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Loan Dataset Analysis

Profiling and Analyzing the Loan Dataset

Introduction:

This project centers on performing an in-depth exploratory data analysis (EDA) on a loan applicant dataset. The dataset comprises crucial financial attributes such as gender, marital status, education, income particulars, loan amounts, credit history, and others. The primary objective is to extract actionable insights into the financial profiles of loan applicants and discern the key determinants influencing loan approval.

Objective:

The central aim of this project is to meticulously explore and analyze the loan applicant dataset to glean invaluable insights into demographics, financial profiles, and pertinent factors impacting loan approval. Through a systematic approach involving targeted inquiries, alongside adept data manipulation, visualization, and statistical analysis, our goal is to reveal latent patterns, emerging trends, and significant correlations inherent within the dataset.

Project Description:

Through a comprehensive series of 30 inquiries, we delve into the loan dataset utilizing diverse techniques including data filtering, grouping, sorting, and visualization. Each question focuses on specific facets of the dataset, spanning from income distribution and loan approval rates to demographic trends and financial ratios.

Commencing with meticulous data preprocessing to ensure data integrity and uniformity, we proceed to apply exploratory data analysis techniques to unveil insights within the dataset. Visual representations such as bar plots are harnessed to depict the data visually, simplifying the interpretation of trends and patterns.

Key revelations from the analysis encompass insights into income distribution, loan approval rates across various parameters, demographic trends among applicants, and interrelations among attributes such as income, loan amount, and credit history. Statistical metrics like mean, median, and percentiles are leveraged to offer quantitative insights into the data.

The culmination of the project entails the presentation of results, wherein findings are succinctly summarized and effectively communicated. This comprehensive analysis yields valuable insights, enhancing our understanding of loan applicant characteristics and the factors shaping loan approval decisions.

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Dataset/Column Explanations

Column #1: ***Gender*** – Gender of Applicant for loan. (Object; “Male” or “Female”)

Column #2: ***Married*** – Whether Applicant is Married or not. Being married suggests that the applicant shares financial responsibility and income with their spouse. (Object; “Yes” or “No”)

Column #3: ***Dependents*** – Number of Individuals who rely on Applicants financial support. (int)

Column #4: ***Education*** – Education Level attained by Applicant. (Object; “Graduated” or “Not Graduated”)

Column #5: ***Self Employed*** – Applicant who runs their own business or works as an independent contractor rather than being employed by another company or organization. (Object; “Yes” or “No”)

Column #6: ***Applicant Income*** – Represents the income of the primary applicant of the loan. Income is a critical factor in assessing loan applications as it directly influences the applicants ability to pay back a loan. (int; USD)

Column #7: ***Co-Applicant Income*** – Represents the income of the Co-Applicant, if applicable, who is jointly applying for the loan with the primary applicant. (int; USD)

Column #8: ***Loan Amount*** – The amount of money that the loan applicant is requesting or has been approved for. (int; USD)

Columns #9: ***Term*** – Represents the duration of the loan, commonly referred to as the loan term. This term specifies the length of time over which the borrower is expected to repay the loan amount to the lender. (float; months)

Column #10: ***Credit History*** – The Credit History of the loan applicant. This is a crucial factor considered by lenders when assessing loan applicants as it provides insight into the applicant’s past credit behavior and repayment patterns. (float; 1.0 = Acceptable Credit History, 0.0 = No/Non-Acceptable Credit History)

Column #11: ***Area*** – The geographical area or location associated with the loan applicants. (String; “Urban”, “Semiurban”, “Rural”)

Columns added from ‘Data Preprocessing’

Column #12: ***Household Income*** – The total income of the household to which the loan applicant belongs. This column provides a comprehensive view of the financial resources available to the applicant and their family. Household Income = Applicant Income + Co-applicant Income (int; USD)

Column #13: ***Total Yearly Debt*** – The sum of all the borrower’s debts over the course of a year. This column provides insight into the borrower’s overall debt burden and financial obligations. Total Yearly Debt = Loan Amount / (Term / 12) (float; USD)

***<u>Column #14:</u>* Debt to Income Ratio** – The ratio of the borrower's total yearly debt to their household income. This ratio is a fundamental metric used by lenders to evaluate the borrower's ability to manage debt relative to their income level.
Debt to Income Ratio = Total Yearly Debt / Household Income (float)

***<u>Column #15:</u>* Risk Level** – The risk associated with each loan application. This column is determined based on specific criteria, such as credit history and debt-to-income ratio, to categorize the level of risk posed by each applicant. (String; "Low", "Medium", "High")

Loan Dataset Analysis – Python Script and Outputs

Import Libraries and CSV File

i. Import libraries: Pandas for analysis, Matplotlib for Visualization
ii. Import Dataset: Import CSV file using Pandas

```
# Import Libraries
import pandas as pd
import matplotlib.pyplot as plt

# Import Dataset and View
df= pd.read_csv('loan.csv')
df.head(5)
```

