In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.style as style
import seaborn as sns
import itertools
%matplotlib inline
```

In [2]:
```
style.use('seaborn-poster')
style.use('fivethirtyeight')
```

```
C:\Users\Dell i7\AppData\Local\Temp\ipykernel_12488\3592107732.py:1: Matplotl
ibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated
since 3.6, as they no longer correspond to the styles shipped by seaborn. How
ever, they will remain available as 'seaborn-v0_8-<style>'. Alternatively, di
rectly use the seaborn API instead.
  style.use('seaborn-poster')
```

In [3]:
```
import warnings
warnings.filterwarnings('ignore')
```

In [4]:
```
pd.set_option('display.max_rows', 500)
pd.set_option('display.max_columns', 500)
pd.set_option('display.width', 1000)
pd.set_option('display.expand_frame_repr', False)
```

In [5]:
```
import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

In [6]:
```
applicationDF =pd.read_csv(r'C:\Users\Dell i7\Desktop\11th_resume project\appl
previousDF=pd.read_csv(r'C:\Users\Dell i7\Desktop\11th_resume project\previous
applicationDF.head()
```

Out[6]:

	SK_ID_CURR	TARGET	NAME_CONTRACT_TYPE	CODE_GENDER	FLAG_OWN_CAR	FLAG_O
0	100002	1	Cash loans	M	N	
1	100003	0	Cash loans	F	N	
2	100004	0	Revolving loans	M	Y	
3	100006	0	Cash loans	F	N	
4	100007	0	Cash loans	M	N	

In [7]:
```
previousDF.head()
```

Out[7]:

	SK_ID_PREV	SK_ID_CURR	NAME_CONTRACT_TYPE	AMT_ANNUITY	AMT_APPLICATION	AM
0	2030495	271877	Consumer loans	1730.430	17145.0	
1	2802425	108129	Cash loans	25188.615	607500.0	
2	2523466	122040	Cash loans	15060.735	112500.0	
3	2819243	176158	Cash loans	47041.335	450000.0	
4	1784265	202054	Cash loans	31924.395	337500.0	

In [8]:
```
print("Database dimension - applicationDF     :",applicationDF.shape)
print("Database dimension - previousDF        :",previousDF.shape)


print("Database size - applicationDF          :",applicationDF.size)
print("Database size - previousDF             :",previousDF.size)
```

```
Database dimension - applicationDF     : (307511, 122)
Database dimension - previousDF        : (1670214, 37)
Database size - applicationDF          : 37516342
Database size - previousDF             : 61797918
```

In [9]:
```
applicationDF.info(verbose=True)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 307511 entries, 0 to 307510
Data columns (total 122 columns):
 #    Column                       Dtype
---   ------                       -----
 0    SK_ID_CURR                   int64
 1    TARGET                       int64
 2    NAME_CONTRACT_TYPE           object
 3    CODE_GENDER                  object
 4    FLAG_OWN_CAR                 object
 5    FLAG_OWN_REALTY              object
 6    CNT_CHILDREN                 int64
 7    AMT_INCOME_TOTAL             float64
 8    AMT_CREDIT                   float64
 9    AMT_ANNUITY                  float64
 10   AMT_GOODS_PRICE              float64
 11   NAME_TYPE_SUITE              object
 12   NAME_INCOME_TYPE             object
 13   NAME_EDUCATION_TYPE          object
```

In [10]:
```
applicationDF.describe()
```

Out[10]:

	SK_ID_CURR	TARGET	CNT_CHILDREN	AMT_INCOME_TOTAL	AMT_CREDIT	AMT
count	307511.000000	307511.000000	307511.000000	3.075110e+05	3.075110e+05	3074
mean	278180.518577	0.080729	0.417052	1.687979e+05	5.990260e+05	271
std	102790.175348	0.272419	0.722121	2.371231e+05	4.024908e+05	144
min	100002.000000	0.000000	0.000000	2.565000e+04	4.500000e+04	16
25%	189145.500000	0.000000	0.000000	1.125000e+05	2.700000e+05	165
50%	278202.000000	0.000000	0.000000	1.471500e+05	5.135310e+05	249
75%	367142.500000	0.000000	1.000000	2.025000e+05	8.086500e+05	345
max	456255.000000	1.000000	19.000000	1.170000e+08	4.050000e+06	258(

In [11]:
```
previousDF.describe()
```

Out[11]:

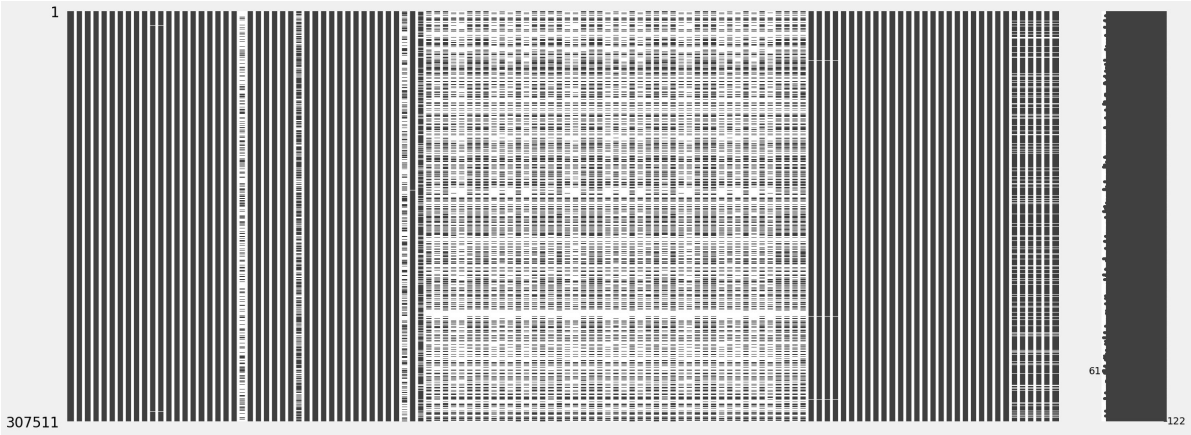
	SK_ID_PREV	SK_ID_CURR	AMT_ANNUITY	AMT_APPLICATION	AMT_CREDIT	AMT_DOW
count	1.670214e+06	1.670214e+06	1.297979e+06	1.670214e+06	1.670213e+06	1
mean	1.923089e+06	2.783572e+05	1.595512e+04	1.752339e+05	1.961140e+05	6
std	5.325980e+05	1.028148e+05	1.478214e+04	2.927798e+05	3.185746e+05	2
min	1.000001e+06	1.000010e+05	0.000000e+00	0.000000e+00	0.000000e+00	-
25%	1.461857e+06	1.893290e+05	6.321780e+03	1.872000e+04	2.416050e+04	0
50%	1.923110e+06	2.787145e+05	1.125000e+04	7.104600e+04	8.054100e+04	1
75%	2.384280e+06	3.675140e+05	2.065842e+04	1.803600e+05	2.164185e+05	1
max	2.845382e+06	4.562550e+05	4.180581e+05	6.905160e+06	6.905160e+06	3

In [12]:
```
pip install missingno
```

```
Requirement already satisfied: missingno in c:\users\dell i7\anaconda3\lib\si
te-packages (0.5.2)
Requirement already satisfied: numpy in c:\users\dell i7\anaconda3\lib\site-p
ackages (from missingno) (1.24.3)
Requirement already satisfied: matplotlib in c:\users\dell i7\anaconda3\lib\s
ite-packages (from missingno) (3.7.1)
Requirement already satisfied: scipy in c:\users\dell i7\anaconda3\lib\site-p
ackages (from missingno) (1.10.1)
Requirement already satisfied: seaborn in c:\users\dell i7\anaconda3\lib\site
-packages (from missingno) (0.12.2)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\dell i7\anaconda
3\lib\site-packages (from matplotlib->missingno) (1.0.5)
Requirement already satisfied: cycler>=0.10 in c:\users\dell i7\anaconda3\li
b\site-packages (from matplotlib->missingno) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\dell i7\anaconda
3\lib\site-packages (from matplotlib->missingno) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\dell i7\anaconda
3\lib\site-packages (from matplotlib->missingno) (1.4.4)
Requirement already satisfied: packaging>=20.0 in c:\users\dell i7\anaconda3\
lib\site-packages (from matplotlib->missingno) (23.0)
Requirement already satisfied: pillow>=6.2.0 in c:\users\dell i7\anaconda3\li
b\site-packages (from matplotlib->missingno) (9.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\dell i7\anaconda
3\lib\site-packages (from matplotlib->missingno) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\dell i7\anaco
nda3\lib\site-packages (from matplotlib->missingno) (2.8.2)
Requirement already satisfied: pandas>=0.25 in c:\users\dell i7\anaconda3\li
b\site-packages (from seaborn->missingno) (1.5.3)
Requirement already satisfied: pytz>=2020.1 in c:\users\dell i7\anaconda3\li
b\site-packages (from pandas>=0.25->seaborn->missingno) (2022.7)
Requirement already satisfied: six>=1.5 in c:\users\dell i7\anaconda3\lib\sit
e-packages (from python-dateutil>=2.7->matplotlib->missingno) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

In [13]:
```
import missingno as mn
mn.matrix(applicationDF)
```

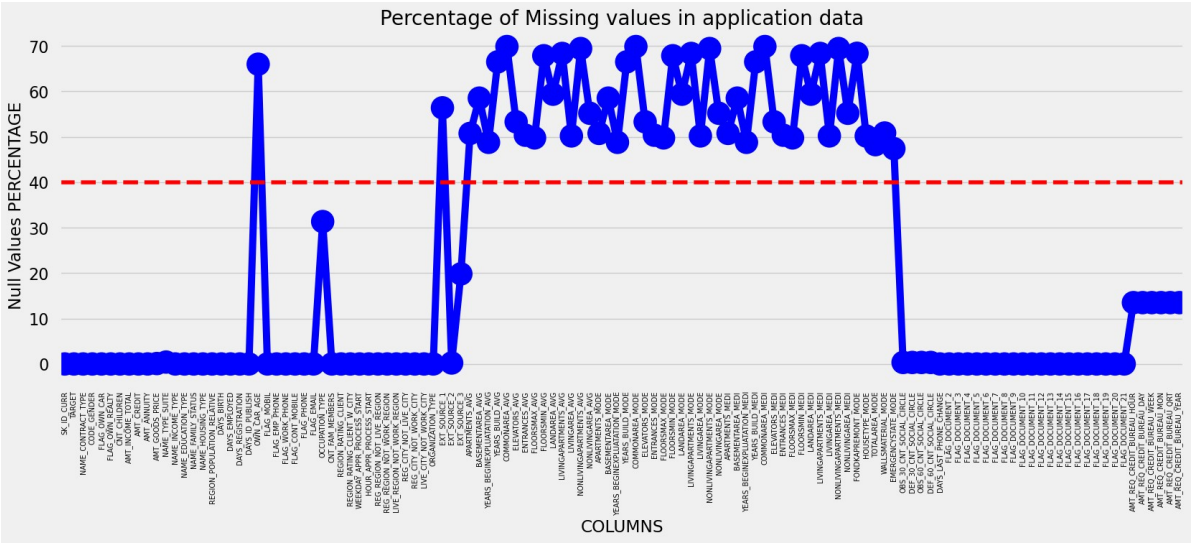
Out[13]: <Axes: >



In [14]:
```
round(applicationDF.isnull().sum() / applicationDF.shape[0] * 100.00,2)
```

Out[14]:
```
SK_ID_CURR                    0.00
TARGET                        0.00
NAME_CONTRACT_TYPE            0.00
CODE_GENDER                   0.00
FLAG_OWN_CAR                  0.00
FLAG_OWN_REALTY               0.00
CNT_CHILDREN                  0.00
AMT_INCOME_TOTAL              0.00
AMT_CREDIT                    0.00
AMT_ANNUITY                   0.00
AMT_GOODS_PRICE               0.09
NAME_TYPE_SUITE               0.42
NAME_INCOME_TYPE              0.00
NAME_EDUCATION_TYPE           0.00
NAME_FAMILY_STATUS            0.00
NAME_HOUSING_TYPE             0.00
REGION_POPULATION_RELATIVE    0.00
DAYS_BIRTH                    0.00
DAYS_EMPLOYED                 0.00
```

In [15]:
```
null_applicationDF = pd.DataFrame((applicationDF.isnull().sum())*100/applicati
null_applicationDF.columns = ['Column Name', 'Null Values Percentage']
fig = plt.figure(figsize=(18,6))
ax = sns.pointplot(x="Column Name",y="Null Values Percentage",data=null_applic
plt.xticks(rotation =90,fontsize =7)
ax.axhline(40, ls='--',color='red')
plt.title("Percentage of Missing values in application data")
plt.ylabel("Null Values PERCENTAGE")
plt.xlabel("COLUMNS")
plt.show()
```



In [16]:
```
nullcol_40_application = null_applicationDF[null_applicationDF["Null Values Pe
nullcol_40_application
```

Out[16]:

	Column Name	Null Values Percentage
21	OWN_CAR_AGE	65.990810
41	EXT_SOURCE_1	56.381073
44	APARTMENTS_AVG	50.749729
45	BASEMENTAREA_AVG	58.515956
46	YEARS_BEGINEXPLUATATION_AVG	48.781019
47	YEARS_BUILD_AVG	66.497784
48	COMMONAREA_AVG	69.872297
49	ELEVATORS_AVG	53.295980
50	ENTRANCES_AVG	50.348768
51	FLOORSMAX_AVG	49.760822
52	FLOORSMIN_AVG	67.848630
53	LANDAREA_AVG	59.376738
54	LIVINGAPARTMENTS_AVG	68.354953
55	LIVINGAREA_AVG	50.193326
56	NONLIVINGAPARTMENTS_AVG	69.432963
57	NONLIVINGAREA_AVG	55.179164
58	APARTMENTS_MODE	50.749729
59	BASEMENTAREA_MODE	58.515956
60	YEARS_BEGINEXPLUATATION_MODE	48.781019
61	YEARS_BUILD_MODE	66.497784
62	COMMONAREA_MODE	69.872297
63	ELEVATORS_MODE	53.295980
64	ENTRANCES_MODE	50.348768
65	FLOORSMAX_MODE	49.760822
66	FLOORSMIN_MODE	67.848630
67	LANDAREA_MODE	59.376738
68	LIVINGAPARTMENTS_MODE	68.354953
69	LIVINGAREA_MODE	50.193326
70	NONLIVINGAPARTMENTS_MODE	69.432963
71	NONLIVINGAREA_MODE	55.179164
72	APARTMENTS_MEDI	50.749729
73	BASEMENTAREA_MEDI	58.515956
74	YEARS_BEGINEXPLUATATION_MEDI	48.781019

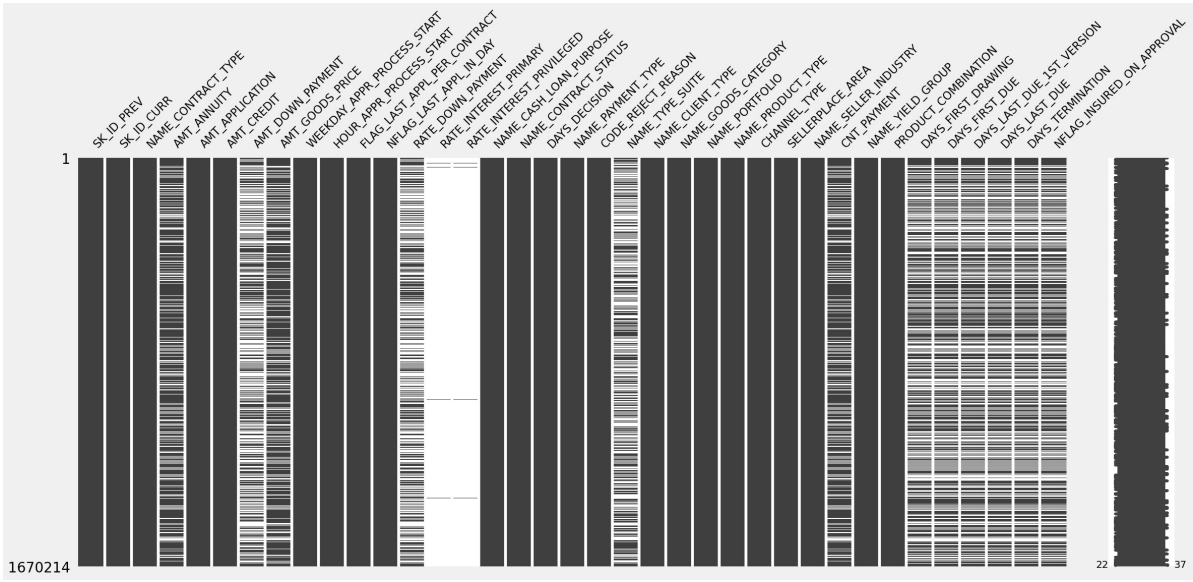
	Column Name	Null Values Percentage
75	YEARS_BUILD_MEDI	66.497784
76	COMMONAREA_MEDI	69.872297
77	ELEVATORS_MEDI	53.295980
78	ENTRANCES_MEDI	50.348768
79	FLOORSMAX_MEDI	49.760822
80	FLOORSMIN_MEDI	67.848630
81	LANDAREA_MEDI	59.376738
82	LIVINGAPARTMENTS_MEDI	68.354953
83	LIVINGAREA_MEDI	50.193326
84	NONLIVINGAPARTMENTS_MEDI	69.432963
85	NONLIVINGAREA_MEDI	55.179164
86	FONDKAPREMONT_MODE	68.386172
87	HOUSETYPE_MODE	50.176091
88	TOTALAREA_MODE	48.268517
89	WALLSMATERIAL_MODE	50.840783

In [17]:
```
len(nullcol_40_application)
```

Out[17]: 49

In [18]:
```
mn.matrix(previousDF)
```

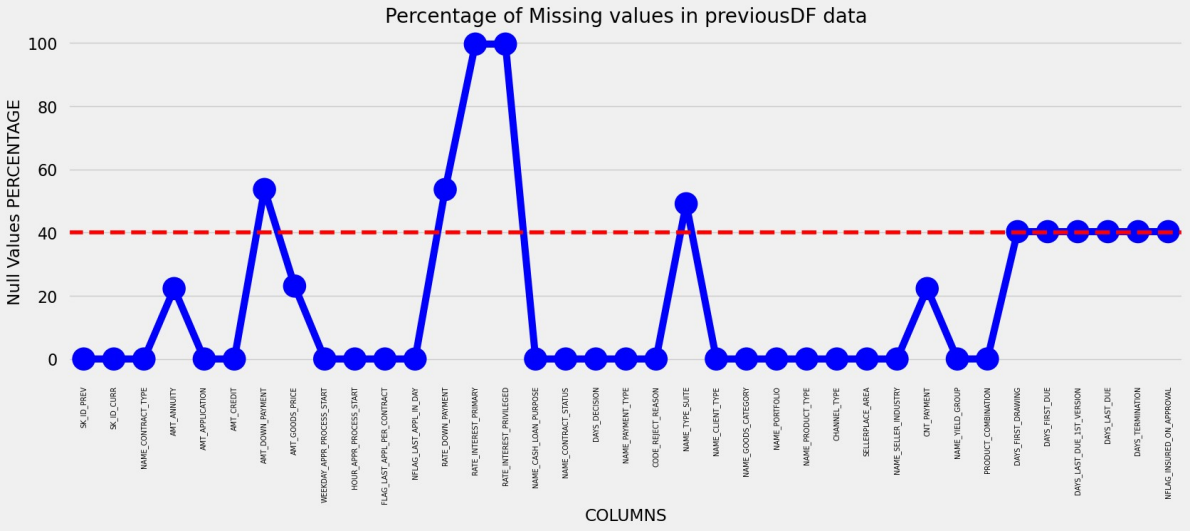
Out[18]: <Axes: >



In [19]:
```
round(previousDF.isnull().sum() / previousDF.shape[0] * 100.00,2)
```

Out[19]:
```
SK_ID_PREV                     0.00
SK_ID_CURR                     0.00
NAME_CONTRACT_TYPE             0.00
AMT_ANNUITY                   22.29
AMT_APPLICATION                0.00
AMT_CREDIT                     0.00
AMT_DOWN_PAYMENT              53.64
AMT_GOODS_PRICE               23.08
WEEKDAY_APPR_PROCESS_START     0.00
HOUR_APPR_PROCESS_START        0.00
FLAG_LAST_APPL_PER_CONTRACT    0.00
NFLAG_LAST_APPL_IN_DAY         0.00
RATE_DOWN_PAYMENT             53.64
RATE_INTEREST_PRIMARY         99.64
RATE_INTEREST_PRIVILEGED      99.64
NAME_CASH_LOAN_PURPOSE         0.00
NAME_CONTRACT_STATUS           0.00
DAYS_DECISION                  0.00
NAME_PAYMENT_TYPE              0.00
CODE_REJECT_REASON             0.00
NAME_TYPE_SUITE               49.12
NAME_CLIENT_TYPE               0.00
NAME_GOODS_CATEGORY            0.00
NAME_PORTFOLIO                 0.00
NAME_PRODUCT_TYPE              0.00
CHANNEL_TYPE                   0.00
SELLERPLACE_AREA               0.00
NAME_SELLER_INDUSTRY           0.00
CNT_PAYMENT                   22.29
NAME_YIELD_GROUP               0.00
PRODUCT_COMBINATION            0.02
DAYS_FIRST_DRAWING            40.30
DAYS_FIRST_DUE                40.30
DAYS_LAST_DUE_1ST_VERSION     40.30
DAYS_LAST_DUE                 40.30
DAYS_TERMINATION              40.30
NFLAG_INSURED_ON_APPROVAL     40.30
dtype: float64
```

In [20]:
```
null_previousDF = pd.DataFrame((previousDF.isnull().sum())*100/previousDF.shap
null_previousDF.columns = ['Column Name', 'Null Values Percentage']
fig = plt.figure(figsize=(18,6))
ax = sns.pointplot(x="Column Name",y="Null Values Percentage",data=null_previo
plt.xticks(rotation =90,fontsize =7)
ax.axhline(40, ls='--',color='red')
plt.title("Percentage of Missing values in previousDF data")
plt.ylabel("Null Values PERCENTAGE")
plt.xlabel("COLUMNS")
plt.show()
```



In [21]:
```
nullcol_40_previous = null_previousDF[null_previousDF["Null Values Percentage"
nullcol_40_previous
```

Out[21]:

	Column Name	Null Values Percentage
6	AMT_DOWN_PAYMENT	53.636480
12	RATE_DOWN_PAYMENT	53.636480
13	RATE_INTEREST_PRIMARY	99.643698
14	RATE_INTEREST_PRIVILEGED	99.643698
20	NAME_TYPE_SUITE	49.119754
31	DAYS_FIRST_DRAWING	40.298129
32	DAYS_FIRST_DUE	40.298129
33	DAYS_LAST_DUE_1ST_VERSION	40.298129
34	DAYS_LAST_DUE	40.298129
35	DAYS_TERMINATION	40.298129
36	NFLAG_INSURED_ON_APPROVAL	40.298129

In [22]:
```
len(nullcol_40_previous)
```

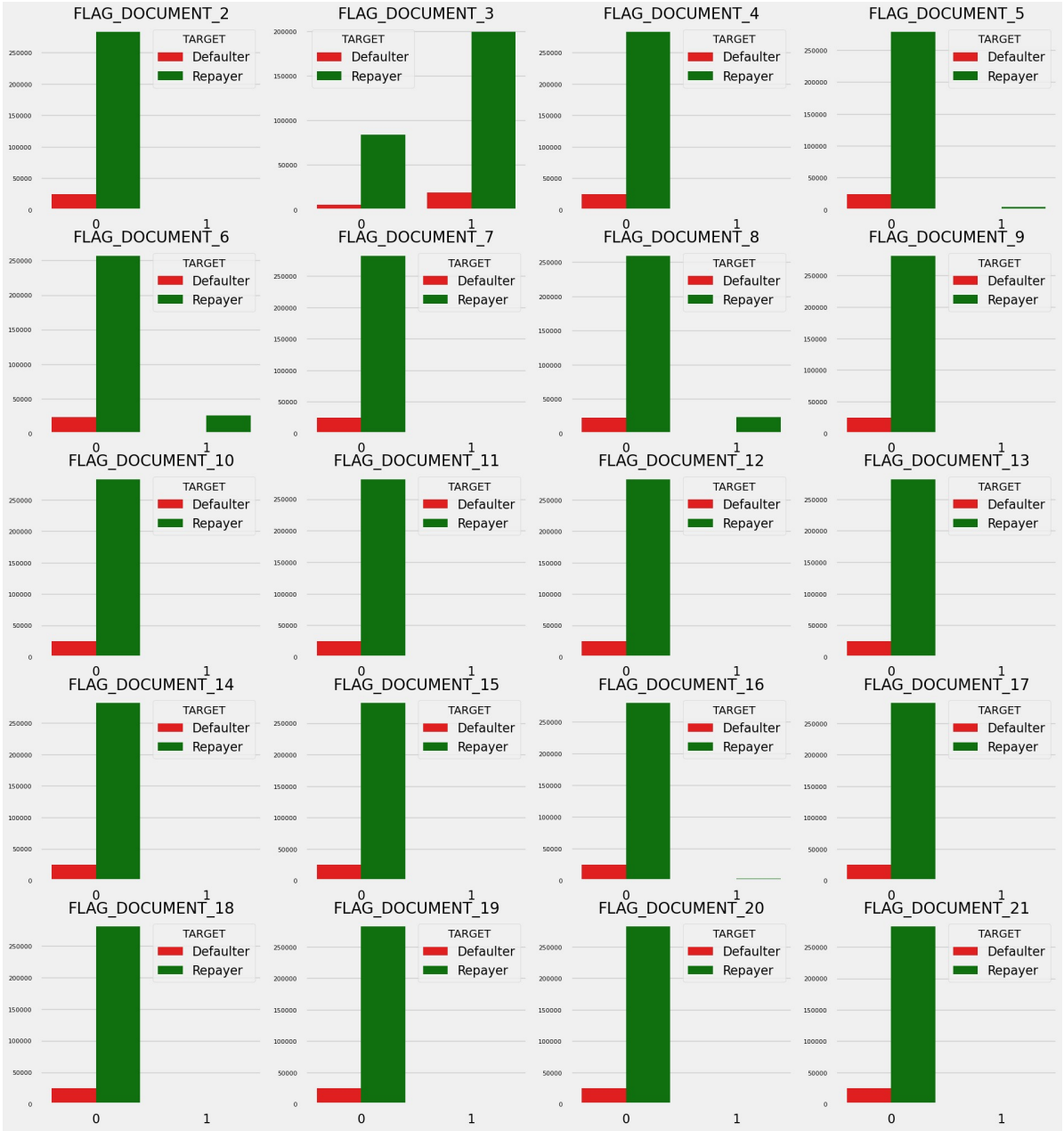
Out[22]: 11

In [23]:
```
Source = applicationDF[["EXT_SOURCE_1","EXT_SOURCE_2","EXT_SOURCE_3","TARGET"]]
source_corr = Source.corr()
ax = sns.heatmap(source_corr,
                 xticklabels=source_corr.columns,
                 yticklabels=source_corr.columns,
                 annot = True,
                 cmap ="RdYlGn")
```

In [24]:
```
Unwanted_application = nullcol_40_application["Column Name"].tolist()+ ['EXT_S

