```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
import pandas as pd
df = pd.read_csv('/content/drive/MyDrive/trainity assignments/application_data.csv')
```

```
df.shape
```

```
(49999, 122)
```

```
df.describe()
```

	SK_ID_CURR	TARGET	CNT_CHILDREN	AMT_INCOME_TOTAL	AMT_CREDIT	AMT_ANNUITY	AMT_GOODS_PRICE	REGION_POPULATION_RI
count	49999.000000	49999.000000	49999.000000	4.999900e+04	4.999900e+04	49998.000000	4.996100e+04	49999
mean	129013.210584	0.080522	0.419848	1.707676e+05	5.997006e+05	27107.377355	5.390600e+05	0
std	16690.512048	0.272102	0.724039	5.318191e+05	4.024154e+05	14562.944435	3.698533e+05	0
min	100002.000000	0.000000	0.000000	2.565000e+04	4.500000e+04	2052.000000	4.500000e+04	0
25%	114570.500000	0.000000	0.000000	1.125000e+05	2.700000e+05	16456.500000	2.385000e+05	0
50%	129076.000000	0.000000	0.000000	1.458000e+05	5.147775e+05	24939.000000	4.500000e+05	0
75%	143438.500000	0.000000	1.000000	2.025000e+05	8.086500e+05	34596.000000	6.795000e+05	0
max	157875.000000	1.000000	11.000000	1.170000e+08	4.050000e+06	258025.500000	4.050000e+06	0

8 rows × 106 columns

```
df.duplicated().sum()
```

```
0
```

```
null_percentage = (df.isnull().sum() / len(df)) * 100
null_percentage.sort_values(ascending=False)
```

	0
COMMONAREA_MEDI	69.921398
COMMONAREA_AVG	69.921398
COMMONAREA_MODE	69.921398
NONLIVINGAPARTMENTS_MODE	69.429389
NONLIVINGAPARTMENTS_AVG	69.429389
...	...
NAME_HOUSING_TYPE	0.000000
NAME_FAMILY_STATUS	0.000000
NAME_EDUCATION_TYPE	0.000000
NAME_INCOME_TYPE	0.000000
SK_ID_CURR	0.000000

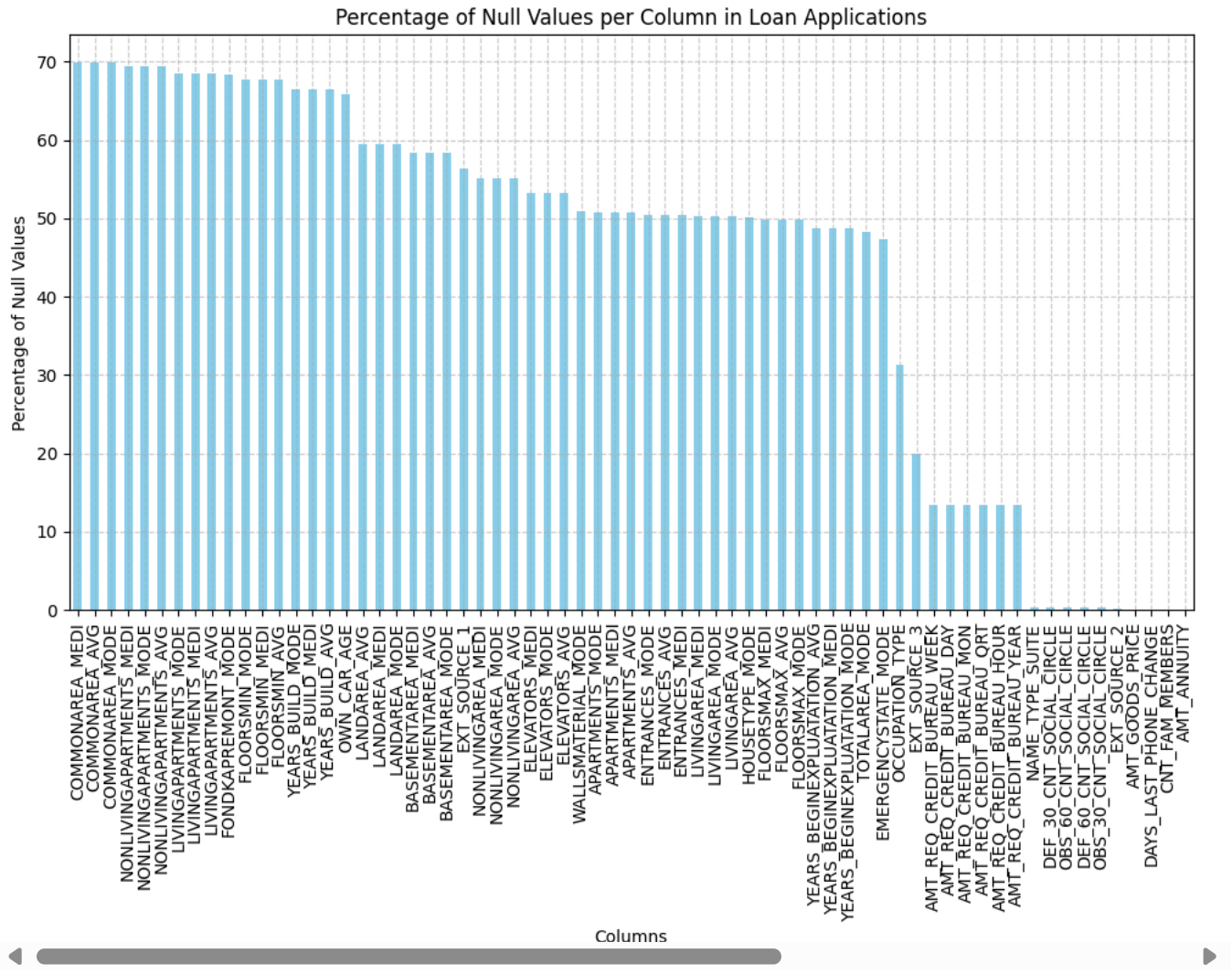
122 rows × 1 columns

```
null_percentage_filtered = null_percentage[null_percentage > 0]
```

```
null_percentage_filtered = null_percentage_filtered.sort_values(ascending=False)
```

```
import matplotlib.pyplot as plt
plt.figure(figsize=(10, 8))
null_percentage_filtered.plot(kind='bar', color='skyblue')
plt.title('Percentage of Null Values per Column in Loan Applications')
plt.xlabel('Columns')
plt.ylabel('Percentage of Null Values')
plt.xticks(rotation=90)
```

```
plt.grid(True, linestyle='--', alpha=0.6)
plt.tight_layout()
plt.show()
```