	Gender	Married	Dependents	Education	Self_Employed	Applicant_Income	Coapplicant_Income	Loan_Amount	Term	Credit_History	Area
0	Male	Yes	0.0	Graduate	No	572000	0	220000	360.0	1.0	Urban
1	Male	Yes	1.0	Graduate	No	307600	150000	252000	360.0	1.0	Urban
2	Male	Yes	2.0	Graduate	No	500000	180000	416000	360.0	1.0	Urban
3	Male	Yes	2.0	Graduate	No	234000	254600	200000	360.0	NaN	Urban
4	Male	No	0.0	Not Graduate	No	327600	0	156000	360.0	1.0	Urban

Dataset Preprocessing

iii. View Datatypes before analyzation

```
# View data types for each column
df.dtypes
```

```
Gender                 object
Married                object
Dependents            float64
Education              object
Self_Employed          object
Applicant_Income        int64
Coapplicant_Income      int64
Loan_Amount             int64
Term                  float64
Credit_History        float64
Area                   object
dtype: object
```

iv. All missing (NaN) values in the Credit History Column will be treated as a Credit History of zero.

```
# Change all NaN values in Credit History to 0
# 1.0 represents a Credit History meeting a specificed criteria
# 0.0 represents a Credit History as not meeting a specified criteria or no Credit History
df['Credit_History'].fillna(0, inplace = True)
df['Credit_History']
```

```
0      1.0
1      1.0
2      1.0
3      0.0
4      1.0
      ...
362    1.0
363    1.0
364    0.0
365    1.0
366    1.0
Name: Credit_History, Length: 367, dtype: float64
```

v. Calculate Household Income Column, by adding the Applicant Income and Co-Applicant Income

```
# Create column to represent the entire Household Income
df['Household Income'] = 0
df['Household Income'] = df['Applicant Income'] + df['Coapplicant Income']
df.head(5)
```

vi. Calculate new columns, 'Debt to Income Ratio' & 'Risk Level', these metrics will be used to judge whether a loan was approve dor not

```
# Create Debt to Income Ratio & Risk Level column to help assess Loan Approval

#Debt to Income Ratio
# Calculate Total Monthly Debt
df['Total Yearly Debt'] = df['Loan Amount'] / (df['Term'] / 12)

# Calculate Debt to Income Ratio
df['Debt to Income Ratio'] = df['Total Yearly Debt'] / (df['Household Income'])

#Risk Level Assessment
df['Risk Level'] = 'Low'
df.loc[(df['Credit History'] < 0.5) | (df['Debt to Income Ratio'] > 0.3), 'Risk Level'] = 'High'
df.loc[(df['Credit History'] >= 0.5) & (df['Debt to Income Ratio'] <= 0.3), 'Risk Level'] = 'Medium'
```

vii. Identify two thresholds used for Loan Approval; Credit History Threshold set to 0.5 and Debt to Income Ratio Threshold to 0.3.

viii. Three columns for Loan Approval were taken into consideration; Credit History, Debt to Income Ration and the Risk Calculated.

ix. A Loan is approved if either the Credit History or the Debt-to-Income Ratio were above their respective thresholds and the Risk Level calculated was not High. All other loans were not approved.

x. Among 367 applicants, 75.7% were approved.

```python
# Create a column to represent Loan Approval Status

# Threshold
credit_history_threshold = 0.5
dti_ratio_threshold = 0.3
# Risk Level must be Low or Medium

# Calculate Loan Approval Column
df['Approval Status'] = 'No'
df.loc[((df['Credit History'] > credit_history_threshold) | (df['Debt to Income Ratio'] > dti_ratio_threshold)) & (df['Risk Level'] != 'High'),
'Approval Status'] = 'Yes'

# Calculate number of Loans Approved and not
loan_approved = len(df.loc[df['Approval Status'] == 'Yes'])
loan_not_approved = len(df.loc[df['Approval Status'] == 'No'])

print(f"Number of Loans Approved: {loan_approved}")
print(f"Number of Loans not Approved: {loan_not_approved}")

# Calculate percentage of Approved Loans
percentage_approved = (loan_approved/(loan_approved + loan_not_approved))*100
print(f"The percentage of loans that were approved: {percentage_approved}%")
```

```
Number of Loans Approved: 278
Number of Loans not Approved: 89
The percentage of loans that were approved: 75.74931880108991%
```