len(Unwanted_application)
```

Out[24]: 51

In [25]:
```
col_Doc = [ 'FLAG_DOCUMENT_2', 'FLAG_DOCUMENT_3','FLAG_DOCUMENT_4', 'FLAG_DOCU
            'FLAG_DOCUMENT_8', 'FLAG_DOCUMENT_9','FLAG_DOCUMENT_10', 'FLAG_DOCU
            'FLAG_DOCUMENT_14', 'FLAG_DOCUMENT_15','FLAG_DOCUMENT_16', 'FLAG_DO
            'FLAG_DOCUMENT_19', 'FLAG_DOCUMENT_20', 'FLAG_DOCUMENT_21']
df_flag = applicationDF[col_Doc+["TARGET"]]

length = len(col_Doc)

df_flag["TARGET"] = df_flag["TARGET"].replace({1:"Defaulter",0:"Repayer"})

fig = plt.figure(figsize=(21,24))

for i,j in itertools.zip_longest(col_Doc,range(length)):
    plt.subplot(5,4,j+1)
    ax = sns.countplot(x=df_flag[i],hue=df_flag["TARGET"],palette=["r","g"])
    plt.yticks(fontsize=8)
    plt.xlabel("")
    plt.ylabel("")
    plt.title(i)
```



In [26]:
```
col_Doc.remove('FLAG_DOCUMENT_3')
Unwanted_application = Unwanted_application + col_Doc
len(Unwanted_application)
```

Out[26]: 70

In [27]:
```
contact_col =['FLAG_MOBIL','FLAG_EMP_PHONE','FLAG_WORK_PHONE','FLAG_CONT_MOBIL
Contact_corr= applicationDF[contact_col].corr()
fig=plt.figure(figsize=(8,8,))
ax=sns.heatmap(Contact_corr,
               xticklabels=Contact_corr.columns,
               yticklabels=Contact_corr.columns,
               annot=True,
               cmap="RdYlGn",
               linewidth=1)
```

In [28]:
```
contact_col.remove('TARGET')
Unwanted_application = Unwanted_application + contact_col
```

In [29]:
```
len(Unwanted_application)
```

Out[29]: 76

In [30]:
```
applicationDF.drop(labels=Unwanted_application,axis=1,inplace=True)
```

In [31]:
```
applicationDF.shape
```

Out[31]:
```
(307511, 46)
```

In [32]:
```
applicationDF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 307511 entries, 0 to 307510
Data columns (total 46 columns):
 #   Column                       Non-Null Count   Dtype  
---  ------                       --------------   -----  
 0   SK_ID_CURR                   307511 non-null  int64  
 1   TARGET                       307511 non-null  int64  
 2   NAME_CONTRACT_TYPE           307511 non-null  object 
 3   CODE_GENDER                  307511 non-null  object 
 4   FLAG_OWN_CAR                 307511 non-null  object 
 5   FLAG_OWN_REALTY              307511 non-null  object 
 6   CNT_CHILDREN                 307511 non-null  int64  
 7   AMT_INCOME_TOTAL             307511 non-null  float64
 8   AMT_CREDIT                   307511 non-null  float64
 9   AMT_ANNUITY                  307499 non-null  float64
 10  AMT_GOODS_PRICE              307233 non-null  float64
 11  NAME_TYPE_SUITE              306219 non-null  object 
 12  NAME_INCOME_TYPE             307511 non-null  object 
 13  NAME_EDUCATION_TYPE          307511 non-null  object 
 14  NAME_FAMILY_STATUS           307511 non-null  object 
 15  NAME_HOUSING_TYPE            307511 non-null  object 
 16  REGION_POPULATION_RELATIVE   307511 non-null  float64
 17  DAYS_BIRTH                   307511 non-null  int64  
 18  DAYS_EMPLOYED                307511 non-null  int64  
 19  DAYS_REGISTRATION            307511 non-null  float64
 20  DAYS_ID_PUBLISH              307511 non-null  int64  
 21  OCCUPATION_TYPE              211120 non-null  object 
 22  CNT_FAM_MEMBERS              307509 non-null  float64
 23  REGION_RATING_CLIENT         307511 non-null  int64  
 24  REGION_RATING_CLIENT_W_CITY  307511 non-null  int64  
 25  WEEKDAY_APPR_PROCESS_START   307511 non-null  object 
 26  HOUR_APPR_PROCESS_START      307511 non-null  int64  
 27  REG_REGION_NOT_LIVE_REGION   307511 non-null  int64  
 28  REG_REGION_NOT_WORK_REGION   307511 non-null  int64  
 29  LIVE_REGION_NOT_WORK_REGION  307511 non-null  int64  
 30  REG_CITY_NOT_LIVE_CITY       307511 non-null  int64  
 31  REG_CITY_NOT_WORK_CITY       307511 non-null  int64  
 32  LIVE_CITY_NOT_WORK_CITY      307511 non-null  int64  
 33  ORGANIZATION_TYPE            307511 non-null  object 
 34  OBS_30_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 35  DEF_30_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 36  OBS_60_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 37  DEF_60_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 38  DAYS_LAST_PHONE_CHANGE       307510 non-null  float64
 39  FLAG_DOCUMENT_3              307511 non-null  int64  
 40  AMT_REQ_CREDIT_BUREAU_HOUR   265992 non-null  float64
 41  AMT_REQ_CREDIT_BUREAU_DAY    265992 non-null  float64
 42  AMT_REQ_CREDIT_BUREAU_WEEK   265992 non-null  float64
 43  AMT_REQ_CREDIT_BUREAU_MON    265992 non-null  float64
 44  AMT_REQ_CREDIT_BUREAU_QRT    265992 non-null  float64
 45  AMT_REQ_CREDIT_BUREAU_YEAR   265992 non-null  float64
dtypes: float64(18), int64(16), object(12)
memory usage: 107.9+ MB
```

In [33]:
```
Unwanted_previous = nullcol_40_previous["Column Name"].tolist()
Unwanted_previous
```

Out[33]:
```
['AMT_DOWN_PAYMENT',
 'RATE_DOWN_PAYMENT',
 'RATE_INTEREST_PRIMARY',
 'RATE_INTEREST_PRIVILEGED',
 'NAME_TYPE_SUITE',
 'DAYS_FIRST_DRAWING',
 'DAYS_FIRST_DUE',
 'DAYS_LAST_DUE_1ST_VERSION',
 'DAYS_LAST_DUE',
 'DAYS_TERMINATION',
 'NFLAG_INSURED_ON_APPROVAL']
```

In [34]:
```
Unnecessary_previous=['WEEKDAY_APPR_PROCESS_START','HOUR_APPR_PROCESS_START',
                      'FLAG_LAST_APPL_PER_CONTRACT',
                       'NFLAG_LAST_APPL_IN_DAY']
```

In [35]:
```
Unwanted_previous = Unwanted_previous + Unnecessary_previous
```

In [36]:
```
len(Unwanted_previous)
```

Out[36]:
```
15
```

In [37]:
```
previousDF.drop(labels=Unwanted_previous,axis=1,inplace=True)
previousDF.shape
```

Out[37]:
```
(1670214, 22)
```

In [38]:
```
previousDF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1670214 entries, 0 to 1670213
Data columns (total 22 columns):
 #   Column                  Non-Null Count    Dtype  
---  ------                  --------------    -----  
 0   SK_ID_PREV              1670214 non-null  int64  
 1   SK_ID_CURR              1670214 non-null  int64  
 2   NAME_CONTRACT_TYPE      1670214 non-null  object 
 3   AMT_ANNUITY             1297979 non-null  float64
 4   AMT_APPLICATION         1670214 non-null  float64
 5   AMT_CREDIT              1670213 non-null  float64
 6   AMT_GOODS_PRICE         1284699 non-null  float64
 7   NAME_CASH_LOAN_PURPOSE  1670214 non-null  object 
 8   NAME_CONTRACT_STATUS    1670214 non-null  object 
 9   DAYS_DECISION           1670214 non-null  int64  
 10  NAME_PAYMENT_TYPE       1670214 non-null  object 
 11  CODE_REJECT_REASON      1670214 non-null  object 
 12  NAME_CLIENT_TYPE        1670214 non-null  object 
 13  NAME_GOODS_CATEGORY     1670214 non-null  object 
 14  NAME_PORTFOLIO          1670214 non-null  object 
 15  NAME_PRODUCT_TYPE       1670214 non-null  object 
 16  CHANNEL_TYPE            1670214 non-null  object 
 17  SELLERPLACE_AREA        1670214 non-null  int64  
 18  NAME_SELLER_INDUSTRY    1670214 non-null  object 
 19  CNT_PAYMENT             1297984 non-null  float64
 20  NAME_YIELD_GROUP        1670214 non-null  object 
 21  PRODUCT_COMBINATION     1669868 non-null  object 
dtypes: float64(5), int64(4), object(13)
memory usage: 280.3+ MB
```

In [39]:
```
date_col=['DAYS_BIRTH','DAYS_EMPLOYED','DAYS_REGISTRATION','DAYS_ID_PUBLISH']
for col in date_col:
    applicationDF[col]=abs(applicationDF[col])
```

In [40]:
```
applicationDF['AMT_INCOME_TOTAL']=applicationDF['AMT_INCOME_TOTAL']/100000
bins=[0,1,2,3,4,5,6,7,8,9,10,11]
slot=['0-100K','100L-200K','200K-300K','300K-400K','400K-500K','500K-600K','60
applicationDF['AMT_INCOME_RANGE']=pd.cut(applicationDF['AMT_INCOME_TOTAL'],bin
```

In [41]:
```
applicationDF['AMT_INCOME_RANGE'].value_counts(normalize=True)*100
```

Out[41]:
```
100L-200K    50.735000
200K-300K    21.210691
0-100K       20.729695
300K-400K     4.776116
400K-500K     1.744669
500K-600K     0.356354
600K-700K     0.282805
800K-900K     0.096980
700K-800K     0.052721
900K-1M       0.009112
1Above        0.005858
Name: AMT_INCOME_RANGE, dtype: float64
```

In [42]:
```
applicationDF['AMT_CREDIT']=applicationDF['AMT_CREDIT']/100000