Generate a slider using jupyter widgets Close

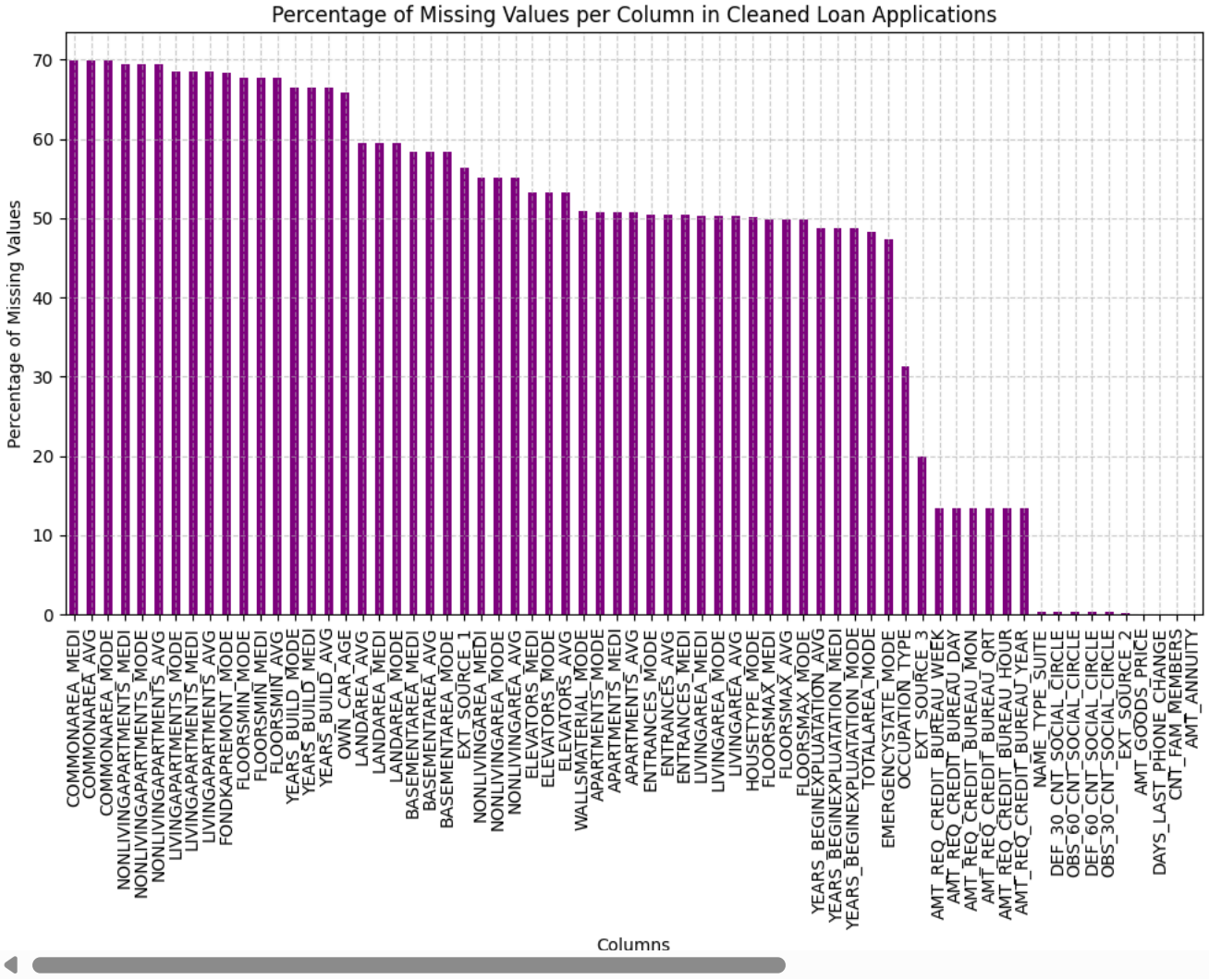
```
drop_columns = null_percentage[null_percentage > 40].index


df_cleaned = df.drop(columns=drop_columns)


original_shape = df.shape
cleaned_shape = df_cleaned.shape
df_cleaned.shape
```

```
(49999, 73)
```

```
import numpy as np


negative_values_columns = {column: (df_cleaned[column] < 0).any()
                           for column in df_cleaned.select_dtypes(include=[np.number]).columns
                           if (df_cleaned[column] < 0).any()}


for column in negative_values_columns:
    df_cleaned[column] = df_cleaned[column].abs() / 365


df_cleaned[['DAYS_BIRTH', 'DAYS_EMPLOYED', 'DAYS_REGISTRATION', 'DAYS_ID_PUBLISH', 'DAYS_LAST_PHONE_CHANGE']].head()
```

	DAYS_BIRTH	DAYS_EMPLOYED	DAYS_REGISTRATION	DAYS_ID_PUBLISH	DAYS_LAST_PHONE_CHANGE
0	25.920548	1.745205	9.994521	5.808219	3.106849
1	45.931507	3.254795	3.249315	0.797260	2.268493
2	52.180822	0.616438	11.671233	6.934247	2.232877
3	52.068493	8.326027	26.939726	6.676712	1.690411
4	54.608219	8.323288	11.810959	9.473973	3.030137

```
plt.figure(figsize=(10, 8))
null_percentage_filtered.plot(kind='bar', color='purple')
plt.title('Percentage of Missing Values per Column in Cleaned Loan Applications')
plt.xlabel('Columns')
plt.ylabel('Percentage of Missing Values')
plt.xticks(rotation=90)
plt.grid(True, linestyle='--', alpha=0.6)
plt.tight_layout()
plt.show()
```




```
# List of columns you wanted to drop
document_flag_columns = [
    'FLAG_DOCUMENT_2', 'FLAG_DOCUMENT_3', 'FLAG_DOCUMENT_4', 'FLAG_DOCUMENT_5', 'FLAG_DOCUMENT_6',
    'FLAG_DOCUMENT_7', 'FLAG_DOCUMENT_8', 'FLAG_DOCUMENT_9', 'FLAG_DOCUMENT_10', 'FLAG_DOCUMENT_11',
    'FLAG_DOCUMENT_12', 'FLAG_DOCUMENT_13', 'FLAG_DOCUMENT_14', 'FLAG_DOCUMENT_15', 'FLAG_DOCUMENT_16',
    'FLAG_DOCUMENT_17', 'FLAG_DOCUMENT_18', 'FLAG_DOCUMENT_19', 'FLAG_DOCUMENT_20', 'FLAG_DOCUMENT_21',
    'FLAG_WORK_PHONE', 'FLAG_CONT_MOBILE', 'FLAG_PHONE', 'EXT_SOURCE_2', 'EXT_SOURCE_3']


# Adjusting the list to include only columns still present in the dataset
document_flag_columns_adjusted = [col for col in document_flag_columns if col in df_cleaned.columns]


# Drop these columns from the dataset
df_reduced = df_cleaned.drop(columns=document_flag_columns_adjusted)
```

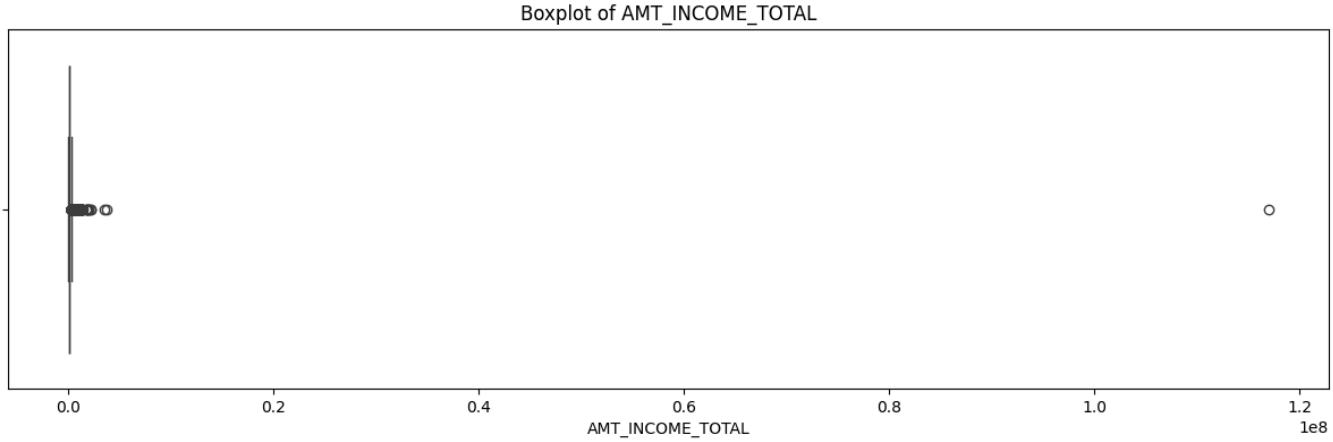
```
# Print the new shape of the DataFrame and the columns that were actually dropped
print("New DataFrame shape:", df_reduced.shape)
print("Columns dropped:", document_flag_columns_adjusted)
```

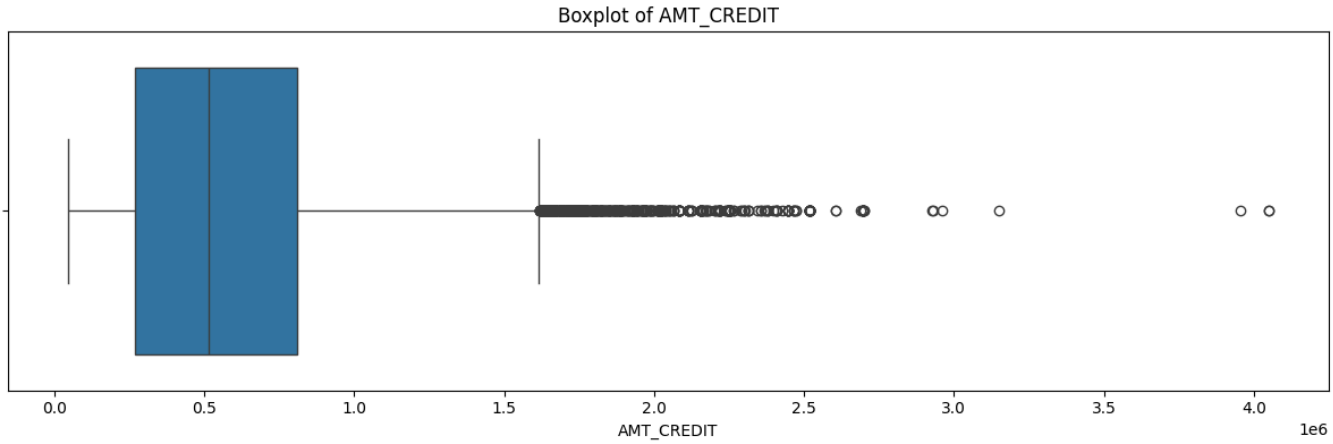
```
New DataFrame shape: (49999, 48)
Columns dropped: ['FLAG_DOCUMENT_2', 'FLAG_DOCUMENT_3', 'FLAG_DOCUMENT_4', 'FLAG_DOCUMENT_5', 'FLAG_DOCUMENT_6', 'FLAG_DOCUMENT_7',
```