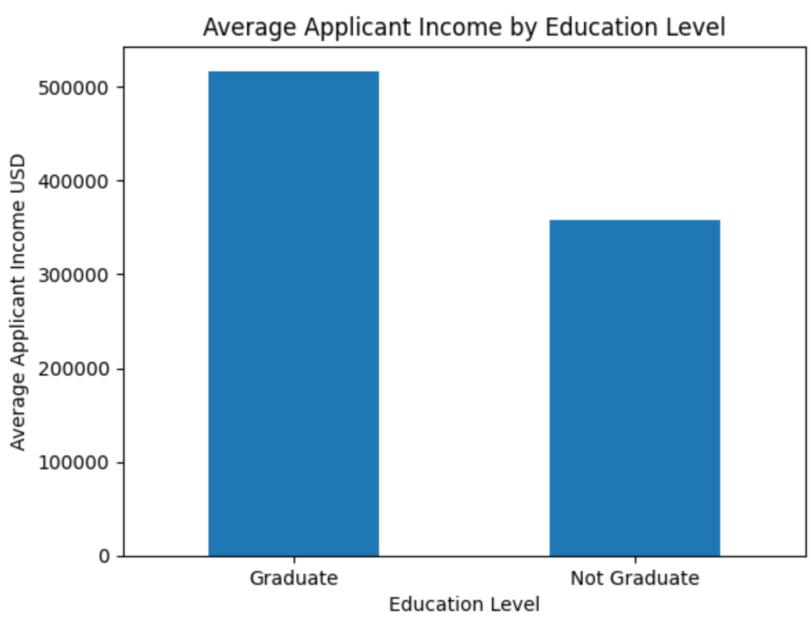
Dataset Analysis

Plotting

```
#1. What is the average 'Applicant Income' of individuals grouped by their 'Education' level?
avg_inc_by_ed = df.groupby('Education')['Applicant Income'].mean()
print(f"Output \n{avg_inc_by_ed}")

# Plot
avg_inc_by_ed.plot(kind = 'bar')
plt.title("Average Applicant Income by Education Level")
plt.xlabel("Education Level")
plt.xticks(rotation=0)
plt.ylabel("Average Applicant Income USD")
plt.show()
```

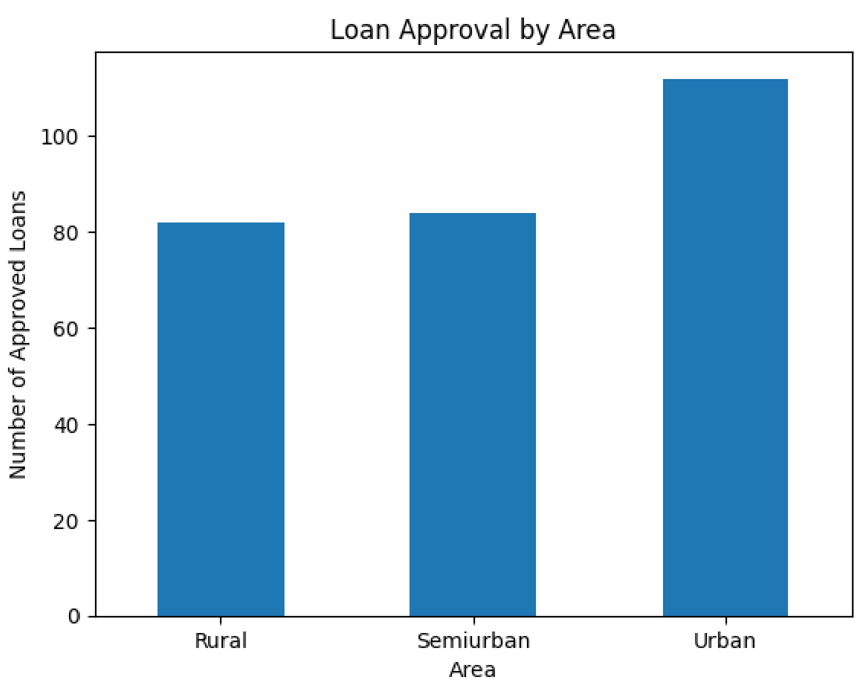
```
Output
Education
Graduate        516994.346290
Not Graduate    357810.714286
Name: Applicant Income, dtype: float64
```



```python
#2. How many individuals in each 'Area' have been approved for a loan?
loan_app_by_area = df.loc[df['Approval Status'] == 'Yes'].groupby('Area').size()
print(f"Output \n{loan_app_by_area}")

# Plot
loan_app_by_area.plot(kind = 'bar')
plt.title("Loan Approval by Area")
plt.xlabel("Area")
plt.xticks(rotation=0)
plt.ylabel("Number of Approved Loans")
plt.show()
```