bins = [0,1,2,3,4,5,6,7,8,9,10,100]
slots = ['0-100K','100K-200K', '200k-300k','300k-400k','400k-500k','500k-600k'
       '800k-900k','900k-1M', '1M Above']

applicationDF['AMT_CREDIT_RANGE']=pd.cut(applicationDF['AMT_CREDIT'],bins=bins
```

In [43]:
```
applicationDF['AMT_CREDIT_RANGE'].value_counts(normalize=True)*100
```

Out[43]:
```
200k-300k    17.824728
1M Above     16.254703
500k-600k    11.131960
400k-500k    10.418489
100K-200K     9.801275
300k-400k     8.564897
600k-700k     7.820533
800k-900k     7.086576
700k-800k     6.241403
900k-1M       2.902986
0-100K        1.952450
Name: AMT_CREDIT_RANGE, dtype: float64
```

In [44]:
```
applicationDF['AGE'] = applicationDF['DAYS_BIRTH'] // 365
bins = [0,20,30,40,50,100]
slots = ['0-20','20-30','30-40','40-50','50 above']

applicationDF['AGE_GROUP']=pd.cut(applicationDF['AGE'],bins=bins,labels=slots)
```

In [45]:
```
applicationDF['AGE_GROUP'].value_counts(normalize=True)*100
```

Out[45]:
```
50 above    31.604398
30-40       27.028952
40-50       24.194582
20-30       17.171743
0-20         0.000325
Name: AGE_GROUP, dtype: float64
```

In [46]:
```
applicationDF['YEARS_EMPLOYED'] = applicationDF['DAYS_EMPLOYED'] // 365
bins = [0,5,10,20,30,40,50,60,150]
slots = ['0-5','5-10','10-20','20-30','30-40','40-50','50-60','60 above']

applicationDF['EMPLOYMENT_YEAR']=pd.cut(applicationDF['YEARS_EMPLOYED'],bins=b
```

In [47]:
```
applicationDF['EMPLOYMENT_YEAR'].value_counts(normalize=True)*100
```

Out[47]:
```
0-5         55.582363
5-10        24.966441
10-20       14.564315
20-30        3.750117
30-40        1.058720
40-50        0.078044
50-60        0.000000
60 above     0.000000
Name: EMPLOYMENT_YEAR, dtype: float64
```

In [48]:
```
applicationDF.nunique().sort_values()
```

Out[48]:
```
LIVE_CITY_NOT_WORK_CITY              2
TARGET                               2
NAME_CONTRACT_TYPE                   2
REG_REGION_NOT_LIVE_REGION           2
FLAG_OWN_CAR                         2
FLAG_OWN_REALTY                      2
REG_REGION_NOT_WORK_REGION           2
LIVE_REGION_NOT_WORK_REGION          2
FLAG_DOCUMENT_3                      2
REG_CITY_NOT_LIVE_CITY               2
REG_CITY_NOT_WORK_CITY               2
REGION_RATING_CLIENT                 3
CODE_GENDER                          3
REGION_RATING_CLIENT_W_CITY          3
AMT_REQ_CREDIT_BUREAU_HOUR           5
NAME_EDUCATION_TYPE                  5
AGE_GROUP                            5
NAME_FAMILY_STATUS                   6
NAME_HOUSING_TYPE                    6
EMPLOYMENT_YEAR                      6
WEEKDAY_APPR_PROCESS_START           7
NAME_TYPE_SUITE                      7
NAME_INCOME_TYPE                     8
AMT_REQ_CREDIT_BUREAU_WEEK           9
AMT_REQ_CREDIT_BUREAU_DAY            9
DEF_60_CNT_SOCIAL_CIRCLE             9
DEF_30_CNT_SOCIAL_CIRCLE            10
AMT_CREDIT_RANGE                    11
AMT_INCOME_RANGE                    11
AMT_REQ_CREDIT_BUREAU_QRT           11
CNT_CHILDREN                        15
CNT_FAM_MEMBERS                     17
OCCUPATION_TYPE                     18
HOUR_APPR_PROCESS_START             24
AMT_REQ_CREDIT_BUREAU_MON           24
AMT_REQ_CREDIT_BUREAU_YEAR          25
OBS_60_CNT_SOCIAL_CIRCLE            33
OBS_30_CNT_SOCIAL_CIRCLE            33
AGE                                 50
YEARS_EMPLOYED                      51
ORGANIZATION_TYPE                   58
REGION_POPULATION_RELATIVE          81
AMT_GOODS_PRICE                   1002
AMT_INCOME_TOTAL                  2548
DAYS_LAST_PHONE_CHANGE            3773
AMT_CREDIT                        5603
DAYS_ID_PUBLISH                   6168
DAYS_EMPLOYED                    12574
AMT_ANNUITY                      13672
DAYS_REGISTRATION                15688
DAYS_BIRTH                       17460
SK_ID_CURR                      307511
dtype: int64
```

In [49]:
```
applicationDF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 307511 entries, 0 to 307510
Data columns (total 52 columns):
 #   Column                       Non-Null Count   Dtype
---  ------                       --------------   -----
 0   SK_ID_CURR                   307511 non-null  int64
 1   TARGET                       307511 non-null  int64
 2   NAME_CONTRACT_TYPE           307511 non-null  object
 3   CODE_GENDER                  307511 non-null  object
 4   FLAG_OWN_CAR                 307511 non-null  object
 5   FLAG_OWN_REALTY              307511 non-null  object
 6   CNT_CHILDREN                 307511 non-null  int64
 7   AMT_INCOME_TOTAL             307511 non-null  float64
 8   AMT_CREDIT                   307511 non-null  float64
 9   AMT_ANNUITY                  307499 non-null  float64
 10  AMT_GOODS_PRICE              307233 non-null  float64
 11  NAME_TYPE_SUITE              306219 non-null  object
 12  NAME_INCOME_TYPE             307511 non-null  object
 13  NAME_EDUCATION_TYPE          307511 non-null  object
 14  NAME_FAMILY_STATUS           307511 non-null  object
 15  NAME_HOUSING_TYPE            307511 non-null  object
 16  REGION_POPULATION_RELATIVE   307511 non-null  float64
 17  DAYS_BIRTH                   307511 non-null  int64
 18  DAYS_EMPLOYED                307511 non-null  int64
 19  DAYS_REGISTRATION            307511 non-null  float64
 20  DAYS_ID_PUBLISH              307511 non-null  int64
 21  OCCUPATION_TYPE              211120 non-null  object
 22  CNT_FAM_MEMBERS              307509 non-null  float64
 23  REGION_RATING_CLIENT         307511 non-null  int64
 24  REGION_RATING_CLIENT_W_CITY  307511 non-null  int64
 25  WEEKDAY_APPR_PROCESS_START   307511 non-null  object
 26  HOUR_APPR_PROCESS_START      307511 non-null  int64
 27  REG_REGION_NOT_LIVE_REGION   307511 non-null  int64
 28  REG_REGION_NOT_WORK_REGION   307511 non-null  int64
 29  LIVE_REGION_NOT_WORK_REGION  307511 non-null  int64
 30  REG_CITY_NOT_LIVE_CITY       307511 non-null  int64
 31  REG_CITY_NOT_WORK_CITY       307511 non-null  int64
 32  LIVE_CITY_NOT_WORK_CITY      307511 non-null  int64
 33  ORGANIZATION_TYPE            307511 non-null  object
 34  OBS_30_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 35  DEF_30_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 36  OBS_60_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 37  DEF_60_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 38  DAYS_LAST_PHONE_CHANGE       307510 non-null  float64
 39  FLAG_DOCUMENT_3              307511 non-null  int64
 40  AMT_REQ_CREDIT_BUREAU_HOUR   265992 non-null  float64
 41  AMT_REQ_CREDIT_BUREAU_DAY    265992 non-null  float64
 42  AMT_REQ_CREDIT_BUREAU_WEEK   265992 non-null  float64
 43  AMT_REQ_CREDIT_BUREAU_MON    265992 non-null  float64
 44  AMT_REQ_CREDIT_BUREAU_QRT    265992 non-null  float64
 45  AMT_REQ_CREDIT_BUREAU_YEAR   265992 non-null  float64
 46  AMT_INCOME_RANGE             307279 non-null  category
 47  AMT_CREDIT_RANGE             307511 non-null  category
 48  AGE                          307511 non-null  int64
```

```
 49  AGE_GROUP                    307511 non-null  category
 50  YEARS_EMPLOYED               307511 non-null  int64
 51  EMPLOYMENT_YEAR              224233 non-null  category
dtypes: category(4), float64(18), int64(18), object(12)
memory usage: 113.8+ MB
```

In [50]:
```
categorical_columns = ['NAME_CONTRACT_TYPE','CODE_GENDER','NAME_TYPE_SUITE','N
                       'NAME_FAMILY_STATUS','NAME_HOUSING_TYPE','OCCUPATION_TY
                       'ORGANIZATION_TYPE','FLAG_OWN_CAR','FLAG_OWN_REALTY','L
                       'REG_CITY_NOT_LIVE_CITY','REG_CITY_NOT_WORK_CITY','REG_
                       'LIVE_REGION_NOT_WORK_REGION','REGION_RATING_CLIENT','W
                       'REGION_RATING_CLIENT_W_CITY'
                      ]
for col in categorical_columns:
    applicationDF[col] =pd.Categorical(applicationDF[col])
```

In [51]:
```
applicationDF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 307511 entries, 0 to 307510
Data columns (total 52 columns):
 #   Column                       Non-Null Count   Dtype
---  ------                       --------------   -----
 0   SK_ID_CURR                   307511 non-null  int64
 1   TARGET                       307511 non-null  int64
 2   NAME_CONTRACT_TYPE           307511 non-null  category
 3   CODE_GENDER                  307511 non-null  category
 4   FLAG_OWN_CAR                 307511 non-null  category
 5   FLAG_OWN_REALTY              307511 non-null  category
 6   CNT_CHILDREN                 307511 non-null  int64
 7   AMT_INCOME_TOTAL             307511 non-null  float64
 8   AMT_CREDIT                   307511 non-null  float64
 9   AMT_ANNUITY                  307499 non-null  float64
 10  AMT_GOODS_PRICE              307233 non-null  float64
 11  NAME_TYPE_SUITE              306219 non-null  category
 12  NAME_INCOME_TYPE             307511 non-null  category
 13  NAME_EDUCATION_TYPE          307511 non-null  category
 14  NAME_FAMILY_STATUS           307511 non-null  category
 15  NAME_HOUSING_TYPE            307511 non-null  category
 16  REGION_POPULATION_RELATIVE   307511 non-null  float64
 17  DAYS_BIRTH                   307511 non-null  int64
 18  DAYS_EMPLOYED                307511 non-null  int64
 19  DAYS_REGISTRATION            307511 non-null  float64
 20  DAYS_ID_PUBLISH              307511 non-null  int64
 21  OCCUPATION_TYPE              211120 non-null  category
 22  CNT_FAM_MEMBERS              307509 non-null  float64
 23  REGION_RATING_CLIENT         307511 non-null  category
 24  REGION_RATING_CLIENT_W_CITY  307511 non-null  category
 25  WEEKDAY_APPR_PROCESS_START   307511 non-null  category
 26  HOUR_APPR_PROCESS_START      307511 non-null  int64
 27  REG_REGION_NOT_LIVE_REGION   307511 non-null  int64
 28  REG_REGION_NOT_WORK_REGION   307511 non-null  category
 29  LIVE_REGION_NOT_WORK_REGION  307511 non-null  category
 30  REG_CITY_NOT_LIVE_CITY       307511 non-null  category
 31  REG_CITY_NOT_WORK_CITY       307511 non-null  category
 32  LIVE_CITY_NOT_WORK_CITY      307511 non-null  category
 33  ORGANIZATION_TYPE            307511 non-null  category
 34  OBS_30_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 35  DEF_30_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 36  OBS_60_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 37  DEF_60_CNT_SOCIAL_CIRCLE     306490 non-null  float64
 38  DAYS_LAST_PHONE_CHANGE       307510 non-null  float64
 39  FLAG_DOCUMENT_3              307511 non-null  int64
 40  AMT_REQ_CREDIT_BUREAU_HOUR   265992 non-null  float64
 41  AMT_REQ_CREDIT_BUREAU_DAY    265992 non-null  float64
 42  AMT_REQ_CREDIT_BUREAU_WEEK   265992 non-null  float64
 43  AMT_REQ_CREDIT_BUREAU_MON    265992 non-null  float64
 44  AMT_REQ_CREDIT_BUREAU_QRT    265992 non-null  float64
 45  AMT_REQ_CREDIT_BUREAU_YEAR   265992 non-null  float64
 46  AMT_INCOME_RANGE             307279 non-null  category
 47  AMT_CREDIT_RANGE             307511 non-null  category
 48  AGE                          307511 non-null  int64
```