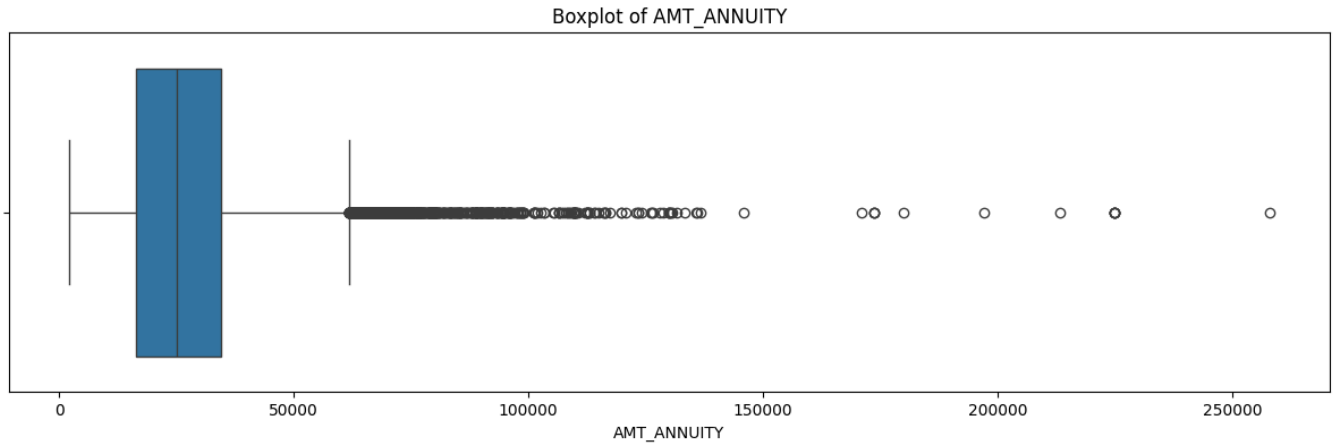
```
#filling missing occupation types
df_reduced.loc[:, 'OCCUPATION_TYPE'] = df_reduced['OCCUPATION_TYPE'].fillna('Unknown')


#handeling credit bureaeu data
credit_bureau_columns = ['AMT_REQ_CREDIT_BUREAU_HOUR', 'AMT_REQ_CREDIT_BUREAU_DAY',
                         'AMT_REQ_CREDIT_BUREAU_WEEK', 'AMT_REQ_CREDIT_BUREAU_MON',
                         'AMT_REQ_CREDIT_BUREAU_QRT', 'AMT_REQ_CREDIT_BUREAU_YEAR']
for column in credit_bureau_columns:
    df_reduced.loc[:, column] = df_reduced[column].fillna(0)


#Filling Other Missing Values: For other columns with fewer missing values, I used the mode for categorical data and the median for cont
#For categorical data (like NAME_TYPE_SUITE), I filled missing entries with the most common value (mode).
#For numerical data (such as AMT_GOODS_PRICE), I used the median value.
for column in ['NAME_TYPE_SUITE', 'OBS_30_CNT_SOCIAL_CIRCLE', 'DEF_30_CNT_SOCIAL_CIRCLE',
               'OBS_60_CNT_SOCIAL_CIRCLE', 'DEF_60_CNT_SOCIAL_CIRCLE', 'AMT_GOODS_PRICE',
               'AMT_ANNUITY', 'CNT_FAM_MEMBERS', 'DAYS_LAST_PHONE_CHANGE']:
    if df_reduced[column].dtype == 'object':
        mode_value = df_reduced[column].mode()[0]
        df_reduced.loc[:, column] = df_reduced[column].fillna(mode_value)
    else:
        median_value = df_reduced[column].median()
        df_reduced.loc[:, column] = df_reduced[column].fillna(median_value)


df_reduced.isnull().sum().max()
```

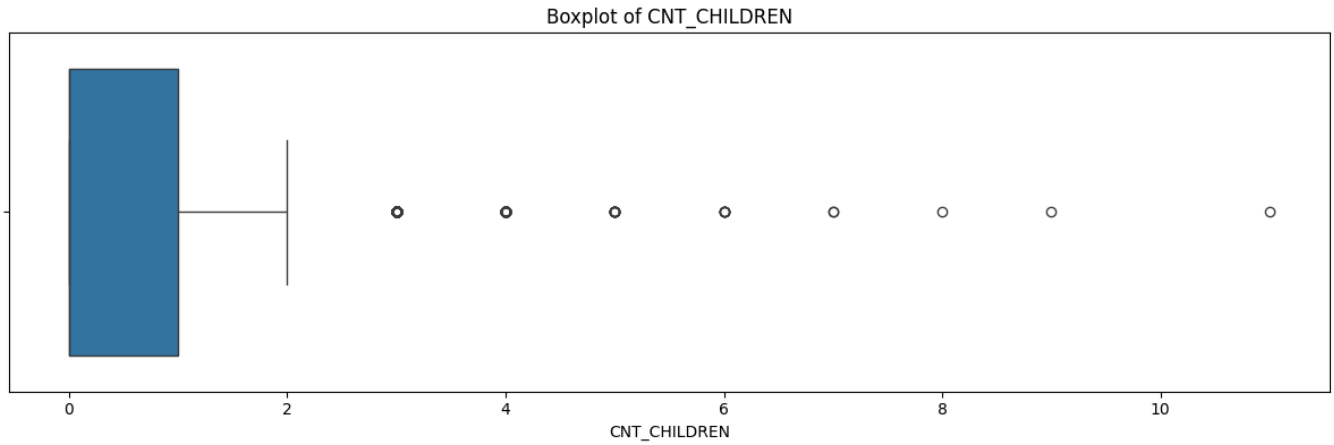
```
0
```

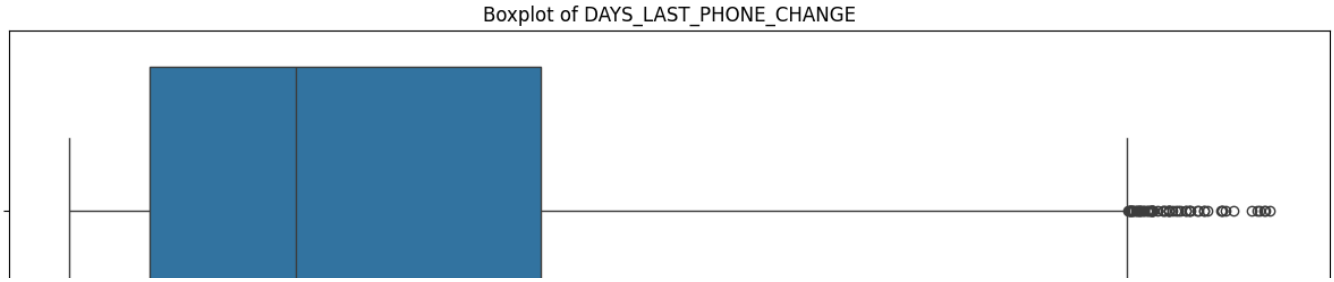
```
file_path = '/content/drive/My Drive/df_reduced.csv'
df_reduced.to_csv(file_path, index=False)


import seaborn as sns
# A simple function to plot boxplots for given numerical columns
def plot_outliers(df_reduced, columns):
    plt.figure(figsize=(12, len(columns) * 4))  # Adjust the figure size for better visibility
    for i, col in enumerate(columns):
        plt.subplot(len(columns), 1, i + 1)  # Create a subplot for each column
        sns.boxplot(x=df_reduced[col])  # Plot a boxplot for the column
        plt.title(f'Boxplot of {col}')  # Give the plot a title for clarity
    plt.tight_layout()  # Adjust subplots to fit into the figure area nicely
    plt.show()

# List of numerical columns you might want to check for outliers
numerical_cols = ['AMT_INCOME_TOTAL', 'AMT_CREDIT', 'AMT_ANNUITY', 'CNT_CHILDREN',
                  'DAYS_LAST_PHONE_CHANGE', 'AMT_REQ_CREDIT_BUREAU_YEAR']

# Call the function with the dataframe and the list of columns
plot_outliers(df_reduced, numerical_cols)
```