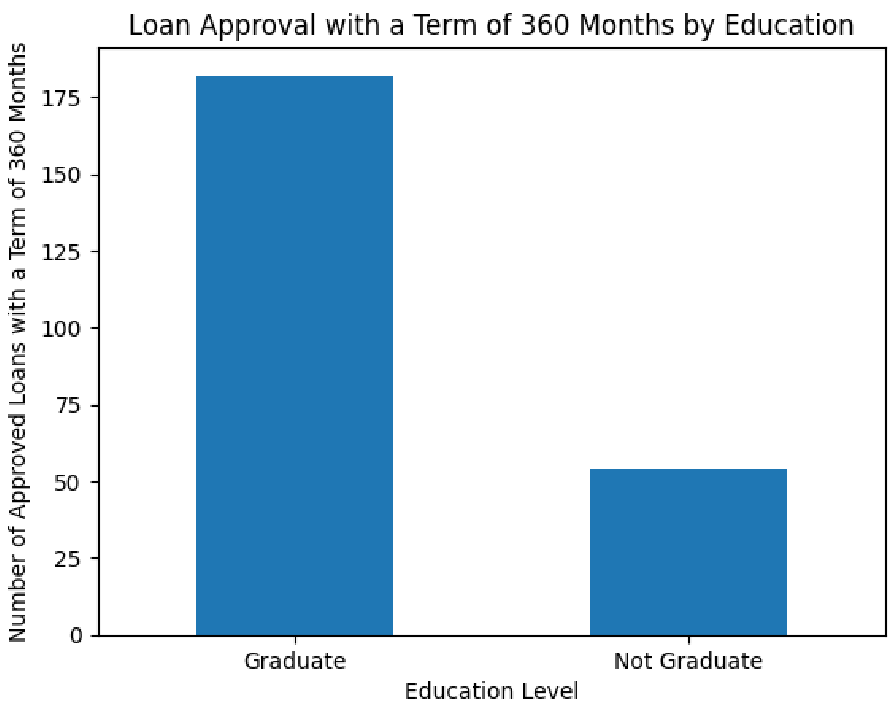
```
Output
Area
Rural          82
Semiurban      84
Urban         112
dtype: int64
```



```python
#3. How many individuals in each 'Education' level have been approved for a loan and have a 'Term' of 360?
app_loans_term_360_by_ed = df.loc[(df['Approval Status'] == 'Yes') & (df['Term'] == 360.0)].groupby('Education')['Approval Status'].count()
print(f"Output \n{app_loans_term_360_by_ed}")

# Plot
app_loans_term_360_by_ed.plot(kind = 'bar')
plt.title("Loan Approval with a Term of 360 Months by Education")
plt.xlabel("Education Level")
plt.xticks(rotation=0)
plt.ylabel("Number of Approved Loans with a Term of 360 Months")
plt.show()
```

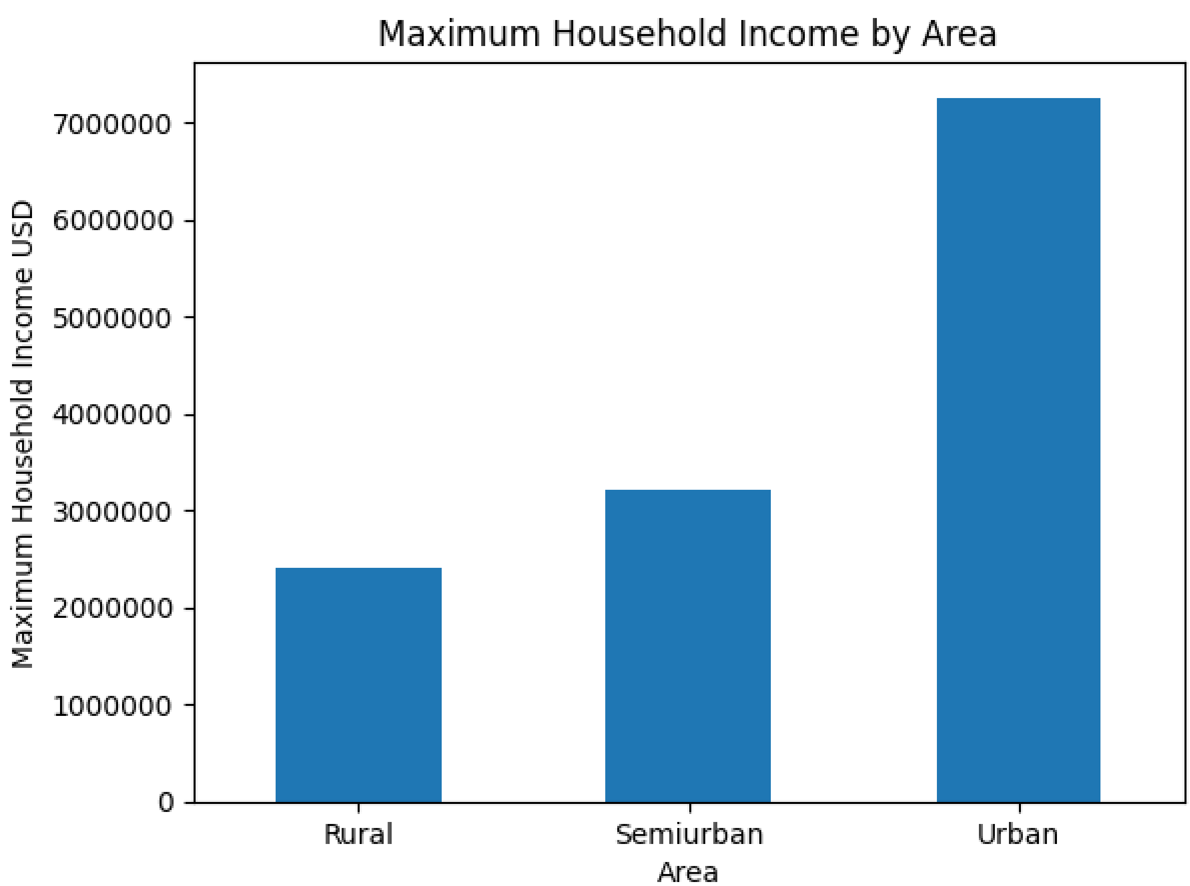
```
Output
Education
Graduate        182
Not Graduate     54
Name: Approval Status, dtype: int64
```



```
#4. What is the maximum 'Household Income' in each 'Area'?
household_inc_by_area = df.groupby('Area')['Household Income'].max()
print(f"Output \n{household_inc_by_area}")

# Plot
household_inc_by_area.plot(kind = 'bar')
plt.title("Maximum Household Income by Area")
plt.xlabel("Area")
plt.xticks(rotation=0)
plt.ylabel("Maximum Household Income USD")
plt.ticklabel_format(style='plain', axis='y')
plt.show()
```

```
Output
Area
Rural        2400000
Semiurban    3200000
Urban        7252900
Name: Household Income, dtype: int64
```



