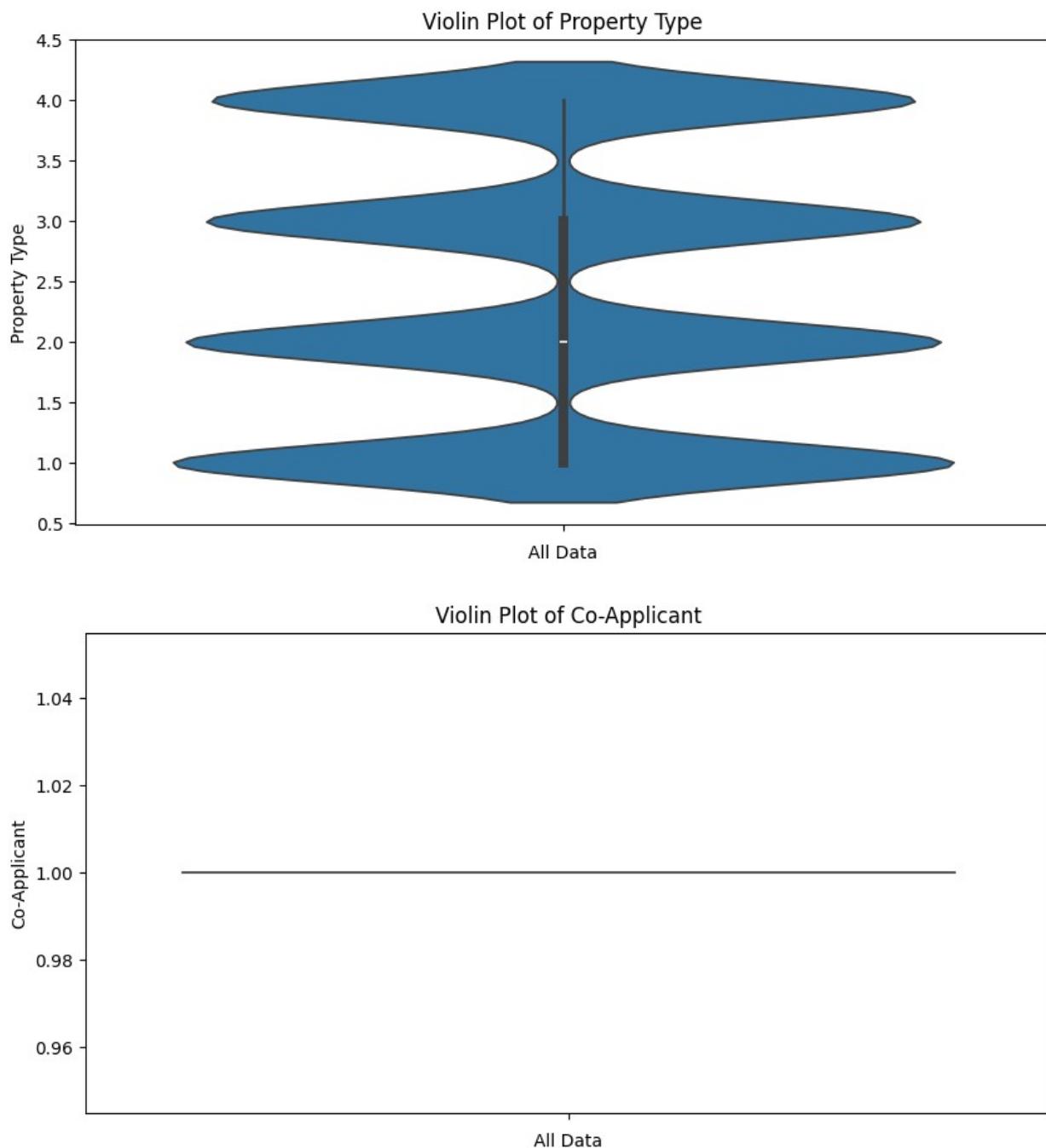


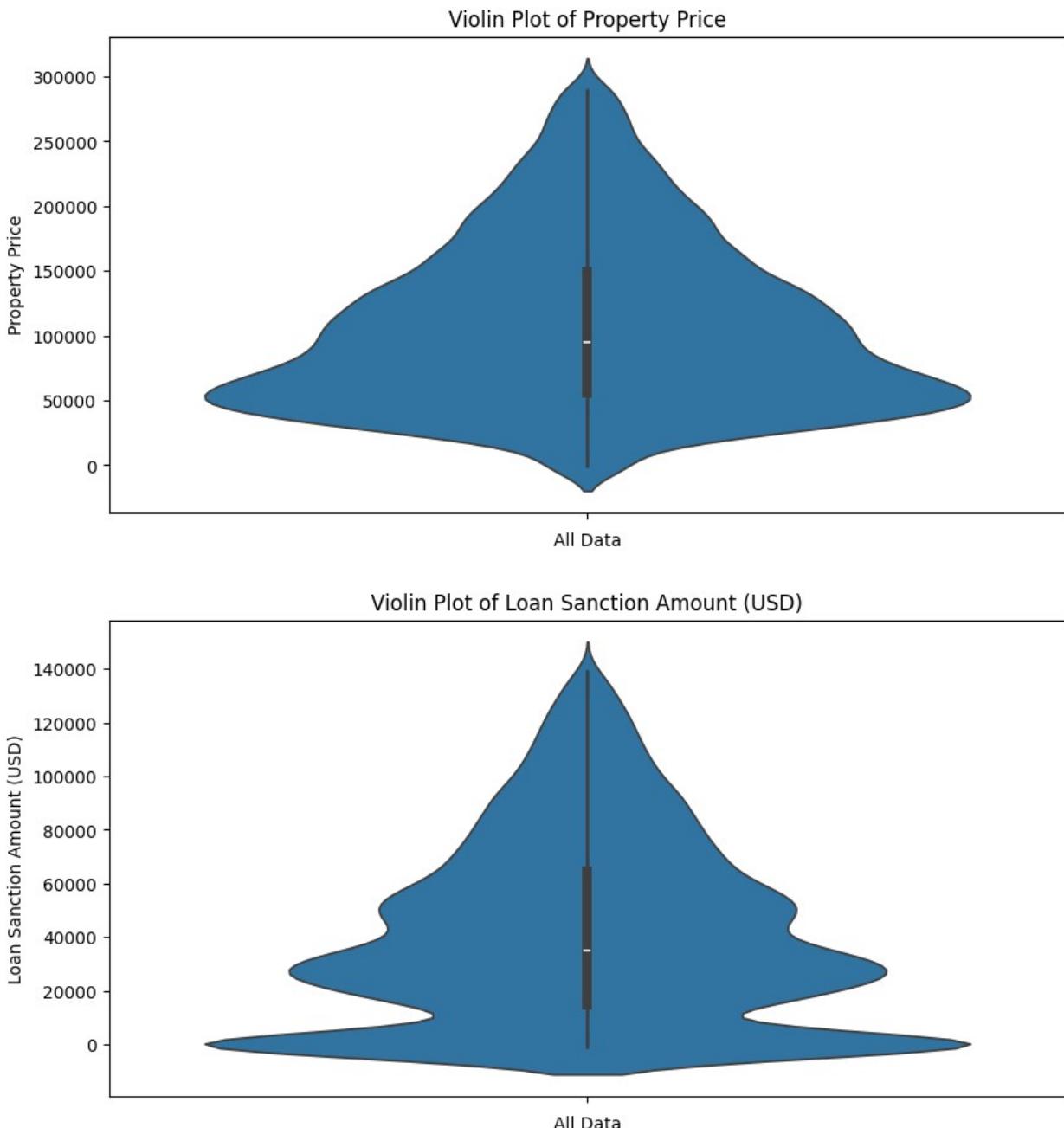
Violin Plot of Property ID



Violin Plot of Property Age







```

# Select numerical columns
numerical_columns = data.select_dtypes(include=['float64',
'int64']).columns

# Discretize numerical data into bins
for column in numerical_columns:
    data[f'{column}_binned'] = pd.qcut(data[column], q=4,
duplicates='drop')

# Contingency Tables and Chi-Square Tests

```

```

binned_columns = [f'{col}_binned' for col in numerical_columns]

print("\nChi-Square Test Results:")
for i, column1 in enumerate(binned_columns):
    for column2 in binned_columns[i+1:]:
        contingency_table = pd.crosstab(data[column1], data[column2])
        if contingency_table.size == 0:
            print(f"\nContingency Table between {column1} and {column2} is empty. Skipping chi-square test.")
            continue
        print(f"\nContingency Table between {column1} and {column2}:")
        print(contingency_table)

        chi2, p, dof, ex = chi2_contingency(contingency_table)
        print(f"Chi-Square Test between {column1} and {column2}:")
        print(f"Chi2 Statistic: {chi2}, p-value: {p}")

    # Bar Plot for contingency table
    contingency_table.plot(kind='bar', stacked=True, figsize=(10,
5))
    plt.title(f'Stacked Bar Plot of {column1} and {column2}')
    plt.xlabel(column1)
    plt.ylabel('Frequency')
    plt.xticks(rotation=45)
    plt.show()

```

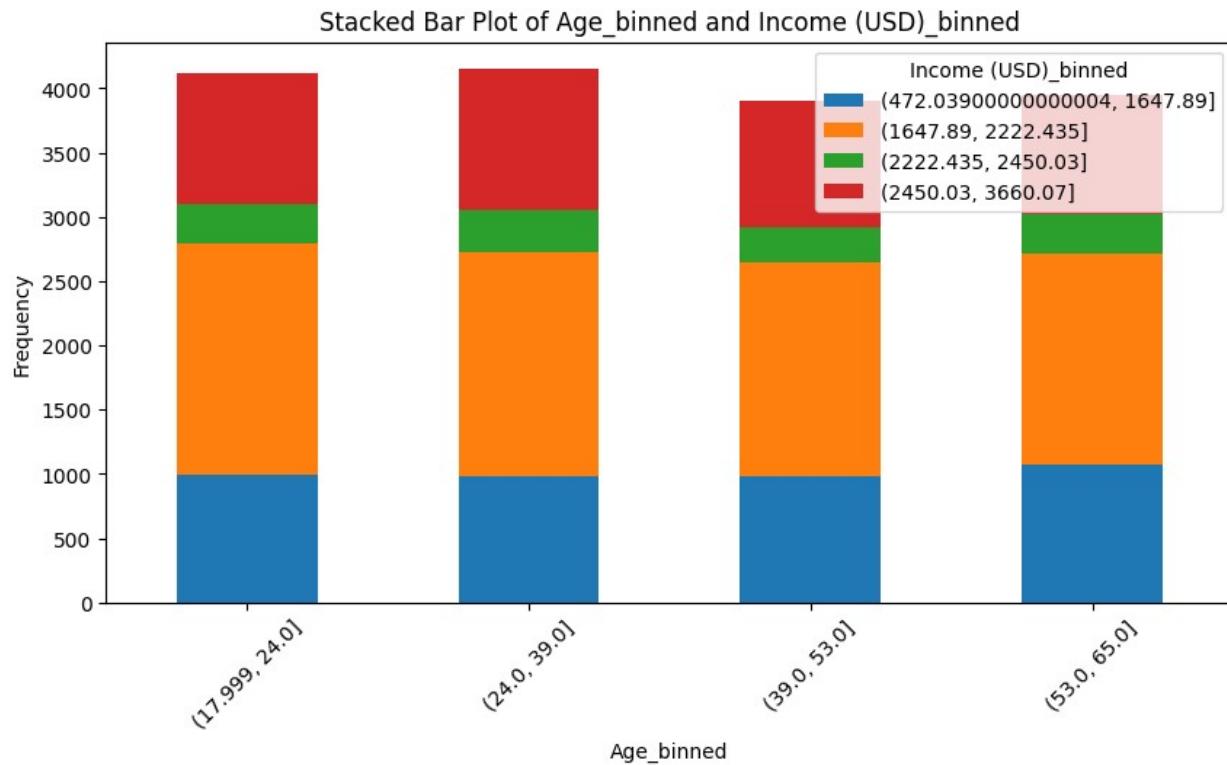
Chi-Square Test Results:

Contingency Table between Age_binned and Income (USD)_binned:
Income (USD)_binned (472.0390000000004, 1647.89] (1647.89,
2222.435] \
Age_binned

(17.999, 24.0]		998
1793		
(24.0, 39.0]		977
1744		
(39.0, 53.0]		980
1664		
(53.0, 65.0]		1075
1637		

Income (USD)_binned	(2222.435, 2450.03]	(2450.03, 3660.07]
Age_binned		
(17.999, 24.0]	309	1015
(24.0, 39.0]	328	1102
(39.0, 53.0]	278	979
(53.0, 65.0]	305	933

Chi-Square Test between Age_binned and Income (USD)_binned:
Chi2 Statistic: 23.57985070997467, p-value: 0.005017390685121089



Contingency Table between Age_binned and Loan Amount Request (USD)_binned:

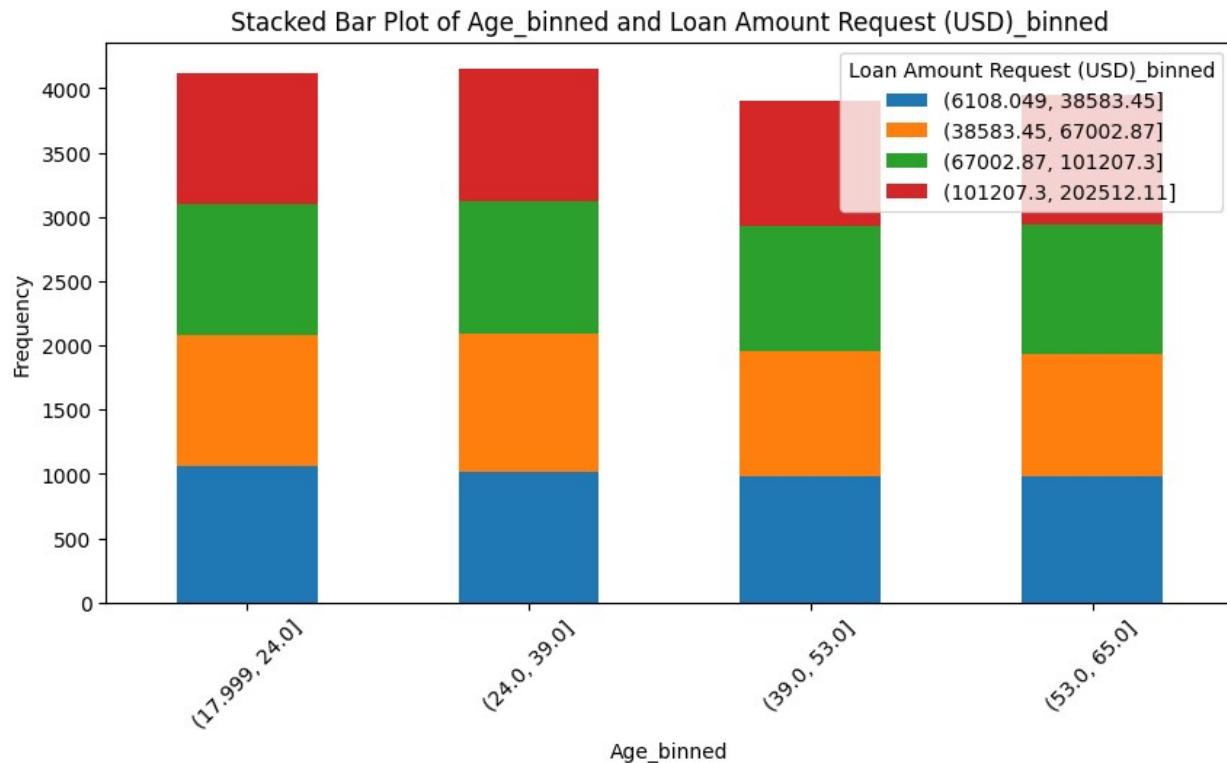
Loan Amount Request (USD)_binned (6108.049, 38583.45] (38583.45, 67002.87] \
Age_binned

(17.999, 24.0]	1059
1025	
(24.0, 39.0]	1015
1077	
(39.0, 53.0]	977
978	
(53.0, 65.0]	979
949	

Loan Amount Request (USD)_binned (67002.87, 101207.3] (101207.3, 202512.11]
Age_binned

(17.999, 24.0]	1010
1021	
(24.0, 39.0]	1024

1035	
(39.0, 53.0]	978
968	
(53.0, 65.0]	1017
1005	
Chi-Square Test between Age_binned and Loan Amount Request (USD)_binned:	
Chi2 Statistic: 6.313967511771276, p-value: 0.7081301499895833	



Contingency Table between Age_binned and Current Loan Expenses (USD)_binned:

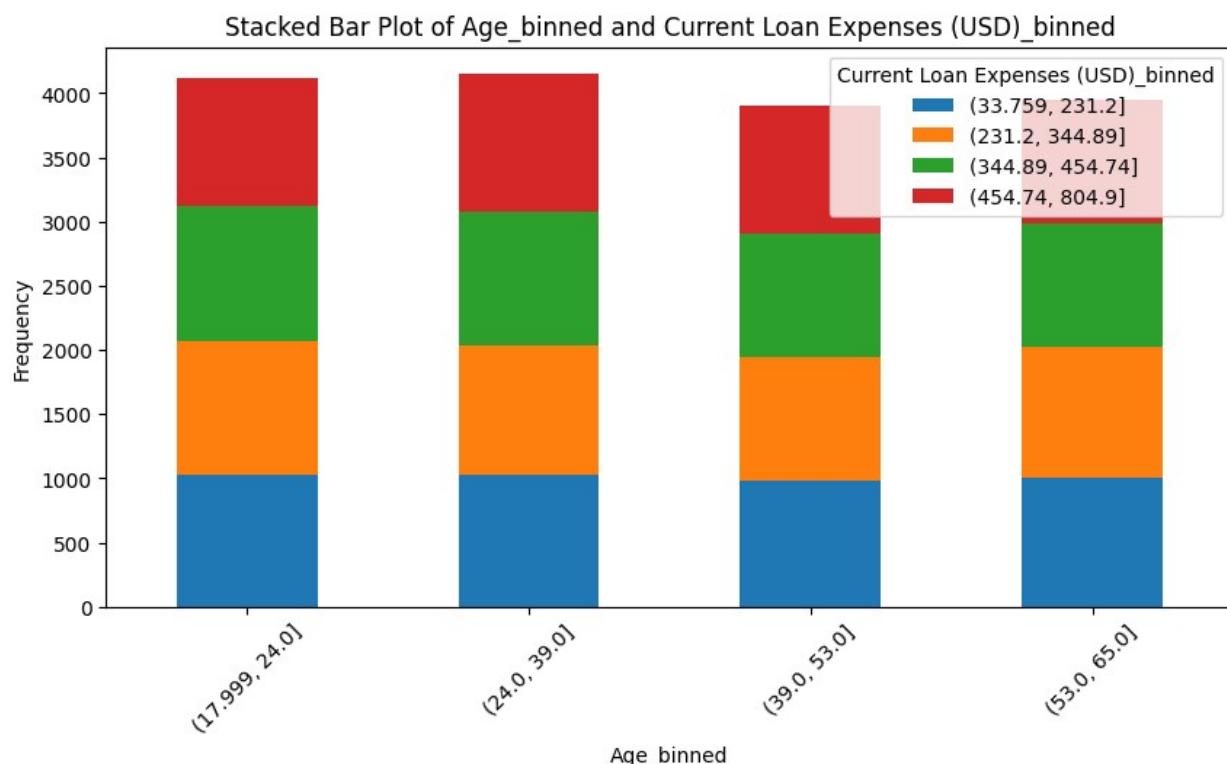
Current Loan Expenses (USD)_binned	(33.759, 231.2]	(231.2, 344.89]	\
Age_binned			
(17.999, 24.0]	1023	1040	
(24.0, 39.0]	1024	1007	
(39.0, 53.0]	984	957	
(53.0, 65.0]	999	1025	
Current Loan Expenses (USD)_binned	(344.89, 454.74]	(454.74, 804.9]	

Age_binned

(17.999, 24.0]	1058	994
(24.0, 39.0]	1050	1070
(39.0, 53.0]	961	999
(53.0, 65.0]	960	966

Chi-Square Test between Age_binned and Current Loan Expenses (USD)_binned:

Chi2 Statistic: 8.399556509141517, p-value: 0.4944350929193646



Contingency Table between Age_binned and Dependents_binned:

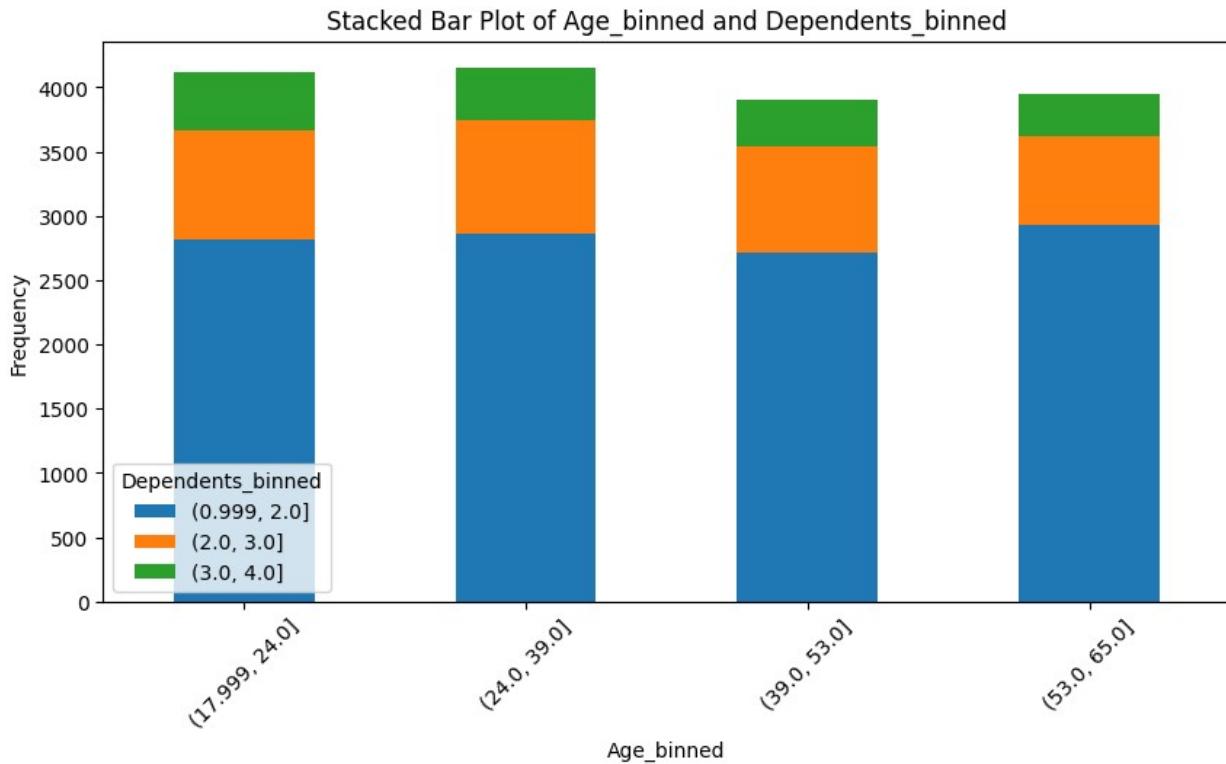
Dependents_binned (0.999, 2.0] (2.0, 3.0] (3.0, 4.0]

Age_binned

(17.999, 24.0]	2813	856	446
(24.0, 39.0]	2856	887	408
(39.0, 53.0]	2708	832	361
(53.0, 65.0]	2934	688	328

Chi-Square Test between Age_binned and Dependents_binned:

Chi2 Statistic: 48.14183079145796, p-value: 1.1069679652059282e-08



Contingency Table between Age_binned and Credit Score_binned:
Credit Score_binned (580.849, 684.22] (684.22, 739.82] (739.82, 787.44] \
Age_binned

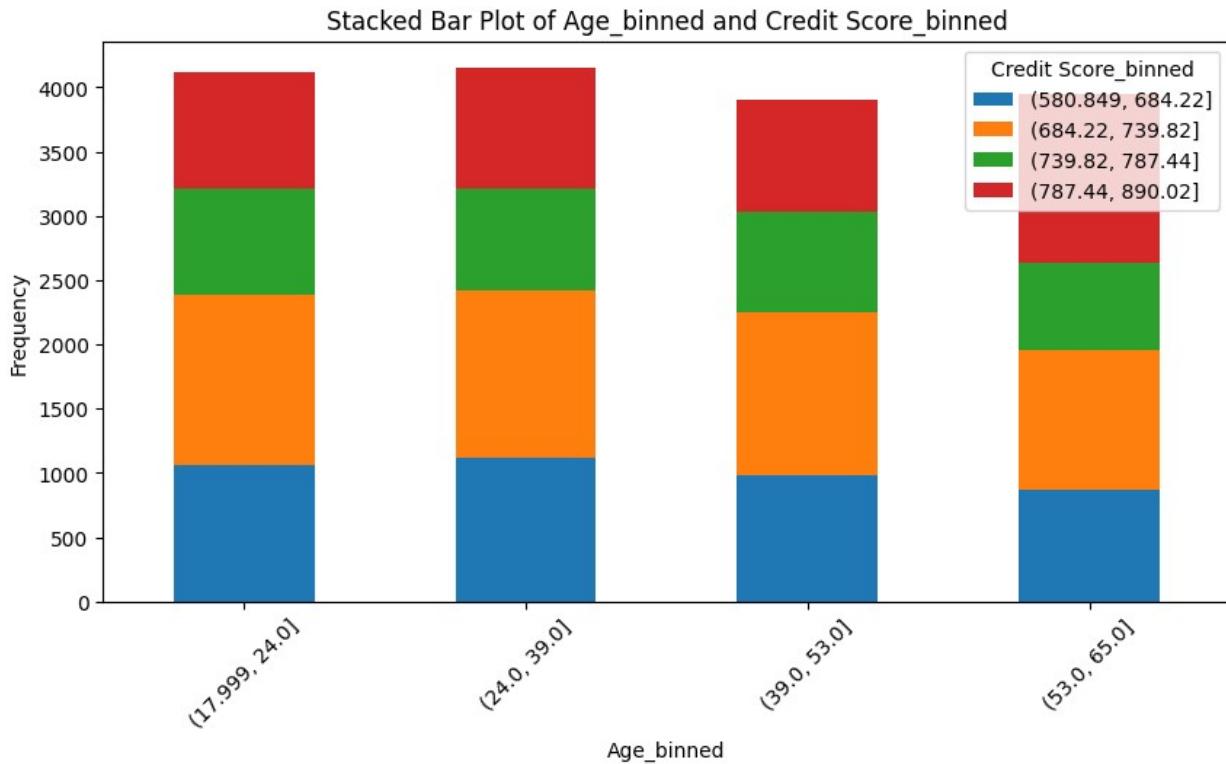
(17.999, 24.0]	1057	1329
821		
(24.0, 39.0]	1118	1304
793		
(39.0, 53.0]	984	1267
776		
(53.0, 65.0]	871	1085
683		

Credit Score_binned (787.44, 890.02]

Age_binned	
(17.999, 24.0]	908
(24.0, 39.0]	936
(39.0, 53.0]	874
(53.0, 65.0]	1311

Chi-Square Test between Age_binned and Credit Score_binned:

Chi2 Statistic: 192.19263245073552, p-value: 1.4310970745243544e-36



Contingency Table between Age_binned and No. of Defaults_binned is empty. Skipping chi-square test.