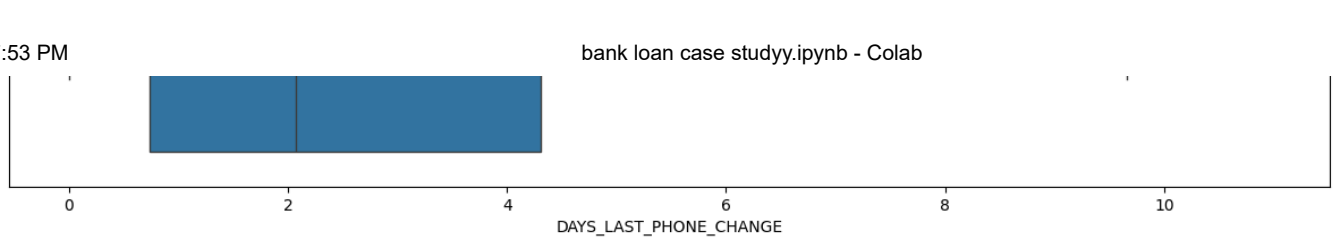

Boxplot of AMT_INCOME_TOTAL
0.0
0.2
0.4
0.6
0.8
1.0
1.2
AMT_INCOME_TOTAL
1e8

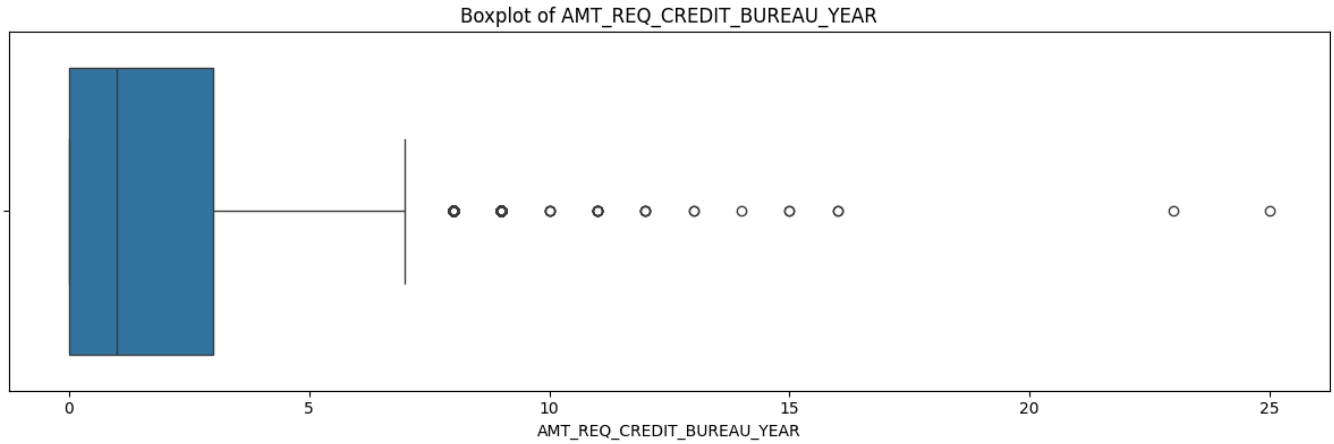

Boxplot of AMT_CREDIT
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
AMT_CREDIT
1e6


Boxplot of AMT_ANNUITY
0
50000
100000
150000
200000
250000
AMT_ANNUITY


Boxplot of CNT_CHILDREN
0
2
4
6
8
10
CNT_CHILDREN


Boxplot of DAYS_LAST_PHONE_CHANGE


0
2
4
6
8
10
DAYS_LAST_PHONE_CHANGE


Boxplot of AMT_REQ_CREDIT_BUREAU_YEAR
0
5
10
15
20
25
AMT_REQ_CREDIT_BUREAU_YEAR

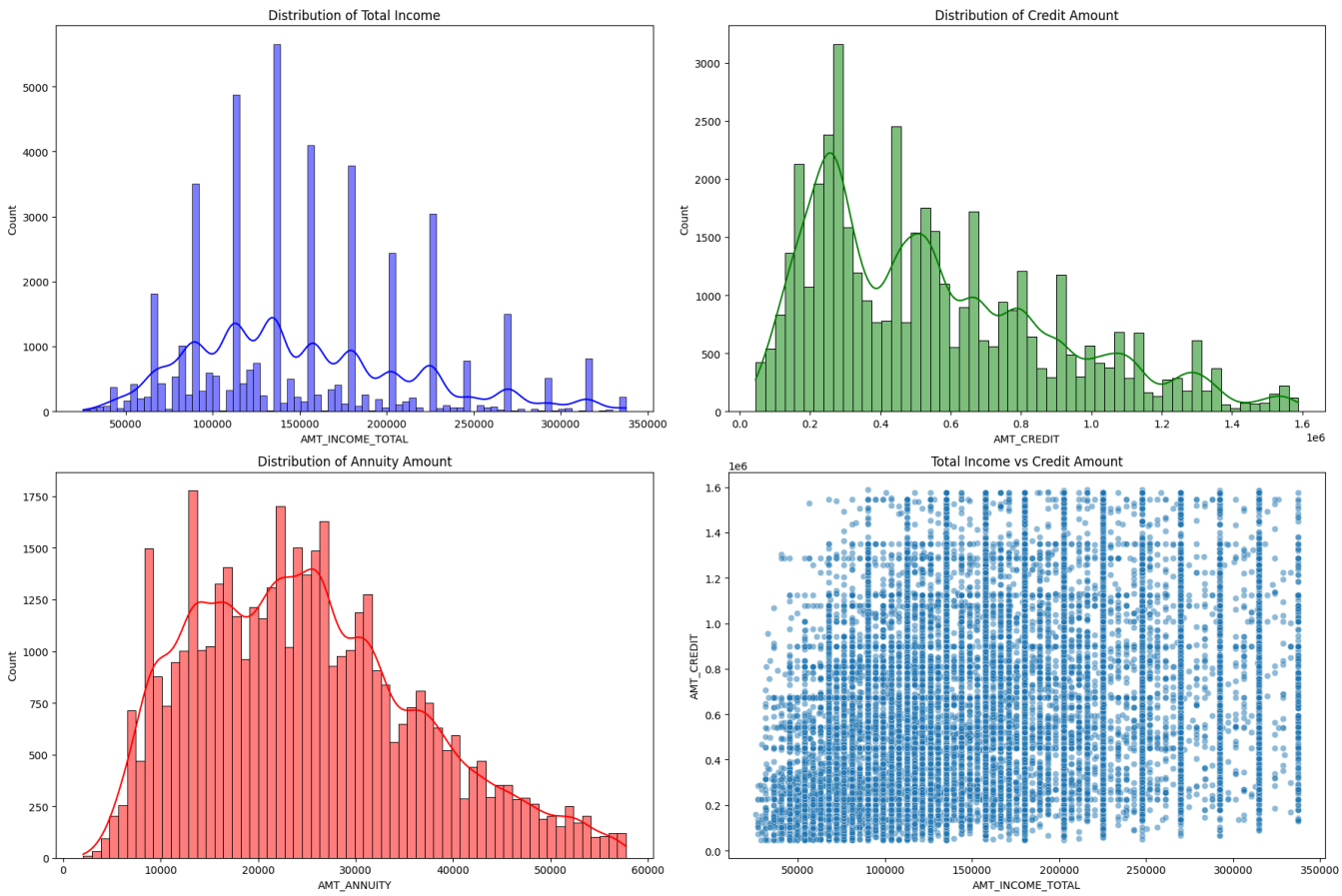
```
def remove_outliers(df_reduced, columns):
    for col in columns:
        Q1 = df_reduced[col].quantile(0.25)
        Q3 = df_reduced[col].quantile(0.75)
        IQR = Q3 - Q1
        lower_bound = Q1 - 1.5 * IQR
        upper_bound = Q3 + 1.5 * IQR

# Filter out the outliers from the dataframe
        df_reduced = df_reduced[(df_reduced [col] >= lower_bound) & (df_reduced [col] <= upper_bound)]
    return df_reduced

# Columns to clean for outliers
columns_to_clean = ['AMT_INCOME_TOTAL', 'AMT_CREDIT', 'AMT_ANNUITY', 'CNT_CHILDREN',
                    'DAYS_LAST_PHONE_CHANGE', 'AMT_REQ_CREDIT_BUREAU_YEAR']

# Apply the outlier removal function
df_clean = remove_outliers(df_reduced, columns_to_clean)

# Show how much data remains after removing outliers
print(f"Original data size: {df.shape[0]} entries")
print(f"Cleaned data size: {df_clean.shape[0]} entries, after removing outliers")

# Optionally, display the first few rows of the cleaned dataframe
df_clean.head()
```

```
Original data size: 49999 entries
Cleaned data size: 44909 entries, after removing outliers
```