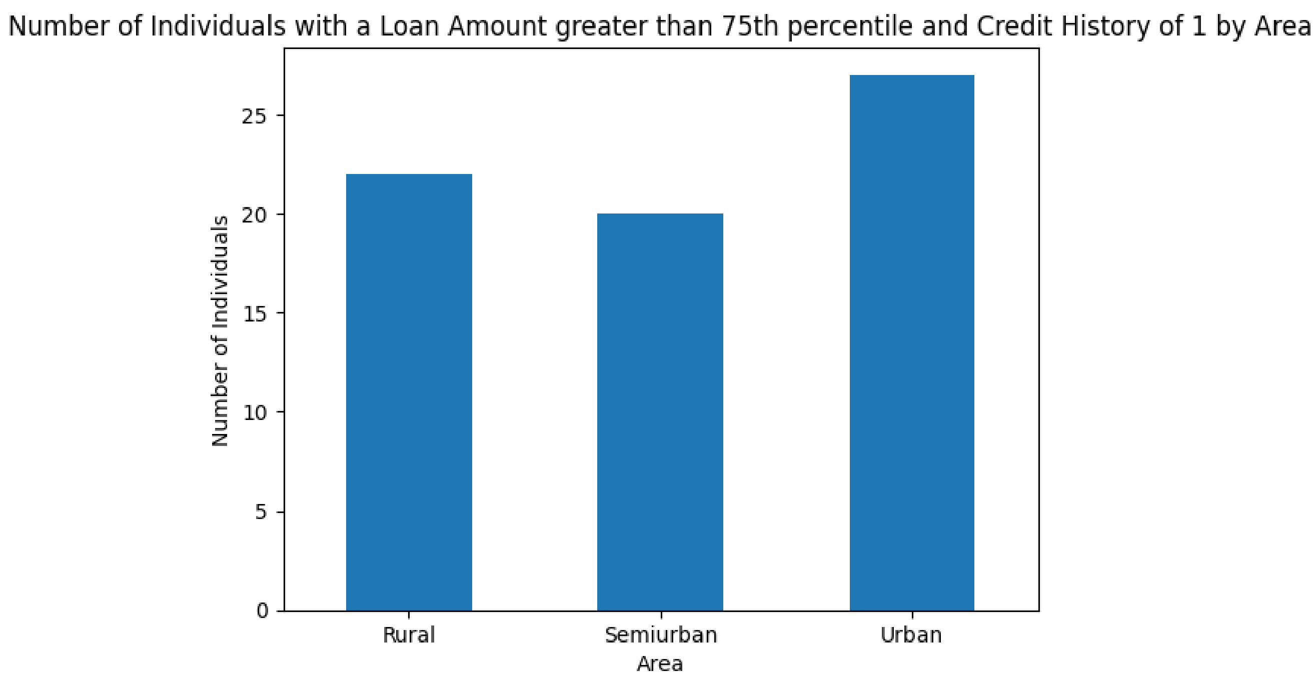
```python
#5.  How many individuals in each 'Area' have a 'Loan Amount' greater than the 75th percentile of 'Loan Amount' and a 'Credit History' of 1.0?

# Calculate Percentiles
loan_75 = df['Loan Amount'].quantile(q = 0.75)

# Filter
num_ind = df.loc[(df['Loan Amount'] > loan_75) & (df['Credit History'] == 1.0)].groupby('Area').size()
print(f"Output: {num_ind}")

# Plot
num_ind.plot(kind = 'bar')
plt.title("Number of Individuals with a Loan Amount greater than 75th percentile and Credit History of 1 by Area")
plt.xlabel("Area")
plt.xticks(rotation=0)
plt.ylabel("Number of Individuals")
plt.ticklabel_format(style='plain', axis='y')
plt.show()
```