```
 49  AGE_GROUP                    307511 non-null  category
 50  YEARS_EMPLOYED               307511 non-null  int64
 51  EMPLOYMENT_YEAR              224233 non-null  category
dtypes: category(23), float64(18), int64(11)
memory usage: 74.8 MB
```

In [52]:
```
previousDF.nunique().sort_values()
```

Out[52]:
```
NAME_PRODUCT_TYPE             3
NAME_PAYMENT_TYPE             4
NAME_CONTRACT_TYPE            4
NAME_CLIENT_TYPE              4
NAME_CONTRACT_STATUS          4
NAME_PORTFOLIO                5
NAME_YIELD_GROUP              5
CHANNEL_TYPE                  8
CODE_REJECT_REASON            9
NAME_SELLER_INDUSTRY         11
PRODUCT_COMBINATION          17
NAME_CASH_LOAN_PURPOSE       25
NAME_GOODS_CATEGORY          28
CNT_PAYMENT                  49
SELLERPLACE_AREA           2097
DAYS_DECISION              2922
AMT_CREDIT                86803
AMT_GOODS_PRICE           93885
AMT_APPLICATION           93885
SK_ID_CURR               338857
AMT_ANNUITY              357959
SK_ID_PREV              1670214
dtype: int64
```

In [53]:
```
previousDF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1670214 entries, 0 to 1670213
Data columns (total 22 columns):
 #   Column                  Non-Null Count    Dtype
---  ------                  --------------    -----
 0   SK_ID_PREV              1670214 non-null  int64
 1   SK_ID_CURR              1670214 non-null  int64
 2   NAME_CONTRACT_TYPE      1670214 non-null  object
 3   AMT_ANNUITY             1297979 non-null  float64
 4   AMT_APPLICATION         1670214 non-null  float64
 5   AMT_CREDIT              1670213 non-null  float64
 6   AMT_GOODS_PRICE         1284699 non-null  float64
 7   NAME_CASH_LOAN_PURPOSE  1670214 non-null  object
 8   NAME_CONTRACT_STATUS    1670214 non-null  object
 9   DAYS_DECISION           1670214 non-null  int64
 10  NAME_PAYMENT_TYPE       1670214 non-null  object
 11  CODE_REJECT_REASON      1670214 non-null  object
 12  NAME_CLIENT_TYPE        1670214 non-null  object
 13  NAME_GOODS_CATEGORY     1670214 non-null  object
 14  NAME_PORTFOLIO          1670214 non-null  object
 15  NAME_PRODUCT_TYPE       1670214 non-null  object
 16  CHANNEL_TYPE            1670214 non-null  object
 17  SELLERPLACE_AREA        1670214 non-null  int64
 18  NAME_SELLER_INDUSTRY    1670214 non-null  object
 19  CNT_PAYMENT             1297984 non-null  float64
 20  NAME_YIELD_GROUP        1670214 non-null  object
 21  PRODUCT_COMBINATION     1669868 non-null  object
dtypes: float64(5), int64(4), object(13)
memory usage: 280.3+ MB
```

In [54]:
```
previousDF['DAYS_DECISION'] = abs(previousDF ['DAYS_DECISION'])
```

In [55]:
```
previousDF['DAYS_DECISION_GROUP'] = (previousDF['DAYS_DECISION']-(previousDF['
```

In [56]:
```
previousDF['DAYS_DECISION_GROUP'].value_counts(normalize=True)*100
```

Out[56]:
```
0-400        37.490525
400-800      22.944724
800-1200     12.444753
1200-1600     7.904556
2400-2800     6.297456
1600-2000     5.795784
2000-2400     5.684960
2800-3200     1.437241
Name: DAYS_DECISION_GROUP, dtype: float64
```

In [57]:
```
Catgorical_col_p = ['NAME_CASH_LOAN_PURPOSE','NAME_CONTRACT_STATUS','NAME_PAYM
                    'CODE_REJECT_REASON','NAME_CLIENT_TYPE','NAME_GOODS_CATEGO
                   'NAME_PRODUCT_TYPE','CHANNEL_TYPE','NAME_SELLER_INDUSTRY','
                    'NAME_CONTRACT_TYPE','DAYS_DECISION_GROUP']

for col in Catgorical_col_p:
    previousDF[col] =pd.Categorical(previousDF[col])
```

In [58]:
```
previousDF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1670214 entries, 0 to 1670213
Data columns (total 23 columns):
 #   Column                  Non-Null Count    Dtype
---  ------                  --------------    -----
 0   SK_ID_PREV              1670214 non-null  int64
 1   SK_ID_CURR              1670214 non-null  int64
 2   NAME_CONTRACT_TYPE      1670214 non-null  category
 3   AMT_ANNUITY             1297979 non-null  float64
 4   AMT_APPLICATION         1670214 non-null  float64
 5   AMT_CREDIT              1670213 non-null  float64
 6   AMT_GOODS_PRICE         1284699 non-null  float64
 7   NAME_CASH_LOAN_PURPOSE  1670214 non-null  category
 8   NAME_CONTRACT_STATUS    1670214 non-null  category
 9   DAYS_DECISION           1670214 non-null  int64
 10  NAME_PAYMENT_TYPE       1670214 non-null  category
 11  CODE_REJECT_REASON      1670214 non-null  category
 12  NAME_CLIENT_TYPE        1670214 non-null  category
 13  NAME_GOODS_CATEGORY     1670214 non-null  category
 14  NAME_PORTFOLIO          1670214 non-null  category
 15  NAME_PRODUCT_TYPE       1670214 non-null  category
 16  CHANNEL_TYPE            1670214 non-null  category
 17  SELLERPLACE_AREA        1670214 non-null  int64
 18  NAME_SELLER_INDUSTRY    1670214 non-null  category
 19  CNT_PAYMENT             1297984 non-null  float64
 20  NAME_YIELD_GROUP        1670214 non-null  category
 21  PRODUCT_COMBINATION     1669868 non-null  category
 22  DAYS_DECISION_GROUP     1670214 non-null  category
dtypes: category(14), float64(5), int64(4)
memory usage: 137.0 MB
```

In [59]:
```
round(applicationDF.isnull().sum()/applicationDF.shape[0]*100.00,2)
```

Out[59]:
```
SK_ID_CURR                     0.00
TARGET                         0.00
NAME_CONTRACT_TYPE             0.00
CODE_GENDER                    0.00
FLAG_OWN_CAR                   0.00
FLAG_OWN_REALTY                0.00
CNT_CHILDREN                   0.00
AMT_INCOME_TOTAL               0.00
AMT_CREDIT                     0.00
AMT_ANNUITY                    0.00
AMT_GOODS_PRICE                0.09
NAME_TYPE_SUITE                0.42
NAME_INCOME_TYPE               0.00
NAME_EDUCATION_TYPE            0.00
NAME_FAMILY_STATUS             0.00
NAME_HOUSING_TYPE              0.00
REGION_POPULATION_RELATIVE     0.00
DAYS_BIRTH                     0.00
DAYS_EMPLOYED                  0.00
DAYS_REGISTRATION              0.00
DAYS_ID_PUBLISH                0.00
OCCUPATION_TYPE               31.35
CNT_FAM_MEMBERS                0.00
REGION_RATING_CLIENT           0.00
REGION_RATING_CLIENT_W_CITY    0.00
WEEKDAY_APPR_PROCESS_START     0.00
HOUR_APPR_PROCESS_START        0.00
REG_REGION_NOT_LIVE_REGION     0.00
REG_REGION_NOT_WORK_REGION     0.00
LIVE_REGION_NOT_WORK_REGION    0.00
REG_CITY_NOT_LIVE_CITY         0.00
REG_CITY_NOT_WORK_CITY         0.00
LIVE_CITY_NOT_WORK_CITY        0.00
ORGANIZATION_TYPE              0.00
OBS_30_CNT_SOCIAL_CIRCLE       0.33
DEF_30_CNT_SOCIAL_CIRCLE       0.33
OBS_60_CNT_SOCIAL_CIRCLE       0.33
DEF_60_CNT_SOCIAL_CIRCLE       0.33
DAYS_LAST_PHONE_CHANGE         0.00
FLAG_DOCUMENT_3                0.00
AMT_REQ_CREDIT_BUREAU_HOUR    13.50
AMT_REQ_CREDIT_BUREAU_DAY     13.50
AMT_REQ_CREDIT_BUREAU_WEEK    13.50
AMT_REQ_CREDIT_BUREAU_MON     13.50
AMT_REQ_CREDIT_BUREAU_QRT     13.50
AMT_REQ_CREDIT_BUREAU_YEAR    13.50
AMT_INCOME_RANGE               0.08
AMT_CREDIT_RANGE               0.00
AGE                            0.00
AGE_GROUP                      0.00
YEARS_EMPLOYED                 0.00
EMPLOYMENT_YEAR               27.08
dtype: float64
```

In [60]:
```
applicationDF['NAME_TYPE_SUITE'].describe()
```

Out[60]:
```
count            306219
unique                7
top       Unaccompanied
freq             248526
Name: NAME_TYPE_SUITE, dtype: object
```

In [61]:
```
applicationDF['NAME_TYPE_SUITE'].fillna((applicationDF['NAME_TYPE_SUITE'].mode
```

In [62]:
```
applicationDF['OCCUPATION_TYPE'] = applicationDF['OCCUPATION_TYPE'].cat.add_ca
applicationDF['OCCUPATION_TYPE'].fillna('Unknown', inplace =True)
```

In [63]:
```
applicationDF[['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']].desc
```

Out[63]:

	AMT_REQ_CREDIT_BUREAU_HOUR	AMT_REQ_CREDIT_BUREAU_DAY	AMT_REQ_CREDIT_
count	265992.000000	265992.000000	
mean	0.006402	0.007000	
std	0.083849	0.110757	
min	0.000000	0.000000	
25%	0.000000	0.000000	
50%	0.000000	0.000000	
75%	0.000000	0.000000	
max	4.000000	9.000000	

In [64]:
```
amount = ['AMT_REQ_CREDIT_BUREAU_HOUR', 'AMT_REQ_CREDIT_BUREAU_DAY','AMT_REQ_C
          'AMT_REQ_CREDIT_BUREAU_QRT','AMT_REQ_CREDIT_BUREAU_YEAR']

for col in amount:
    applicationDF[col].fillna(applicationDF[col].median(),inplace = True)
```

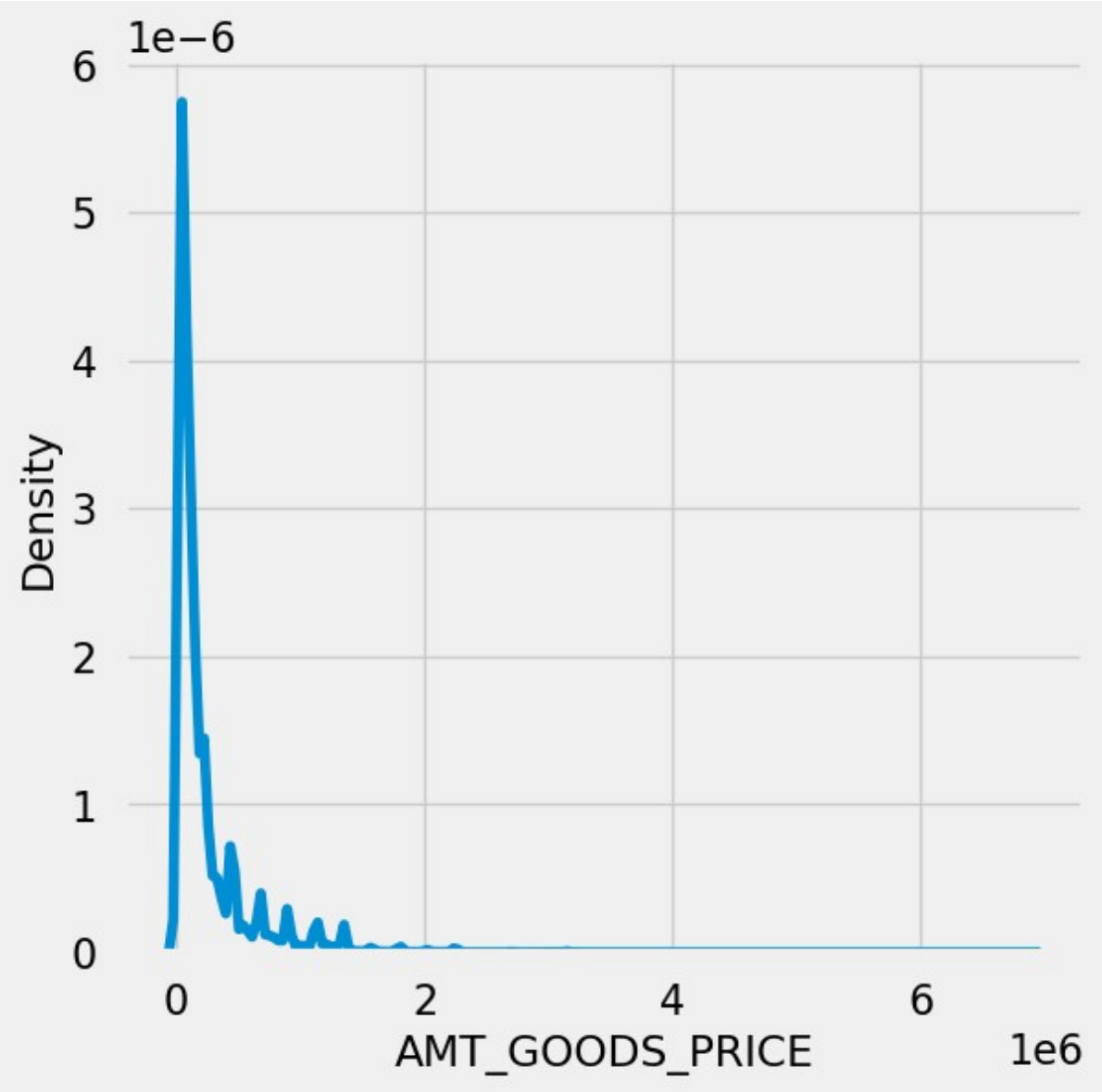
In [65]:
```
round(applicationDF.isnull().sum()/previousDF.shape[0]* 100.00,2)
```

Out[65]:
```
SK_ID_CURR                     0.00
TARGET                         0.00
NAME_CONTRACT_TYPE             0.00
CODE_GENDER                    0.00
FLAG_OWN_CAR                   0.00
FLAG_OWN_REALTY                0.00
CNT_CHILDREN                   0.00
AMT_INCOME_TOTAL               0.00
AMT_CREDIT                     0.00
AMT_ANNUITY                    0.00
AMT_GOODS_PRICE                0.02
NAME_TYPE_SUITE                0.00
NAME_INCOME_TYPE               0.00
NAME_EDUCATION_TYPE            0.00
NAME_FAMILY_STATUS             0.00
NAME_HOUSING_TYPE              0.00
REGION_POPULATION_RELATIVE     0.00
DAYS_BIRTH                     0.00
DAYS_EMPLOYED                  0.00
DAYS_REGISTRATION              0.00
DAYS_ID_PUBLISH                0.00
OCCUPATION_TYPE                0.00
CNT_FAM_MEMBERS                0.00
REGION_RATING_CLIENT           0.00
REGION_RATING_CLIENT_W_CITY    0.00
WEEKDAY_APPR_PROCESS_START     0.00
HOUR_APPR_PROCESS_START        0.00
REG_REGION_NOT_LIVE_REGION     0.00
REG_REGION_NOT_WORK_REGION     0.00
LIVE_REGION_NOT_WORK_REGION    0.00
REG_CITY_NOT_LIVE_CITY         0.00
REG_CITY_NOT_WORK_CITY         0.00
LIVE_CITY_NOT_WORK_CITY        0.00
ORGANIZATION_TYPE              0.00
OBS_30_CNT_SOCIAL_CIRCLE       0.06
DEF_30_CNT_SOCIAL_CIRCLE       0.06
OBS_60_CNT_SOCIAL_CIRCLE       0.06
DEF_60_CNT_SOCIAL_CIRCLE       0.06
DAYS_LAST_PHONE_CHANGE         0.00
FLAG_DOCUMENT_3                0.00
AMT_REQ_CREDIT_BUREAU_HOUR     0.00
AMT_REQ_CREDIT_BUREAU_DAY      0.00
AMT_REQ_CREDIT_BUREAU_WEEK     0.00
AMT_REQ_CREDIT_BUREAU_MON      0.00
AMT_REQ_CREDIT_BUREAU_QRT      0.00
AMT_REQ_CREDIT_BUREAU_YEAR     0.00
AMT_INCOME_RANGE               0.01
AMT_CREDIT_RANGE               0.00
AGE                            0.00
AGE_GROUP                      0.00
YEARS_EMPLOYED                 0.00
EMPLOYMENT_YEAR                4.99
dtype: float64
```

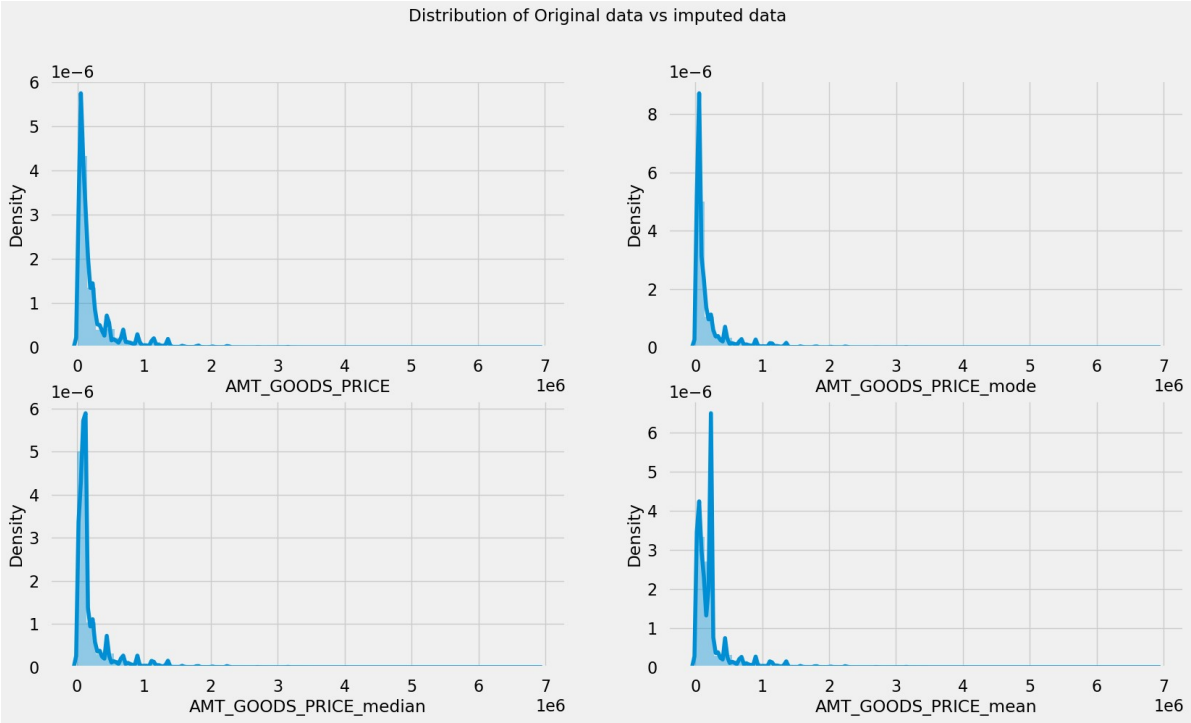
In [66]:
```
round(previousDF.isnull().sum() / previousDF.shape[0] * 100.00,2)
```

Out[66]:
```
SK_ID_PREV                    0.00
SK_ID_CURR                    0.00
NAME_CONTRACT_TYPE            0.00
AMT_ANNUITY                  22.29
AMT_APPLICATION               0.00
AMT_CREDIT                    0.00
AMT_GOODS_PRICE              23.08
NAME_CASH_LOAN_PURPOSE        0.00
NAME_CONTRACT_STATUS          0.00
DAYS_DECISION                 0.00
NAME_PAYMENT_TYPE             0.00
CODE_REJECT_REASON            0.00
NAME_CLIENT_TYPE              0.00
NAME_GOODS_CATEGORY           0.00
NAME_PORTFOLIO                0.00
NAME_PRODUCT_TYPE             0.00
CHANNEL_TYPE                  0.00
SELLERPLACE_AREA              0.00
NAME_SELLER_INDUSTRY          0.00
CNT_PAYMENT                  22.29
NAME_YIELD_GROUP              0.00
PRODUCT_COMBINATION           0.02
DAYS_DECISION_GROUP           0.00
dtype: float64
```

In [67]:
```
plt.figure(figsize=(6,6))
sns.kdeplot(previousDF['AMT_GOODS_PRICE'][pd.notnull(previousDF['AMT_GOODS_PRI
plt.show()
```



In [68]:
```
statsDF = pd.DataFrame()
statsDF['AMT_GOODS_PRICE_mode'] = previousDF['AMT_GOODS_PRICE'].fillna(previou
statsDF['AMT_GOODS_PRICE_median'] = previousDF['AMT_GOODS_PRICE'].fillna(previ
statsDF['AMT_GOODS_PRICE_mean'] = previousDF['AMT_GOODS_PRICE'].fillna(previou