	SK_ID_CURR	TARGET	NAME_CONTRACT_TYPE	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	AMT_CREDIT	A
0	100002	1	Cash loans	M	N	Y	0	202500.0	406597.5	
1	100003	0	Cash loans	F	N	N	0	270000.0	1293502.5	
2	100004	0	Revolving loans	M	Y	Y	0	67500.0	135000.0	
3	100006	0	Cash loans	F	N	Y	0	135000.0	312682.5	
4	100007	0	Cash loans	M	N	Y	0	121500.0	513000.0	

5 rows × 48 columns

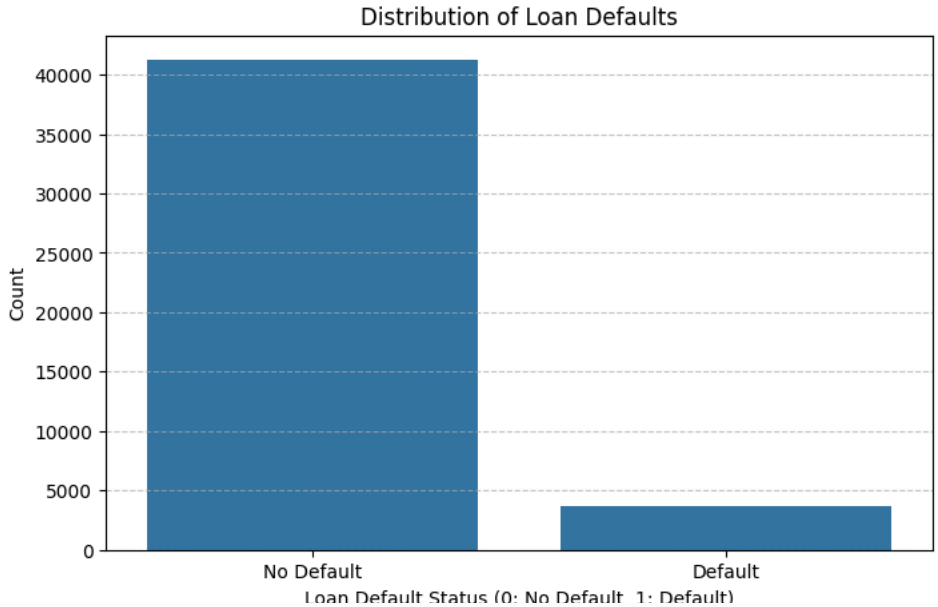
```
# Setting up the visualizations for the cleaned data

plt.figure(figsize=(18, 12))

# Histogram for AMT_INCOME_TOTAL
plt.subplot(2, 2, 1)
sns.histplot(df_clean['AMT_INCOME_TOTAL'], kde=True, color='blue')
plt.title('Distribution of Total Income')

# Histogram for AMT_CREDIT
plt.subplot(2, 2, 2)
sns.histplot(df_clean['AMT_CREDIT'], kde=True, color='green')
plt.title('Distribution of Credit Amount')

# Histogram for AMT_ANNUITY
plt.subplot(2, 2, 3)
sns.histplot(df_clean['AMT_ANNUITY'], kde=True, color='red')
plt.title('Distribution of Annuity Amount')

# Scatter plot for AMT_INCOME_TOTAL vs AMT_CREDIT
plt.subplot(2, 2, 4)
sns.scatterplot(x='AMT_INCOME_TOTAL', y='AMT_CREDIT', data=df_clean, alpha=0.5)
plt.title('Total Income vs Credit Amount')

plt.tight_layout()
plt.show()
```




```
# Analyzing the data imbalance in the 'TARGET' column which indicates loan defaults (1) and non-defaults (0)
target_counts = df_clean['TARGET'].value_counts()
imbalance_ratio = target_counts[0] / target_counts[1]

# Display the counts of each class and the calculated ratio of imbalance
target_counts, imbalance_ratio
```

```
(TARGET
 0    41238
 1     3671
 Name: count, dtype: int64,
 11.233451375646963)
```

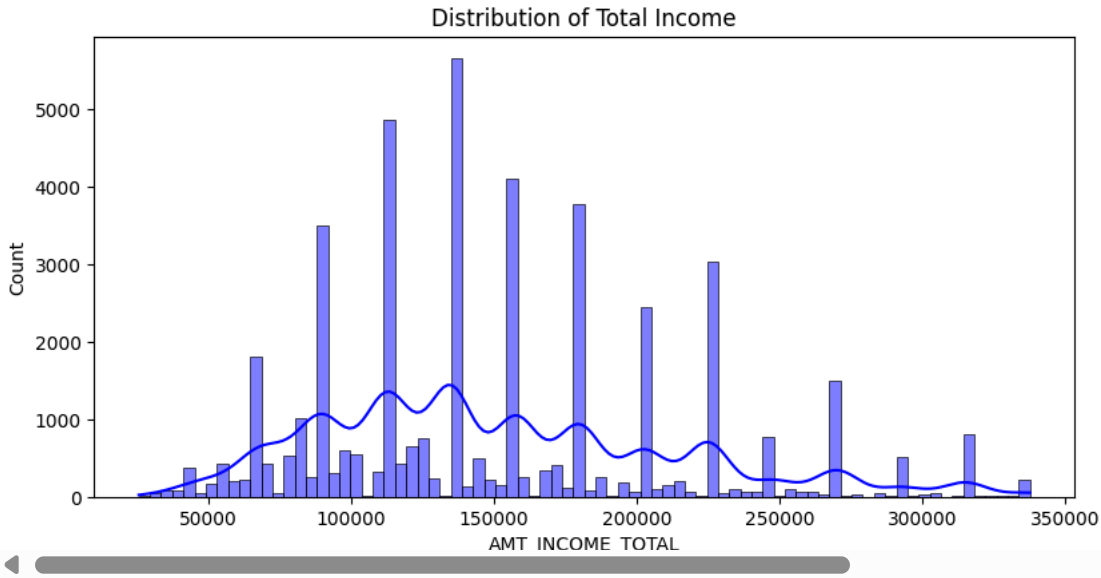
```
# Visualizing the data imbalance in the 'TARGET' column
plt.figure(figsize=(8, 5))
sns.countplot(x='TARGET', data=df_clean)
plt.title('Distribution of Loan Defaults')
plt.xlabel('Loan Default Status (0: No Default, 1: Default)')
plt.ylabel('Count')
plt.xticks([0, 1], ['No Default', 'Default'])
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.show()
```



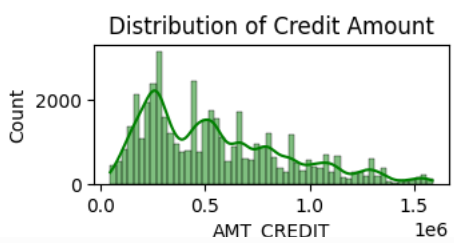

```
# Assuming 'target_counts' holds the counts of each class from df_clean['TARGET'].value_counts()
imbalance_ratio = target_counts[0] / target_counts[1]
print("The ratio of non-defaults to defaults is:", imbalance_ratio)
```

```
The ratio of non-defaults to defaults is: 11.233451375646963
```

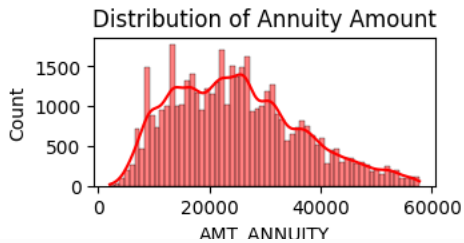
```
# Setting up univariate analysis for several key variables
plt.figure(figsize=(16, 12))

# Histogram for AMT_INCOME_TOTAL
plt.subplot(3, 2, 1)
sns.histplot(df_clean['AMT_INCOME_TOTAL'], kde=True, color='blue')
plt.title('Distribution of Total Income')
plt.tight_layout()
plt.show()
```