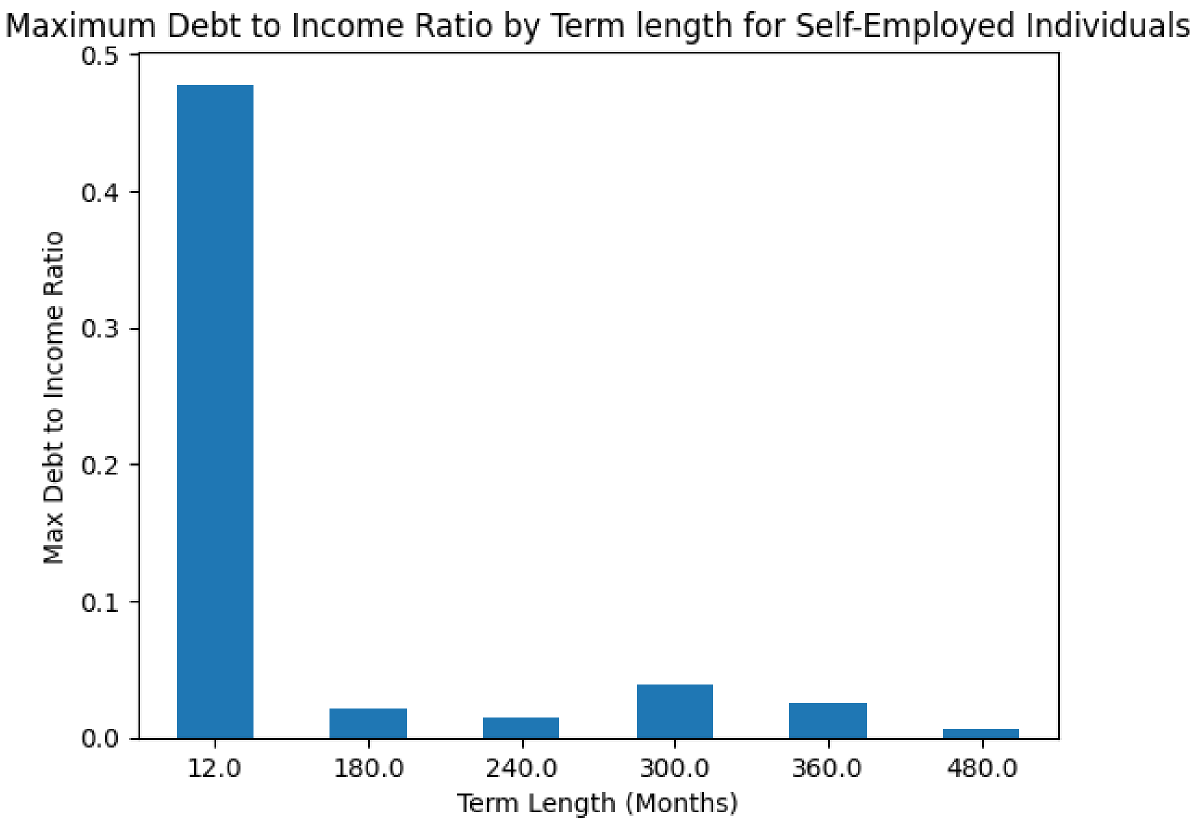
```
Output: Area
Rural        22
Semiurban    20
Urban        27
dtype: int64
```



```python
#6. Among self-employed applicants, what is the maximum 'Debt to Income Ratio' for each term length?
self_emp_dti_by_term = df.loc[df['Self Employed'] == 'Yes'].groupby('Term')['Debt to Income Ratio'].max()
print(f"Output: \n{self_emp_dti_by_term}")

# Plot
self_emp_dti_by_term.plot(kind = 'bar')
plt.title("Maximum Debt to Income Ratio by Term length for Self-Employed Individuals")
plt.xlabel("Term Length (Months)")
plt.xticks(rotation=0)
plt.ylabel("Max Debt to Income Ratio")
plt.ticklabel_format(style='plain', axis='y')
plt.show()
```

```
Output:
Term
12.0     0.477502
180.0    0.021823
240.0    0.015223
300.0    0.039199
360.0    0.025804
480.0    0.006203
Name: Debt to Income Ratio, dtype: float64
```