cols = ['AMT_GOODS_PRICE_mode', 'AMT_GOODS_PRICE_median','AMT_GOODS_PRICE_mean

plt.figure(figsize=(18,10))
plt.suptitle('Distribution of Original data vs imputed data')
plt.subplot(221)
sns.distplot(previousDF['AMT_GOODS_PRICE'][pd.notnull(previousDF['AMT_GOODS_PR
for i in enumerate(cols):
    plt.subplot(2,2,i[0]+2)
    sns.distplot(statsDF[i[1]])
```



In [69]:
```
previousDF['AMT_GOODS_PRICE'].fillna(previousDF['AMT_GOODS_PRICE'].mode()[0],
```

In [70]:
```
previousDF.loc[previousDF['CNT_PAYMENT'].isnull(),'NAME_CONTRACT_STATUS'].valu
```

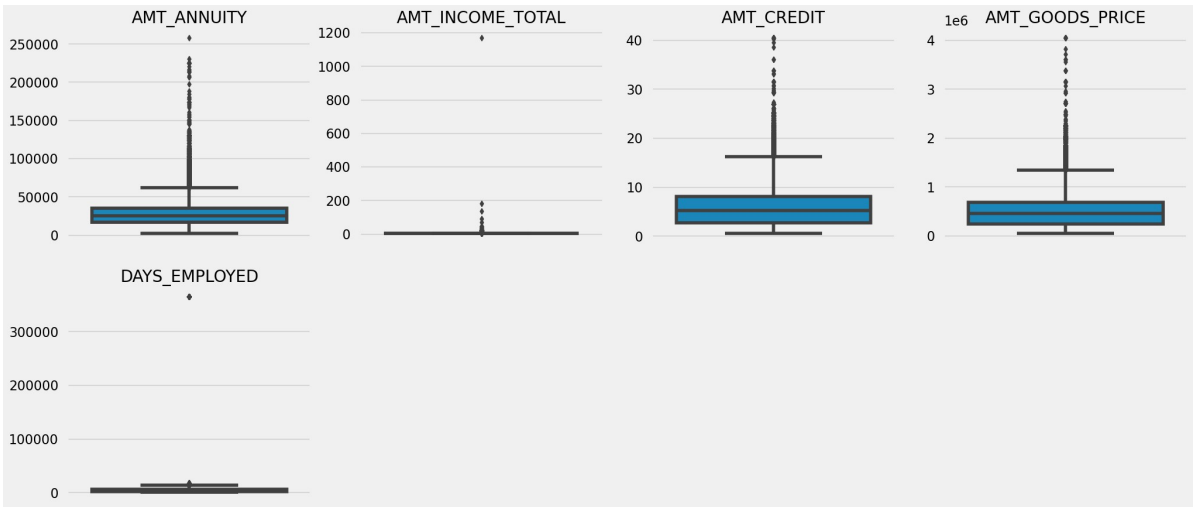
Out[70]:
```
Canceled        305805
Refused          40897
Unused offer     25524
Approved             4
Name: NAME_CONTRACT_STATUS, dtype: int64
```

In [71]:
```
previousDF['CNT_PAYMENT'].fillna(0,inplace = True)
```

In [72]:
```
round(previousDF.isnull().sum() / previousDF.shape[0] * 100.00,2)
```

Out[72]:
```
SK_ID_PREV                   0.00
SK_ID_CURR                   0.00
NAME_CONTRACT_TYPE           0.00
AMT_ANNUITY                 22.29
AMT_APPLICATION              0.00
AMT_CREDIT                   0.00
AMT_GOODS_PRICE              0.00
NAME_CASH_LOAN_PURPOSE       0.00
NAME_CONTRACT_STATUS         0.00
DAYS_DECISION                0.00
NAME_PAYMENT_TYPE            0.00
CODE_REJECT_REASON           0.00
NAME_CLIENT_TYPE             0.00
NAME_GOODS_CATEGORY          0.00
NAME_PORTFOLIO               0.00
NAME_PRODUCT_TYPE            0.00
CHANNEL_TYPE                 0.00
SELLERPLACE_AREA             0.00
NAME_SELLER_INDUSTRY         0.00
CNT_PAYMENT                  0.00
NAME_YIELD_GROUP             0.00
PRODUCT_COMBINATION          0.02
DAYS_DECISION_GROUP          0.00
dtype: float64
```

In [73]:
```
plt.figure(figsize=(22,10))
app_outlier_col_1 = ['AMT_ANNUITY','AMT_INCOME_TOTAL','AMT_CREDIT','AMT_GOODS_
app_outlier_col_2 = ['CNT_CHILDREN','DAYS_BIRTH']
for i in enumerate(app_outlier_col_1):
    plt.subplot(2,4,i[0]+1)
    sns.boxplot(y=applicationDF[i[1]])
    plt.title(i[1])
    plt.ylabel("")
```

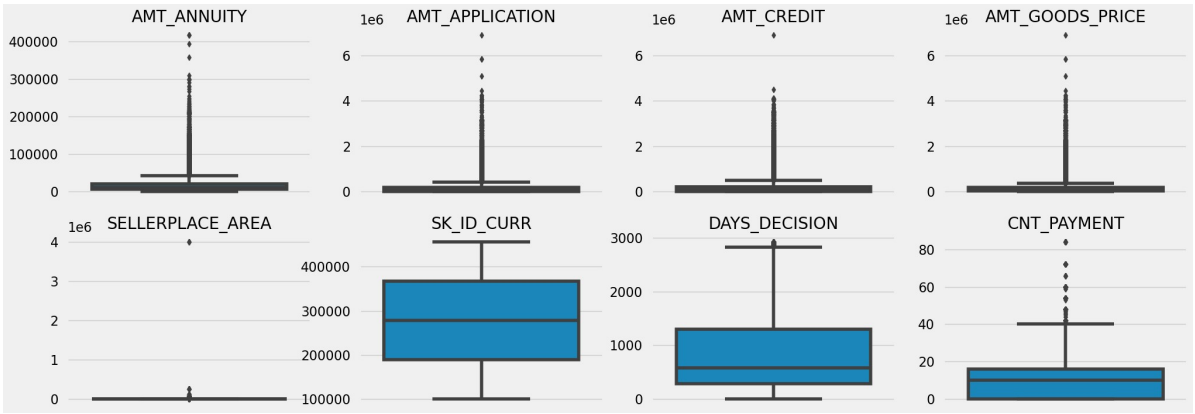


In [74]:
```
applicationDF[['AMT_ANNUITY', 'AMT_INCOME_TOTAL', 'AMT_CREDIT', 'AMT_GOODS_PRI
```

Out[74]:

	AMT_ANNUITY	AMT_INCOME_TOTAL	AMT_CREDIT	AMT_GOODS_PRICE	DAYS_BIRTH
count	307499.000000	307511.000000	307511.000000	3.072330e+05	307511.000000
mean	27108.573909	1.687979	5.990260	5.383962e+05	16036.995067
std	14493.737315	2.371231	4.024908	3.694465e+05	4363.988632
min	1615.500000	0.256500	0.450000	4.050000e+04	7489.000000
25%	16524.000000	1.125000	2.700000	2.385000e+05	12413.000000
50%	24903.000000	1.471500	5.135310	4.500000e+05	15750.000000
75%	34596.000000	2.025000	8.086500	6.795000e+05	19682.000000
max	258025.500000	1170.000000	40.500000	4.050000e+06	25229.000000

In [75]:
```
plt.figure(figsize=(22,8))
prev_outlier_col_1 = ['AMT_ANNUITY','AMT_APPLICATION','AMT_CREDIT','AMT_GOODS_
prev_outlier_col_2 = ['SK_ID_CURR','DAYS_DECISION','CNT_PAYMENT']
for i in enumerate (prev_outlier_col_1):
    plt.subplot(2,4,i[0]+1)
    sns.boxplot(y=previousDF[i[1]])
    plt.title(i[1])
    plt.ylabel("")

for i in enumerate(prev_outlier_col_2):
    plt.subplot(2,4,i[0]+6)
    sns.boxplot(y=previousDF[i[1]])
    plt.title(i[1])
    plt.ylabel("")
```

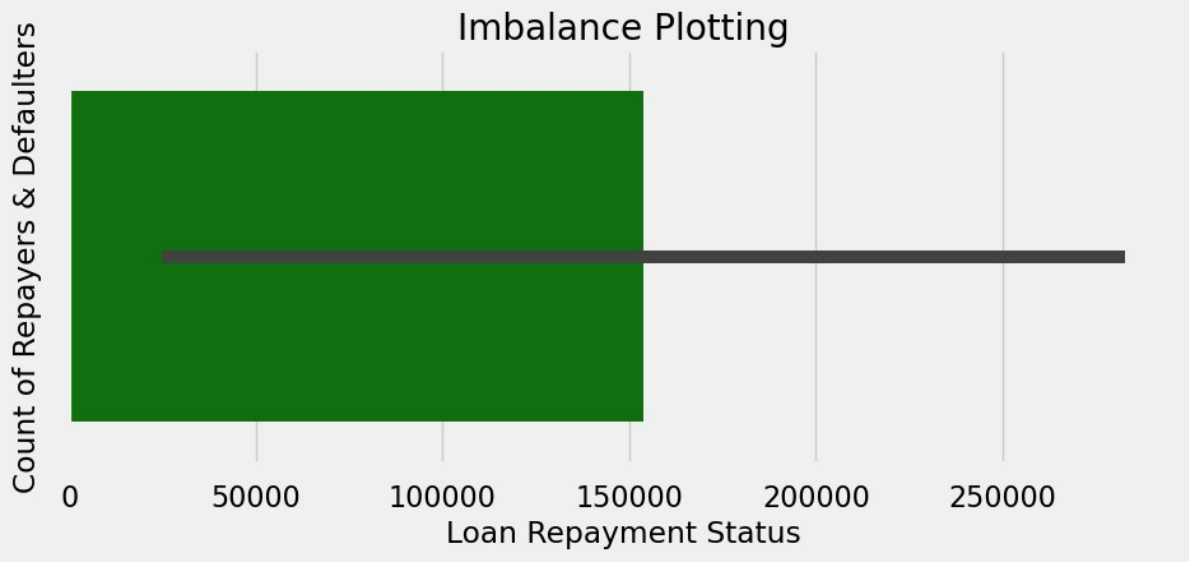


In [76]:
```
previousDF[['AMT_ANNUITY', 'AMT_APPLICATION', 'AMT_CREDIT', 'AMT_GOODS_PRICE',
```

Out[76]:

	AMT_ANNUITY	AMT_APPLICATION	AMT_CREDIT	AMT_GOODS_PRICE	SELLERPLACE_A
count	1.297979e+06	1.670214e+06	1.670213e+06	1.670214e+06	1.670214e
mean	1.595512e+04	1.752339e+05	1.961140e+05	1.856429e+05	3.139511e
std	1.478214e+04	2.927798e+05	3.185746e+05	2.871413e+05	7.127443e
min	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	-1.000000e
25%	6.321780e+03	1.872000e+04	2.416050e+04	4.500000e+04	-1.000000e
50%	1.125000e+04	7.104600e+04	8.054100e+04	7.105050e+04	3.000000e
75%	2.065842e+04	1.803600e+05	2.164185e+05	1.804050e+05	8.200000e
max	4.180581e+05	6.905160e+06	6.905160e+06	6.905160e+06	4.000000e

In [77]:
```
Imbalance = applicationDF["TARGET"].value_counts().reset_index()

plt.figure(figsize=(10,4))
x= ['Repayer','Defaulter']

sns.barplot(x="TARGET",data = Imbalance,palette= ['g','r'])
plt.xlabel("Loan Repayment Status")
plt.ylabel("Count of Repayers & Defaulters")
plt.title("Imbalance Plotting")
plt.show()
```



In [78]:
```
count_0 = Imbalance.iloc[0]["TARGET"]
count_1 = Imbalance.iloc[1]["TARGET"]
count_0_perc = round(count_0/(count_0+count_1)*100,2)
count_1_perc = round(count_1/(count_0+count_1)*100,2)

print('Ratios of imbalance in percentage with respect to Repayer and Defaulter
print('Ratios of imbalance in relative with respect to Repayer and Defaulter d
```

```
Ratios of imbalance in percentage with respect to Repayer and Defaulter datas
are: 91.93 and 8.07
Ratios of imbalance in relative with respect to Repayer and Defaulter datas i
s 11.39 : 1 (approx)
```

In [79]:
```
def univariate_categorical(feature,ylog=False,label_rotation=False,horizontal_
    temp = applicationDF[feature].value_counts()

    df1 = pd.DataFrame({feature: temp.index,'Number of contracts': temp.values
    cat_perc = applicationDF[[feature, 'TARGET']].groupby([feature],as_index=F
    cat_perc["TARGET"] = cat_perc["TARGET"]*100
    cat_perc.sort_values(by='TARGET', ascending=False, inplace=True)

    if(horizontal_layout):
        fig, (ax1, ax2) = plt.subplots(ncols=2, figsize=(12,6))
    else:
        fig, (ax1, ax2) = plt.subplots(nrows=2, figsize=(20,24))



    s = sns.countplot(ax=ax1,
                      x = feature,
                      data=applicationDF,
                      hue ="TARGET",
                      order=cat_perc[feature],
                      palette=['g','r'])


    ax1.set_title(feature, fontdict={'fontsize' : 10, 'fontweight' : 3, 'color
    ax1.legend(['Repayer','Defaulter'])


    if ylog:
        ax1.set_yscale('log')
        ax1.set_ylabel("Count (log)",fontdict={'fontsize' : 10, 'fontweight' :


    if(label_rotation):
        s.set_xticklabels(s.get_xticklabels(),rotation=90)


    s = sns.barplot(ax=ax2,
                      x = feature,
                      y='TARGET',
                      order=cat_perc[feature],
                      data=cat_perc,
                      palette='Set2')

    if(label_rotation):
        s.set_xticklabels(s.get_xticklabels(),rotation=90)
    plt.ylabel('Percent of Defaulters [%]', fontsize=10)
    plt.tick_params(axis='both', which='major', labelsize=10)
    ax2.set_title(feature + " Defaulter %", fontdict={'fontsize' : 15, 'fontwe

    plt.show();
```

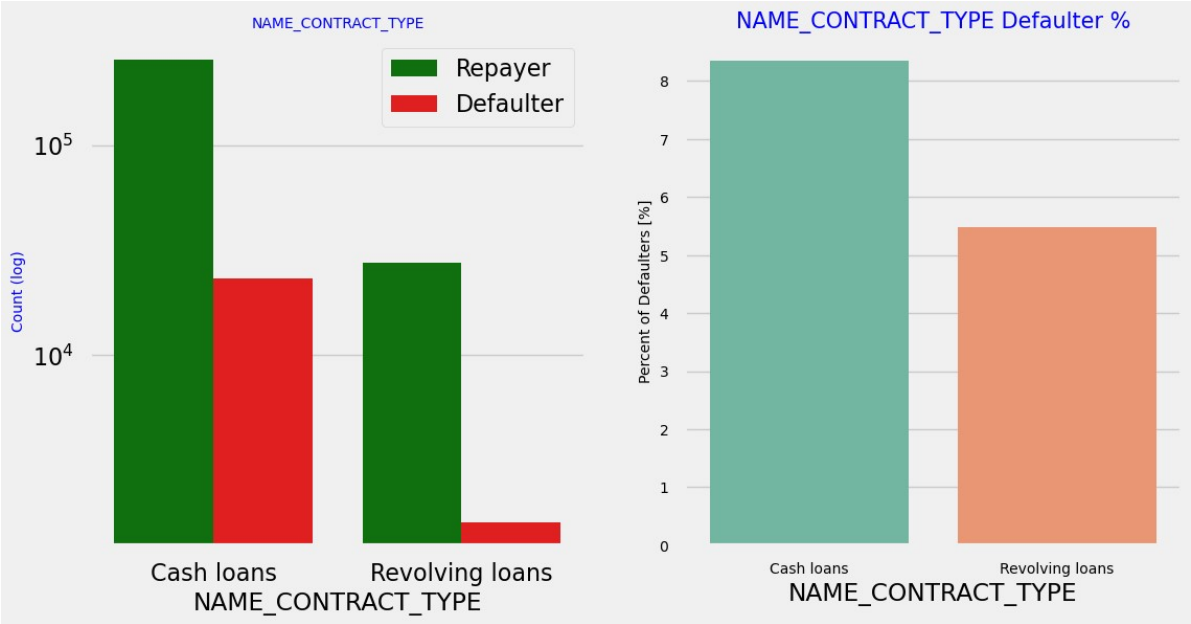
In [80]:
```
def bivariate_bar(x,y,df,hue,figsize):

    plt.figure(figsize=figsize)
    sns.barplot(x=x,
                y=y,
                data=df,
                hue=hue,
                palette =['g','r'])