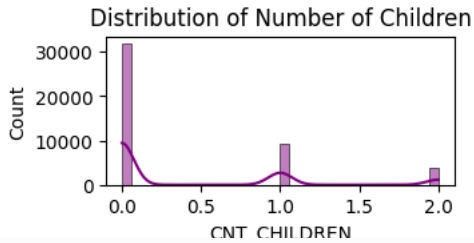

```
# Histogram for AMT_CREDIT
plt.subplot(3, 2, 2)
sns.histplot(df_clean['AMT_CREDIT'], kde=True, color='green')
plt.title('Distribution of Credit Amount')
plt.tight_layout()
plt.show()
```



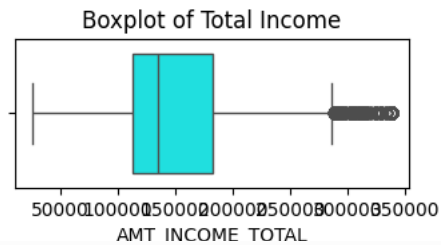

```
# Histogram for AMT_ANNUITY
plt.subplot(3, 2, 3)
sns.histplot(df_clean['AMT_ANNUITY'], kde=True, color='red')
plt.title('Distribution of Annuity Amount')
plt.tight_layout()
plt.show()
```



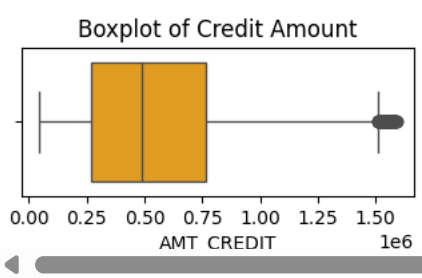

```
# Histogram for CNT_CHILDREN
plt.subplot(3, 2, 4)
sns.histplot(df_clean['CNT_CHILDREN'], kde=True, color='purple')
plt.title('Distribution of Number of Children')
plt.tight_layout()
plt.show()
```




```
# Boxplot for AMT_INCOME_TOTAL
plt.subplot(3, 2, 5)
sns.boxplot(x=df_clean['AMT_INCOME_TOTAL'], color='cyan')
plt.title('Boxplot of Total Income')
plt.tight_layout()
plt.show()
```



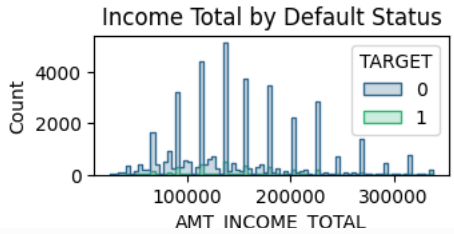

```
# Boxplot for AMT_CREDIT
plt.subplot(3, 2, 6)
sns.boxplot(x=df_clean['AMT_CREDIT'], color='orange')
plt.title('Boxplot of Credit Amount')
plt.tight_layout()
plt.show()
```



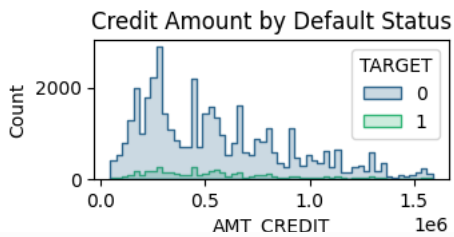

```
#segmented univerate analysis
# Setting up segmented univariate analysis for the same variables, split by default status
plt.figure(figsize=(16, 18))
```

```
<Figure size 1600x1800 with 0 Axes>
```

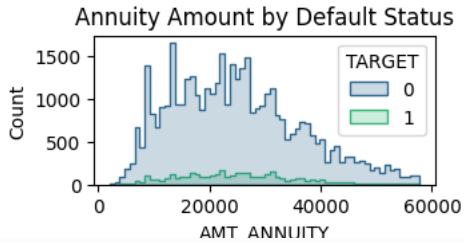
```
# Histogram for AMT_INCOME_TOTAL segmented by TARGET
plt.subplot(3, 2, 1)
sns.histplot(data=df_clean, x='AMT_INCOME_TOTAL', hue='TARGET', element='step', palette='viridis')
plt.title('Income Total by Default Status')
plt.tight_layout()
plt.show()
```



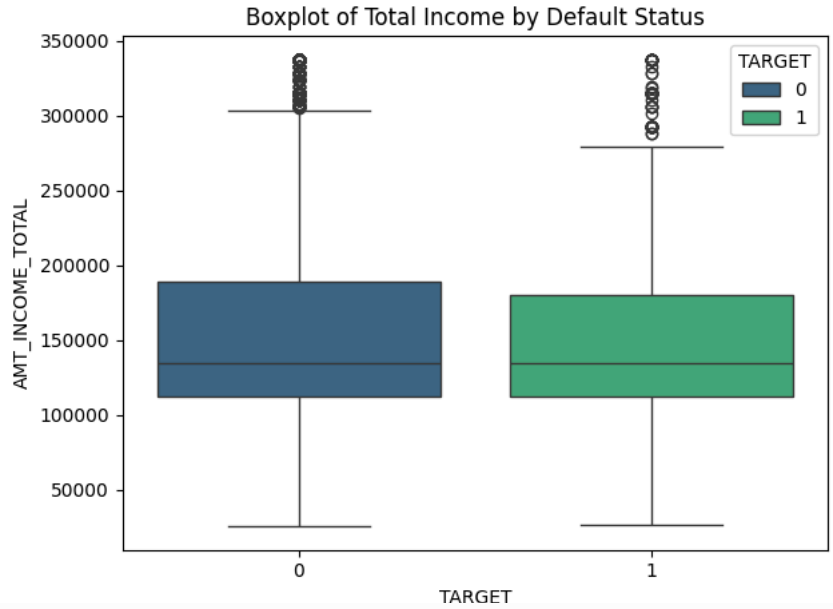

```
# Histogram for AMT_CREDIT segmented by TARGET
plt.subplot(3, 2, 2)
sns.histplot(data=df_clean, x='AMT_CREDIT', hue='TARGET', element='step', palette='viridis')
plt.title('Credit Amount by Default Status')
plt.tight_layout()
plt.show()
```



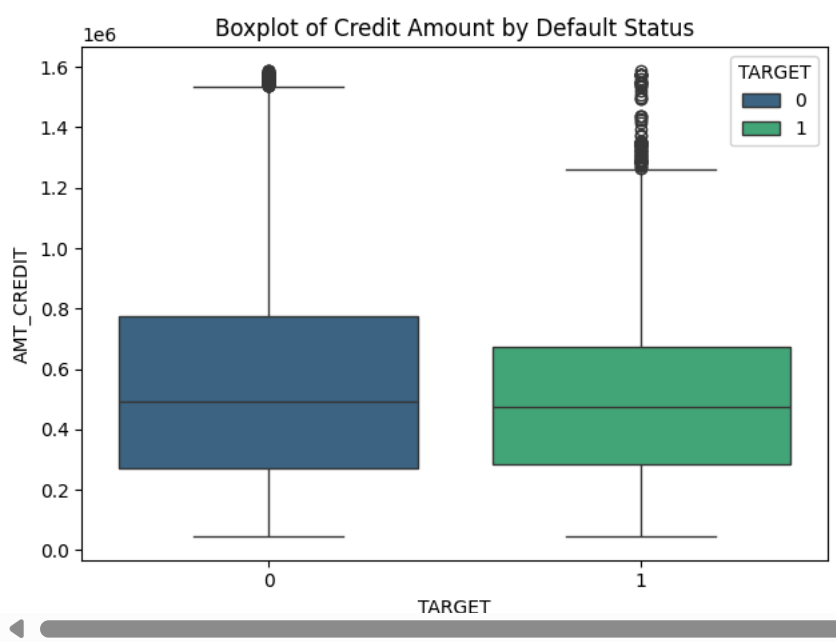

```
# Histogram for AMT_ANNUITY segmented by TARGET
plt.subplot(3, 2, 3)
sns.histplot(data=df_clean, x='AMT_ANNUITY', hue='TARGET', element='step', palette='viridis')
plt.title('Annuity Amount by Default Status')
plt.tight_layout()
plt.show()
```