Filtering

```
#7. How many individuals have a 'Dependents' count of 0 and a 'Loan Amount' less than 500000?
num_ind = len(df.loc[(df['Dependents'] == 0) & (df['Loan Amount'] < 500000)])
print(f"Output: {num_ind} Individuals")
```

```
Output: 194 Individuals
```

```
#8. What is the average 'Coapplicant Income' for individuals who are not self-employed and have a 'Credit History' of 1.0?
avg_coapp_inc = df.loc[(df['Self Employed'] == 'No') & (df['Credit History'] == 1.0)]['Coapplicant Income'].mean()
print(f"Output: ${avg_coapp_inc}")
```

```
Output: $142303.43347639486
```

```
#9. What is the median 'Household Income' for individuals with 'Dependents' greater than 0 and a 'Term' of 360?
med_household_inc = df.loc[(df['Dependents'] > 0) & (df['Term'] == 360.0)]['Household Income'].median()
print(f"Output: ${med_household_inc}")
```

```
Output: $570500.0
```

```
#10. What is the maximum 'Loan Amount' for individuals who are not self-employed and have a 'Credit History' of 1.0?
max_loan_amount = df.loc[(df['Self Employed'] == 'No') & (df['Credit History'] == 1.0)]['Loan Amount'].max()
print(f"Output: ${max_loan_amount}")
```

```
Output: $920000
```

```
#11. What is the average 'Household Income' for individuals who have a 'Loan Amount' greater than the median 'Loan Amount' in the dataset?

#Median Loan Amount
median_loan = df['Loan Amount'].median()
#Filter
avg_household_inc_above_median = df.loc[df['Loan Amount'] > median_loan]['Household Income'].mean()
print(f"Output: ${avg_household_inc_above_median}")
```

```
Output: $777361.4525139665
```

```
#12. How many individuals have an 'Applicant Income' greater than the mean 'Applicant Income' and a 'Loan Amount' less than the median 'Loan Amount'?

# Calculate Mean and Median Values
app_mean = df['Applicant Income'].mean()
loan_med = df['Loan Amount'].median()

#Filter
num_ind = len(df.loc[(df['Applicant Income'] > app_mean) & (df['Loan Amount'] < loan_med)])
print(f"Output: {num_ind} Individuals")
```

```
Output: 28 Individuals
```

```
#13. What is the median 'Household Income' for individuals with 'Dependents' greater than or equal to 2 and a 'Term' of 360?
med_household_inc = df.loc[(df['Dependents'] >= 2) & (df['Term'] == 360.0)]['Household Income'].median()
print(f"Output: ${med_household_inc}")
```

```
Output: $561300.0
```

```python
#14. What is the median 'Debt to Income Ratio' ratio for individuals who are not self-employed and have a 'Credit History' of 1.0?
med_dti = df.loc[(df['Self Employed'] == 'No') & (df['Credit History'] == 1.0)]['Debt to Income Ratio'].median()
print(f"Output: {med_dti}")
```

```
Output: 0.016909347111319868
```

```python
#15. What is the maximum household income among married applicants with more than one dependent?
max_household_inc = df.loc[(df['Married'] == 'Yes') & (df['Dependents'] > 1)]['Household Income'].max()
print(f"Output: ${max_household_inc}")
```

```
Output: $7252900
```

```python
#16. How many applicants in semiurban areas, who are married and have no dependents, have been approved for a loan with a term less than 240 days?
num_app = len(df.loc[(df['Area'] == 'Semiurban') & (df['Married'] == 'Yes') & (df['Dependents'] == 0) & (df['Approval Status'] == 'Yes')
          & (df['Term'] < 240)])
print(f"Output: {num_app} Applicants")
```

```
Output: 3 Applicants
```

```python
#17. Among self-employed applicants, what is the median household income for each combination of gender and education level?
med_household_inc = df.loc[df['Self Employed'] == 'Yes'].groupby(['Gender', 'Education'])['Household Income'].median()
print(f"Output: \n{med_household_inc}")
```

```
Output:
Gender  Education
Female  Graduate        621650.0
Male    Graduate        691050.0
        Not Graduate    558700.0
Name: Household Income, dtype: float64
```

```python
#18. What is the maximum coapplicant income for each combination of gender and education level, among applicants with a credit history of 1.0
#    and household income greater than 500,000?
max_coapp_inc = df.loc[(df['Credit History'] == 1.0) & (df['Household Income'] > 500000)].groupby(['Gender', 'Education'])['Coapplicant Income'].max()
print(f"Output: \n{max_coapp_inc}")
```

```
Output:
Gender  Education
Female  Graduate        1166600
        Not Graduate     357500
Male    Graduate        1450700
        Not Graduate    1398300
Name: Coapplicant Income, dtype: int64
```

Filtering by Percentile

```
#19. How many individuals have an 'Applicant Income' greater than the 75th percentile of 'Applicant Income' and a 'Coapplicant Income'
#    greater than the 90th percentile of 'Coapplicant Income'?

# Calculate Percentiles
app_75 = df['Applicant Income'].quantile(q = 0.75)
coapp_90 = df['Coapplicant Income'].quantile(q = 0.9)

#Filter
num_ind = len(df.loc[(df['Applicant Income'] > app_75) & (df['Coapplicant Income'] > coapp_90)])
print(f"Output: {num_ind} Individuals")
```

```
Output: 10 Individuals
```

```
#20. How many individuals have a 'Loan Amount' greater than the 90th percentile of 'Loan Amount' and a 'Term' of 360,
#    and are self-employed?

# Calculate Percentile
loan_90 = df['Loan Amount'].quantile(q = 0.9)

# Filter and Count
num_ind = len(df.loc[(df['Loan Amount'] > loan_90) & (df['Term'] == 360.0) & (df['Self Employed'] == 'Yes')])
print(f"Output: {num_ind} Individuals")
```

```
Output: 6 Individuals
```

```
#21. How many individuals in each 'Area' have a 'Term' less than the 25th percentile of 'Debt to Income Ratio'
#    and an 'Approval Status' of 'Yes'?
dti_25 = df['Debt to Income Ratio'].quantile(q = 0.25)

df.loc[(df['Debt to Income Ratio'] < dti_25) & (df['Approval Status'] == 'Yes')].groupby('Area').size()
```

```
Area
Rural        21
Semiurban    18
Urban        25
dtype: int64
```