Contingency Table between Age_binned and Property ID_binned:

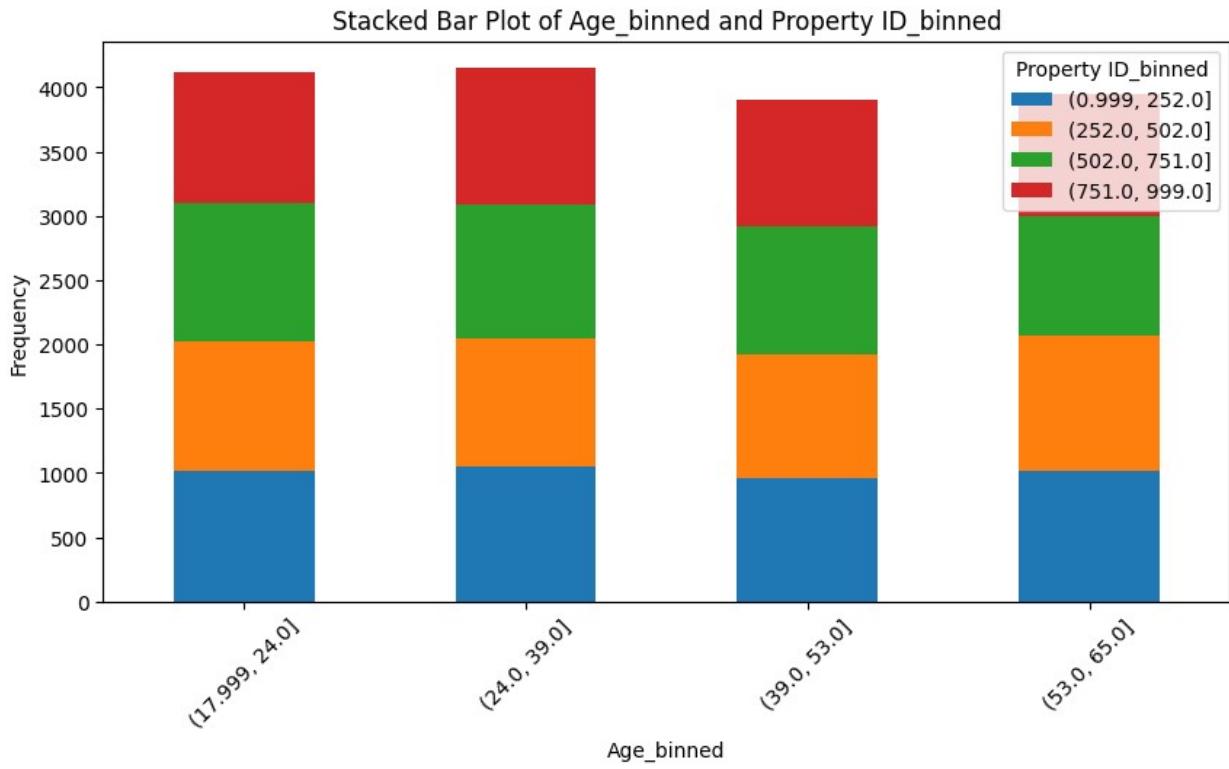
Property ID_binned	(0.999, 252.0]	(252.0, 502.0]	(502.0, 751.0]	\
Age_binned				
(17.999, 24.0]	1015	1011	1077	
(24.0, 39.0]	1045	1001	1044	
(39.0, 53.0]	955	963	1000	
(53.0, 65.0]	1020	1050	921	

Property ID_binned (751.0, 999.0]

Age_binned	
(17.999, 24.0]	1012
(24.0, 39.0]	1061
(39.0, 53.0]	983
(53.0, 65.0]	959

Chi-Square Test between Age_binned and Property ID_binned:

Chi2 Statistic: 16.409187931392438, p-value: 0.05881298746899063



Contingency Table between Age_binned and Property Age_binned:
 Property Age_binned (472.0390000000004, 1654.24] (1654.24, 2223.25]
 \
 Age_binned

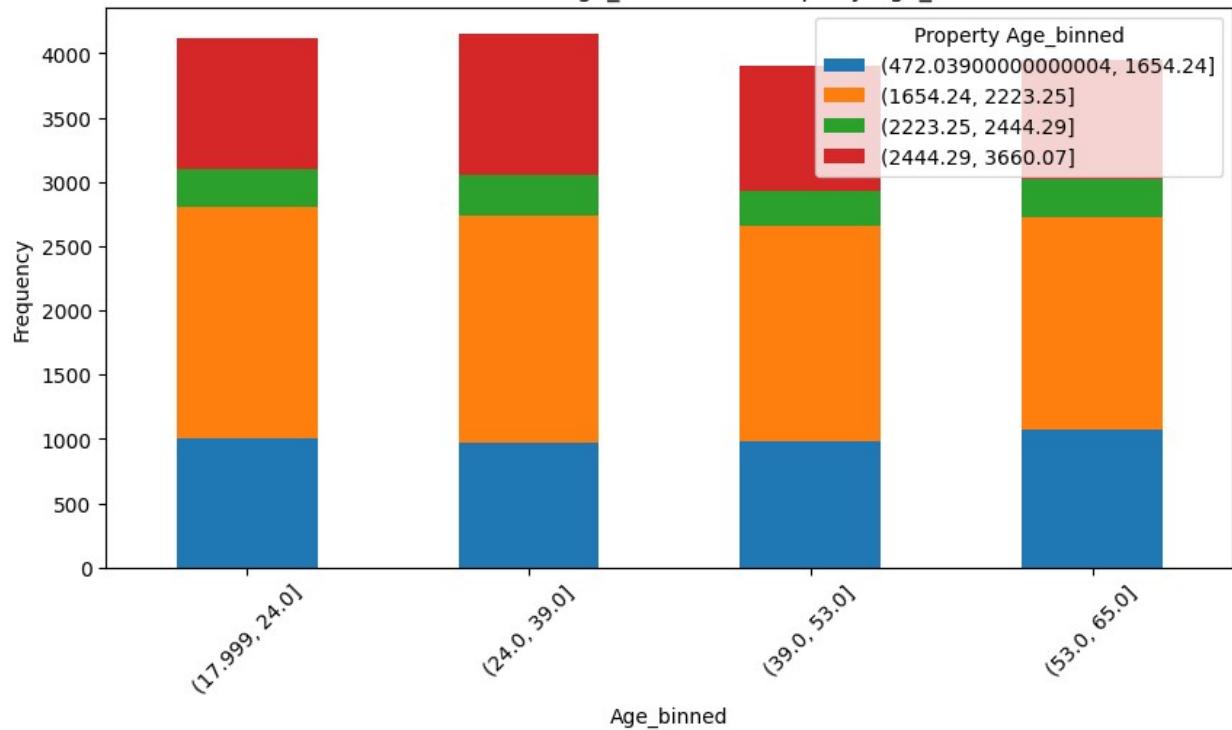
(17.999, 24.0]	1002	1805
(24.0, 39.0]	974	1767
(39.0, 53.0]	984	1671
(53.0, 65.0]	1070	1658

Property Age_binned (2223.25, 2444.29] (2444.29, 3660.07]
 Age_binned

(17.999, 24.0]	294	1014
(24.0, 39.0]	307	1103
(39.0, 53.0]	268	978
(53.0, 65.0]	288	934

Chi-Square Test between Age_binned and Property Age_binned:
 Chi2 Statistic: 21.435980722490324, p-value: 0.010849129296607255

Stacked Bar Plot of Age_binned and Property Age_binned



Contingency Table between Age_binned and Property Type_binned:

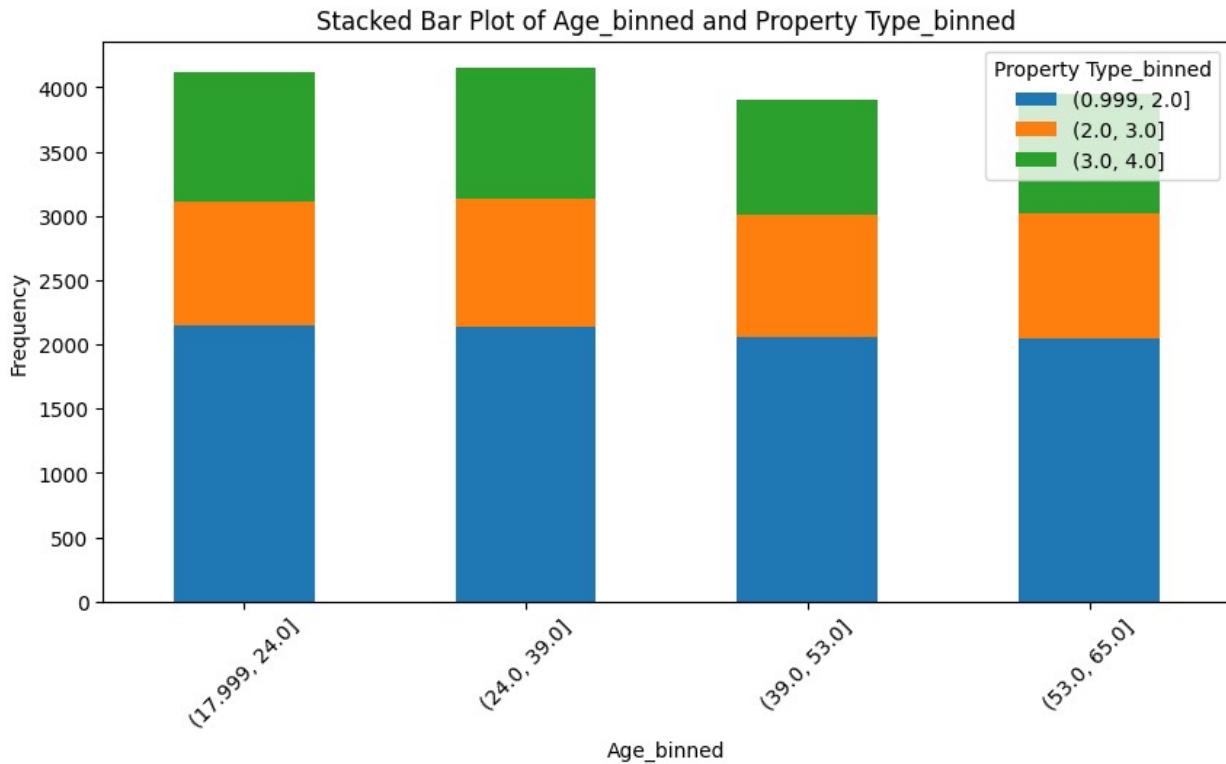
Property Type_binned (0.999, 2.0] (2.0, 3.0] (3.0, 4.0]

Age_binned

(17.999, 24.0]	2147	966	1002
(24.0, 39.0]	2137	999	1015
(39.0, 53.0]	2053	960	888
(53.0, 65.0]	2046	970	934

Chi-Square Test between Age_binned and Property Type_binned:

Chi2 Statistic: 5.021123874122156, p-value: 0.5411066896357166



Contingency Table between Age_binned and Co-Applicant_binned is empty.
Skipping chi-square test.

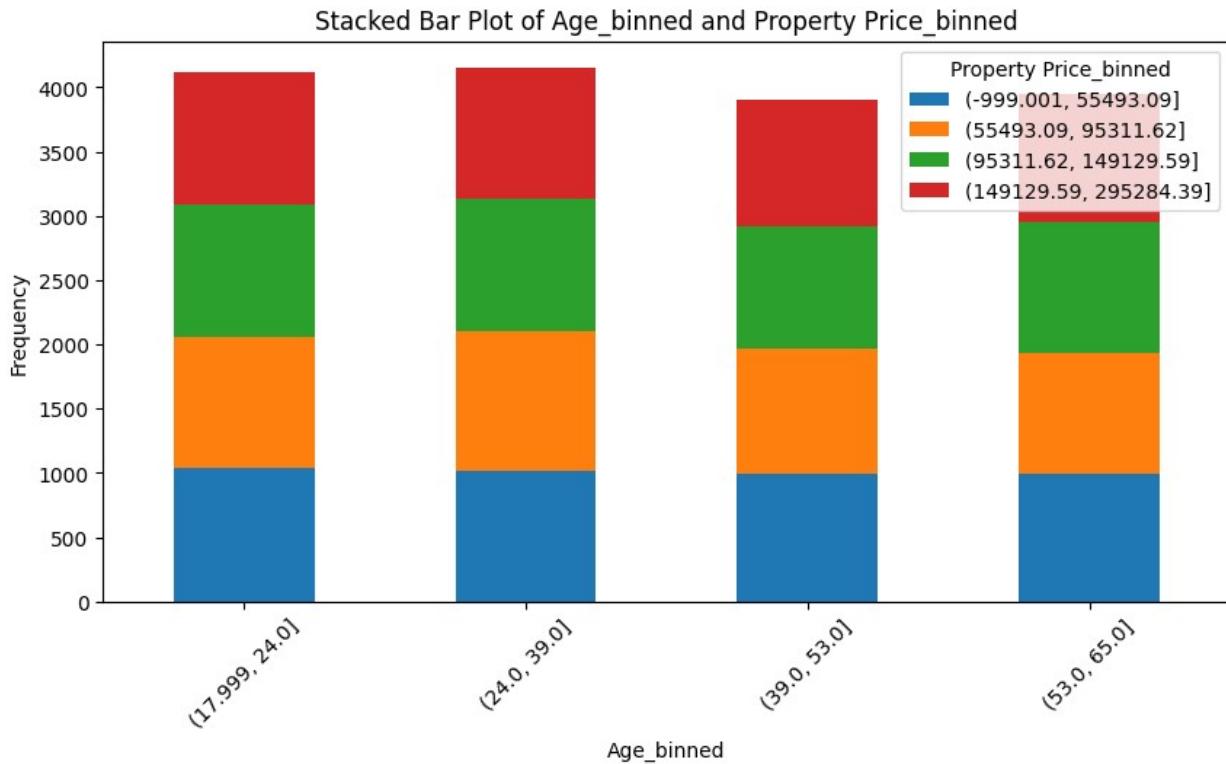
Contingency Table between Age_binned and Property Price_binned:
 Property Price_binned (-999.001, 55493.09] (55493.09, 95311.62] \\\
 Age_binned

Age_binned	(17.999, 24.0]	(24.0, 39.0]	(39.0, 53.0]	(53.0, 65.0]
(17.999, 24.0]	1033	1016	993	988
(24.0, 39.0]				
(39.0, 53.0]				
(53.0, 65.0]				

Property Price_binned (95311.62, 149129.59] (149129.59, 295284.39]
 Age_binned

Age_binned	(17.999, 24.0]	(24.0, 39.0]	(39.0, 53.0]	(53.0, 65.0]
(17.999, 24.0]	1024	1036	952	1017
(24.0, 39.0]				
(39.0, 53.0]				
(53.0, 65.0]				

Chi-Square Test between Age_binned and Property Price_binned:
 Chi2 Statistic: 6.314684055905011, p-value: 0.7080568726426585



Contingency Table between Age_binned and Loan Sanction Amount (USD)_binned:

Age_binned	Loan Sanction Amount (USD)_binned (-999.001, 14966.74]
(17.999, 24.0]	1014
(24.0, 39.0]	1049
(39.0, 53.0]	1018
(53.0, 65.0]	949

Contingency Table between Age_binned and Loan Sanction Amount (USD)_binned (14966.74, 35209.395] \

Age_binned	Loan Sanction Amount (USD)_binned (14966.74, 35209.395]
(17.999, 24.0]	1095
(24.0, 39.0]	1036
(39.0, 53.0]	977
(53.0, 65.0]	1019

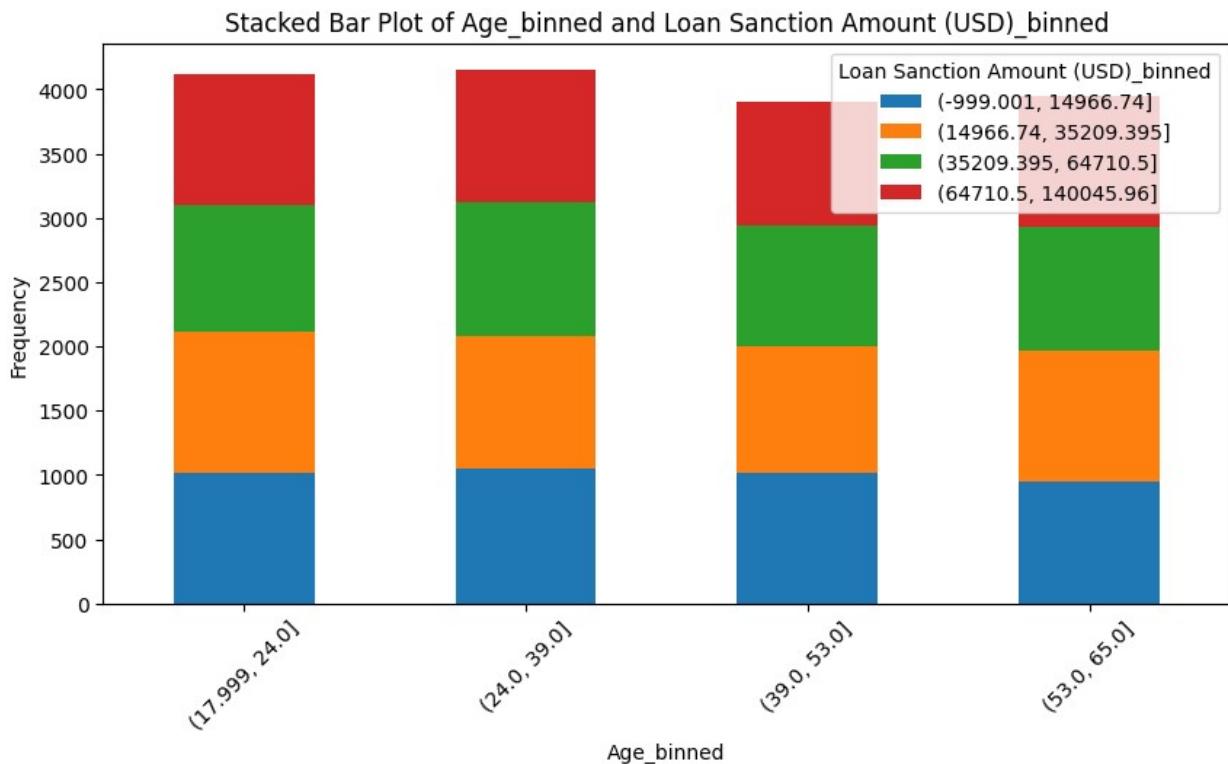
Contingency Table between Age_binned and Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5, 140045.96]

Age_binned	Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5, 140045.96]
(17.999, 24.0]	990
1016	
(24.0, 39.0]	1034
1032	
(39.0, 53.0]	947

```

959
(53.0, 65.0]
1022
Chi-Square Test between Age_binned and Loan Sanction Amount
(USD)_binned:
Chi2 Statistic: 8.888743182917686, p-value: 0.4476070133154232

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Contingency Table between Income (USD)_binned and Loan Amount Request
(USD)_binned:
Loan Amount Request (USD)_binned (6108.049, 38583.45] (38583.45,
67002.87] \
Income (USD)_binned

(472.0390000000004, 1647.89] 1581
1060
(1647.89, 2222.435] 1614
1799
(2222.435, 2450.03] 207
318
(2450.03, 3660.07] 628
852

Loan Amount Request (USD)_binned (67002.87, 101207.3] (101207.3,
202512.11]

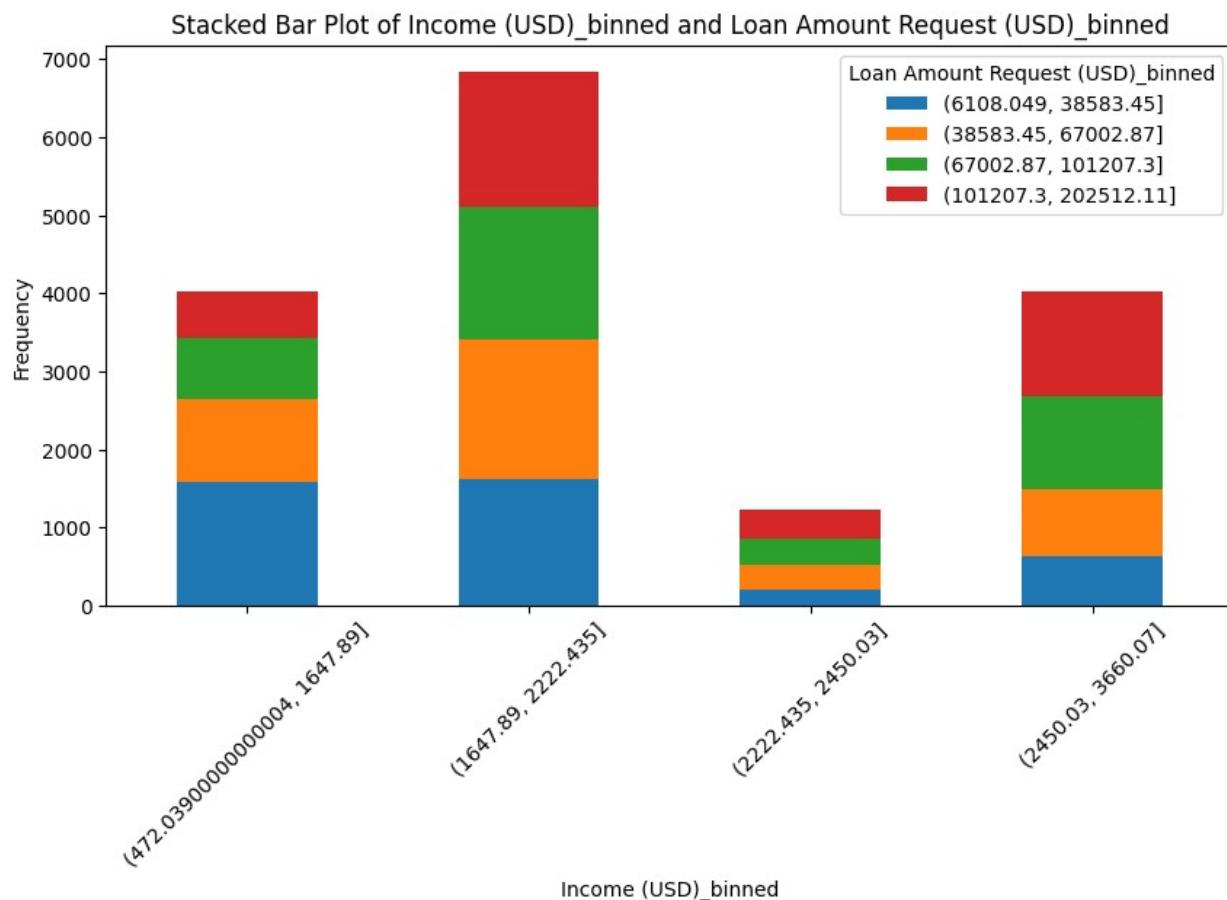
```