    #
    plt.xlabel(x,fontdict={'fontsize' : 10, 'fontweight' : 3, 'color' : 'Blue'
    plt.ylabel(y,fontdict={'fontsize' : 10, 'fontweight' : 3, 'color' : 'Blue'
    plt.title(col, fontdict={'fontsize' : 15, 'fontweight' : 5, 'color' : 'Blu
    plt.xticks(rotation=90, ha='right')
    plt.legend(labels = ['Repayer','Defaulter'])
    plt.show()
```

In [81]:
```
def bivariate_rel(x,y,data, hue, kind, palette, legend,figsize):

    plt.figure(figsize=figsize)
    sns.relplot(x=x,
                y=y,
                data=applicationDF,
                hue="TARGET",
                kind=kind,
                palette = ['g','r'],
                legend = False)
    plt.legend(['Repayer','Defaulter'])
    plt.xticks(rotation=90, ha='right')
    plt.show()
```

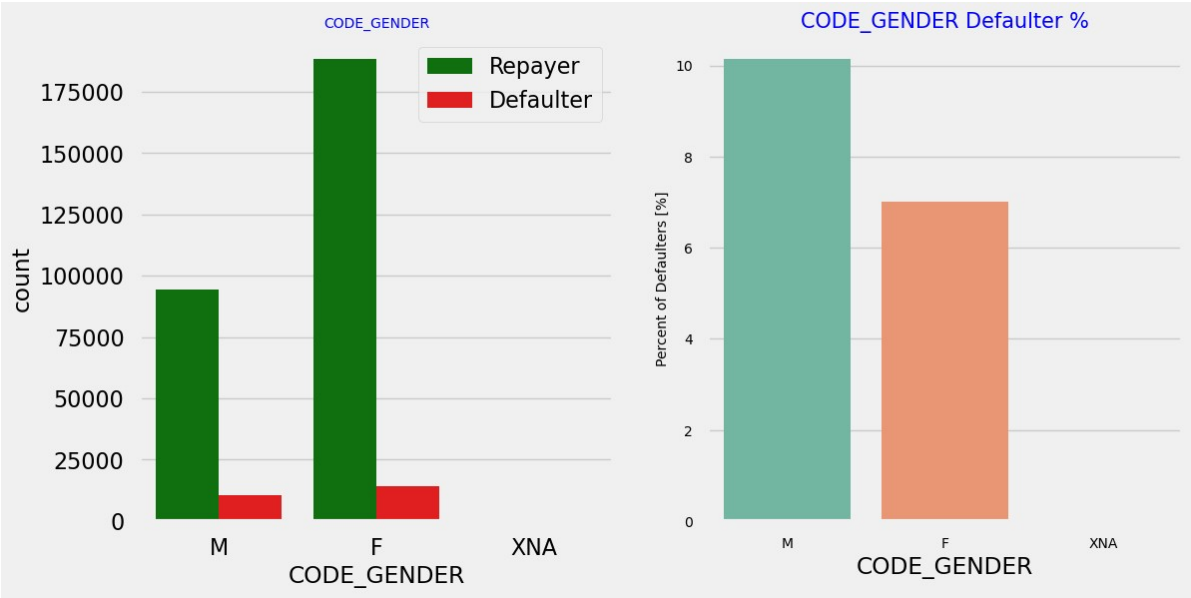
In [82]:
```
def univariate_merged(col,df,hue,palette,ylog,figsize):
    plt.figure(figsize=figsize)
    ax=sns.countplot(x=col,
                  data=df,
                  hue= hue,
                  palette= palette,
                  order=df[col].value_counts().index)


    if ylog:
        plt.yscale('log')
        plt.ylabel("Count (log)",fontdict={'fontsize' : 10, 'fontweight' : 3,
    else:
        plt.ylabel("Count",fontdict={'fontsize' : 10, 'fontweight' : 3, 'color

    plt.title(col , fontdict={'fontsize' : 15, 'fontweight' : 5, 'color' : 'Bl
    plt.legend(loc = "upper right")
    plt.xticks(rotation=90, ha='right')