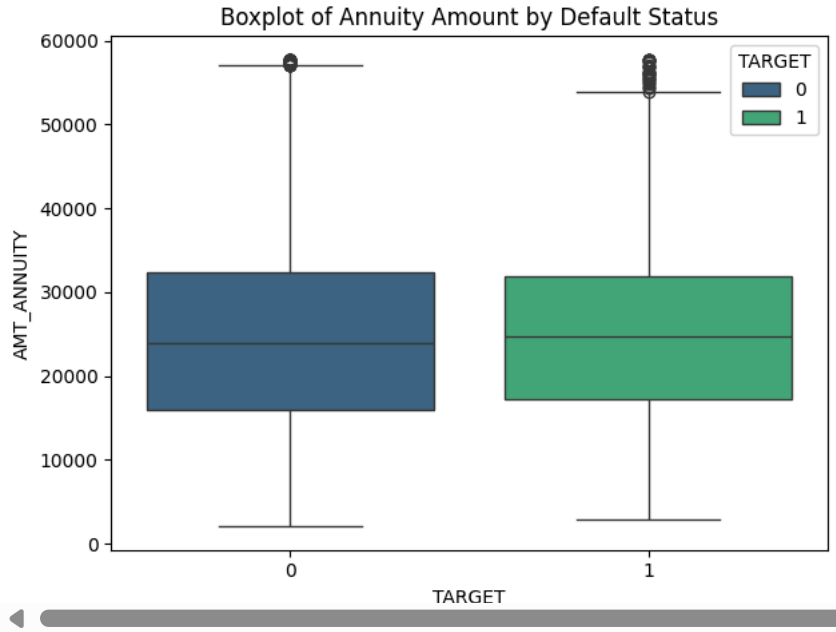

```
sns.boxplot(x='TARGET', y='AMT_INCOME_TOTAL', data=df_clean, hue='TARGET', palette='viridis', dodge=False)
plt.title('Boxplot of Total Income by Default Status')
plt.tight_layout()
plt.show()
```




```
# Boxplot for AMT_CREDIT segmented by TARGET
sns.boxplot(x='TARGET', y='AMT_CREDIT', data=df_clean, hue='TARGET', palette='viridis', dodge=False)
plt.title('Boxplot of Credit Amount by Default Status')
plt.tight_layout()
plt.show()
```



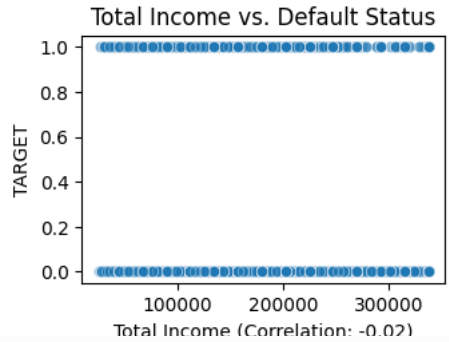

```
# Boxplot for AMT_ANNUITY segmented by TARGET
sns.boxplot(x='TARGET', y='AMT_ANNUITY', data=df_cleaned, hue='TARGET', palette='viridis', dodge=False)
plt.title('Boxplot of Annuity Amount by Default Status')
plt.tight_layout()
plt.show()
```



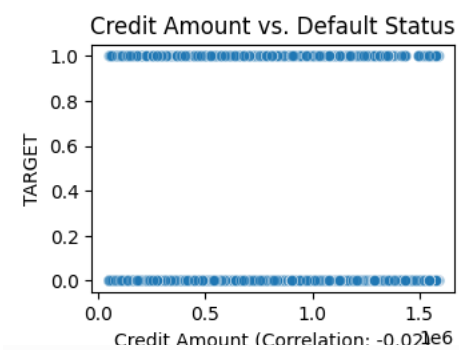

```
#bivariate analysis
# Setting up the figure for multiple plots
plt.figure(figsize=(16, 12))
```

```
<Figure size 1600x1200 with 0 Axes>
```

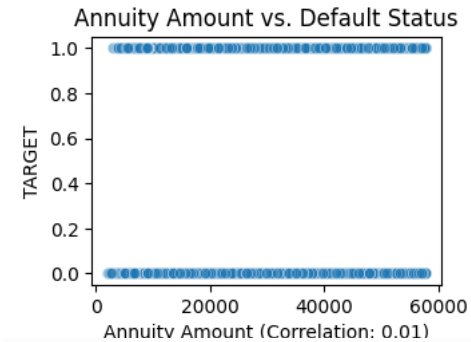
```
# Scatter plot and correlation for AMT_INCOME_TOTAL vs TARGET
plt.subplot(2, 2, 1)
sns.scatterplot(x='AMT_INCOME_TOTAL', y='TARGET', data=df_clean, alpha=0.5)
plt.title('Total Income vs. Default Status')
correlation_income = df_clean['AMT_INCOME_TOTAL'].corr(df_clean['TARGET'])
plt.xlabel(f'Total Income (Correlation: {correlation_income:.2f})')
plt.tight_layout()
plt.show()
```



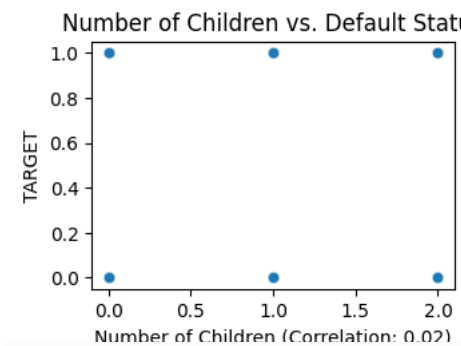

```
# Scatter plot and correlation for AMT_CREDIT vs TARGET
plt.subplot(2, 2, 2)
sns.scatterplot(x='AMT_CREDIT', y='TARGET', data=df_clean, alpha=0.5)
plt.title('Credit Amount vs. Default Status')
correlation_credit = df_clean['AMT_CREDIT'].corr(df_clean['TARGET'])
plt.xlabel(f'Credit Amount (Correlation: {correlation_credit:.2f})')
plt.tight_layout()
plt.show()
```




```
# Scatter plot and correlation for AMT_ANNUITY vs TARGET
plt.subplot(2, 2, 3)
sns.scatterplot(x='AMT_ANNUITY', y='TARGET', data=df_clean, alpha=0.5)
plt.title('Annuity Amount vs. Default Status')
correlation_annuity = df_clean['AMT_ANNUITY'].corr(df_clean['TARGET'])
plt.xlabel(f'Annuity Amount (Correlation: {correlation_annuity:.2f})')
plt.tight_layout()
plt.show()
```



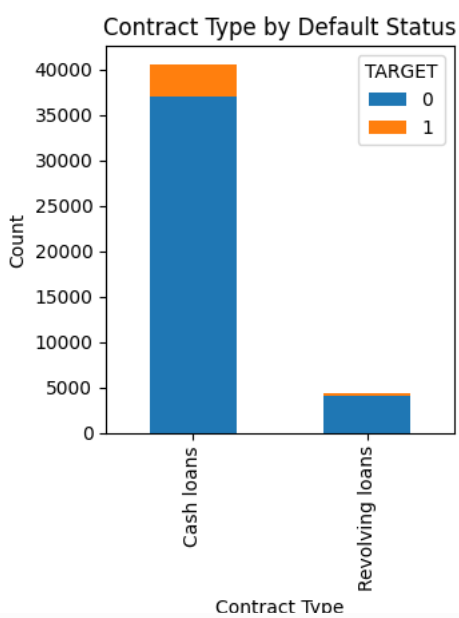

```
# Scatter plot and correlation for CNT_CHILDREN vs TARGET
plt.subplot(2, 2, 4)
sns.scatterplot(x='CNT_CHILDREN', y='TARGET', data=df_clean, alpha=0.5)
plt.title('Number of Children vs. Default Status')
correlation_children = df_clean['CNT_CHILDREN'].corr(df_clean['TARGET'])
plt.xlabel(f'Number of Children (Correlation: {correlation_children:.2f})')
plt.tight_layout()
plt.show()
```



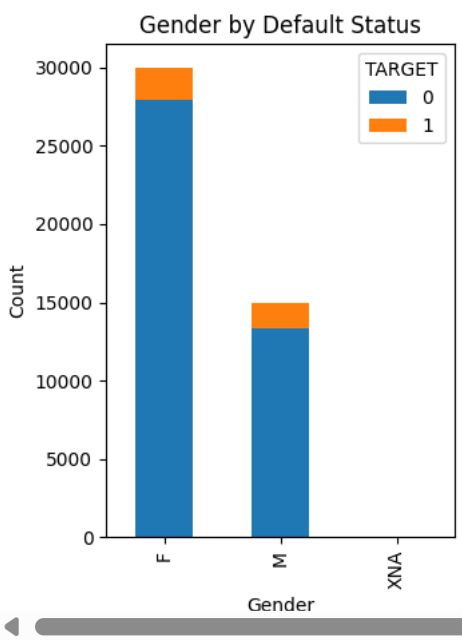

```
# Step 1: Create stacked bar charts for categorical variables
plt.figure(figsize=(12, 6))
```

```
<Figure size 1200x600 with 0 Axes>
```