Income (USD)_binned

(472.03900000000004, 1647.89]	790
599	
(1647.89, 2222.435]	1695
1730	
(2222.435, 2450.03]	334
361	
(2450.03, 3660.07]	1210
1339	

Chi-Square Test between Income (USD)_binned and Loan Amount Request (USD)_binned:

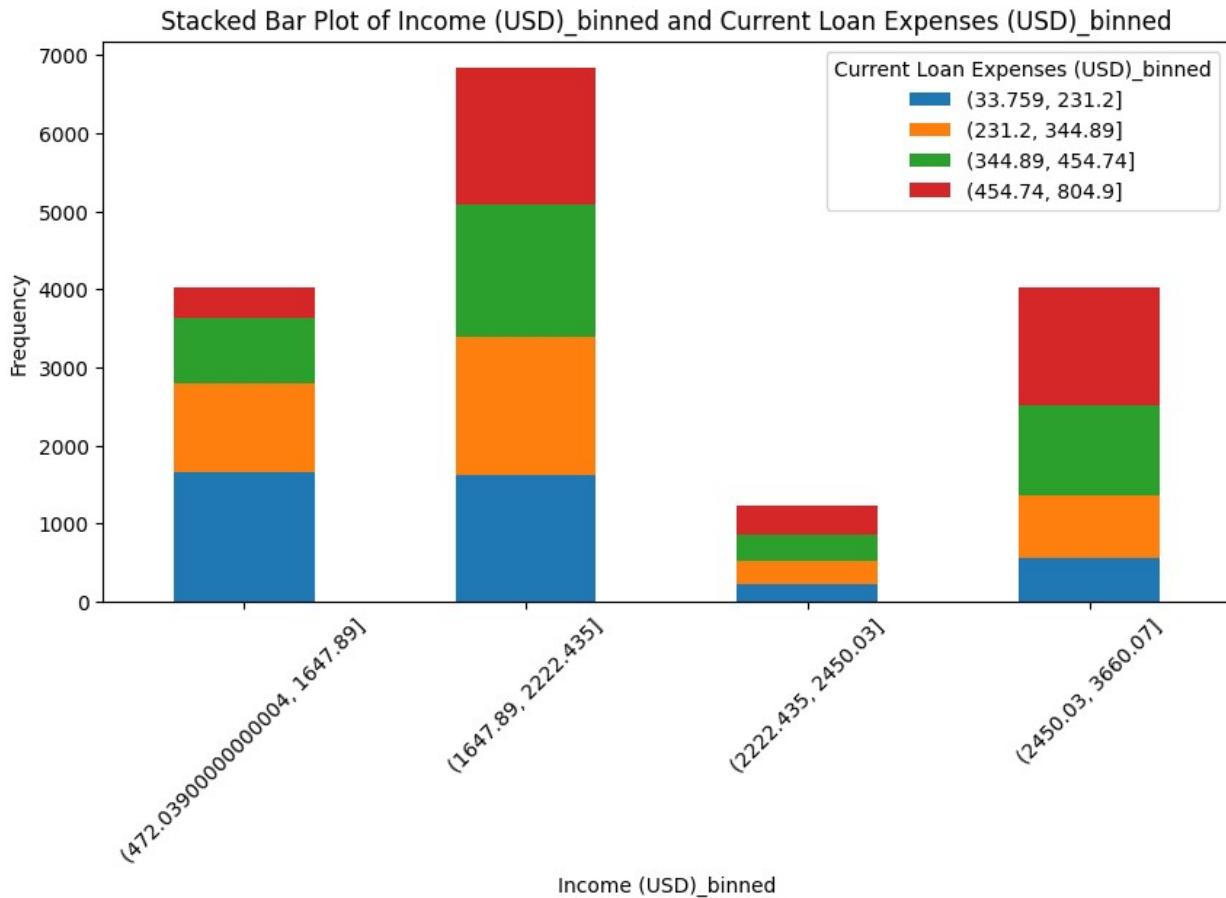
Chi2 Statistic: 913.9781345375056, p-value: 6.019043873728398e-191



Contingency Table between Income (USD)_binned and Current Loan Expenses (USD)_binned:

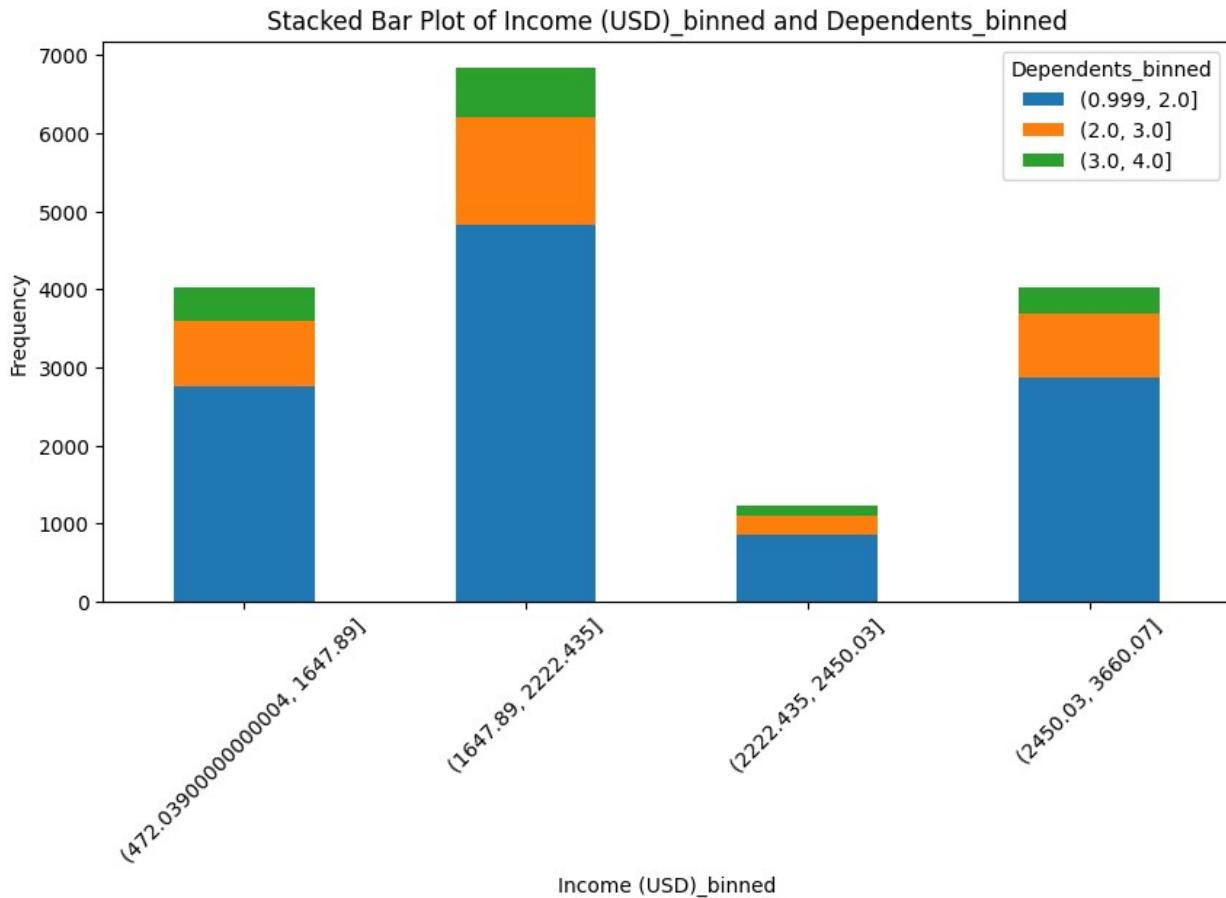
Current Loan Expenses (USD)_binned (33.759, 231.2] (231.2, 344.89] \ Income (USD)_binned

(472.03900000000004, 1647.89]	1659	1138
(1647.89, 2222.435]	1610	1784
(2222.435, 2450.03]	211	298
(2450.03, 3660.07]	550	809
Current Loan Expenses (USD)_binned (344.89, 454.74] (454.74, 804.9]		
Income (USD)_binned		
(472.03900000000004, 1647.89]	828	405
(1647.89, 2222.435]	1700	1744
(2222.435, 2450.03]	354	357
(2450.03, 3660.07]	1147	1523
Chi-Square Test between Income (USD)_binned and Current Loan Expenses (USD)_binned:		
Chi2 Statistic: 1416.1251023515229, p-value: 2.53569278499951e-299		

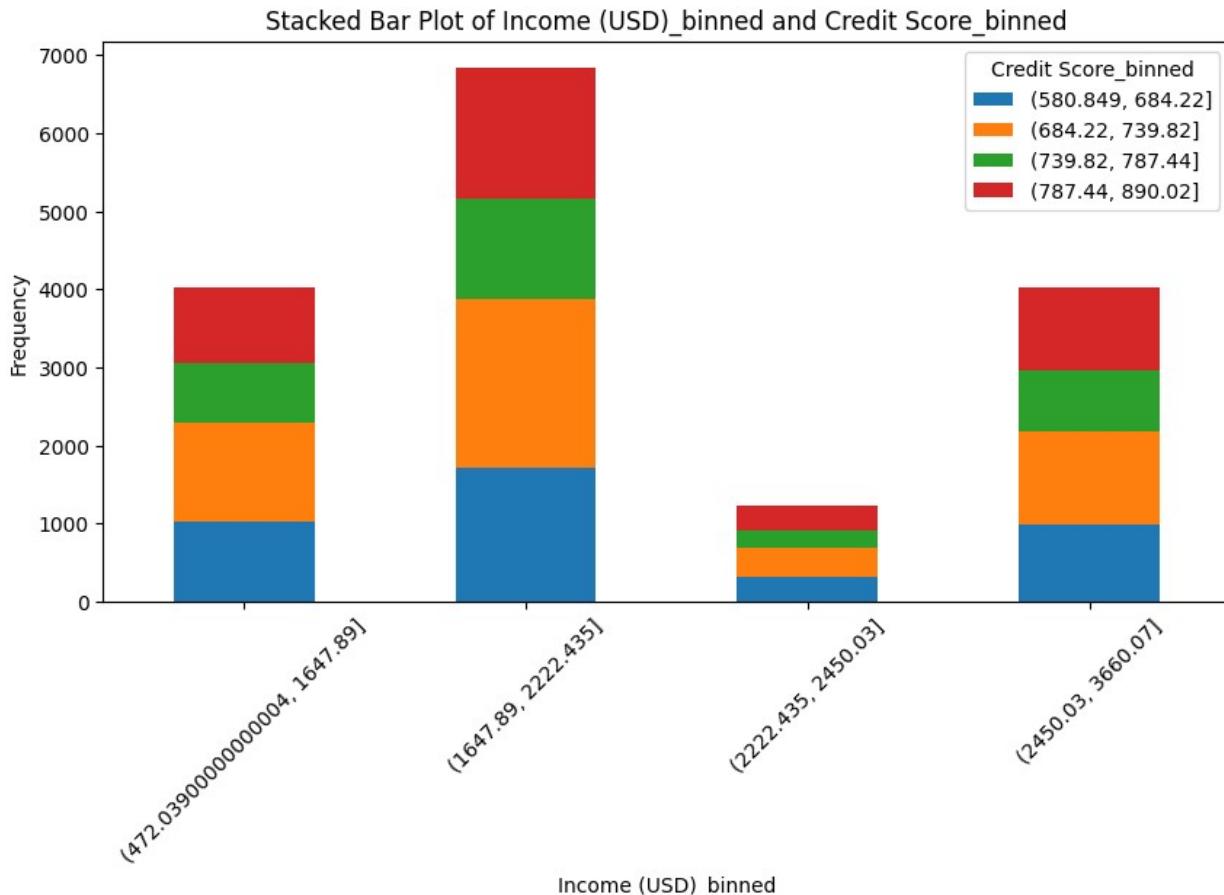


Contingency Table between Income (USD)_binned and Dependents_binned:			
Dependents_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
Income (USD)_binned			
(472.0390000000004, 1647.89]	2764	828	438
(1647.89, 2222.435]	4818	1381	639
(2222.435, 2450.03]	860	240	120
(2450.03, 3660.07]	2869	814	346

Chi-Square Test between Income (USD)_binned and Dependents_binned:
Chi2 Statistic: 14.159563971756487, p-value: 0.02790365573031419



Contingency Table between Income (USD)_binned and Credit Score_binned:			
Credit Score_binned	(580.849, 684.22]	(684.22, 739.82]	\
Income (USD)_binned			
(472.0390000000004, 1647.89]	1014	1269	
(1647.89, 2222.435]	1718	2159	
(2222.435, 2450.03]	322	355	
(2450.03, 3660.07]	976	1202	
Credit Score_binned	(739.82, 787.44] (787.44, 890.02]		
Income (USD)_binned			
(472.0390000000004, 1647.89]	765	982	
(1647.89, 2222.435]	1283	1678	
(2222.435, 2450.03]	236	307	
(2450.03, 3660.07]	789	1062	
Chi-Square Test between Income (USD)_binned and Credit Score_binned:			
Chi2 Statistic:	11.38614670795716	p-value:	0.2501660440502295



Contingency Table between Income (USD)_binned and No. of Defaults_binned is empty. Skipping chi-square test.

Contingency Table between Income (USD)_binned and Property ID_binned:
 Property ID_binned (0.999, 252.0] (252.0, 502.0] (502.0,

751.0] \

Income (USD)_binned

(472.0390000000004, 1647.89]	973	1009
1019		
(1647.89, 2222.435]	1749	1692
1693		
(2222.435, 2450.03]	303	289
325		
(2450.03, 3660.07]	1010	1035
1005		

Property ID_binned (751.0, 999.0]

Income (USD)_binned	(472.0390000000004, 1647.89]	1029
	(1647.89, 2222.435]	1704

(2222.435, 2450.03]
(2450.03, 3660.07]

303

979

Chi-Square Test between Income (USD)_binned and Property ID_binned:
Chi2 Statistic: 6.683786938111426, p-value: 0.6700033825335634



Contingency Table between Income (USD)_binned and Property Age_binned:
Property Age_binned (472.0390000000004, 1654.24] \

Income (USD)_binned
(472.0390000000004, 1647.89]
(1647.89, 2222.435]
(2222.435, 2450.03]
(2450.03, 3660.07]

(472.0390000000004, 1654.24]

3987

43

0

0

Property Age_binned (1654.24, 2223.25] (2223.25, 2444.29] \

Income (USD)_binned

(472.0390000000004, 1647.89] 43 0

(1647.89, 2222.435] 6795 0

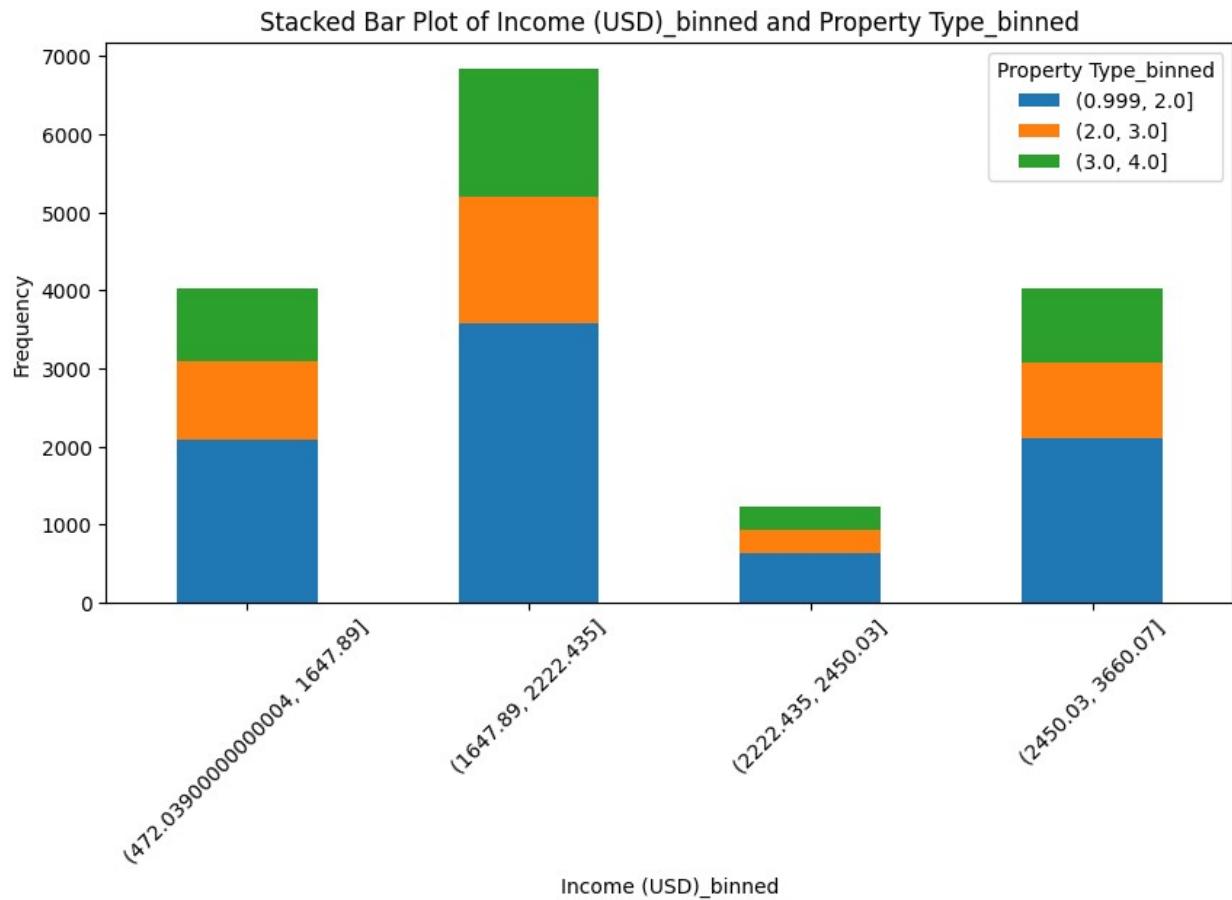
(2222.435, 2450.03]	20	1157
(2450.03, 3660.07]	43	0
Property Age_binned	(2444.29, 3660.07]	
Income (USD)_binned		
(472.0390000000004, 1647.89]	0	
(1647.89, 2222.435]	0	
(2222.435, 2450.03]	43	
(2450.03, 3660.07]	3986	
Chi-Square Test between Income (USD)_binned and Property Age_binned:		
Chi2 Statistic: 46497.14335778686, p-value: 0.0		



Contingency Table between Income (USD)_binned and Property Type_binned:

Property Type_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
Income (USD)_binned			
(472.0390000000004, 1647.89]	2081	1003	946
(1647.89, 2222.435]	3573	1622	1643
(2222.435, 2450.03]	624	308	288

```
(2450.03, 3660.07]           2105      962      962
Chi-Square Test between Income (USD)_binned and Property Type_binned:
Chi2 Statistic: 2.9171131884729196, p-value: 0.8191758300496713
```



Contingency Table between Income (USD)_binned and Co-Applicant_binned is empty. Skipping chi-square test.

Contingency Table between Income (USD)_binned and Property Price_binned:

Property Price_binned	Income (USD)_binned
(-999.001, 55493.09]	(472.0390000000004, 1647.89]
(55493.09, 95311.62]	1086

Income (USD)_binned

(472.0390000000004, 1647.89]	1541
1086	
(1647.89, 2222.435]	1633
1749	
(2222.435, 2450.03]	207
303	
(2450.03, 3660.07]	649

891

Property Price_binned (95311.62, 149129.59] (149129.59, 295284.39]

Income (USD)_binned

(472.0390000000004, 1647.89] 780

623

(1647.89, 2222.435] 1750

1706

(2222.435, 2450.03] 357

353

(2450.03, 3660.07] 1142

1347

Chi-Square Test between Income (USD)_binned and Property Price_binned:

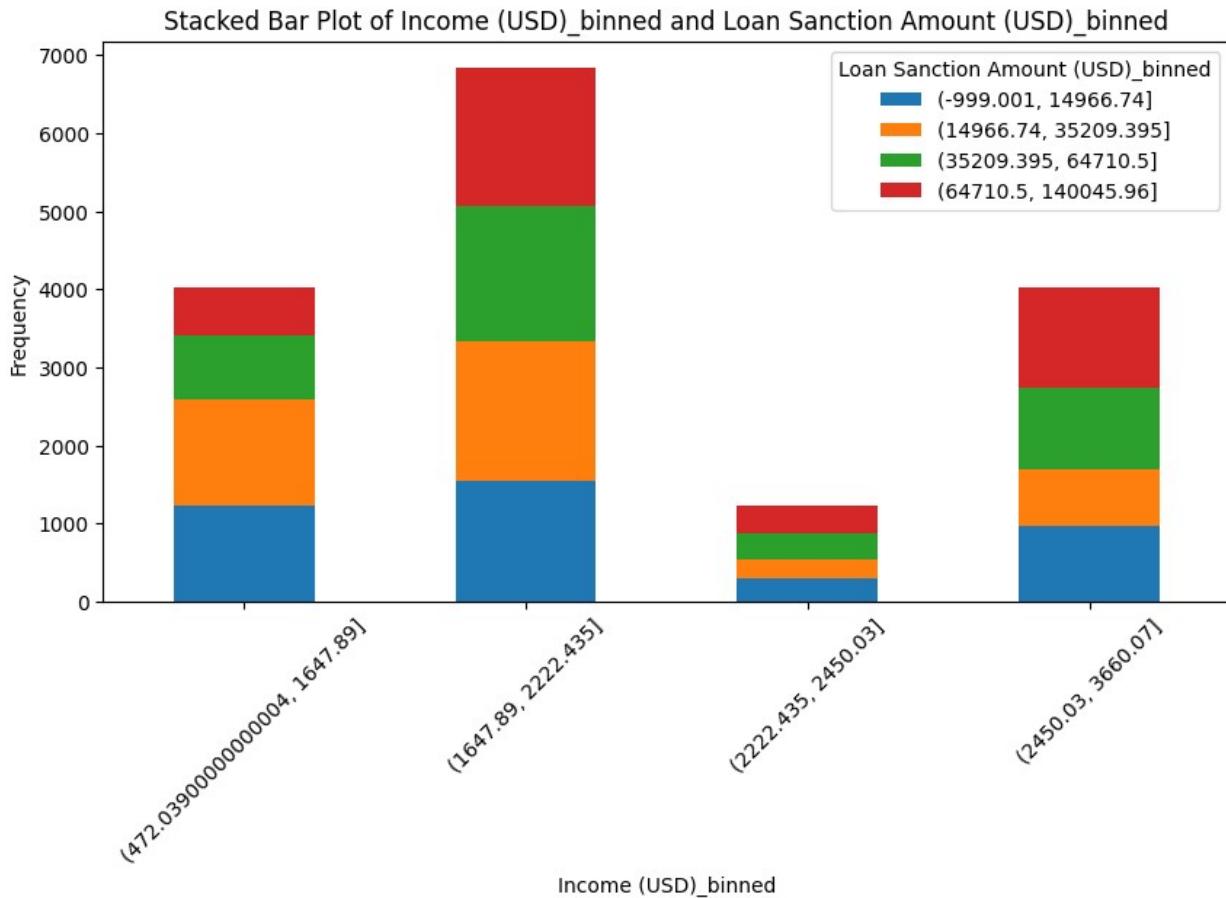
Chi2 Statistic: 813.3566009258907, p-value: 2.833589873836567e-169



Contingency Table between Income (USD)_binned and Loan Sanction Amount (USD)_binned:

Loan Sanction Amount (USD)_binned (-999.001, 14966.74] \

Income (USD)_binned	
(472.03900000000004, 1647.89]	1233
(1647.89, 2222.435]	1546
(2222.435, 2450.03]	288
(2450.03, 3660.07]	963
Loan Sanction Amount (USD)_binned	(14966.74, 35209.395] \
Income (USD)_binned	
(472.03900000000004, 1647.89]	1362
(1647.89, 2222.435]	1793
(2222.435, 2450.03]	244
(2450.03, 3660.07]	728
Loan Sanction Amount (USD)_binned	(35209.395, 64710.5] (64710.5,
140045.96]	
Income (USD)_binned	
(472.03900000000004, 1647.89]	812
623	
(1647.89, 2222.435]	1732
1767	
(2222.435, 2450.03]	342
346	
(2450.03, 3660.07]	1045
1293	
Chi-Square Test between Income (USD)_binned and Loan Sanction Amount (USD)_binned:	
Chi2 Statistic: 557.979133324729, p-value: 2.166442813259676e-114	



Contingency Table between Loan Amount Request (USD)_binned and Current Loan Expenses (USD)_binned:

Current Loan Expenses (USD)_binned (33.759, 231.2] (231.2, 344.89] \

Loan Amount Request (USD)_binned

(6108.049, 38583.45]	2907	759
(38583.45, 67002.87]	1026	1903
(67002.87, 101207.3]	97	1078
(101207.3, 202512.11]	0	289

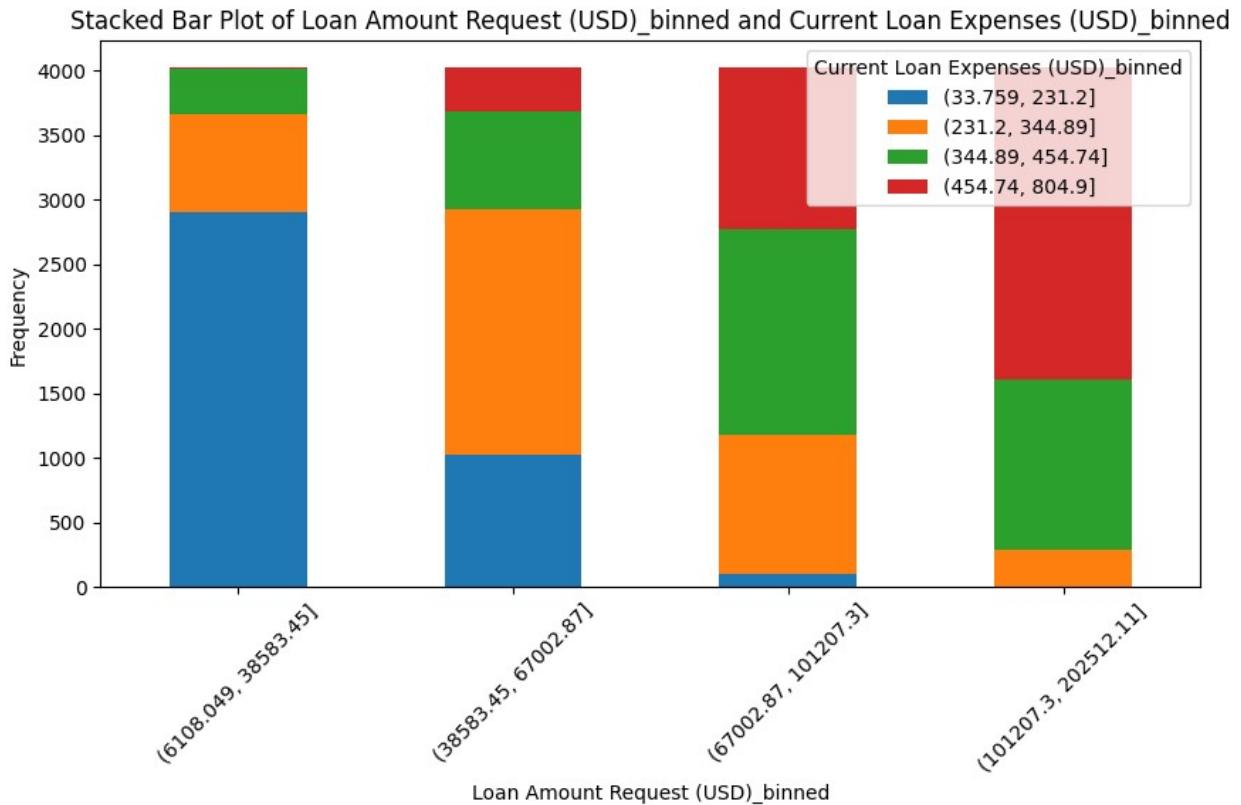
Current Loan Expenses (USD)_binned (344.89, 454.74] (454.74, 804.9]

Loan Amount Request (USD)_binned

(6108.049, 38583.45]	352	12
(38583.45, 67002.87]	753	347

(67002.87, 101207.3]	1603	1251
(101207.3, 202512.11]	1321	2419

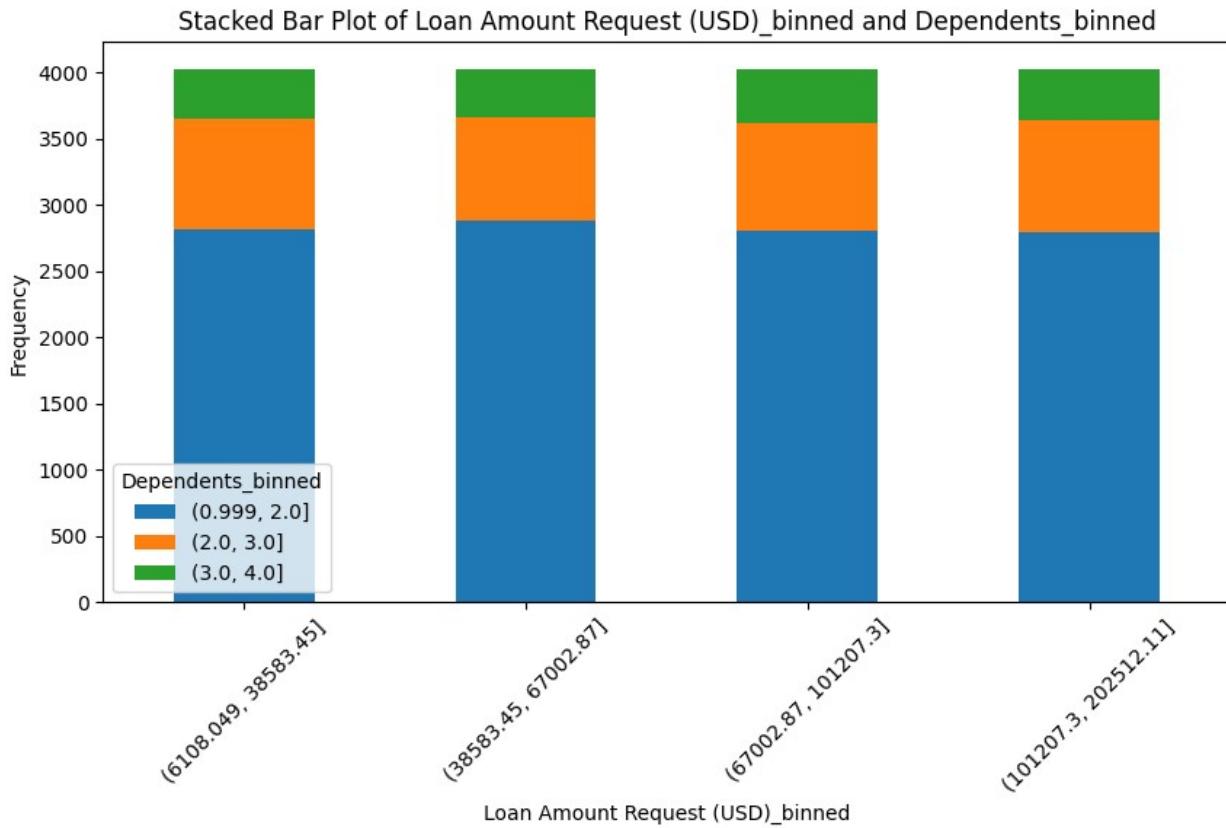
Chi-Square Test between Loan Amount Request (USD)_binned and Current Loan Expenses (USD)_binned:
Chi2 Statistic: 11180.674236482279, p-value: 0.0



Contingency Table between Loan Amount Request (USD)_binned and Dependents_binned:

Dependents_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
Loan Amount Request (USD)_binned			
(6108.049, 38583.45]	2819	830	381
(38583.45, 67002.87]	2885	780	364
(67002.87, 101207.3]	2811	809	409
(101207.3, 202512.11]	2796	844	389

Chi-Square Test between Loan Amount Request (USD)_binned and Dependents_binned:
Chi2 Statistic: 7.205407512854273, p-value: 0.30226841137054034



Contingency Table between Loan Amount Request (USD)_binned and Credit Score_binned:

Credit Score_binned \ Loan Amount Request (USD)_binned

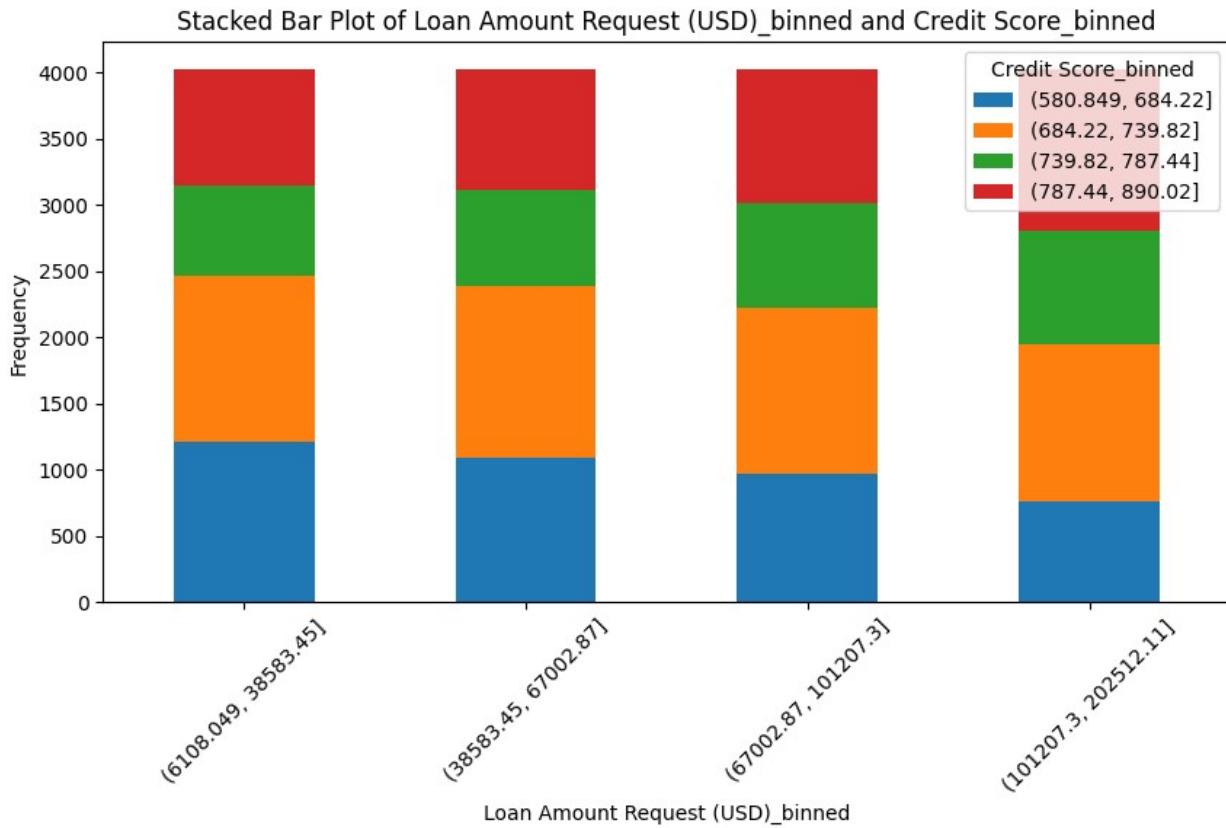
(6108.049, 38583.45]	1210	1258
(38583.45, 67002.87]	1093	1290
(67002.87, 101207.3]	971	1248
(101207.3, 202512.11]	756	1189

Credit Score_binned \ Loan Amount Request (USD)_binned

(6108.049, 38583.45]	683	879
(38583.45, 67002.87]	735	911
(67002.87, 101207.3]	794	1016
(101207.3, 202512.11]	861	1223

Chi-Square Test between Loan Amount Request (USD)_binned and Credit Score_binned:

Chi2 Statistic: 211.11170117014078, p-value: 1.5442647038386379e-40



Contingency Table between Loan Amount Request (USD)_binned and No. of Defaults_binned is empty. Skipping chi-square test.

Contingency Table between Loan Amount Request (USD)_binned and Property ID_binned:

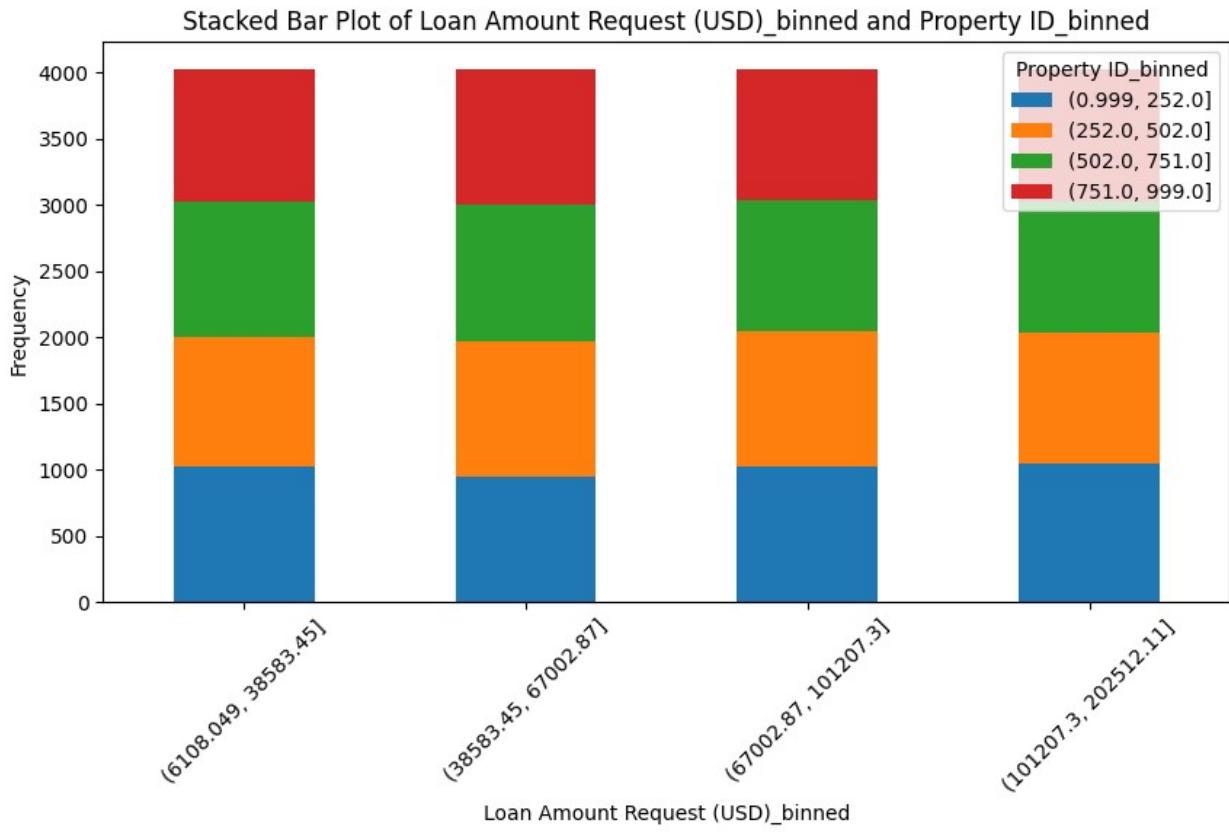
Property ID_binned	(0.999, 252.0]	(252.0, 502.0]	\
Loan Amount Request (USD)_binned			
(6108.049, 38583.45]	1021	983	
(38583.45, 67002.87]	950	1017	
(67002.87, 101207.3]	1021	1029	
(101207.3, 202512.11]	1043	996	

Property ID_binned

Property ID_binned	(502.0, 751.0]	(751.0, 999.0]
Loan Amount Request (USD)_binned		
(6108.049, 38583.45]	1024	1002
(38583.45, 67002.87]	1042	1020
(67002.87, 101207.3]	989	990
(101207.3, 202512.11]	987	1003

Chi-Square Test between Loan Amount Request (USD)_binned and Property ID_binned:

Chi2 Statistic: 8.774280169538965, p-value: 0.45836577094254993



Contingency Table between Loan Amount Request (USD)_binned and Property Age_binned:

Property Age_binned	(472.03900000000004, 1654.24] \
Loan Amount Request (USD)_binned	
(6108.049, 38583.45]	1585
(38583.45, 67002.87]	1058
(67002.87, 101207.3]	785
(101207.3, 202512.11]	602
Property Age_binned	(1654.24, 2223.25] (2223.25,
2444.29] \	
Loan Amount Request (USD)_binned	
(6108.049, 38583.45]	1619
200	
(38583.45, 67002.87]	1815
299	
(67002.87, 101207.3]	1720
320	
(101207.3, 202512.11]	1747
338	
Property Age_binned	(2444.29, 3660.07]

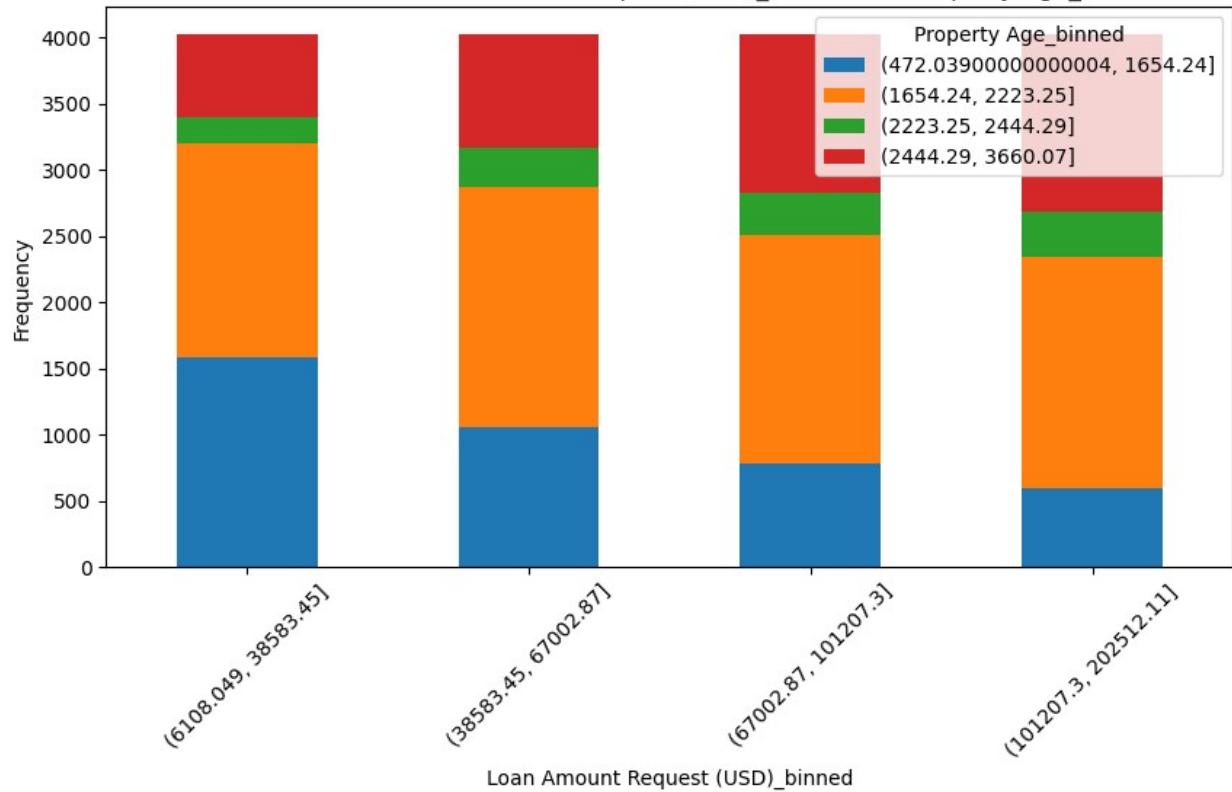
Loan Amount Request (USD)_binned

(6108.049, 38583.45]	626
(38583.45, 67002.87]	857
(67002.87, 101207.3]	1204
(101207.3, 202512.11]	1342

Chi-Square Test between Loan Amount Request (USD)_binned and Property Age_binned:

Chi2 Statistic: 913.084837875218, p-value: 9.376080282558037e-191

Stacked Bar Plot of Loan Amount Request (USD)_binned and Property Age_binned

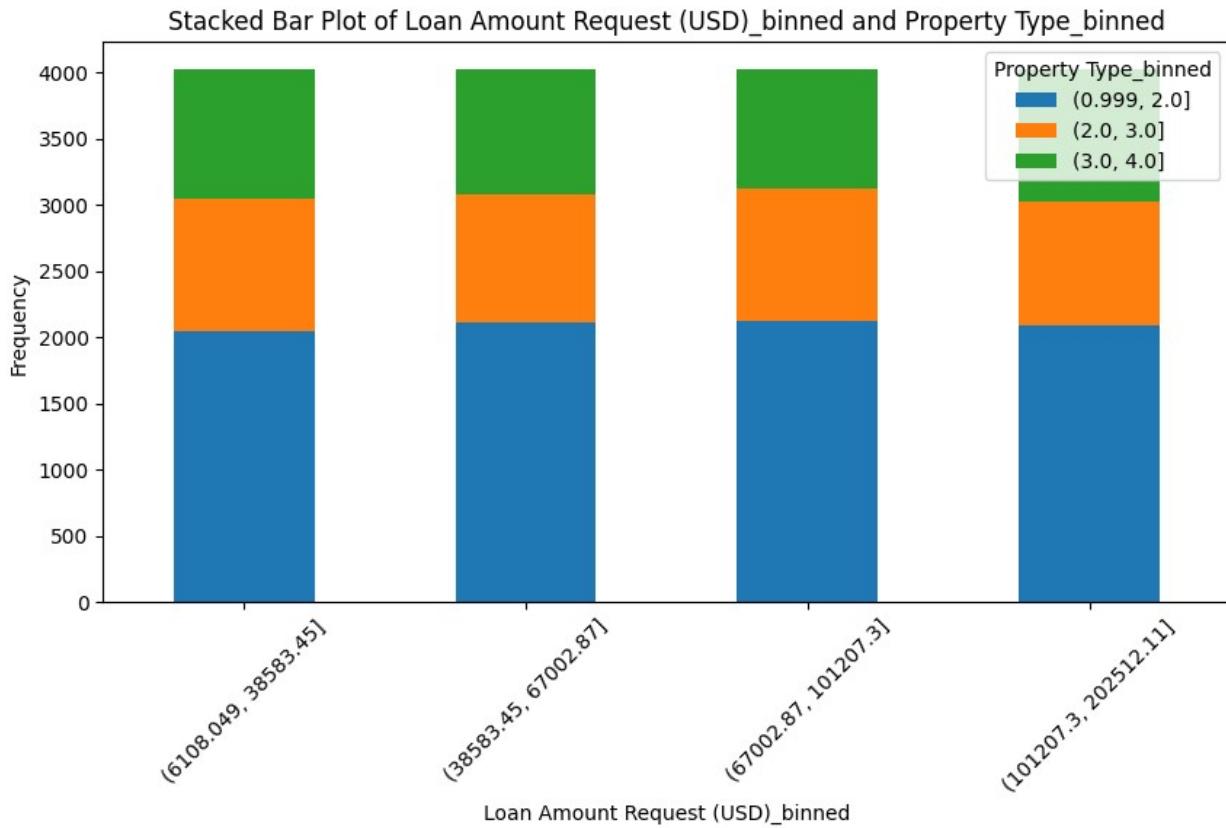


Contingency Table between Loan Amount Request (USD)_binned and Property Type_binned:

Property Type_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
Loan Amount Request (USD)_binned			
(6108.049, 38583.45]	2051	992	987
(38583.45, 67002.87]	2108	975	946
(67002.87, 101207.3]	2128	997	904
(101207.3, 202512.11]	2096	931	1002

Chi-Square Test between Loan Amount Request (USD)_binned and Property Type_binned:

Chi2 Statistic: 10.368021672465048, p-value: 0.10998506784732737



Contingency Table between Loan Amount Request (USD)_binned and Co-Applicant_binned is empty. Skipping chi-square test.