    plt.show()
```

In [83]:
```
def merged_pointplot(x,y):
    plt.figure(figsize=(8,4))
    sns.pointplot(x=x,
                  y=y,
                  hue="TARGET",
                  data=loan_process_df,
                  palette =['g','r'])
```

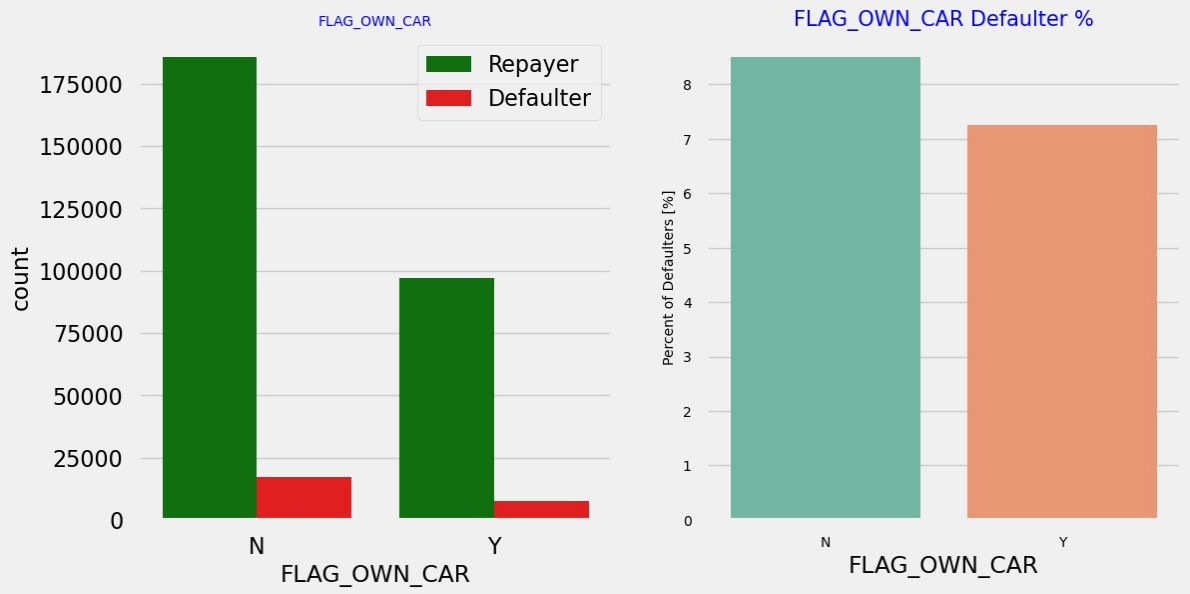
In [84]:
```
univariate_categorical('NAME_CONTRACT_TYPE',True)
```



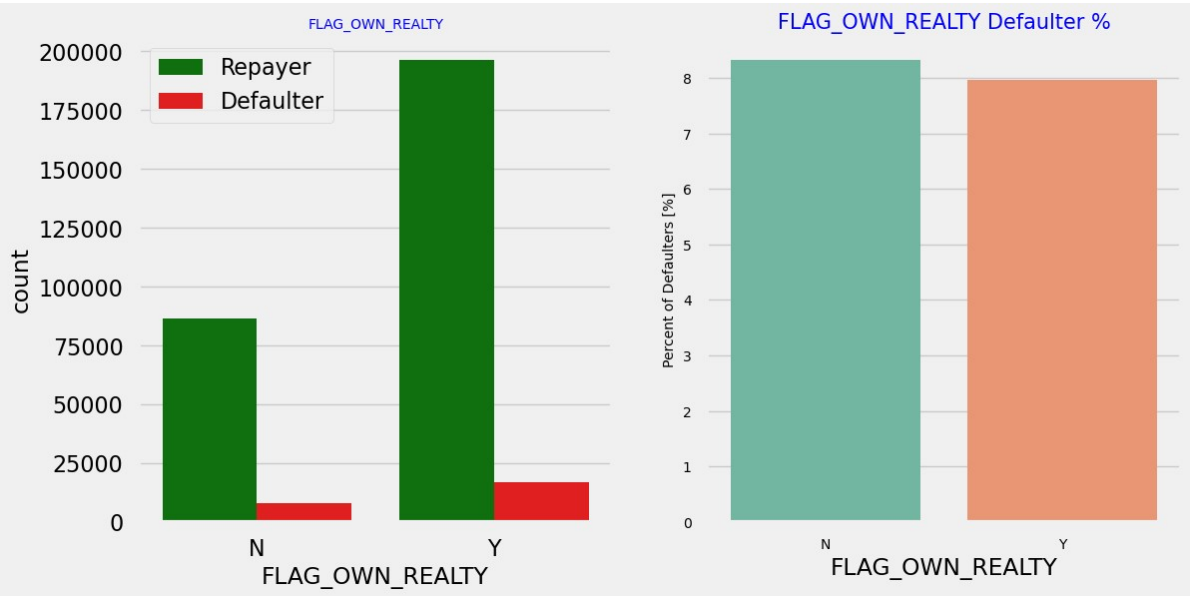
In [85]:
```
univariate_categorical('CODE_GENDER')
```



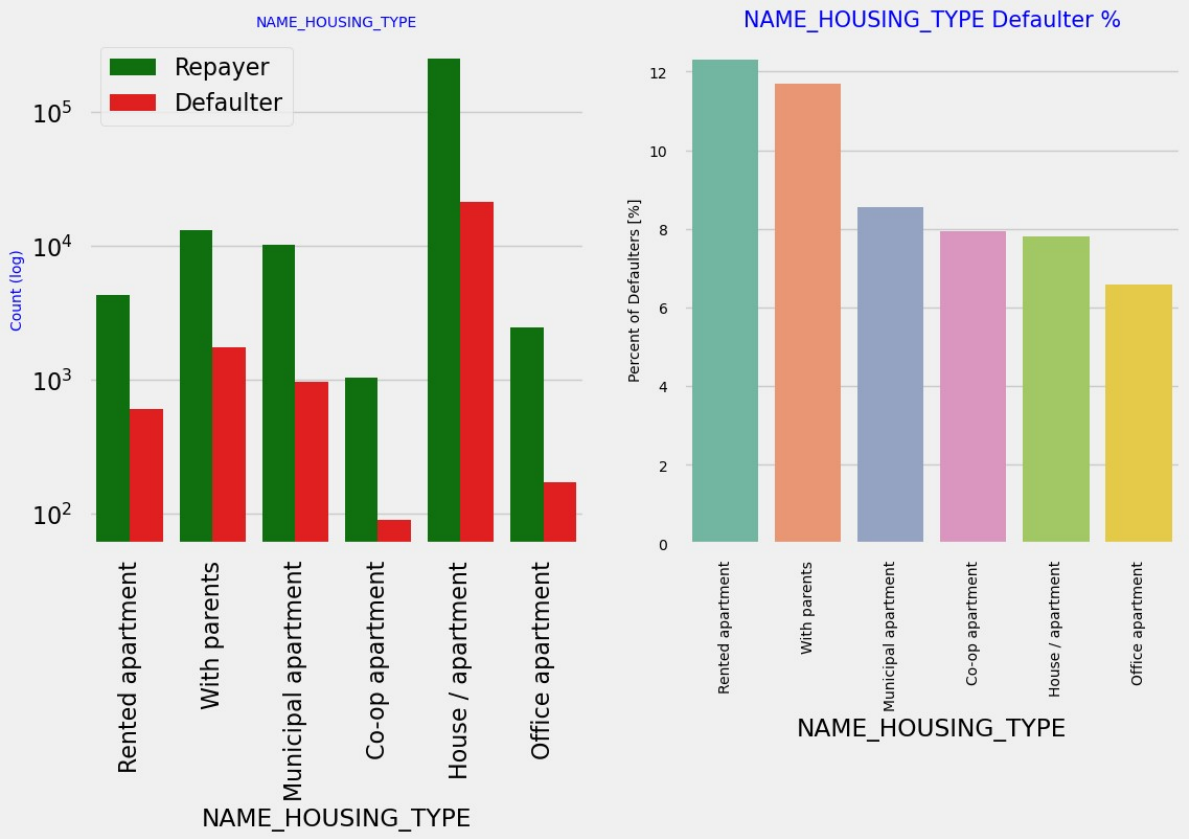
In [86]:
```
univariate_categorical('FLAG_OWN_CAR')
```



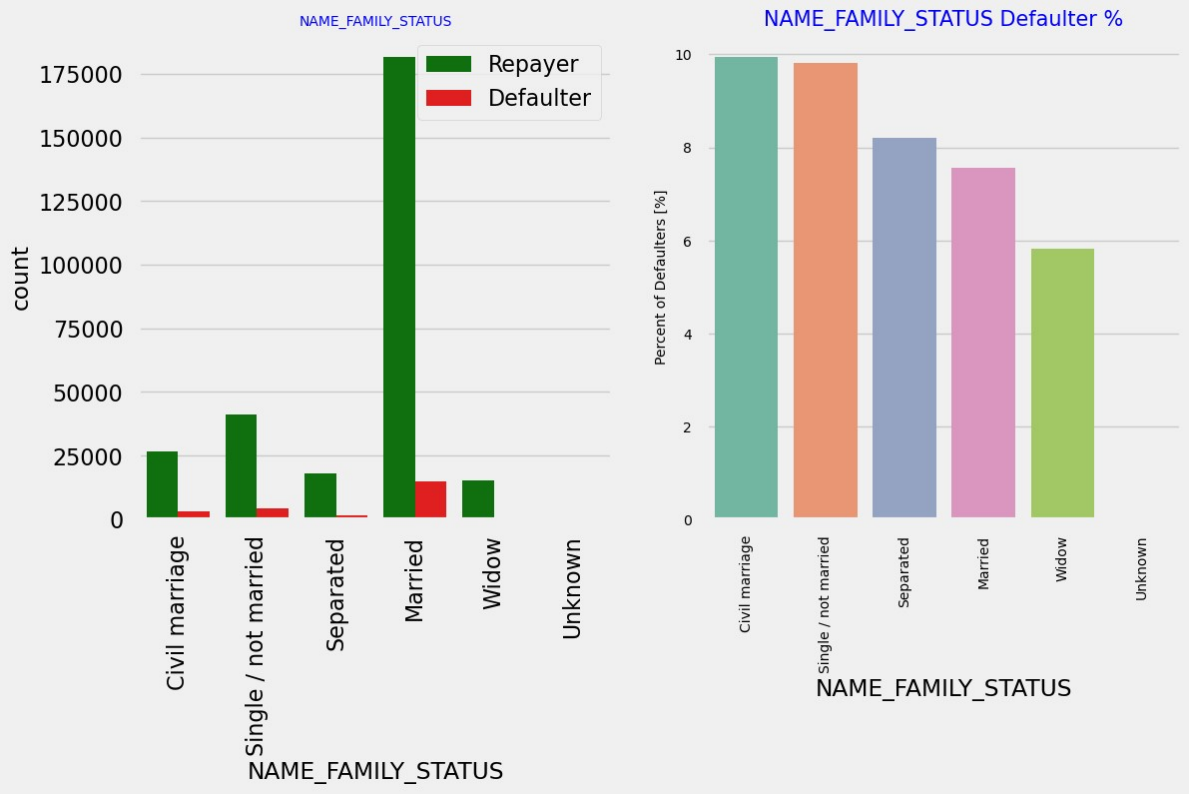
In [87]:
```
univariate_categorical('FLAG_OWN_REALTY')
```



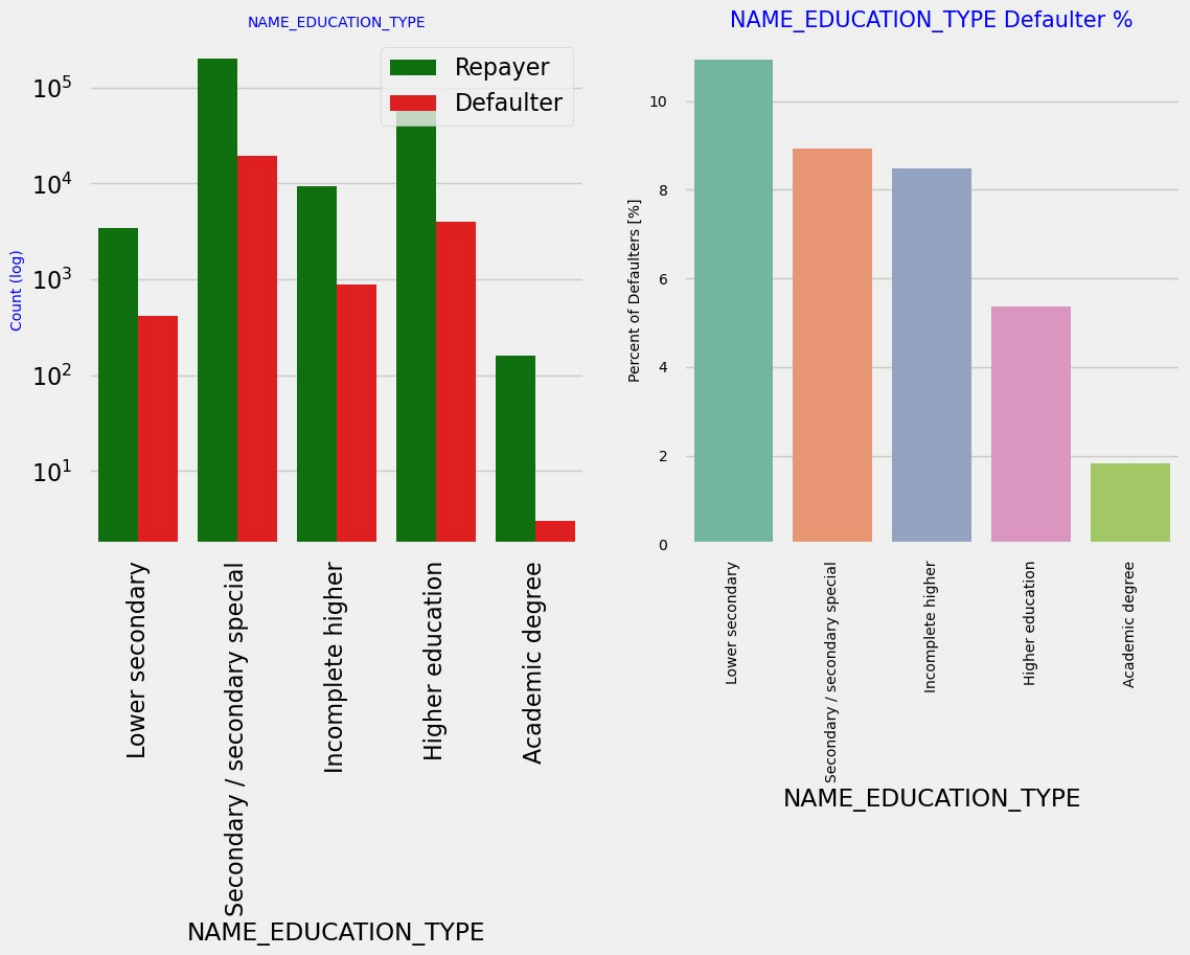
In [88]:
```
univariate_categorical("NAME_HOUSING_TYPE",True,True,True)
```



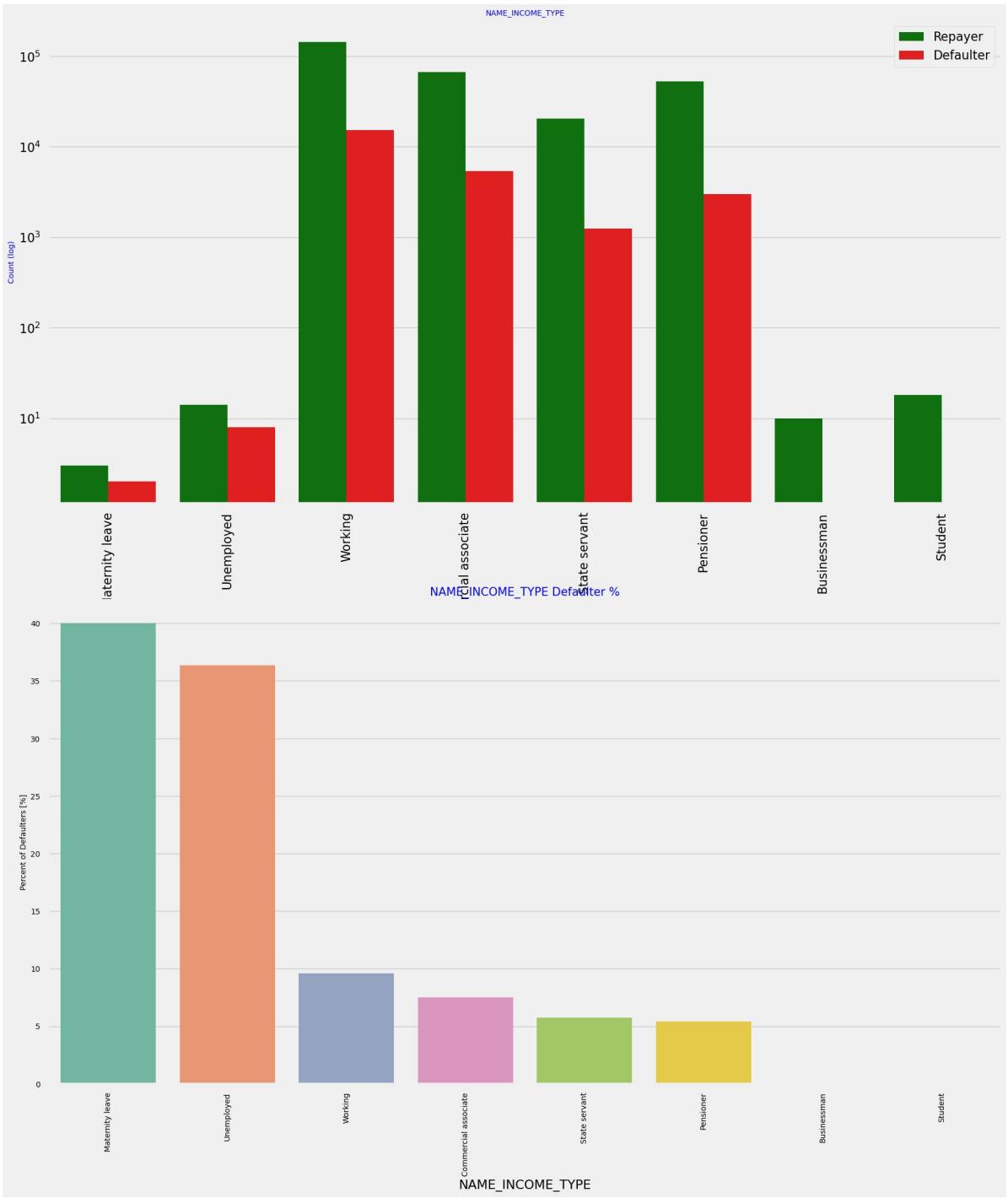
In [89]:
```
univariate_categorical("NAME_FAMILY_STATUS",False,True,True)
```



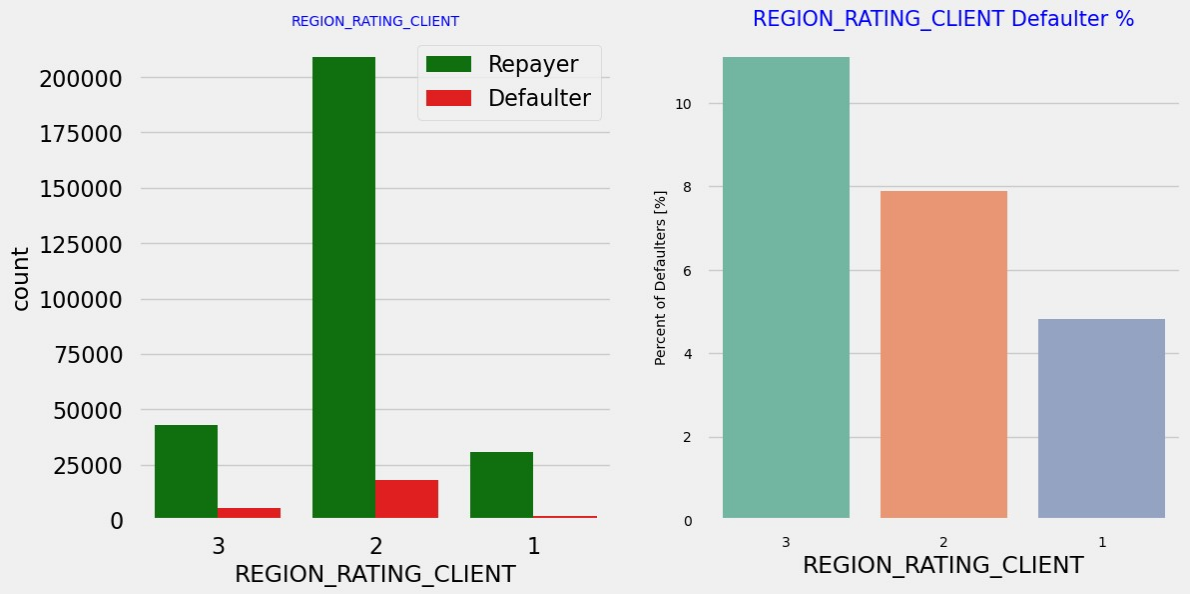
In [90]:
```
univariate_categorical("NAME_EDUCATION_TYPE",True,True,True)
```



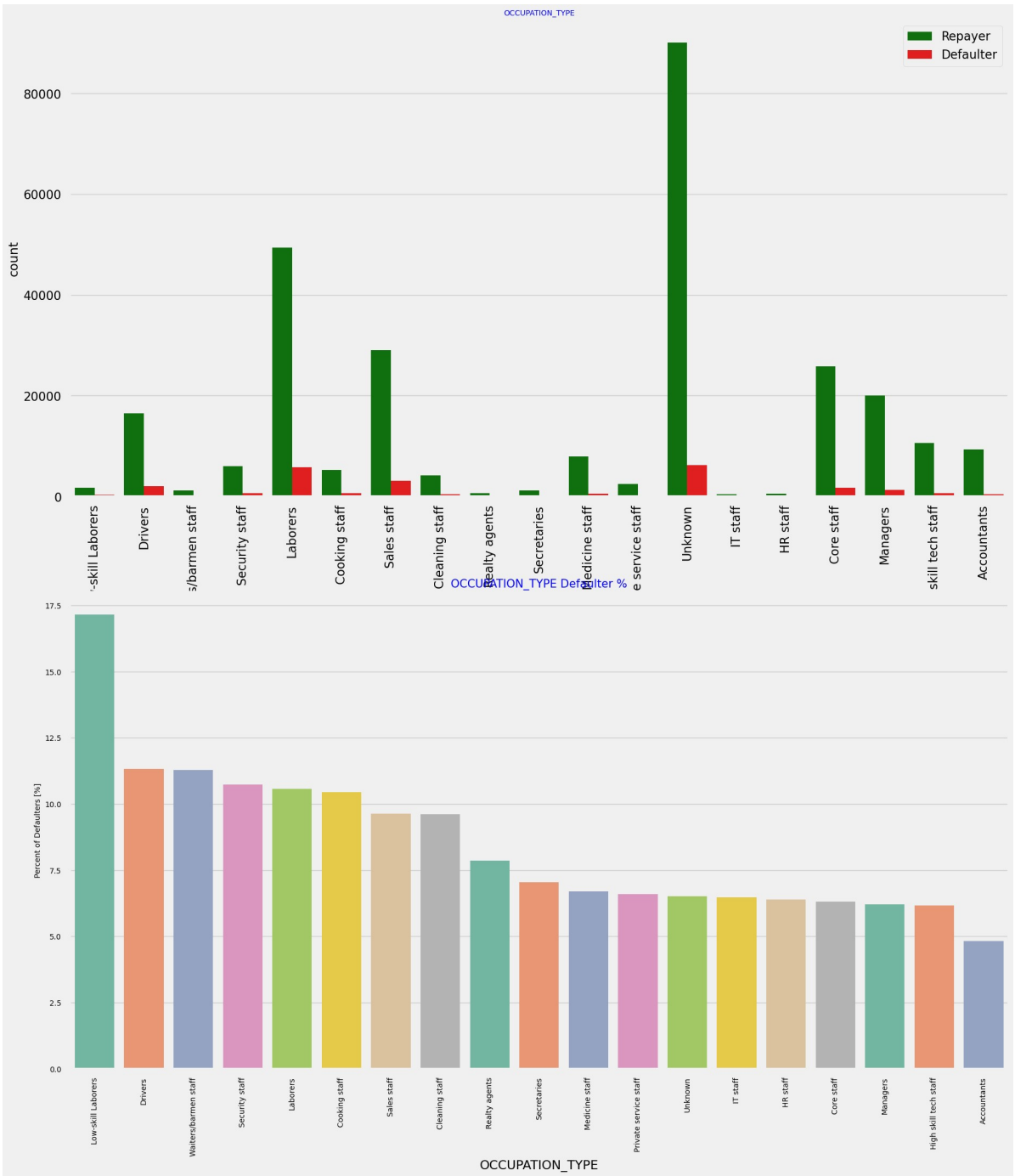
In [91]:
```