Grouping and Sorting

```
#22. What is the average 'Loan Amount' for individuals who are self-employed and have a 'Credit History' of 1.0, grouped by their 'Education' level?
avg_loan_amount = df.loc[(df['Self Employed'] == 'Yes') & (df['Credit History'] == 1.0)].groupby('Education')['Loan Amount'].mean()
print(f"Output: ${avg_loan_amount}")
```

```
Output: $Education
Graduate        283846.153846
Not Graduate    228857.142857
Name: Loan Amount, dtype: float64
```

```python
#23. Can you provide the top 3 records with the highest 'Debt to Income Ratio' , sorted in descending order?
dti_sorted = df.sort_values('Debt to Income Ratio', ascending = False)
dti_top_3 = dti_sorted.head(3)
print(dti_top_3)
```

```
    Gender Married  Dependents     Education Self Employed  Applicant Income  \
325   Male      No         0.0      Graduate            No            287500   
144   Male     Yes         2.0      Graduate           Yes           1089000   
216   Male     Yes         0.0  Not Graduate            No            274700   

     Coapplicant Income  Loan Amount  Term  Credit History       Area  \
325              241600       190000   6.0             0.0  Semiurban   
144                   0       520000  12.0             1.0      Rural   
216              245800       236000  36.0             1.0  Semiurban   

     Household Income  Total Yearly Debt  Debt to Income Ratio Risk Level  \
325            529100      380000.000000              0.718201       High   
144           1089000      520000.000000              0.477502       High   
216            520500       78666.666667              0.151137     Medium   

    Approval Status  
325              No  
144              No  
216             Yes  
```

```python
#24. What is the median household income for each area, sorted in descending order?
med_household_inc_by_area = df.groupby('Area')['Household Income'].median().sort_values(ascending = False)
print(f"Output: \n{med_household_inc_by_area}")
```

```
Output: 
Area
Rural        547400.0
Urban        529850.0
Semiurban    487550.0
Name: Household Income, dtype: float64
```

```python
#25. What is the median coapplicant income for each combination of gender, education level, and credit history category, sorted in
#    descending order of median coapplicant income?
med_coapp_inc = df.groupby(['Gender', 'Education', 'Credit History'])['Coapplicant Income'].median().sort_values(ascending = False)
print(f"Output: \n{med_coapp_inc}")
```

```
Output:
Gender  Education     Credit History
Female  Graduate      0.0               200000.0
        Not Graduate  0.0               170000.0
Male    Graduate      0.0               140850.0
        Not Graduate  1.0               135000.0
        Graduate      1.0               134050.0
        Not Graduate  0.0                52800.0
Female  Graduate      1.0                    0.0
        Not Graduate  1.0                    0.0
Name: Coapplicant Income, dtype: float64
```

```python
#26. What is the average loan amount for each combination of gender, education level, and self-employed status?
avg_loan_amount = df.groupby(['Gender', 'Education', 'Self Employed'])['Loan Amount'].mean()
print(f"Output: \n{avg_loan_amount}")
```

```
Output:
Gender  Education     Self Employed
Female  Graduate      No               248448.979592
                      Yes              342000.000000
        Not Graduate  No               229000.000000
Male    Graduate      No               280340.659341
                      Yes              311250.000000
        Not Graduate  No               228867.924528
                      Yes              266285.714286
Name: Loan Amount, dtype: float64
```

```python
#27. Among individuals with 'Self Employed' status, what is the median 'Total Yearly Debt' for each 'Risk Level',
#    grouped by 'Education'?
self_emp_ind = df.loc[df['Self Employed'] == 'Yes'].groupby(['Risk Level', 'Education'])['Total Yearly Debt'].median()
print(f"Output: \n{self_emp_ind}")
```

```
Output:
Risk Level  Education
High        Graduate        24566.666667
            Not Graduate    13266.666667
Medium      Graduate        10000.000000
            Not Graduate     7533.333333
Name: Total Yearly Debt, dtype: float64
```

```
#28. What is the average debt-to-income ratio for individuals grouped by their 'Education' level?
dti_by_ed = df.groupby('Education')['Debt to Income Ratio'].mean()
print(f"Output: \n{dti_by_ed}")
```

```
Output:
Education
Graduate        0.021600
Not Graduate    0.020416
Name: Debt to Income Ratio, dtype: float64
```

```
#29. How many individuals with a debt-to-income ratio above 0.05 have been approved for a loan
#    ('Approval Status' = 'Yes'), grouped by their 'Gender'?
num_ind = df.loc[(df['Debt to Income Ratio'] > 0.05) & (df['Approval Status'] == 'Yes')].groupby('Gender').size()
print(f"Output: \n{num_ind}")
```

```
Output:
Gender
Female    2
Male      4
dtype: int64
```

```
#30. Among individuals with 'Self Employed' status, what is the median debt-to-income ratio for each
#    'Dependents' category?
med_dti = df.loc[df['Self Employed'] == 'Yes'].groupby('Dependents')['Debt to Income Ratio'].median()
print(f"Output: \n{med_dti}")
```

```
Output:
Dependents
0.0    0.015150
1.0    0.015223
2.0    0.016800
3.0    0.013020
4.0    0.015111
Name: Debt to Income Ratio, dtype: float64
```