Contingency Table between Loan Amount Request (USD)_binned and Property Price_binned:

Property Price_binned	Loan Amount Request (USD)_binned	Count
(-999.001, 55493.09]	(6108.049, 38583.45]	640
(55493.09, 95311.62]	(38583.45, 67002.87]	2863
(95311.62, 149129.59]	(67002.87, 101207.3]	526
(149129.59, 202512.11]	(101207.3, 202512.11]	0

Property Price_binned	Loan Amount Request (USD)_binned	Count
(-999.001, 55493.09]	(6108.049, 38583.45]	3390
(55493.09, 95311.62]	(38583.45, 67002.87]	537
(95311.62, 149129.59]	(67002.87, 101207.3]	46
(149129.59, 202512.11]	(101207.3, 202512.11]	57
(149129.59, 202512.11]	(101207.3, 202512.11]	0

Property Price_binned	Loan Amount Request (USD)_binned	Count
(-999.001, 55493.09]	(6108.049, 38583.45]	0
(55493.09, 95311.62]	(38583.45, 67002.87]	629
(95311.62, 149129.59]	(67002.87, 101207.3]	2896

(101207.3, 202512.11]	504
Property Price_binned	(149129.59, 295284.39]
Loan Amount Request (USD)_binned	
(6108.049, 38583.45]	0
(38583.45, 67002.87]	0
(67002.87, 101207.3]	561
(101207.3, 202512.11]	3468
Chi-Square Test between Loan Amount Request (USD)_binned and Property Price_binned:	
Chi2 Statistic: 25624.20483597591, p-value: 0.0	



Contingency Table between Loan Amount Request (USD)_binned and Loan Sanction Amount (USD)_binned:

Loan Sanction Amount (USD)_binned	(-999.001, 14966.74] \
Loan Amount Request (USD)_binned	
(6108.049, 38583.45]	1645
(38583.45, 67002.87]	873
(67002.87, 101207.3]	837
(101207.3, 202512.11]	675

Loan Sanction Amount (USD)_binned	(14966.74, 35209.395] \
Loan Amount Request (USD)_binned	

(6108.049, 38583.45]	2385
(38583.45, 67002.87]	1641
(67002.87, 101207.3]	51
(101207.3, 202512.11]	50

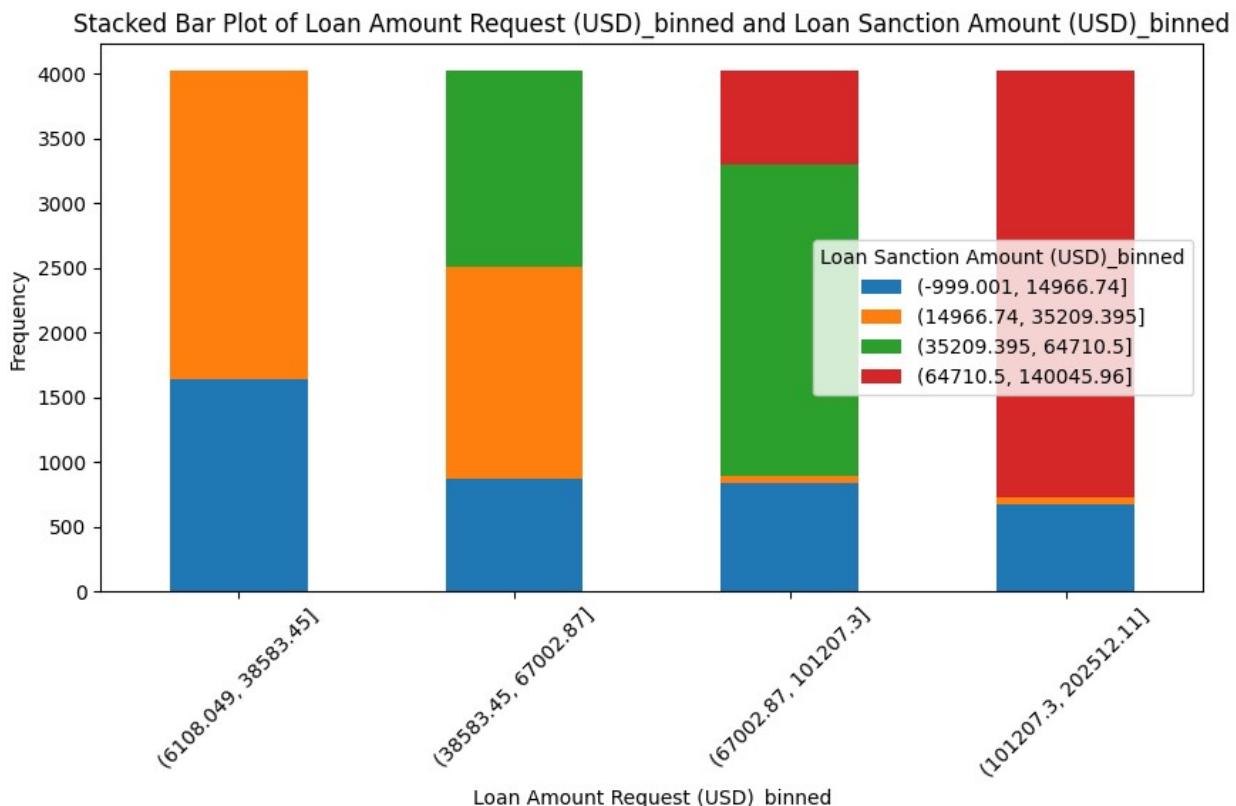
Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5, 140045.96]

Loan Amount Request (USD)_binned

(6108.049, 38583.45]	0
0	
(38583.45, 67002.87]	1514
1	
(67002.87, 101207.3]	2417
724	
(101207.3, 202512.11]	0
3304	

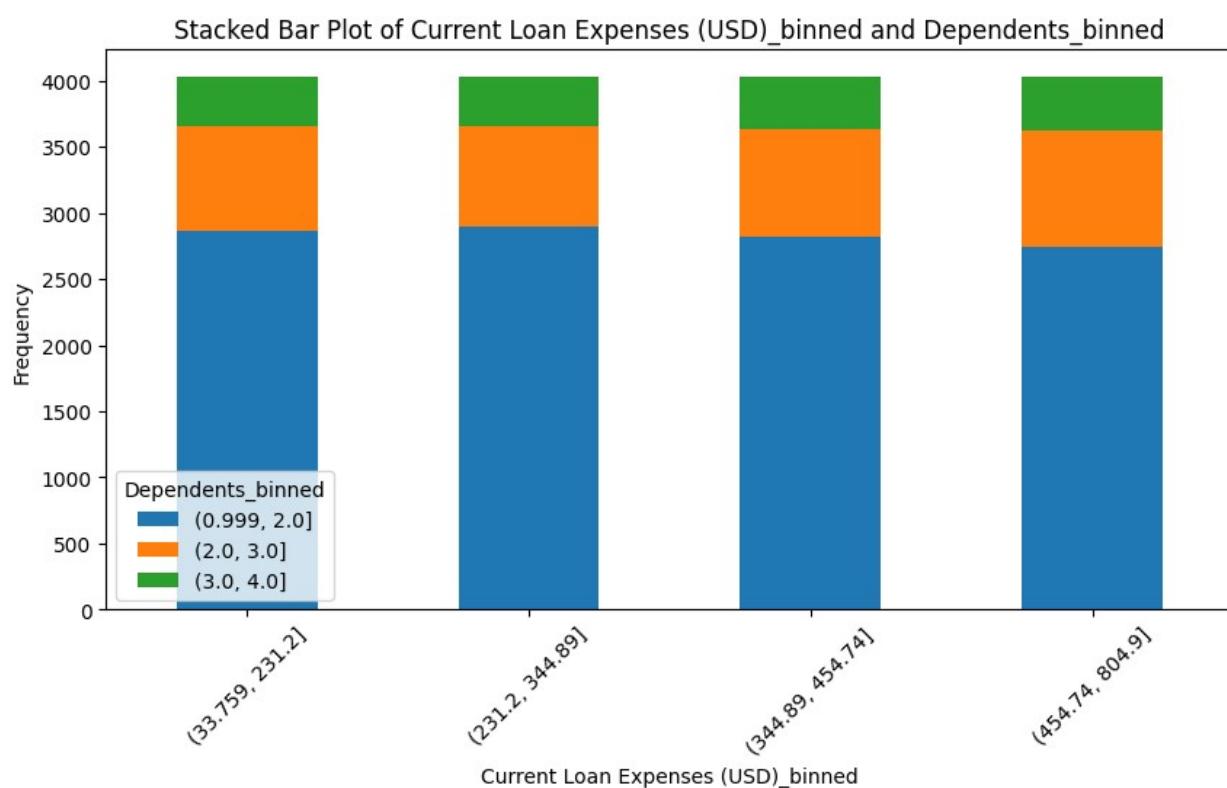
Chi-Square Test between Loan Amount Request (USD)_binned and Loan Sanction Amount (USD)_binned:

Chi2 Statistic: 16236.141626366252, p-value: 0.0



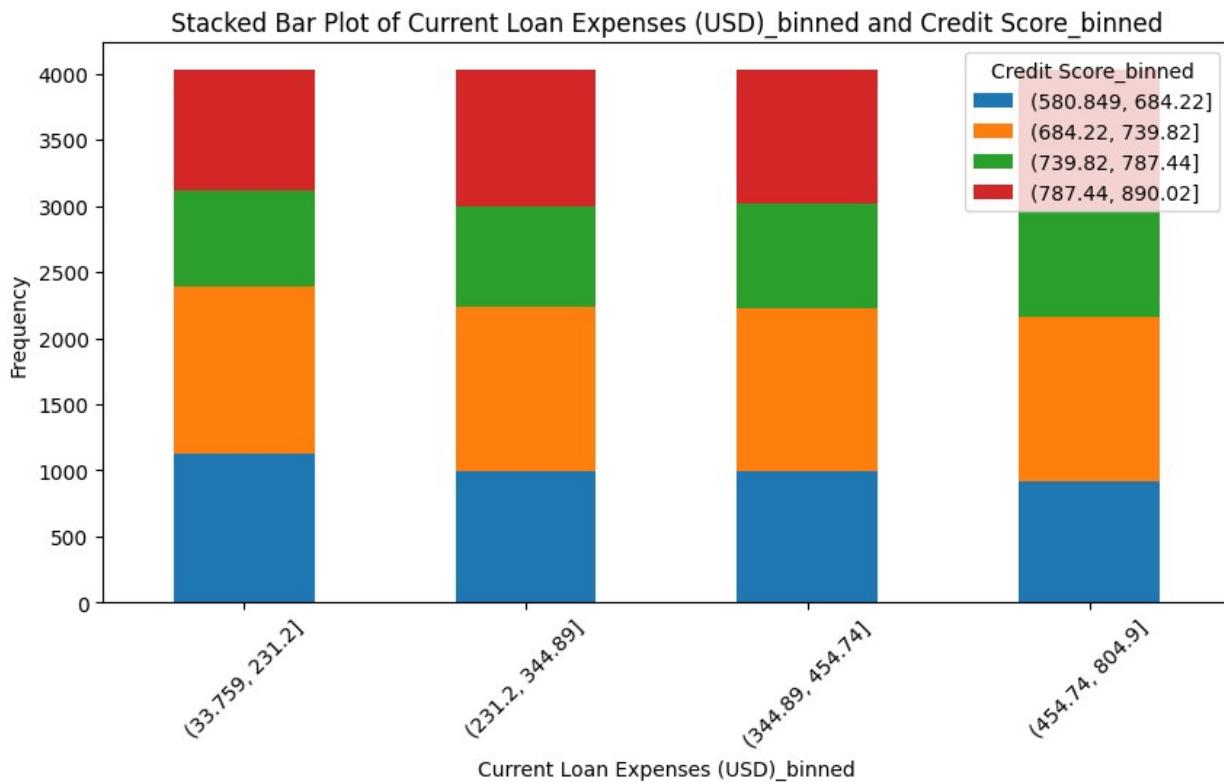
Contingency Table between Current Loan Expenses (USD)_binned and Dependents_binned:

Dependents_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
Current Loan Expenses (USD)_binned			
(33.759, 231.2]	2859	800	
371			
(231.2, 344.89]	2893	765	
371			
(344.89, 454.74]	2818	819	
392			
(454.74, 804.9]	2741	879	
409			
Chi-Square Test between Current Loan Expenses (USD)_binned and Dependents_binned:			
Chi2 Statistic: 15.555482511963442, p-value: 0.016349549864196265			



Contingency Table between Current Loan Expenses (USD)_binned and Credit Score_binned:		
Credit Score_binned	(580.849, 684.22]	(684.22, 739.82] \
Current Loan Expenses (USD)_binned		
(33.759, 231.2]	1124	
1268		

(231.2, 344.89]	991
1245	
(344.89, 454.74]	992
1237	
(454.74, 804.9]	923
1235	
Credit Score_binned	(739.82, 787.44] (787.44, 890.02]
Current Loan Expenses (USD)_binned	
(33.759, 231.2]	727
(231.2, 344.89]	754
(344.89, 454.74]	783
(454.74, 804.9]	809
Chi-Square Test between Current Loan Expenses (USD)_binned and Credit Score_binned:	
Chi2 Statistic: 39.80647157614676, p-value: 8.237126939523076e-06	



Contingency Table between Current Loan Expenses (USD)_binned and No.

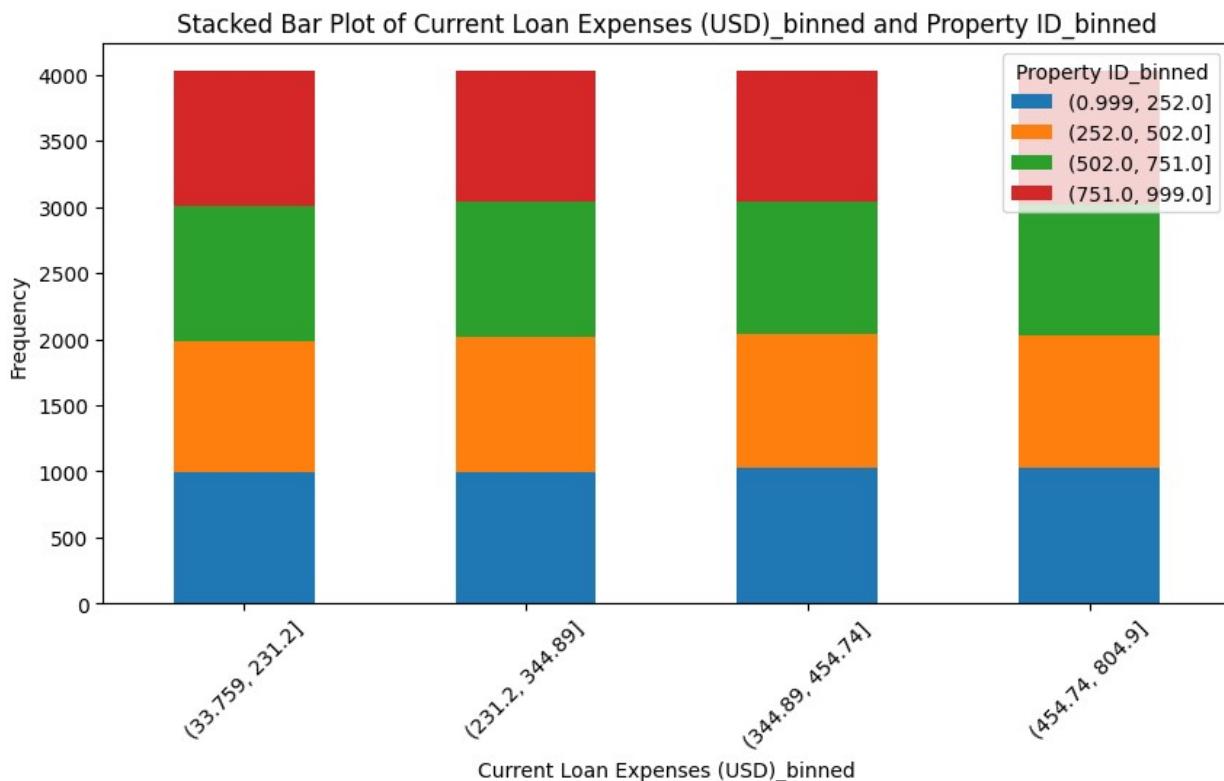
of Defaults_binned is empty. Skipping chi-square test.

Contingency Table between Current Loan Expenses (USD)_binned and Property ID_binned:

Property ID_binned	(0.999, 252.0]	(252.0, 502.0]	\
Current Loan Expenses (USD)_binned			
(33.759, 231.2]	990	990	
(231.2, 344.89]	993	1022	
(344.89, 454.74]	1029	1009	
(454.74, 804.9]	1023	1004	

Property ID_binned	(502.0, 751.0]	(751.0, 999.0]	
Current Loan Expenses (USD)_binned			
(33.759, 231.2]	1023	1027	
(231.2, 344.89]	1023	991	
(344.89, 454.74]	1002	989	
(454.74, 804.9]	994	1008	

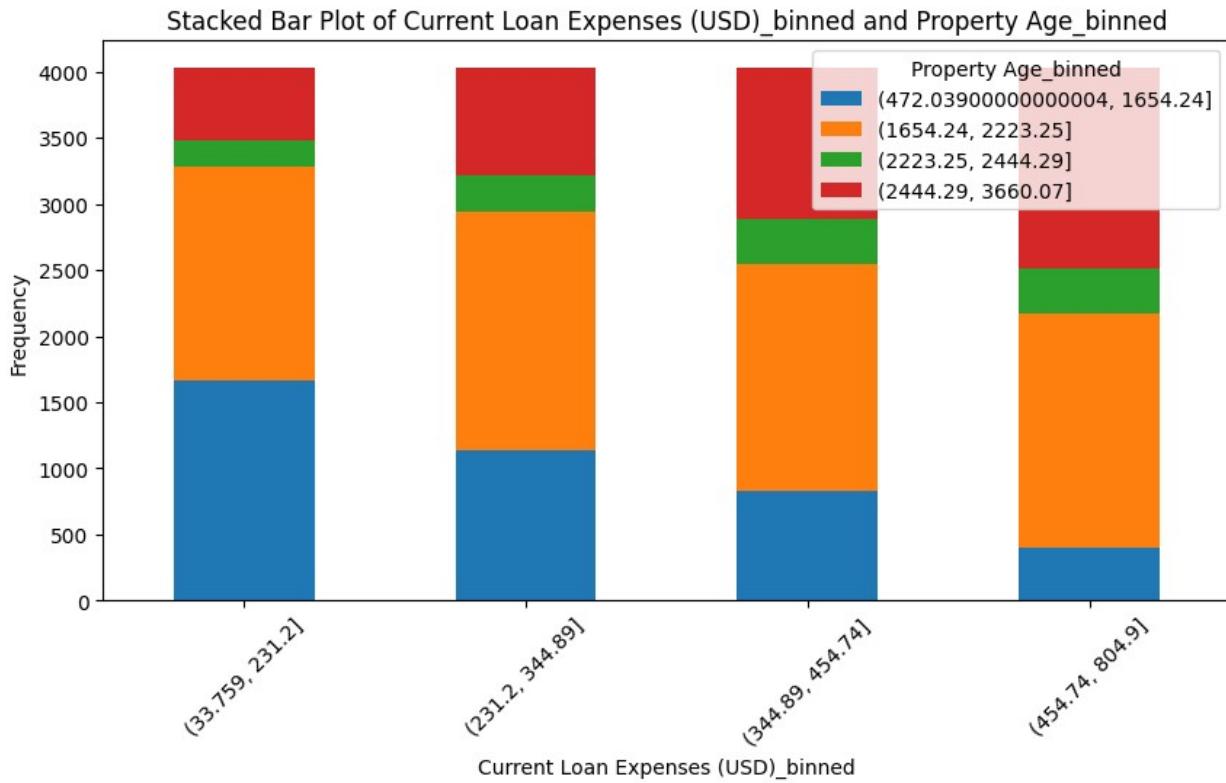
Chi-Square Test between Current Loan Expenses (USD)_binned and Property ID_binned:
Chi2 Statistic: 3.3088327848200763, p-value: 0.9507828920283334



Contingency Table between Current Loan Expenses (USD)_binned and Property Age_binned:

Property Age_binned	(472.03900000000004, 1654.24]	\

Current Loan Expenses (USD)_binned	
(33.759, 231.2]	1661
(231.2, 344.89]	1135
(344.89, 454.74]	828
(454.74, 804.9]	406
Property Age_binned	(1654.24, 2223.25] (2223.25,
2444.29] \	
Current Loan Expenses (USD)_binned	
(33.759, 231.2]	1615
202	
(231.2, 344.89]	1806
277	
(344.89, 454.74]	1719
339	
(454.74, 804.9]	1761
339	
Property Age_binned	(2444.29, 3660.07]
Current Loan Expenses (USD)_binned	
(33.759, 231.2]	552
(231.2, 344.89]	811
(344.89, 454.74]	1143
(454.74, 804.9]	1523
Chi-Square Test between Current Loan Expenses (USD)_binned and Property Age_binned:	
Chi2 Statistic: 1412.9462316766985, p-value: 1.2330154582799328e-298	



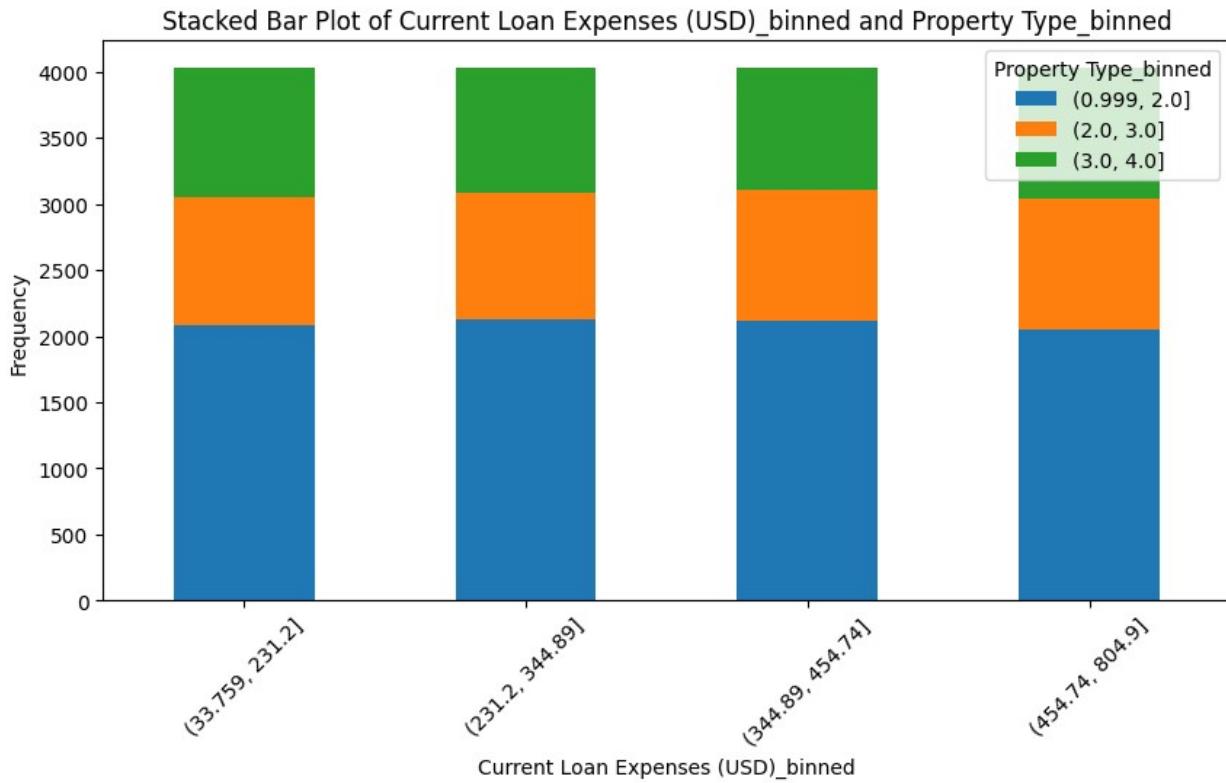
Contingency Table between Current Loan Expenses (USD)_binned and Property Type_binned:

Property Type_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
Current Loan Expenses (USD)_binned			

(33.759, 231.2]	2082	972
976		
(231.2, 344.89]	2132	956
941		
(344.89, 454.74]	2118	982
929		
(454.74, 804.9]	2051	985
993		

Chi-Square Test between Current Loan Expenses (USD)_binned and Property Type_binned:

Chi2 Statistic: 5.21418914650028, p-value: 0.5166499825562365



Contingency Table between Current Loan Expenses (USD)_binned and Co-Applicant_binned is empty. Skipping chi-square test.