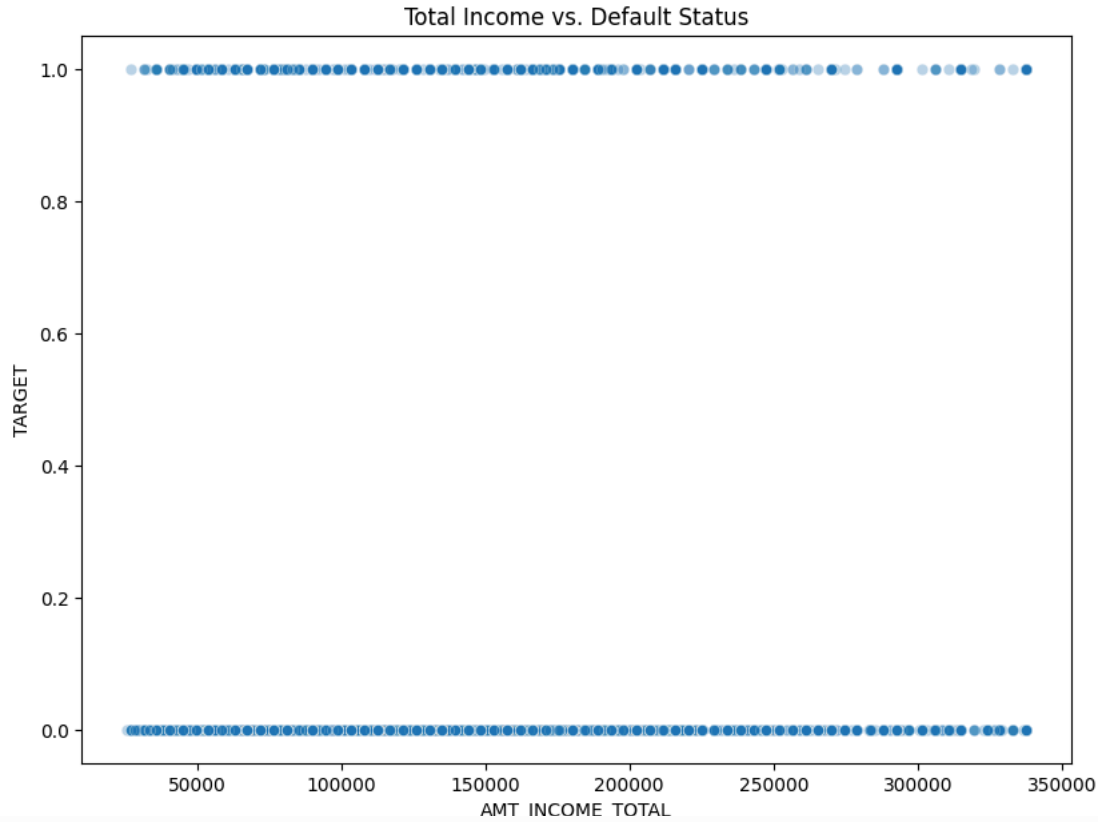
```
# Stacked bar chart for NAME_CONTRACT_TYPE
plt.subplot(1, 2, 1)
contract_type_counts = pd.crosstab(df_clean['NAME_CONTRACT_TYPE'], df_clean['TARGET'])
contract_type_counts.plot(kind='bar', stacked=True, ax=plt.gca())
plt.title('Contract Type by Default Status')
plt.ylabel('Count')
plt.xlabel('Contract Type')
plt.tight_layout()
plt.show()
```



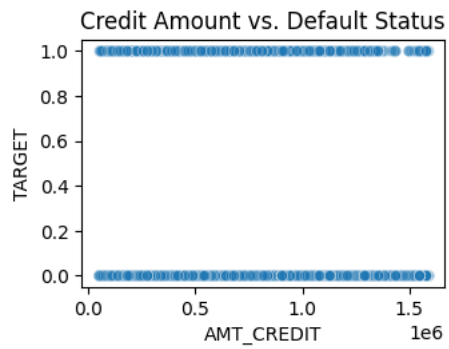

```
# Stacked bar chart for CODE_GENDER
plt.subplot(1, 2, 2)
gender_counts = pd.crosstab(df_clean['CODE_GENDER'], df_clean['TARGET'])
gender_counts.plot(kind='bar', stacked=True, ax=plt.gca())
plt.title('Gender by Default Status')
plt.ylabel('Count')
plt.xlabel('Gender')
plt.tight_layout()
plt.show()
```



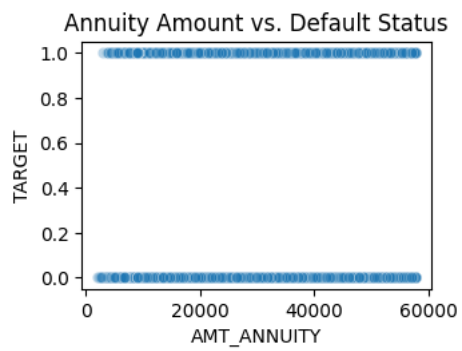

```
# Step 2: Create scatter plots for continuous variables vs. TARGET
plt.figure(figsize=(16, 12))

# Scatter plot for AMT_INCOME_TOTAL vs TARGET
plt.subplot(2, 2, 1)
sns.scatterplot(x='AMT_INCOME_TOTAL', y='TARGET', data=df_clean, alpha=0.3)
plt.title('Total Income vs. Default Status')
plt.tight_layout()
plt.show()
```



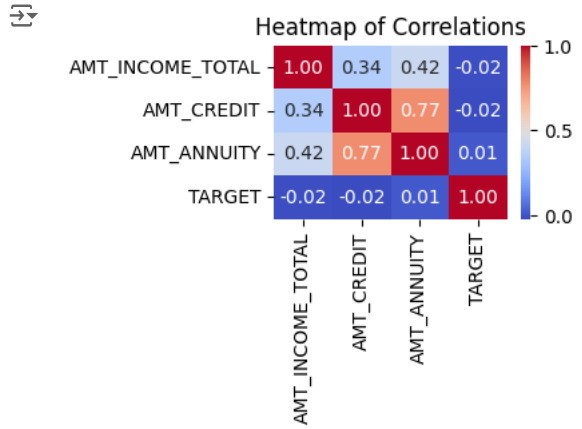

```
# Scatter plot for AMT_CREDIT vs TARGET
plt.subplot(2, 2, 2)
sns.scatterplot(x='AMT_CREDIT', y='TARGET', data=df_clean, alpha=0.3)
plt.title('Credit Amount vs. Default Status')
plt.tight_layout()
plt.show()
```




```
# Scatter plot for AMT_ANNUITY vs TARGET
plt.subplot(2, 2, 3)
sns.scatterplot(x='AMT_ANNUITY', y='TARGET', data=df_clean, alpha=0.3)
plt.title('Annuity Amount vs. Default Status')
plt.tight_layout()
plt.show()
```



```
# Step 3: Create a heatmap of correlations among selected variables and the target
plt.subplot(2, 2, 4)
correlation_matrix = df_clean[['AMT_INCOME_TOTAL', 'AMT_CREDIT', 'AMT_ANNUITY', 'TARGET']].corr()
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Heatmap of Correlations')
plt.tight_layout()
plt.show()
```




```
# Segment the dataset based on the TARGET value
defaulters = df_clean[df_clean['TARGET'] == 1]
non_defaulters = df_clean[df_clean['TARGET'] == 0]

# Filter only numeric columns for correlation calculations
numeric_columns = df_clean.select_dtypes(include=[np.number]).columns

# Calculate correlation matrices for each segment using only numeric columns
correlation_defaulters = defaulters[numeric_columns].corr()
correlation_non_defaulters = non_defaulters[numeric_columns].corr()

# Plotting heatmaps for each correlation matrix
plt.figure(figsize=(16, 12))

# Heatmap for clients with payment difficulties
plt.subplot(1, 2, 1)
sns.heatmap(correlation_defaulters, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Matrix for Defaulters')

# Heatmap for all other cases
plt.subplot(1, 2, 2)
sns.heatmap(correlation_non_defaulters, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Matrix for Non-Defaulters')

plt.tight_layout()
plt.show()
```