Contingency Table between Current Loan Expenses (USD)_binned and Property Price_binned:

Property Price_binned	Current Loan Expenses (USD)_binned	
(-999.001, 55493.09]		\
Current Loan Expenses (USD)_binned		
(33.759, 231.2]		2816
(231.2, 344.89]		803
(344.89, 454.74]		340
(454.74, 804.9]		71

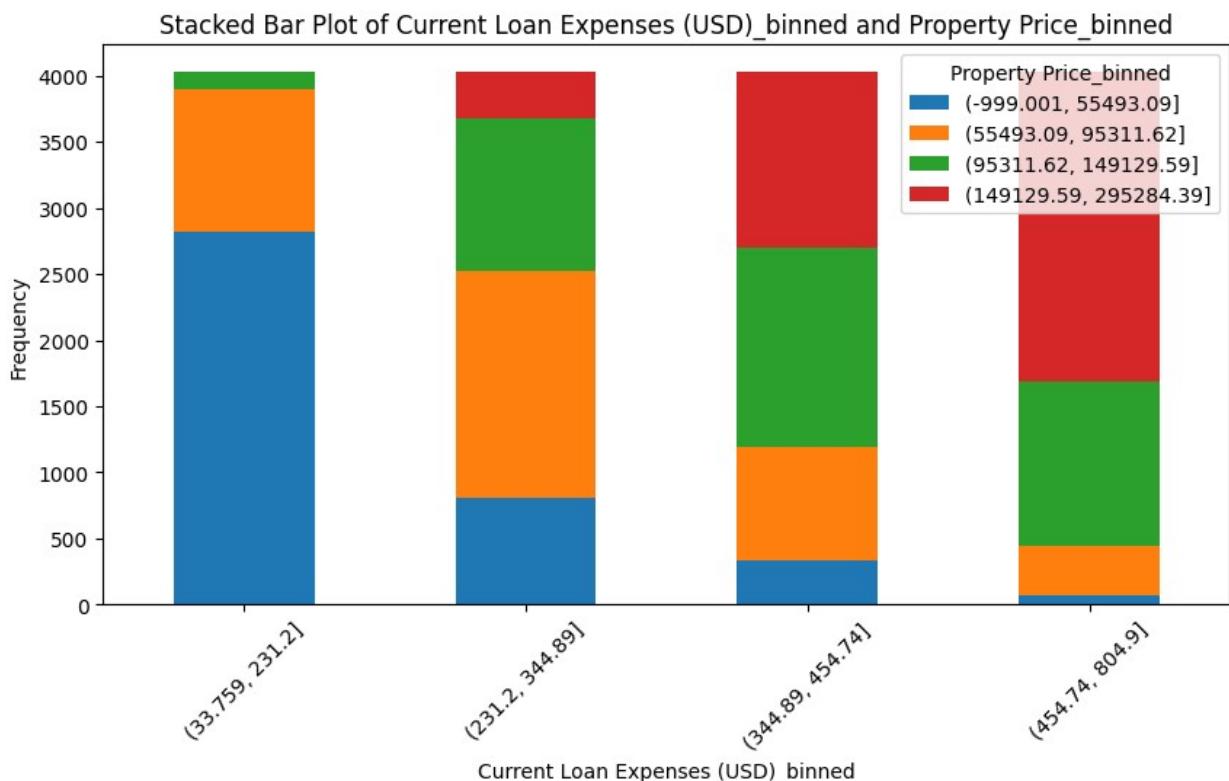
Property Price_binned	Current Loan Expenses (USD)_binned	
(55493.09, 95311.62]		\
Current Loan Expenses (USD)_binned		
(33.759, 231.2]		1085
(231.2, 344.89]		1715
(344.89, 454.74]		852
(454.74, 804.9]		377

Property Price_binned	Current Loan Expenses (USD)_binned	
(95311.62, 149129.59]		\
Current Loan Expenses (USD)_binned		
(33.759, 231.2]		123
(231.2, 344.89]		1161
(344.89, 454.74]		1506
(454.74, 804.9]		1239

```

Property Price_binned          (149129.59, 295284.39]
Current Loan Expenses (USD)_binned
(33.759, 231.2]                      6
(231.2, 344.89]                     350
(344.89, 454.74]                   1331
(454.74, 804.9]                    2342
Chi-Square Test between Current Loan Expenses (USD)_binned and
Property Price_binned:
Chi2 Statistic: 9918.505959434111, p-value: 0.0

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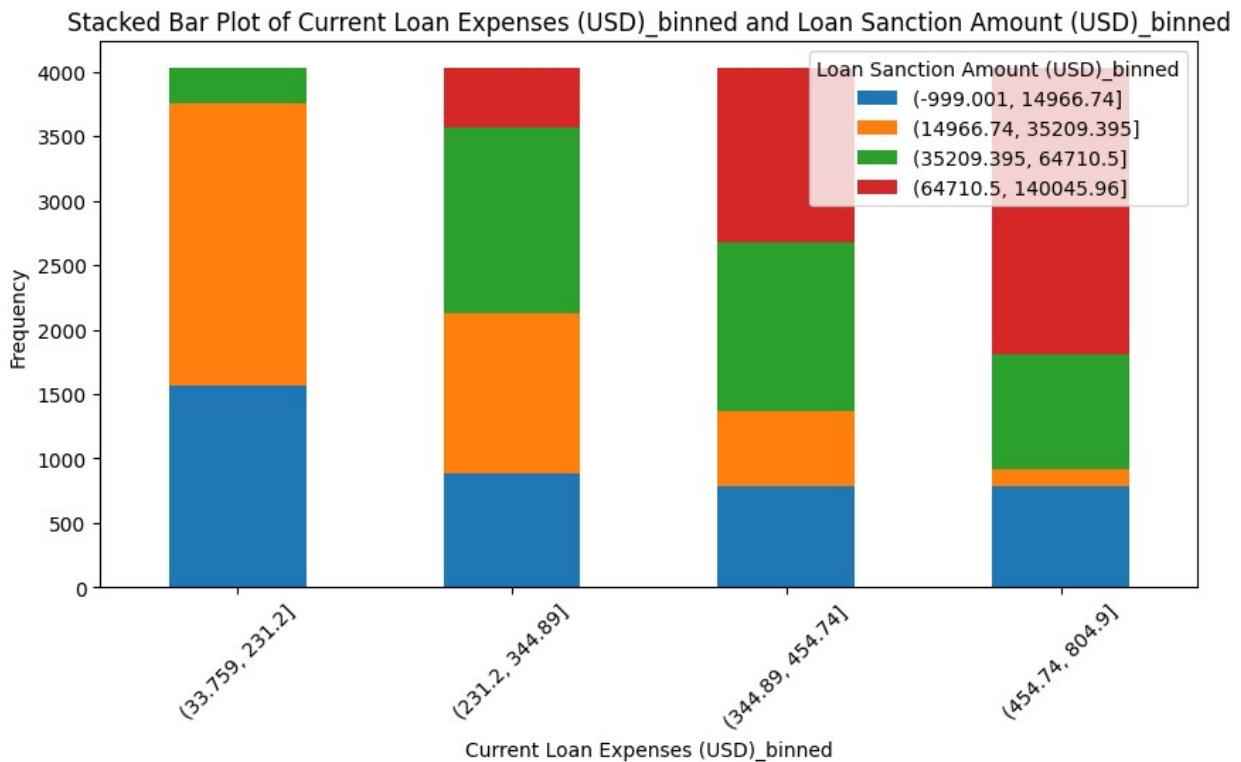
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Contingency Table between Current Loan Expenses (USD)_binned and Loan
Sanction Amount (USD)_binned:
Loan Sanction Amount (USD)_binned   (-999.001, 14966.74] \
Current Loan Expenses (USD)_binned
(33.759, 231.2]                      1567
(231.2, 344.89]                      885
(344.89, 454.74]                     787
(454.74, 804.9]                      791

Loan Sanction Amount (USD)_binned   (14966.74, 35209.395] \
Current Loan Expenses (USD)_binned
(33.759, 231.2]                      2183
(231.2, 344.89]                      1237

```

(344.89, 454.74]	582	
(454.74, 804.9]	125	
Loan Sanction Amount (USD)_binned	(35209.395, 64710.5]	(64710.5, 140045.96]
Current Loan Expenses (USD)_binned		
(33.759, 231.2]	276	
4		
(231.2, 344.89]	1449	
458		
(344.89, 454.74]	1310	
1350		
(454.74, 804.9]	896	
2217		
Chi-Square Test between Current Loan Expenses (USD)_binned and Loan Sanction Amount (USD)_binned:		
Chi2 Statistic: 6452.844027174504, p-value: 0.0		



Contingency Table between Dependents_binned and Credit Score_binned:
Credit Score_binned (580.849, 684.22] (684.22, 739.82] (739.82, 787.44] \ Dependents_binned

(0.999, 2.0]	2697	3302
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2150		
(2.0, 3.0]	909	1114
616		
(3.0, 4.0]	424	569
307		

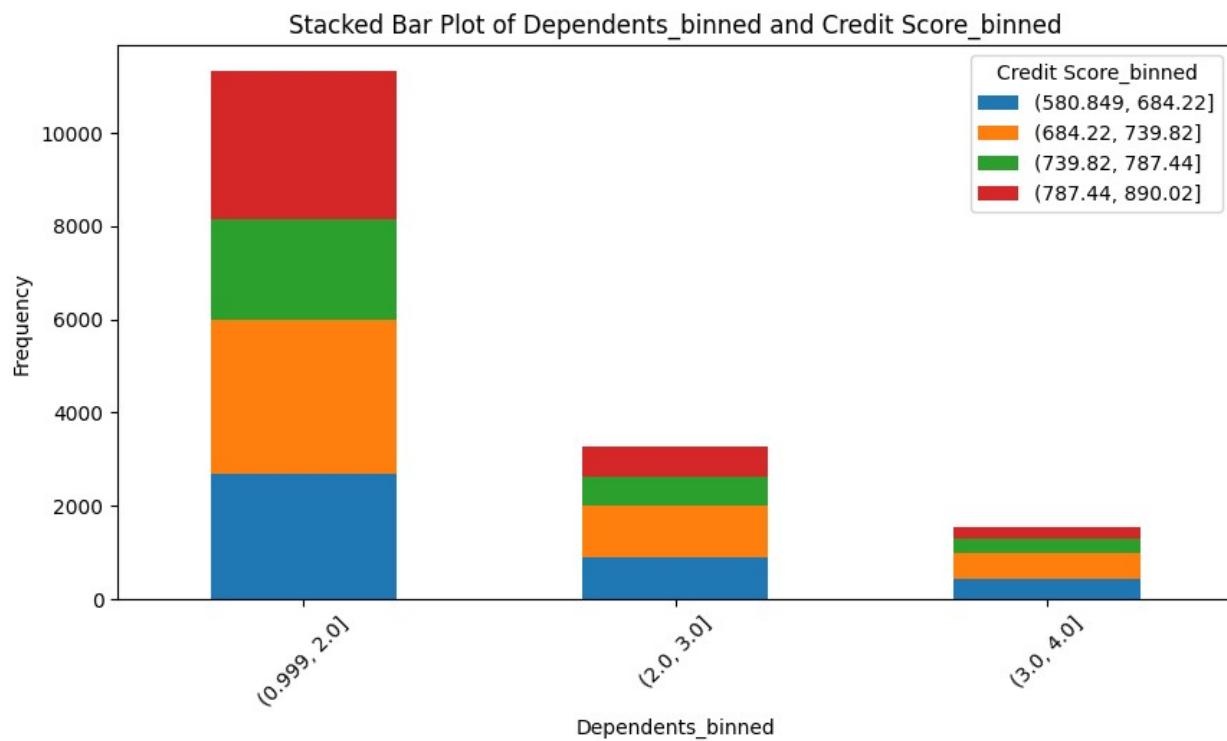
Credit Score_binned (787.44, 890.02]

Dependents_binned

(0.999, 2.0]	3162
(2.0, 3.0]	624
(3.0, 4.0]	243

Chi-Square Test between Dependents_binned and Credit Score_binned:

Chi2 Statistic: 198.09621197217618, p-value: 4.823755202248302e-40



Contingency Table between Dependents_binned and No. of Defaults_binned is empty. Skipping chi-square test.

Contingency Table between Dependents_binned and Property ID_binned:

Property ID_binned (0.999, 252.0] (252.0, 502.0] (502.0, 751.0] \ Dependents_binned

(0.999, 2.0]	2796	2873	2826
(2.0, 3.0]	859	787	813
(3.0, 4.0]	380	365	403

Property ID_binned (751.0, 999.0]

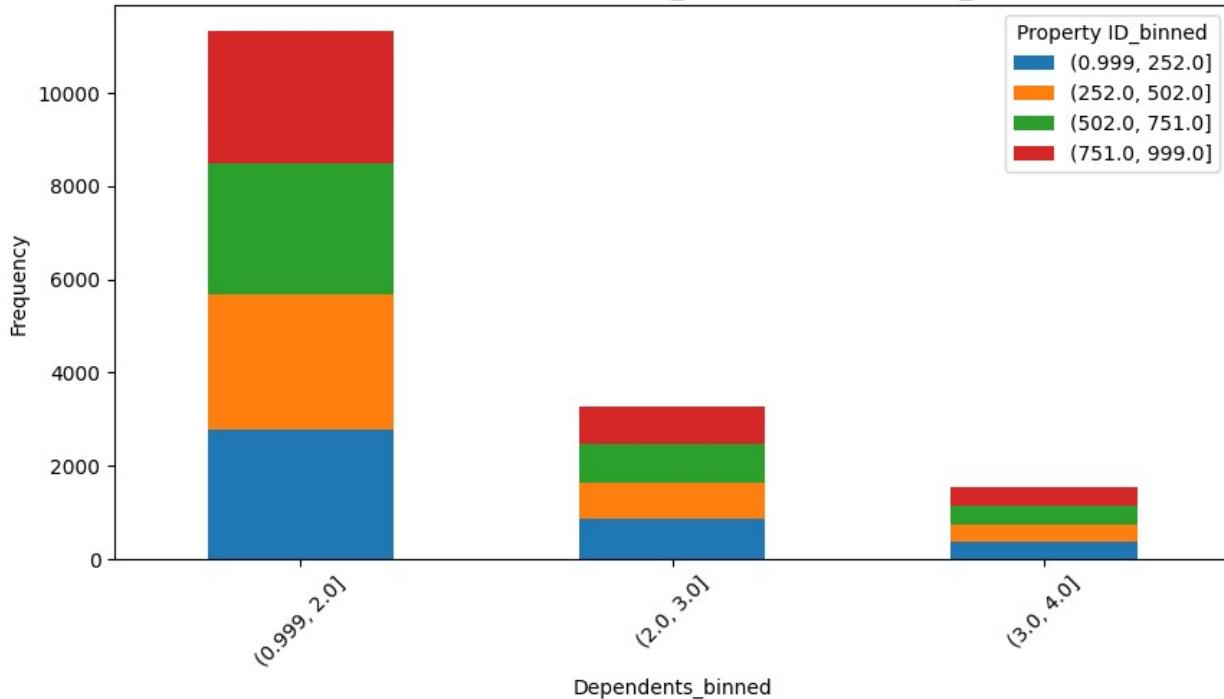
Dependents_binned

(0.999, 2.0]	2816
(2.0, 3.0]	804
(3.0, 4.0]	395

Chi-Square Test between Dependents_binned and Property ID_binned:

Chi2 Statistic: 6.705131592644451, p-value: 0.34897916260270695

Stacked Bar Plot of Dependents_binned and Property ID_binned



Contingency Table between Dependents_binned and Property Age_binned:
Property Age_binned (472.0390000000004, 1654.24] (1654.24, 2223.25]
\Dependents_binned

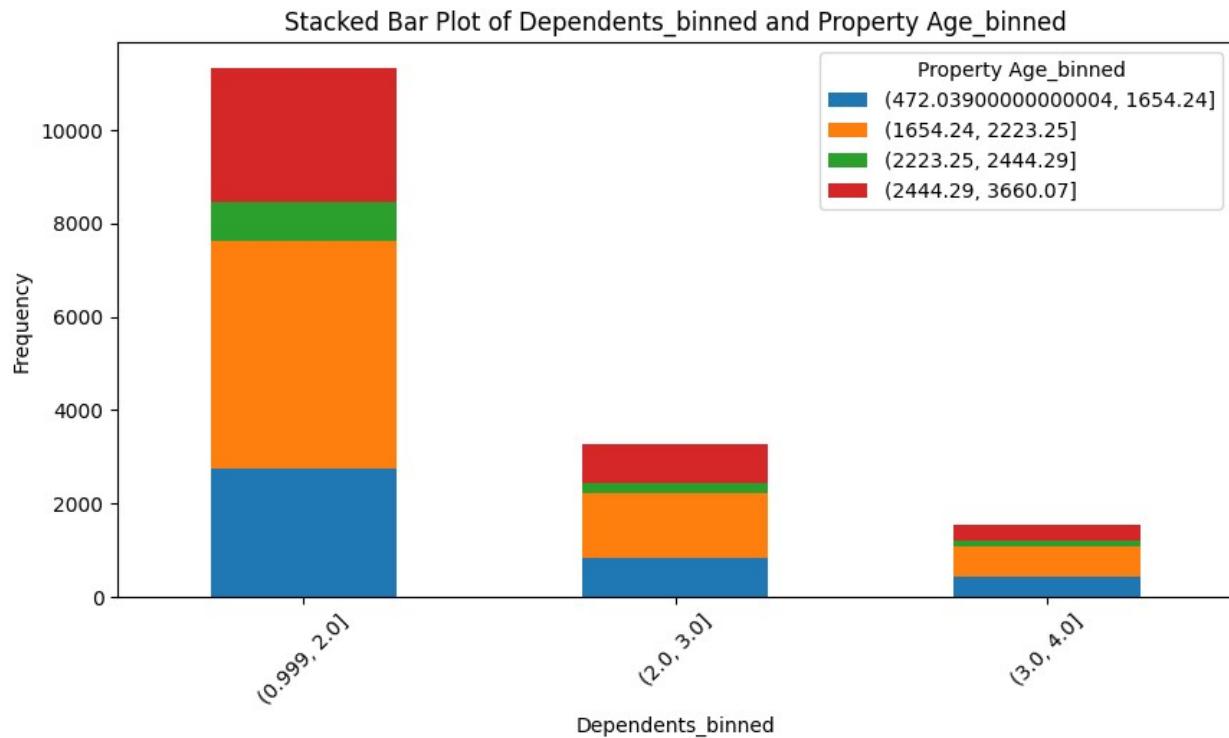
(0.999, 2.0]	2763	4862
(2.0, 3.0]	829	1392
(3.0, 4.0]	438	647

Property Age_binned (2223.25, 2444.29] (2444.29, 3660.07]

Dependents_binned

(0.999, 2.0]	817	2869
(2.0, 3.0]	226	816
(3.0, 4.0]	114	344

Chi-Square Test between Dependents_binned and Property Age_binned:
Chi2 Statistic: 14.68513160831918, p-value: 0.0228522558112539



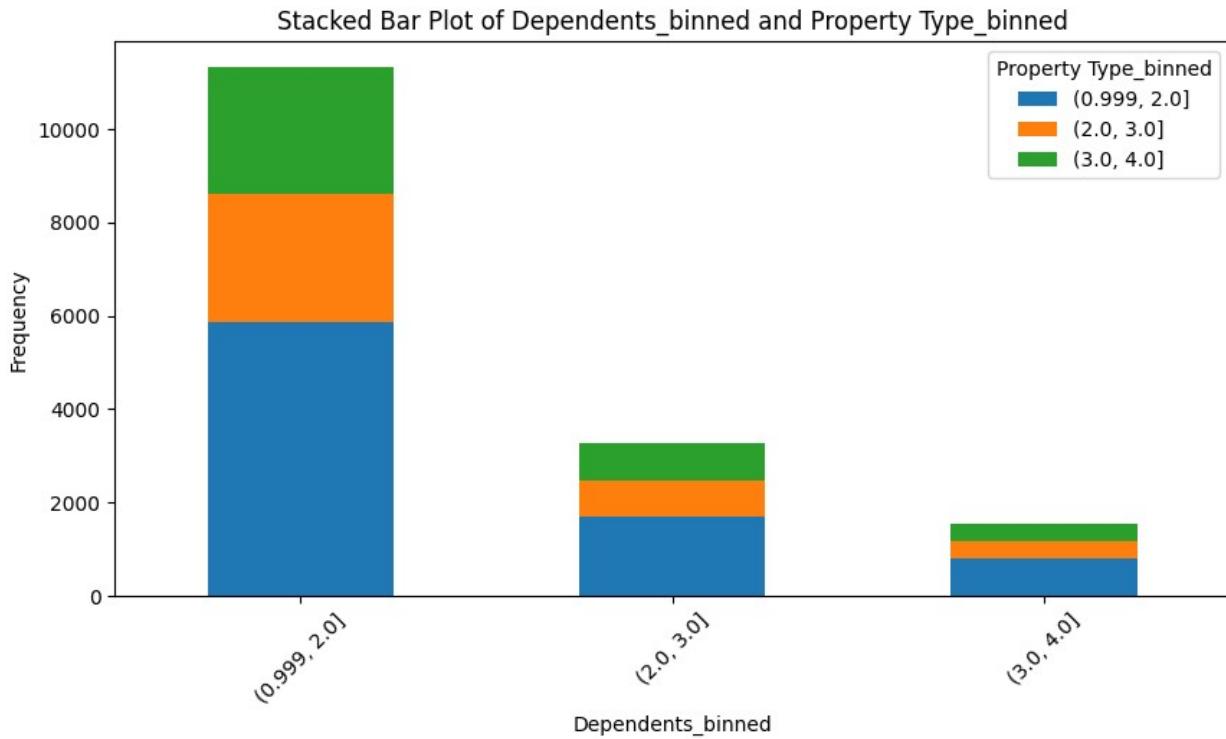
Contingency Table between Dependents_binned and Property Type_binned:
Property Type_binned (0.999, 2.0] (2.0, 3.0] (3.0, 4.0]

Dependents_binned

Dependents_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
(0.999, 2.0]	5875	2736	2700
(2.0, 3.0]	1706	772	785
(3.0, 4.0]	802	387	354

Chi-Square Test between Dependents_binned and Property Type_binned:

Chi2 Statistic: 1.5298483234085796, p-value: 0.8213413848063309



Contingency Table between Dependents_binned and Co-Applicant_binned is empty. Skipping chi-square test.

Contingency Table between Dependents_binned and Property Price_binned:
 Property Price_binned (-999.001, 55493.09] (55493.09, 95311.62] \ Dependents_binned

Dependents_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
(0.999, 2.0]	2831	2835	
(2.0, 3.0]	828	814	
(3.0, 4.0]	371	380	

Property Price_binned (95311.62, 149129.59] (149129.59, 295284.39]
 Dependents_binned

Dependents_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
(0.999, 2.0]	2830	2815	
(2.0, 3.0]	795	826	
(3.0, 4.0]	404	388	

Chi-Square Test between Dependents_binned and Property Price_binned:
 Chi2 Statistic: 2.451944103658739, p-value: 0.8738066418803394



Contingency Table between Dependents_binned and Loan Sanction Amount (USD)_binned:

Loan Sanction Amount (USD)_binned (-999.001, 14966.74] \ Dependents_binned
 (0.999, 2.0] 2754
 (2.0, 3.0] 878
 (3.0, 4.0] 398

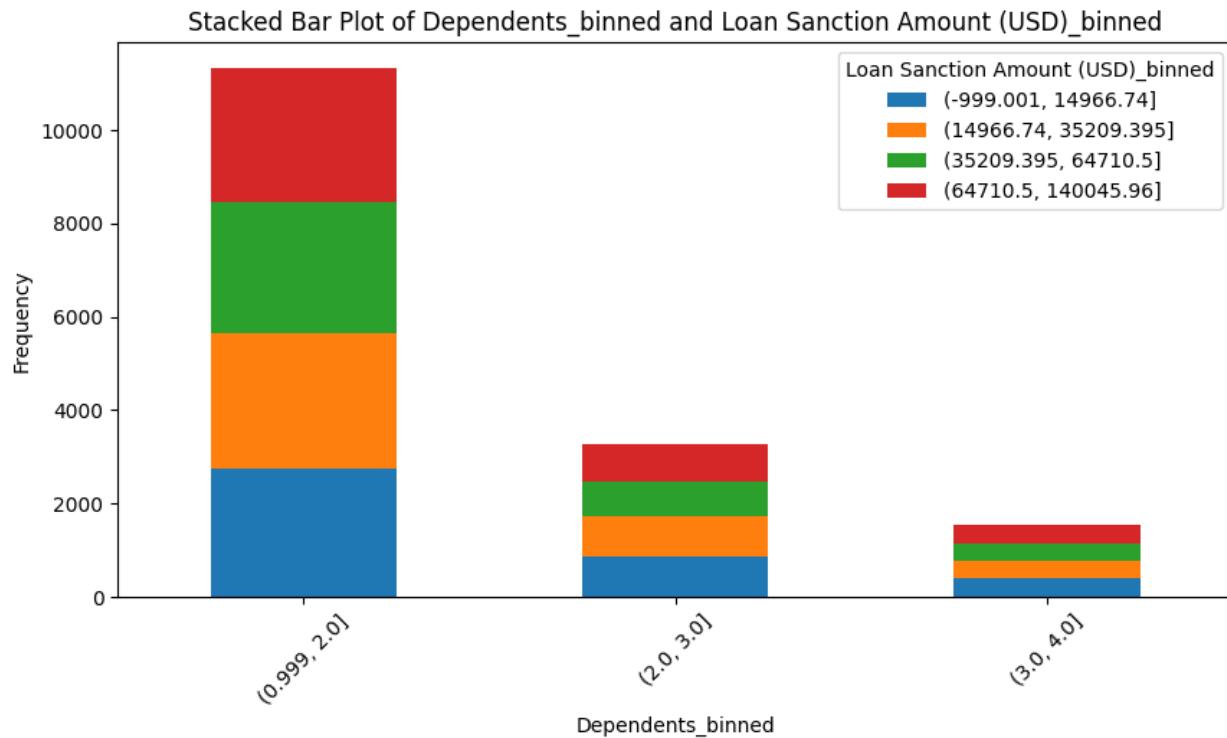
Loan Sanction Amount (USD)_binned (14966.74, 35209.395] \ Dependents_binned
 (0.999, 2.0] 2903
 (2.0, 3.0] 843
 (3.0, 4.0] 381

Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5, 140045.96]
 Dependents_binned

Dependents_binned	Count
(0.999, 2.0]	2793
2.0, 3.0]	759
(3.0, 4.0]	379

Chi-Square Test between Dependents_binned and Loan Sanction Amount

(USD)_binned:
Chi2 Statistic: 11.504105345031256, p-value: 0.07399118560956516



Contingency Table between Credit Score_binned and No. of Defaults_binned is empty. Skipping chi-square test.

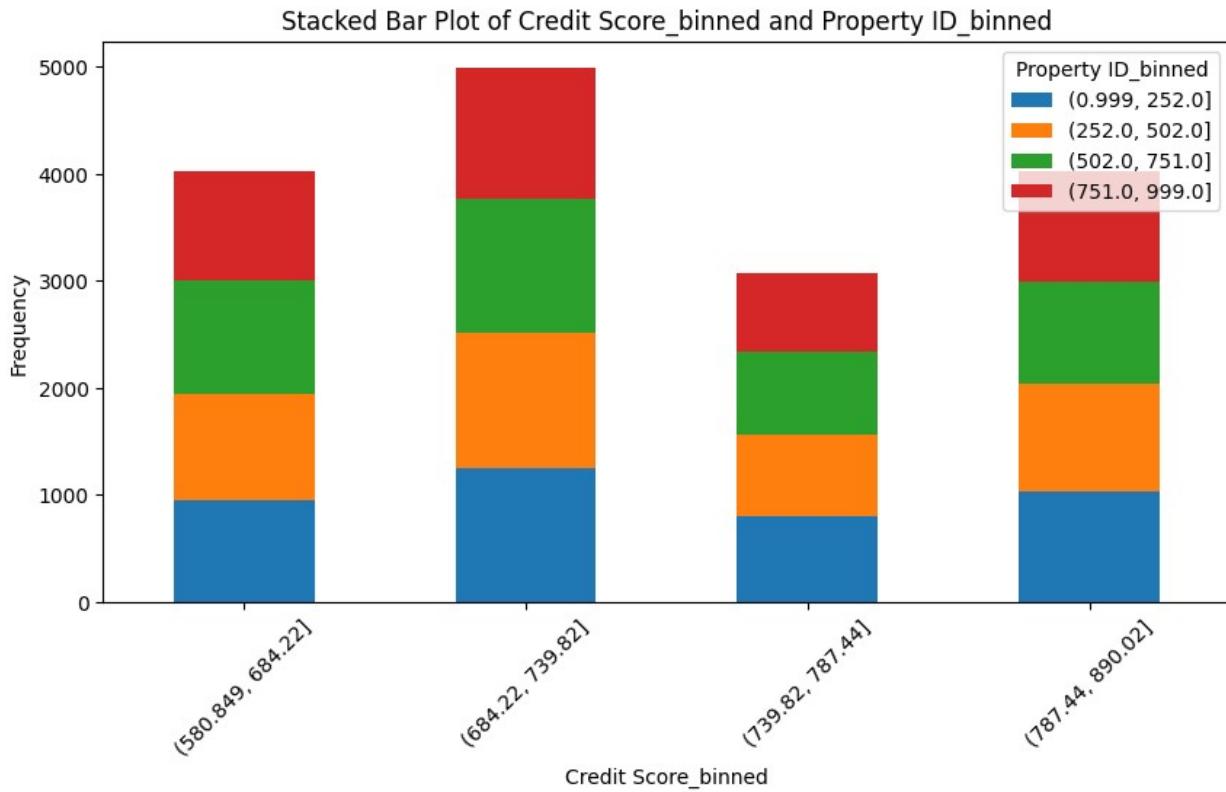
Contingency Table between Credit Score_binned and Property ID_binned:
Property ID_binned (0.999, 252.0] (252.0, 502.0] (502.0, 751.0] \ Credit Score_binned

Credit Score_binned	(580.849, 684.22]	(684.22, 739.82]	(739.82, 787.44]	(787.44, 890.02]
(580.849, 684.22]	956	984	1068	
(684.22, 739.82]	1254	1268	1249	
(739.82, 787.44]	796	767	773	
(787.44, 890.02]	1029	1006	952	

Property ID_binned (751.0, 999.0]
Credit Score_binned

Credit Score_binned	(580.849, 684.22]	(684.22, 739.82]	(739.82, 787.44]	(787.44, 890.02]
(580.849, 684.22]	1022			
(684.22, 739.82]	1214			
(739.82, 787.44]	737			
(787.44, 890.02]	1042			

Chi-Square Test between Credit Score_binned and Property ID_binned:
Chi2 Statistic: 15.17924940096093, p-value: 0.08612851878267722



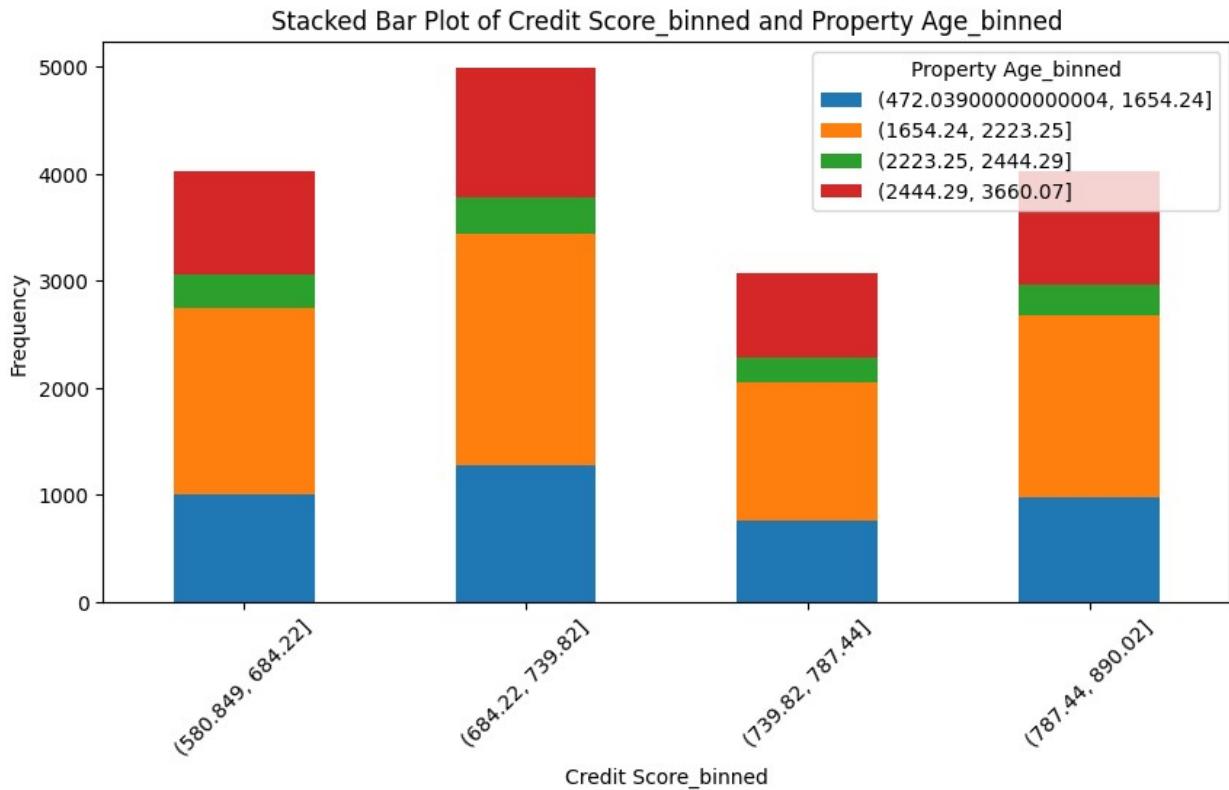
Contingency Table between Credit Score_binned and Property Age_binned:
 Property Age_binned (472.03900000000004, 1654.24] (1654.24, 2223.25]
 \ Credit Score_binned

(580.849, 684.22]	1013	1735
(684.22, 739.82]	1275	2170
(739.82, 787.44]	764	1293
(787.44, 890.02]	978	1703

Property Age_binned (2223.25, 2444.29] (2444.29, 3660.07]
 Credit Score_binned

(580.849, 684.22]	306	976
(684.22, 739.82]	341	1199
(739.82, 787.44]	223	793
(787.44, 890.02]	287	1061

Chi-Square Test between Credit Score_binned and Property Age_binned:
 Chi2 Statistic: 11.131089017342202, p-value: 0.2668304084842257



Contingency Table between Credit Score_binned and Property Type_binned:

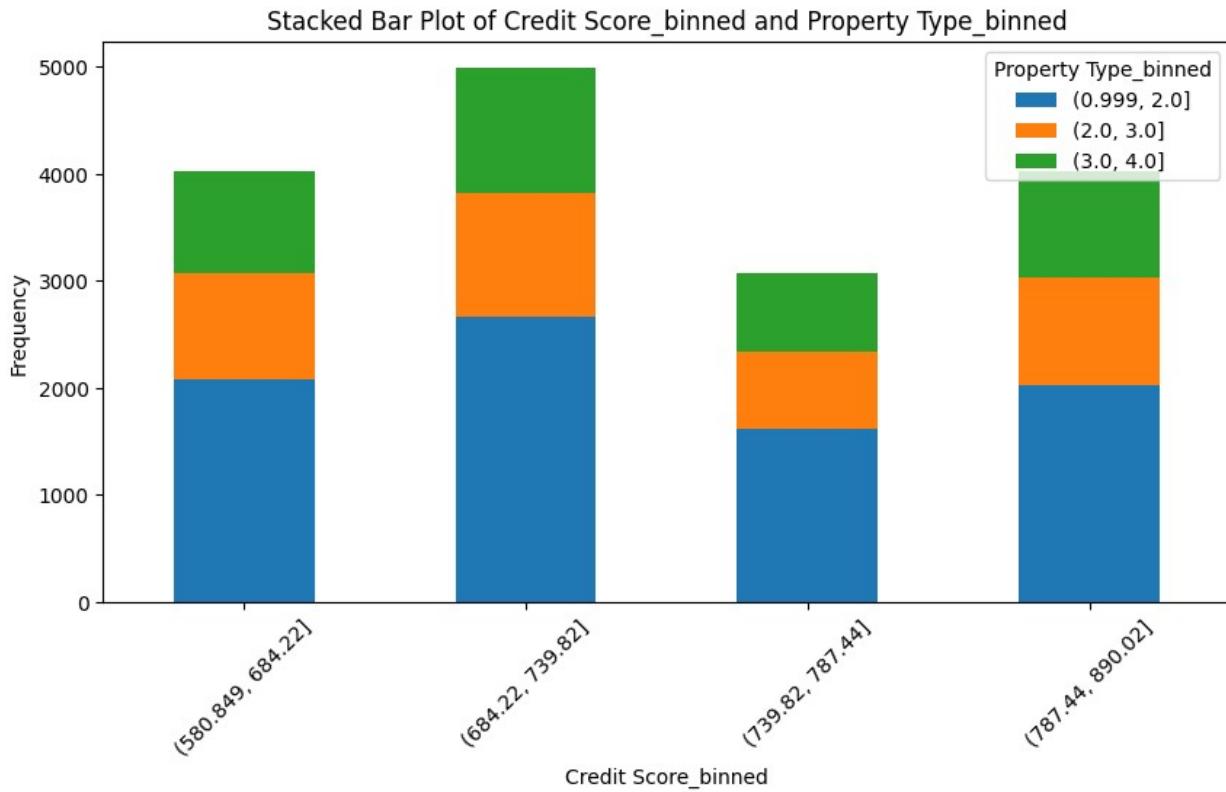
Property Type_binned (0.999, 2.0] (2.0, 3.0] (3.0, 4.0]

Credit Score_binned

Credit Score_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
(580.849, 684.22]	2077	1000	953
(684.22, 739.82]	2663	1160	1162
(739.82, 787.44]	1614	730	729
(787.44, 890.02]	2029	1005	995

Chi-Square Test between Credit Score_binned and Property Type_binned:

Chi2 Statistic: 9.827839682154643, p-value: 0.13209180362546216



Contingency Table between Credit Score_binned and Co-Applicant_binned is empty. Skipping chi-square test.

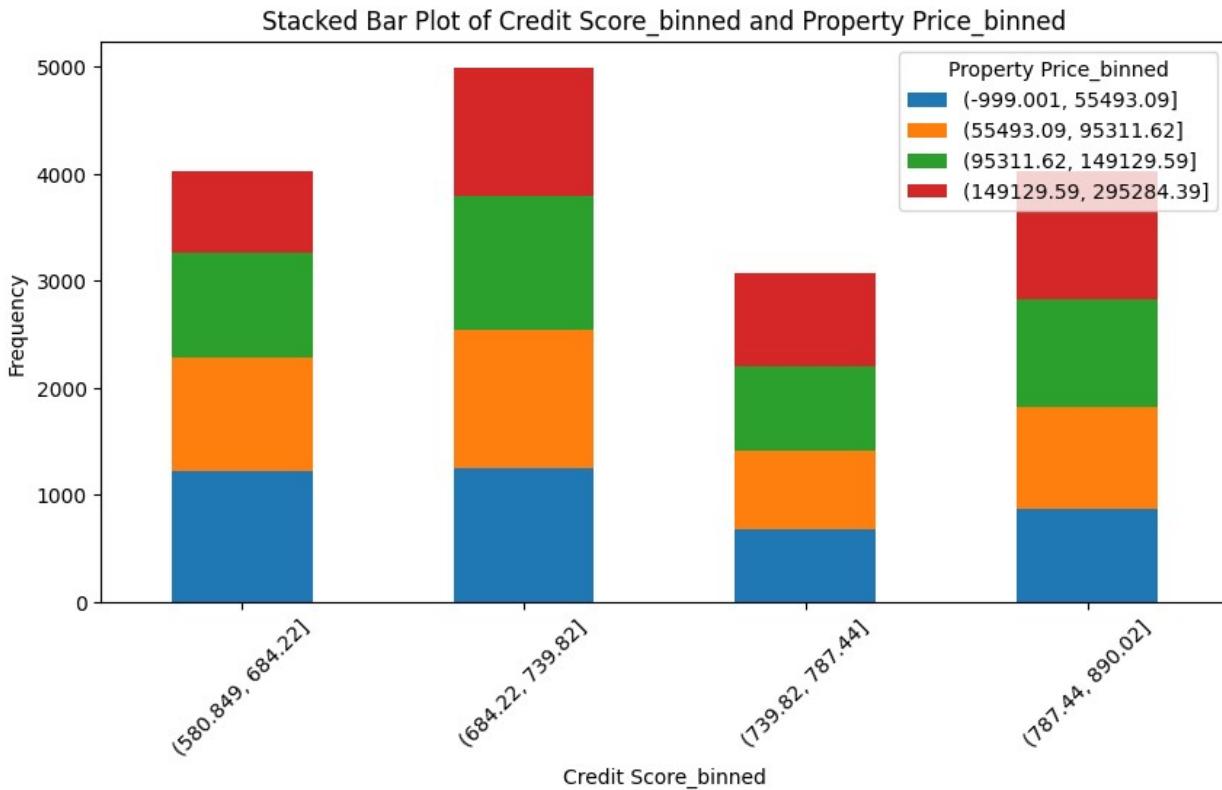
Contingency Table between Credit Score_binned and Property Price_binned:

Property Price_binned	(-999.001, 55493.09]	(55493.09, 95311.62] \ Credit Score_binned
(580.849, 684.22]	1222	1062
(684.22, 739.82]	1254	1295
(739.82, 787.44]	684	725
(787.44, 890.02]	870	947

Property Price_binned (95311.62, 149129.59] (149129.59, 295284.39] Credit Score_binned

(580.849, 684.22]	981	765
(684.22, 739.82]	1243	1193
(739.82, 787.44]	789	875
(787.44, 890.02]	1016	1196

Chi-Square Test between Credit Score_binned and Property Price_binned:
Chi2 Statistic: 196.7337835657857, p-value: 1.6021299861560753e-37



Contingency Table between Credit Score_binned and Loan Sanction Amount (USD)_binned:

Loan Sanction Amount (USD)_binned (-999.001, 14966.74] \

Credit Score_binned

(580.849, 684.22]	2129
(684.22, 739.82]	828
(739.82, 787.44]	476
(787.44, 890.02]	597

Loan Sanction Amount (USD)_binned (14966.74, 35209.395] \

Credit Score_binned

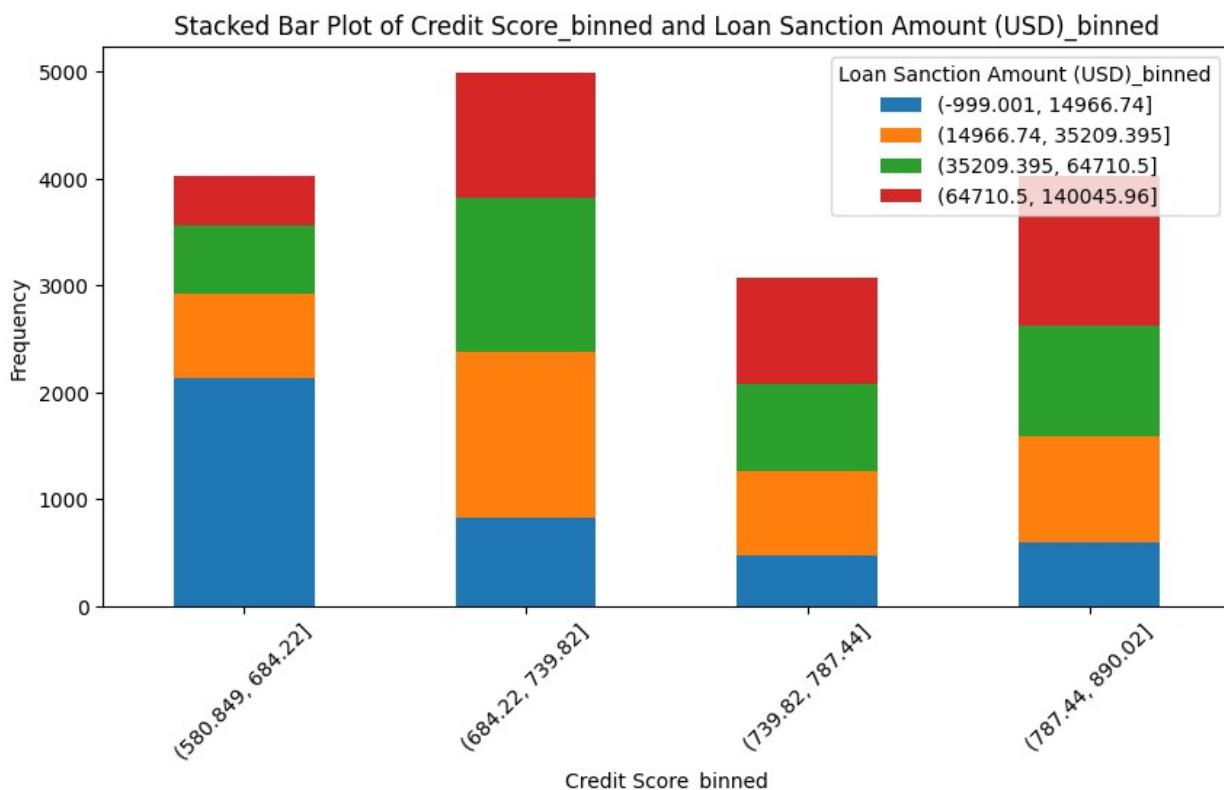
(580.849, 684.22]	800
(684.22, 739.82]	1547
(739.82, 787.44]	782
(787.44, 890.02]	998

Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5, 140045.96]

Credit Score_binned

(580.849, 684.22]	629
472	
(684.22, 739.82]	1445
1165	

(739.82, 787.44]	827
988	
(787.44, 890.02]	1030
1404	
Chi-Square Test between Credit Score_binned and Loan Sanction Amount (USD)_binned:	
Chi2 Statistic: 2467.318952310561, p-value: 0.0	



Contingency Table between No. of Defaults_binned and Property ID_binned is empty. Skipping chi-square test.

Contingency Table between No. of Defaults_binned and Property Age_binned is empty. Skipping chi-square test.

Contingency Table between No. of Defaults_binned and Property Type_binned is empty. Skipping chi-square test.

Contingency Table between No. of Defaults_binned and Co-Applicant_binned is empty. Skipping chi-square test.

Contingency Table between No. of Defaults_binned and Property Price_binned is empty. Skipping chi-square test.

Contingency Table between No. of Defaults_binned and Loan Sanction

Amount (USD)_binned is empty. Skipping chi-square test.

Contingency Table between Property ID_binned and Property Age_binned:
Property Age_binned (472.0390000000004, 1654.24] (1654.24, 2223.25]
\
Property ID_binned

(0.999, 252.0]	975	1762
(252.0, 502.0]	1000	1719
(502.0, 751.0]	1022	1707
(751.0, 999.0]	1033	1713

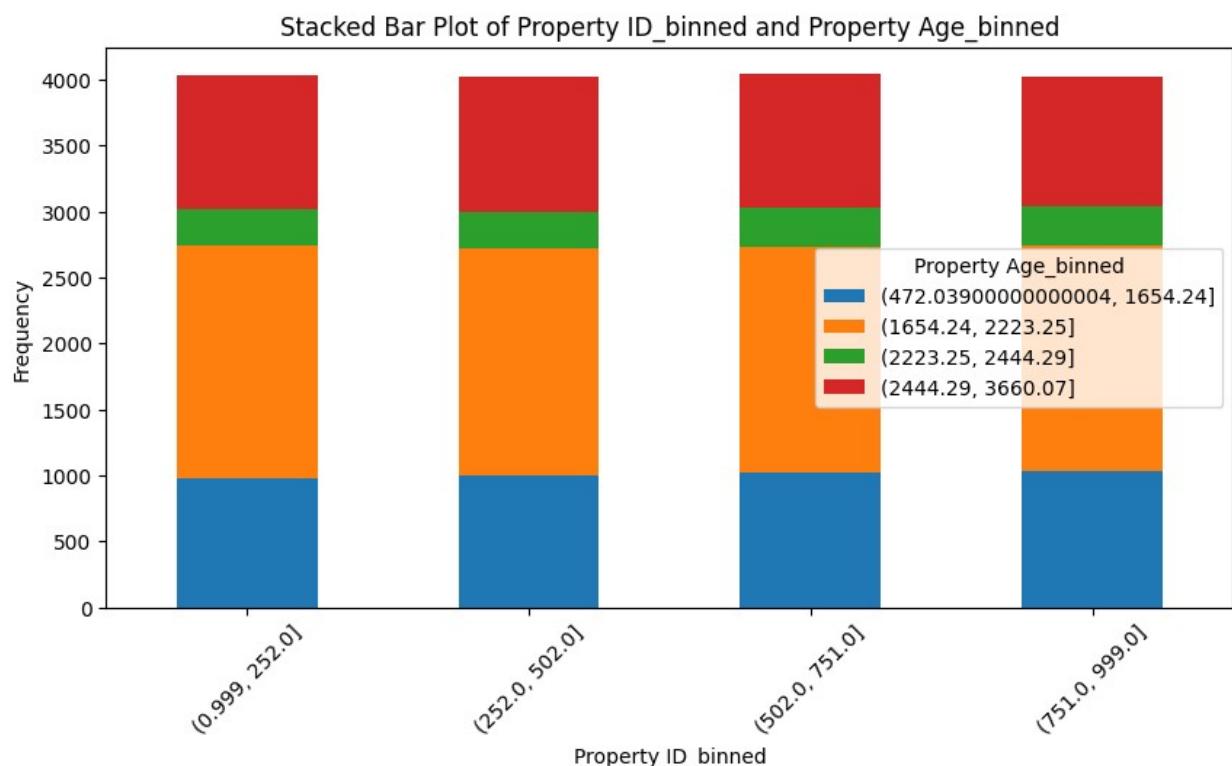
Property Age_binned (2223.25, 2444.29] (2444.29, 3660.07]

Property ID_binned

(0.999, 252.0]	283	1015
(252.0, 502.0]	280	1026
(502.0, 751.0]	303	1010
(751.0, 999.0]	291	978

Chi-Square Test between Property ID_binned and Property Age_binned:

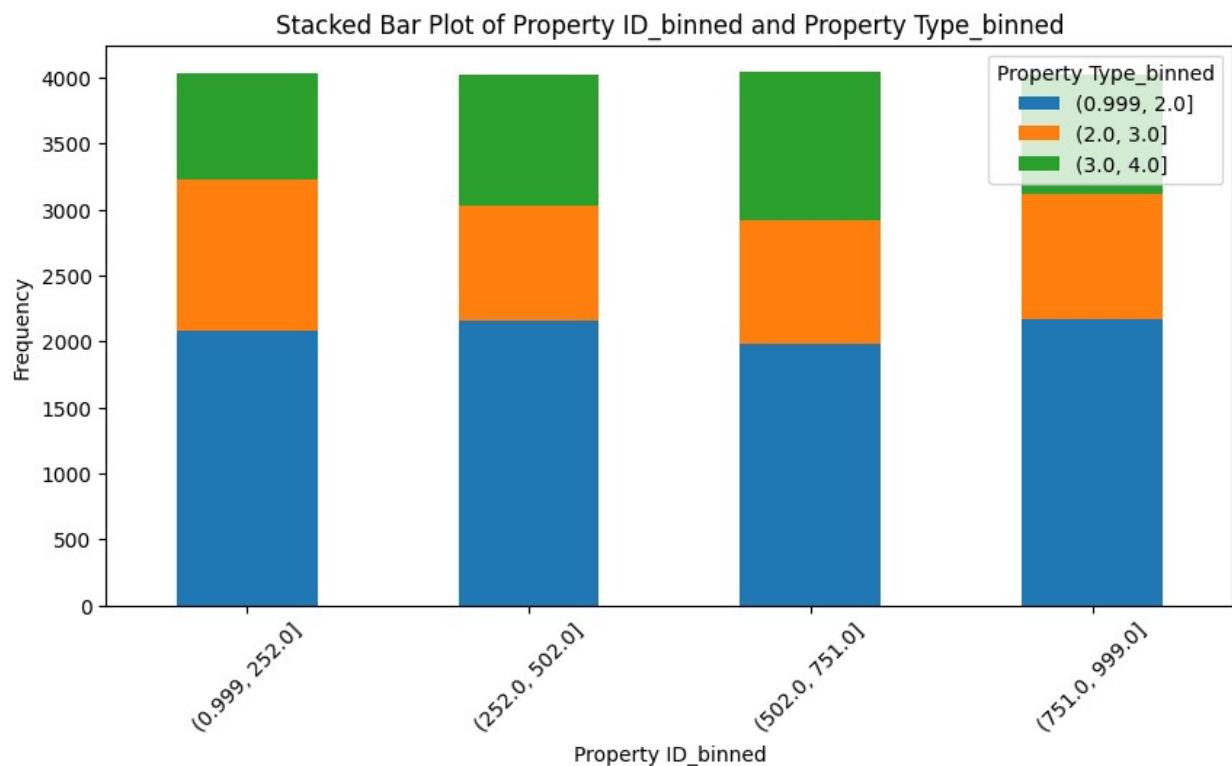
Chi2 Statistic: 5.301155509812165, p-value: 0.8073053820963936



Contingency Table between Property ID_binned and Property Type_binned:
 Property Type_binned (0.999, 2.0] (2.0, 3.0] (3.0, 4.0]
 Property ID_binned

Property ID_binned	(0.999, 252.0]	(252.0, 502.0]	(502.0, 751.0]	(751.0, 999.0]
Property Type_binned (0.999, 2.0]	2083	1139	813	
Property Type_binned (2.0, 3.0]	2156	873	996	
Property Type_binned (3.0, 4.0]	1981	932	1129	
	2163	951	901	

Chi-Square Test between Property ID_binned and Property Type_binned:
 Chi2 Statistic: 108.03265884685096, p-value: 5.2614189681511724e-21



Contingency Table between Property ID_binned and Co-Applicant_binned
 is empty. Skipping chi-square test.

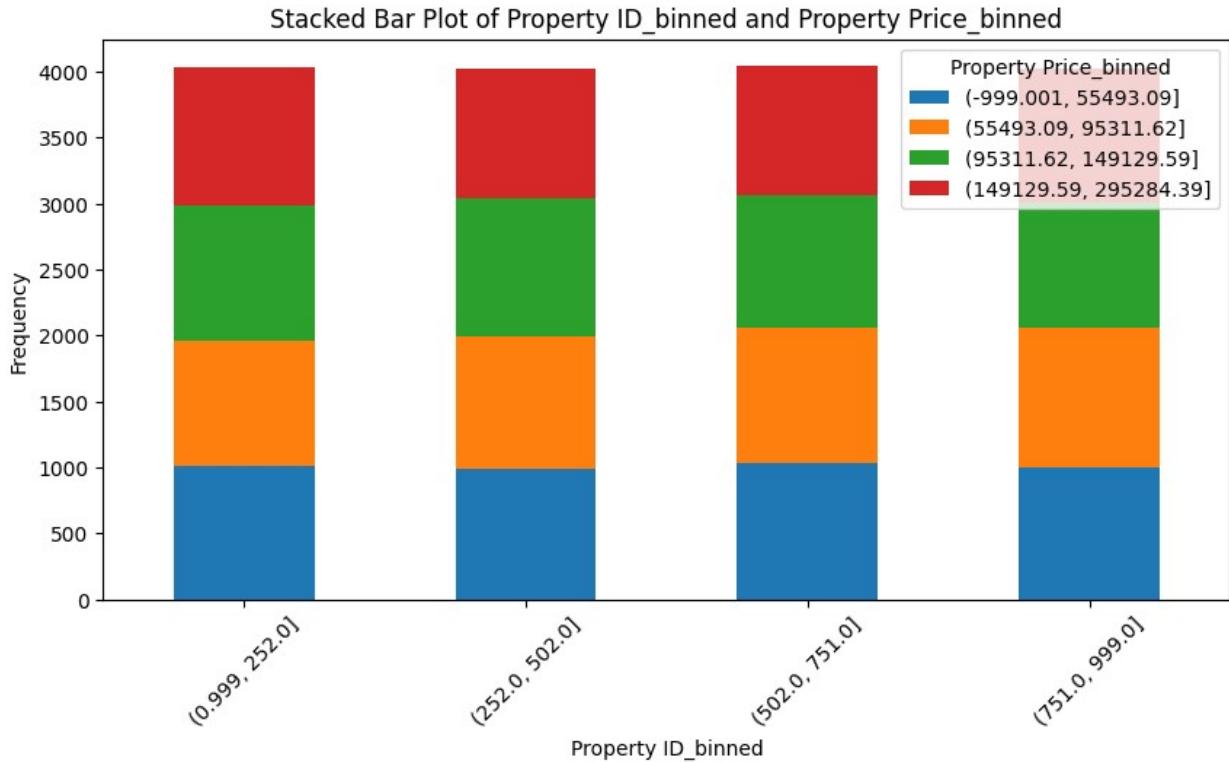
Contingency Table between Property ID_binned and Property Price_binned:
 Property Price_binned (-999.001, 55493.09] (55493.09, 95311.62] \\\
 Property ID_binned

Property ID_binned	Property Price_binned (-999.001, 55493.09]	Property Price_binned (55493.09, 95311.62]
(0.999, 252.0]	1009	946
(252.0, 502.0]	988	1000
(502.0, 751.0]	1030	1027
(751.0, 999.0]	1003	1056

Property Price_binned (95311.62, 149129.59] (149129.59, 295284.39]
 Property ID_binned

(0.999, 252.0]	1029	1051
(252.0, 502.0]	1051	986
(502.0, 751.0]	1005	980
(751.0, 999.0]	944	1012

Chi-Square Test between Property ID_binned and Property Price_binned:
Chi2 Statistic: 16.788883140691027, p-value: 0.05212653083980098



Contingency Table between Property ID_binned and Loan Sanction Amount (USD)_binned:

Loan Sanction Amount (USD)_binned (-999.001, 14966.74] \

Property ID_binned

(0.999, 252.0]	974
(252.0, 502.0]	986
(502.0, 751.0]	1031
(751.0, 999.0]	1039

Loan Sanction Amount (USD)_binned (14966.74, 35209.395] \

Property ID_binned

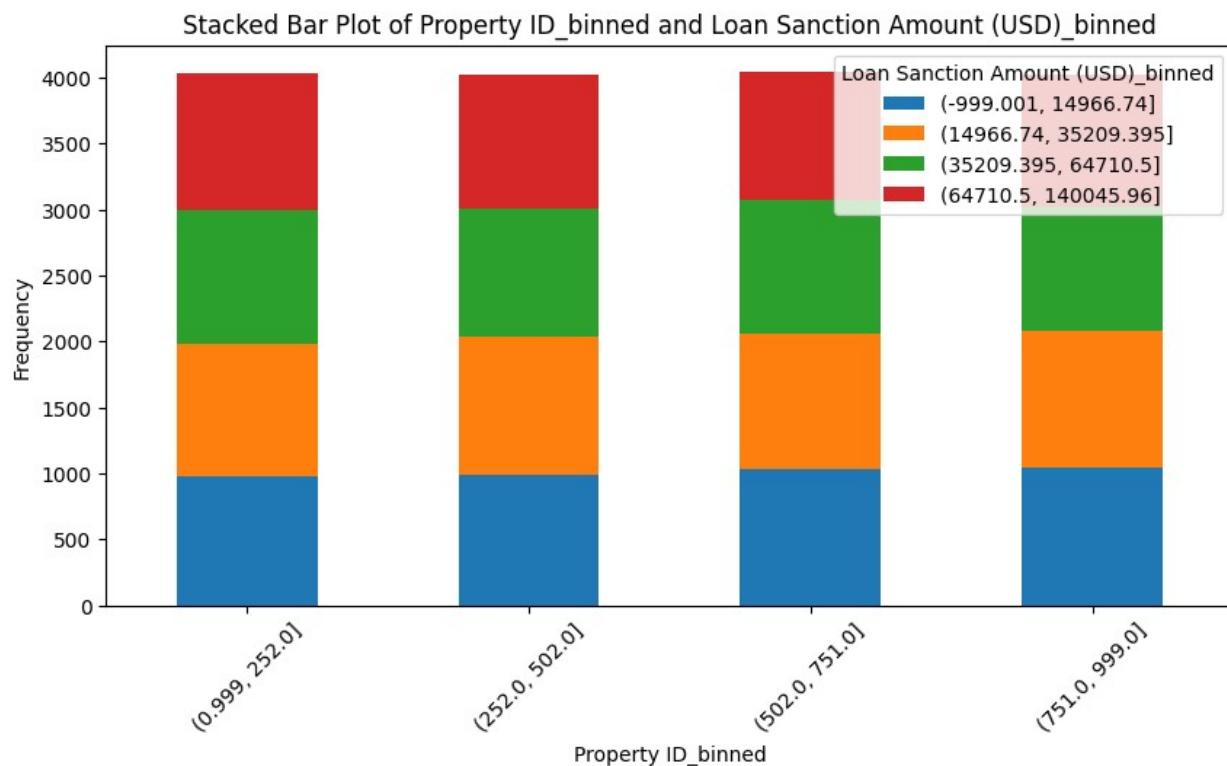
(0.999, 252.0]	1010
(252.0, 502.0]	1046
(502.0, 751.0]	1030
(751.0, 999.0]	1041

Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5,

140045.96]
Property ID_binned

(0.999, 252.0]	1009
1042	
(252.0, 502.0]	977
1016	
(502.0, 751.0]	1006
975	
(751.0, 999.0]	939
996	

Chi-Square Test between Property ID_binned and Loan Sanction Amount (USD)_binned:
Chi2 Statistic: 9.40934604455561, p-value: 0.4003773227049484



Contingency Table between Property Age_binned and Property Type_binned:

Property Type_binned	(0.999, 2.0]	(2.0, 3.0]	(3.0, 4.0]
Property Age_binned			
(472.0390000000004, 1654.24]	2087	1003	940
(1654.24, 2223.25]	3603	1636	1662
(2223.25, 2444.29]	595	291	271
(2444.29, 3660.07]	2098	965	966

Chi-Square Test between Property Age_binned and Property Type_binned:
 Chi2 Statistic: 2.9179739702086858, p-value: 0.8190693492698276



Contingency Table between Property Age_binned and Co-Applicant_binned is empty. Skipping chi-square test.

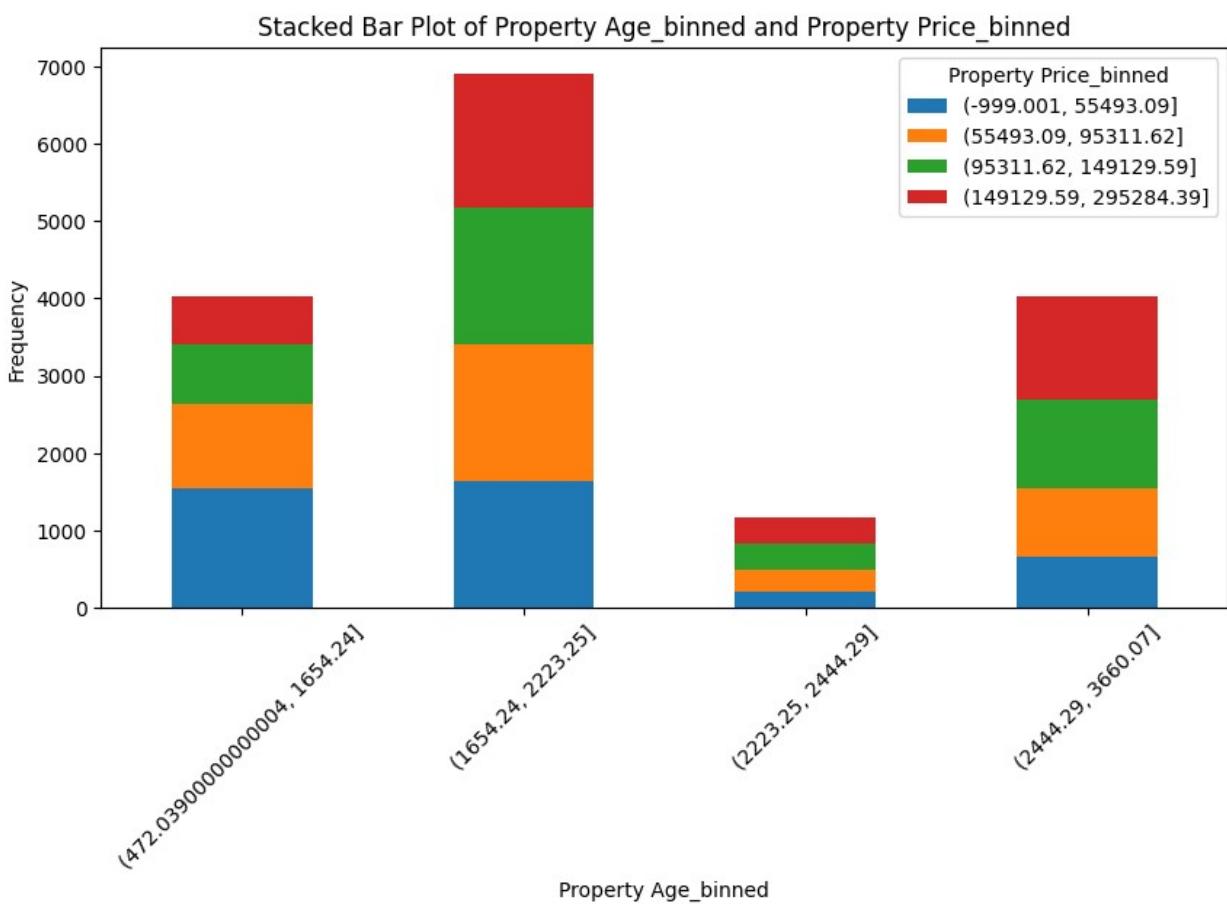
Contingency Table between Property Age_binned and Property Price_binned:

Property Price_binned (-999.001, 55493.09] (55493.09, 95311.62] \
 Property Age_binned

(472.0390000000004, 1654.24]	1546
1079	
(1654.24, 2223.25]	1636
1772	
(2223.25, 2444.29]	199
284	
(2444.29, 3660.07]	649
894	

Property Price_binned	(95311.62, 149129.59]	(149129.59, 295284.39]
Property Age_binned		
(472.0390000000004, 1654.24]	781	624
(1654.24, 2223.25]	1765	1728
(2223.25, 2444.29]	342	332
(2444.29, 3660.07]	1141	1345

Chi-Square Test between Property Age_binned and Property Price_binned:
Chi2 Statistic: 811.8981686335571, p-value: 5.838620672386862e-169



Contingency Table between Property Age_binned and Loan Sanction Amount (USD)_binned:	Loan Sanction Amount (USD)_binned	(-999.001, 14966.74] \
Property Age_binned		
(472.0390000000004, 1654.24]	1239	

(1654.24, 2223.25]	1549
(2223.25, 2444.29]	276
(2444.29, 3660.07]	966

Loan Sanction Amount (USD)_binned (14966.74, 35209.395] \

Property Age_binned	
(472.0390000000004, 1654.24]	1367
(1654.24, 2223.25]	1800
(2223.25, 2444.29]	229
(2444.29, 3660.07]	731

Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5, 140045.96]

Property Age_binned	
(472.0390000000004, 1654.24]	804
620	
(1654.24, 2223.25]	1757
1795	
(2223.25, 2444.29]	330
322	
(2444.29, 3660.07]	1040
1292	

Chi-Square Test between Property Age_binned and Loan Sanction Amount (USD)_binned:

Chi2 Statistic: 569.1212595125527, p-value: 8.835111149854186e-117



Contingency Table between Property Type_binned and Co-Applicant_binned is empty. Skipping chi-square test.

Contingency Table between Property Type_binned and Property Price_binned:

Property Price_binned	(-999.001, 55493.09]	(55493.09, 95311.62]	\
Property Type_binned			
(0.999, 2.0]	2036	2120	
(2.0, 3.0]	1005	957	
(3.0, 4.0]	989	952	

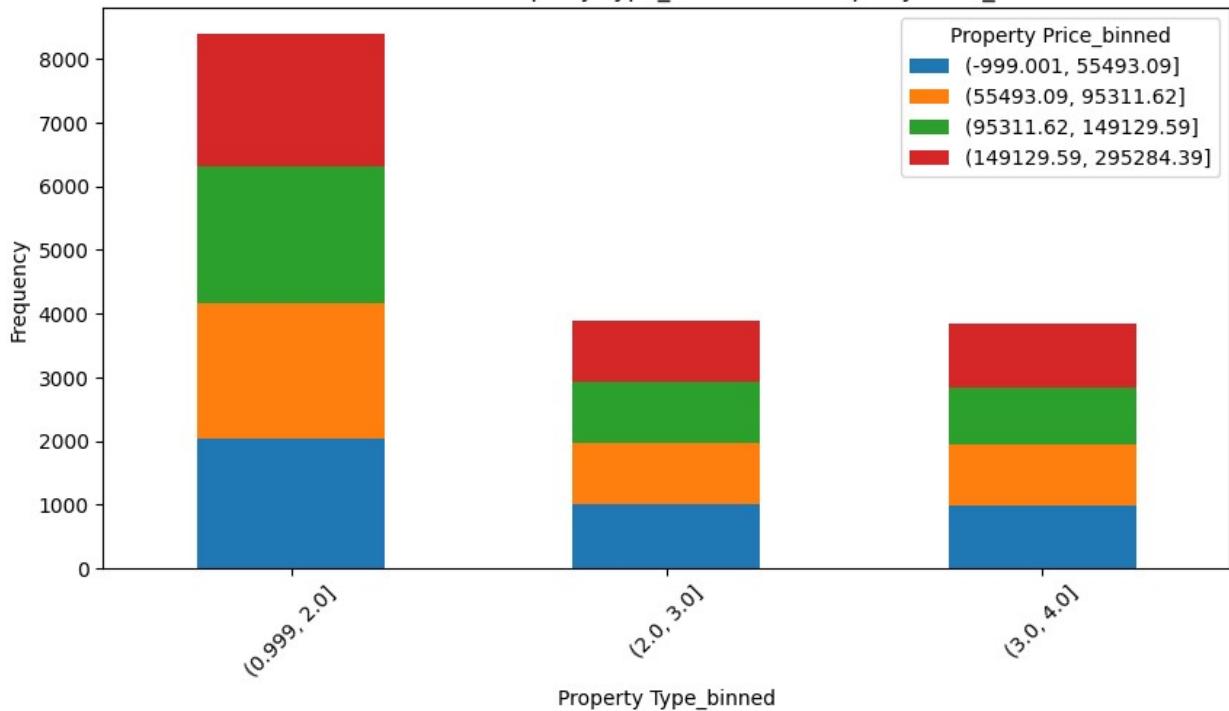
Property Price_binned (95311.62, 149129.59] (149129.59, 295284.39]

Property Type_binned		
(0.999, 2.0]	2153	2074
(2.0, 3.0]	972	961
(3.0, 4.0]	904	994

Chi-Square Test between Property Type_binned and Property Price_binned:

Chi2 Statistic: 10.649085877017253, p-value: 0.09984644008885564

Stacked Bar Plot of Property Type_binned and Property Price_binned



Contingency Table between Property Type_binned and Loan Sanction Amount (USD)_binned:

Loan Sanction Amount (USD)_binned	Property Type_binned	
(-999.001, 14966.74]	(0.999, 2.0]	2072
(14966.74, 35209.395]	(2.0, 3.0]	991
(35209.395, 64710.5]	(3.0, 4.0]	967

Loan Sanction Amount (USD)_binned (14966.74, 35209.395] \\\nProperty Type_binned

(0.999, 2.0]	2117
(2.0, 3.0]	1027
(3.0, 4.0]	983

Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5, 140045.96]

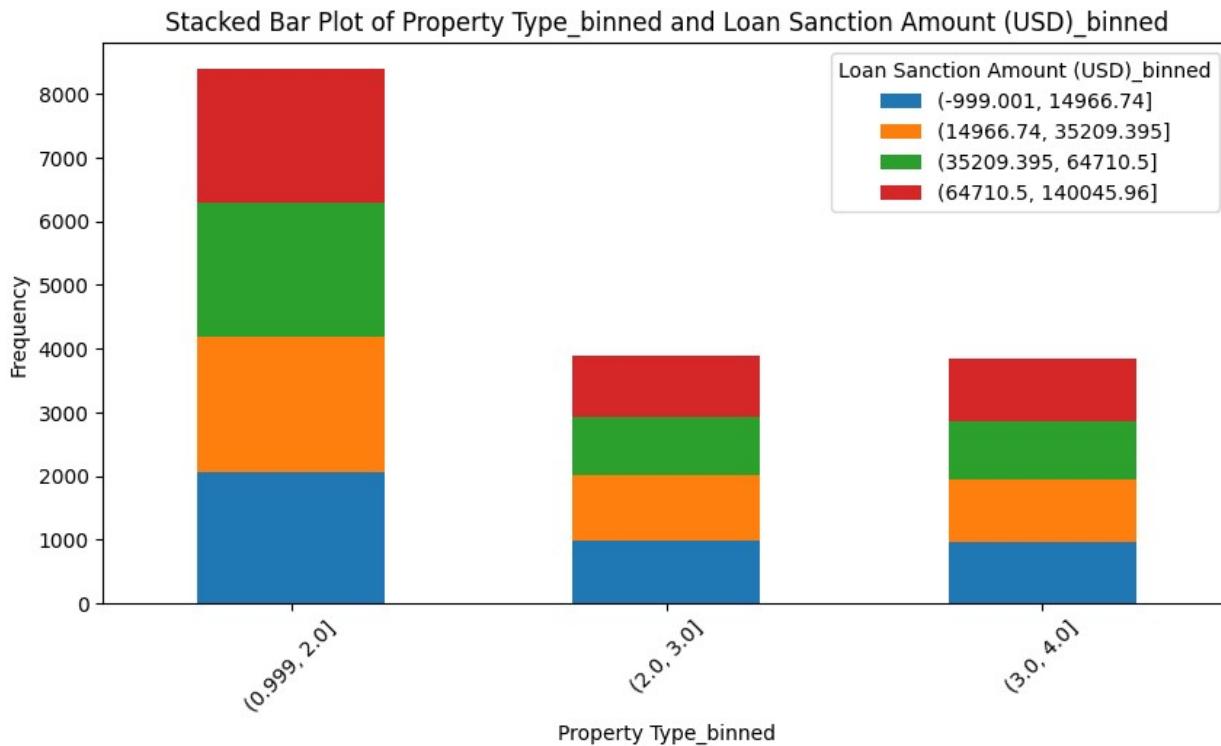
Property Type_binned

(0.999, 2.0]	2109
2085	
(2.0, 3.0]	918
959	
(3.0, 4.0]	904
985	

Chi-Square Test between Property Type_binned and Loan Sanction Amount

(USD)_binned:

Chi2 Statistic: 7.081393043137292, p-value: 0.31338560712470936



Contingency Table between Co-Applicant_binned and Property_Price_binned is empty. Skipping chi-square test.

Contingency Table between Co-Applicant_binned and Loan_Sanction_Amount_(USD)_binned is empty. Skipping chi-square test.

Contingency Table between Property_Price_binned and Loan_Sanction_Amount_(USD)_binned:

Loan Sanction Amount (USD)_binned	\
Property Price_binned	
(-999.001, 55493.09]	1656
(55493.09, 95311.62]	860
(95311.62, 149129.59]	817
(149129.59, 295284.39]	697

Loan Sanction Amount (USD)_binned	\
Property Price_binned	
(-999.001, 55493.09]	2252
(55493.09, 95311.62]	1764
(95311.62, 149129.59]	65
(149129.59, 295284.39]	46

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Loan Sanction Amount (USD)_binned (35209.395, 64710.5] (64710.5,
140045.96]
Property Price_binned

( -999.001, 55493.09] 56
66
(55493.09, 95311.62] 1400
5
(95311.62, 149129.59] 2288
859
(149129.59, 295284.39] 187
3099
Chi-Square Test between Property Price_binned and Loan Sanction Amount
(USD)_binned:
Chi2 Statistic: 14052.831166399712, p-value: 0.0

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