univariate_categorical("NAME_INCOME_TYPE",True,True,False)
```



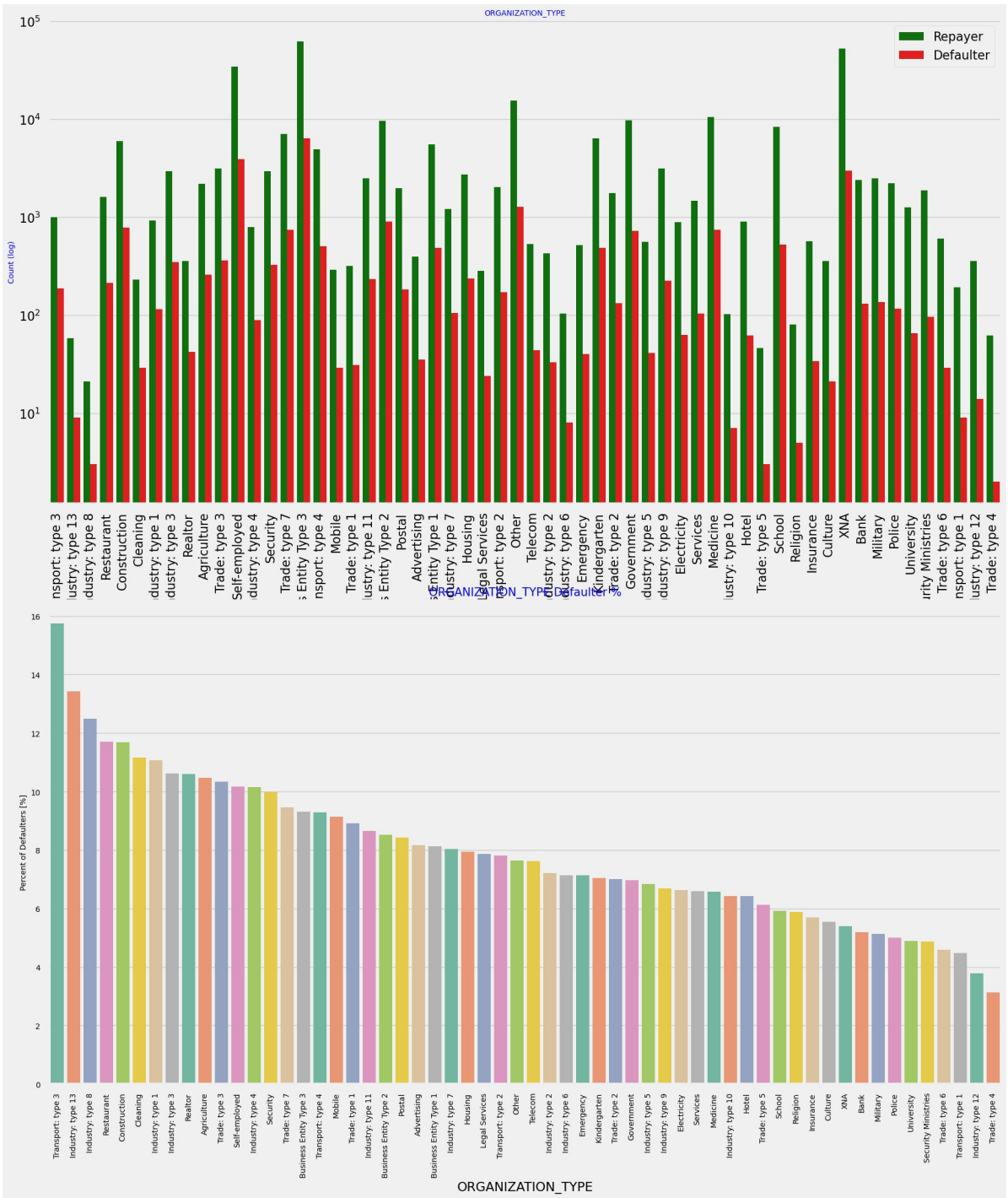
In [92]:
```
univariate_categorical("REGION_RATING_CLIENT",False,False,True)
```



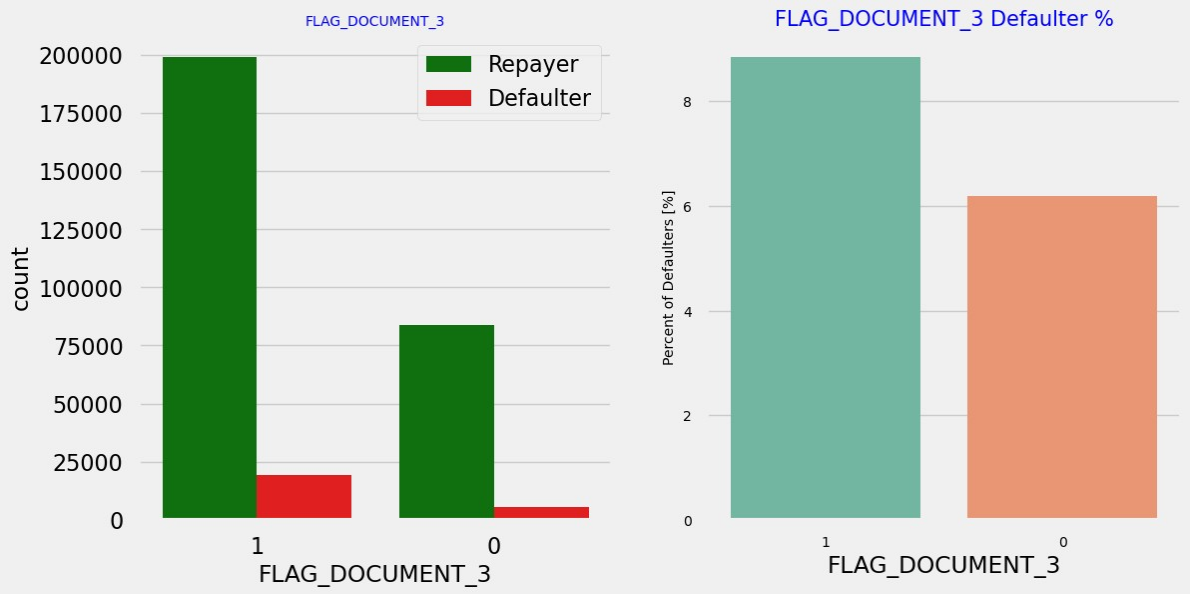
In [93]:
```
univariate_categorical("OCCUPATION_TYPE",False,True,False)
```



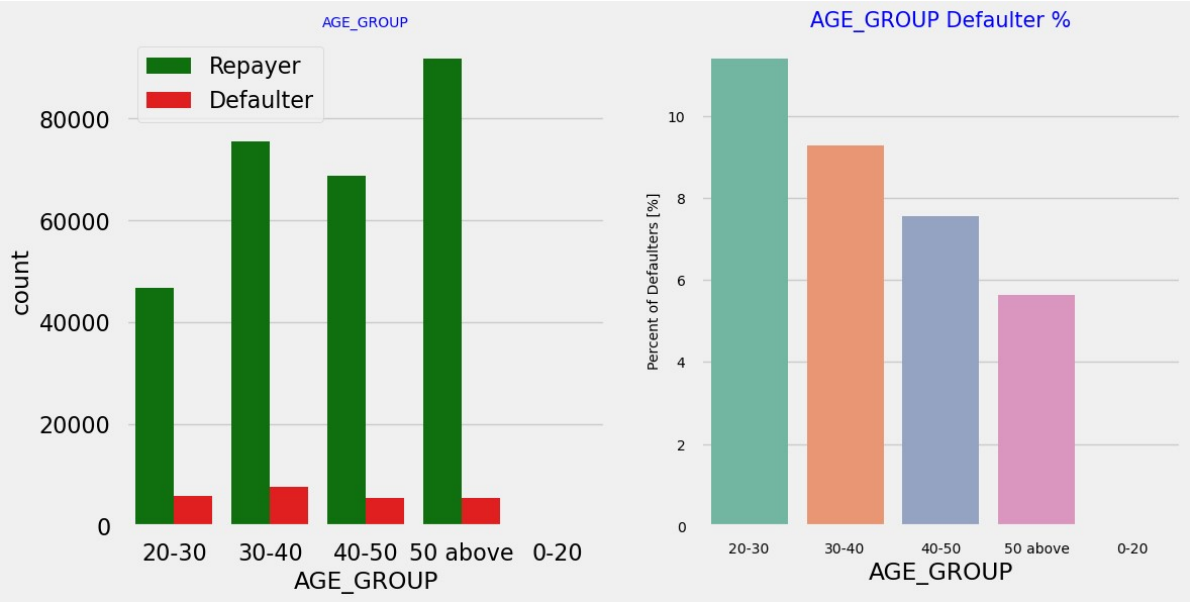
In [94]:
```
univariate_categorical("ORGANIZATION_TYPE",True,True,False)
```



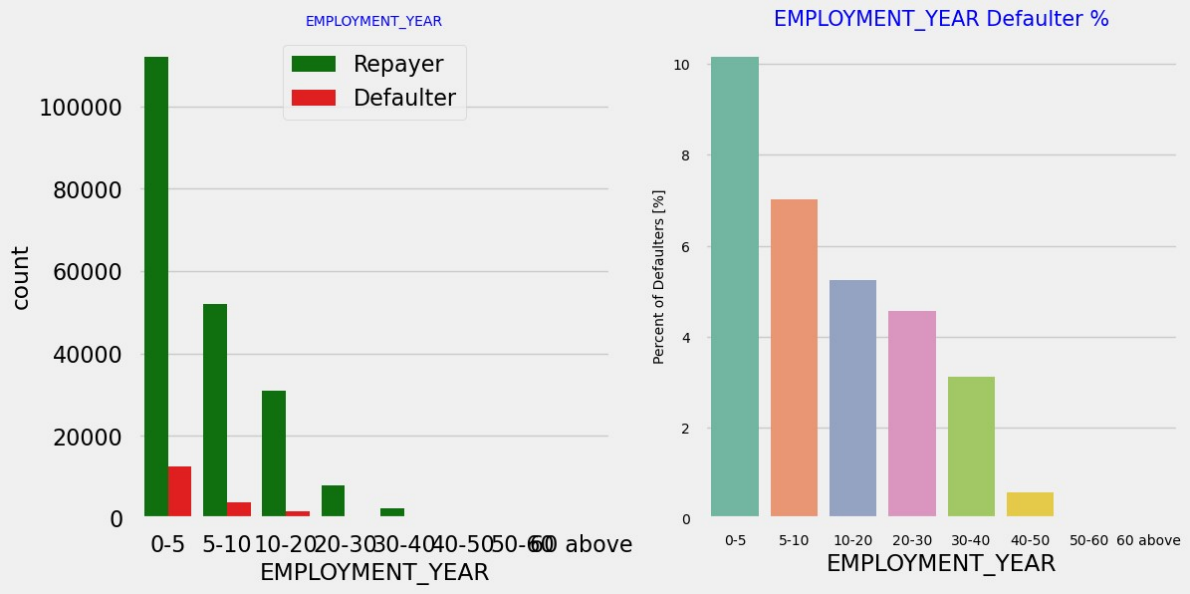
In [95]:
```
univariate_categorical("FLAG_DOCUMENT_3",False,False,True)
```



In [96]:
```
univariate_categorical("AGE_GROUP",False,False,True)
```

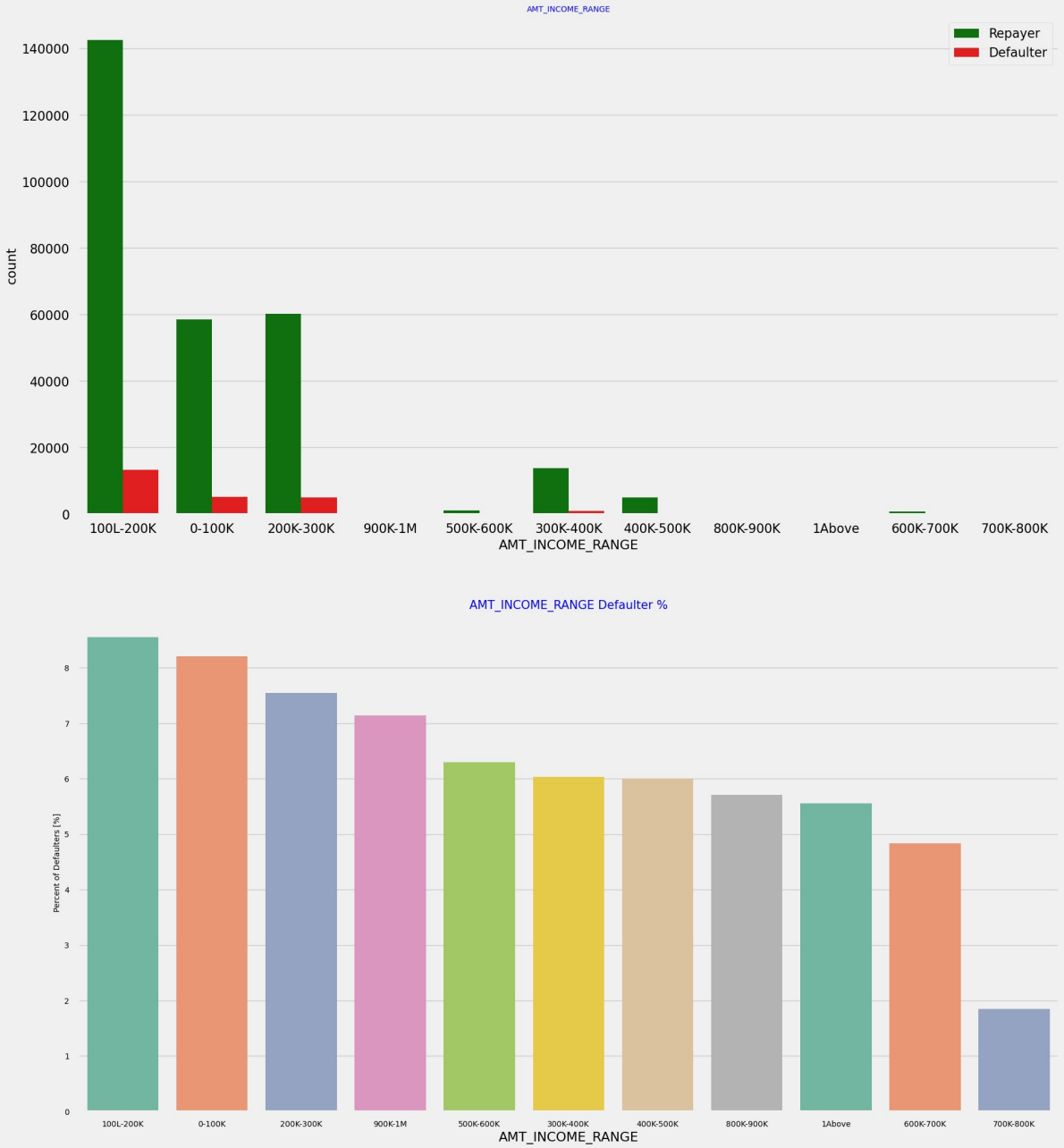


In [97]:
```
univariate_categorical("EMPLOYMENT_YEAR",False,False,True)
```

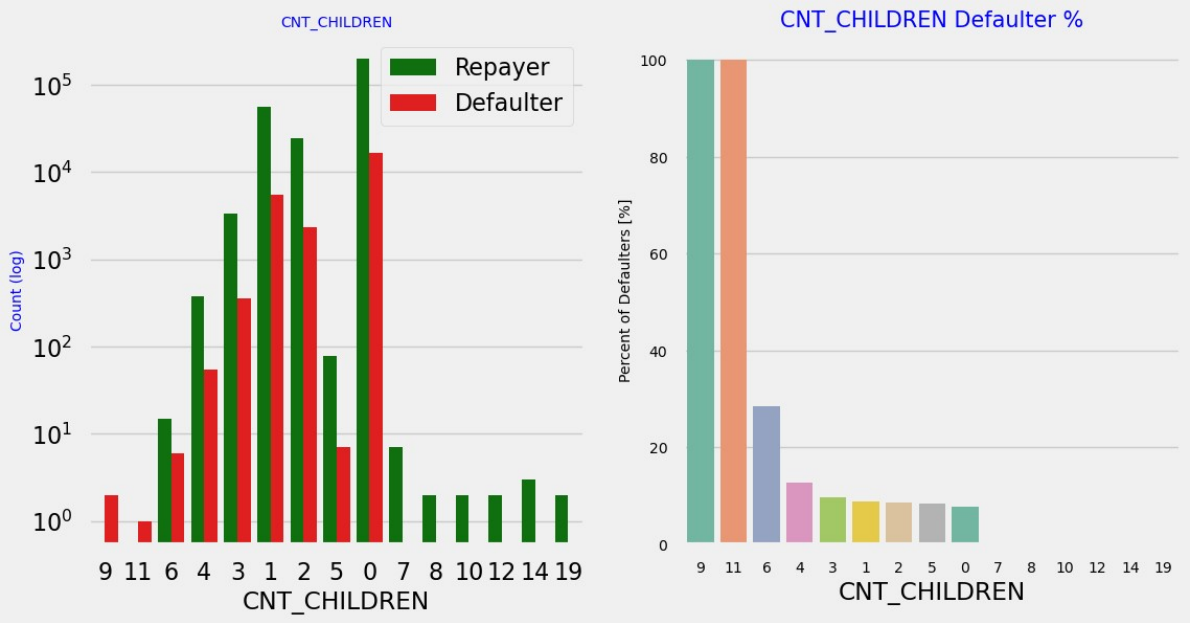


In [98]:
```
univariate_categorical("AMT_CREDIT_RANGE",False,False,False)
```

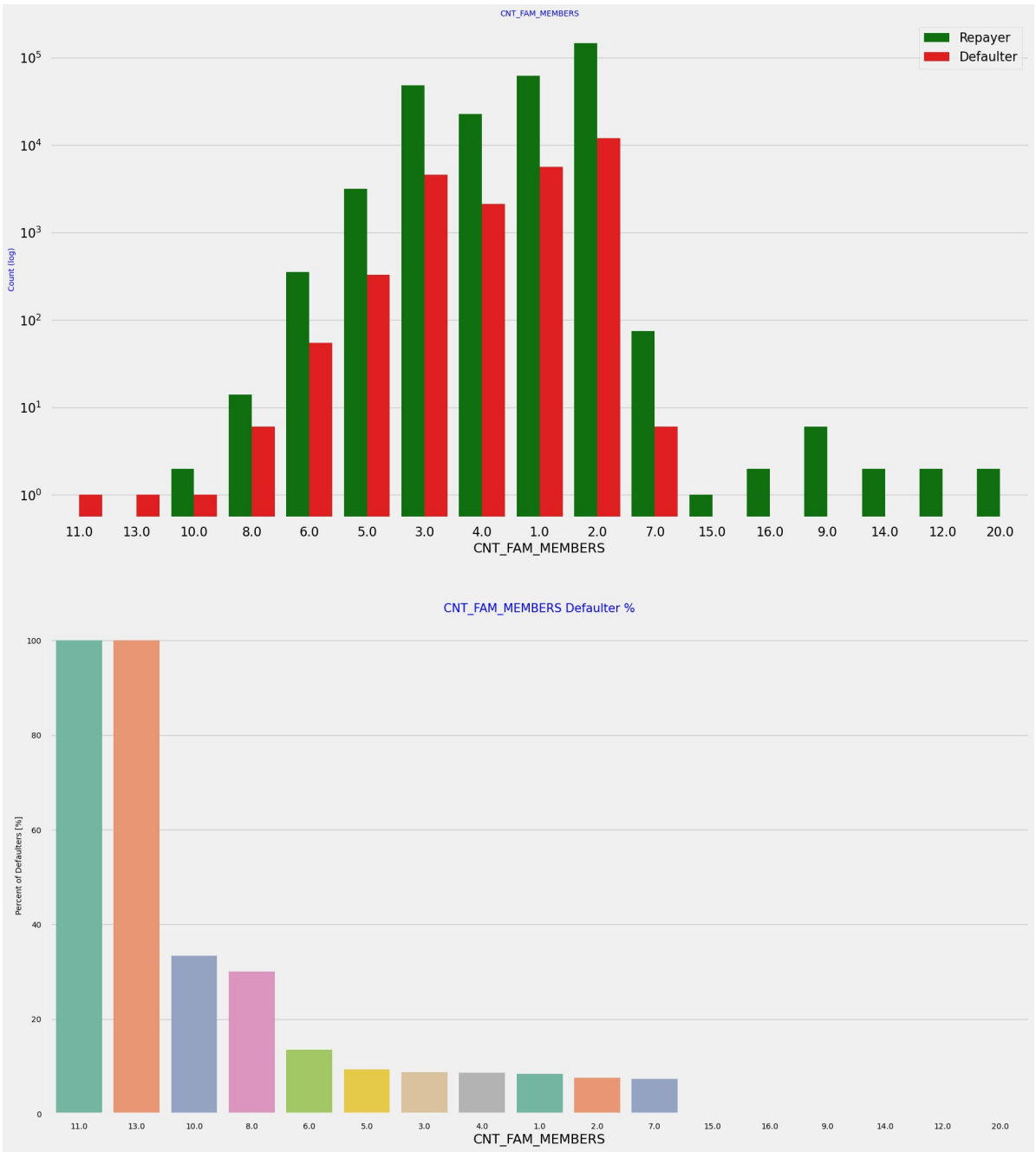
In [99]:
```
univariate_categorical("AMT_INCOME_RANGE",False,False,False)
```



In [100]:
```
univariate_categorical("CNT_CHILDREN",True)
```



In [101]:
```
univariate_categorical("CNT_FAM_MEMBERS",True, False, False)
```

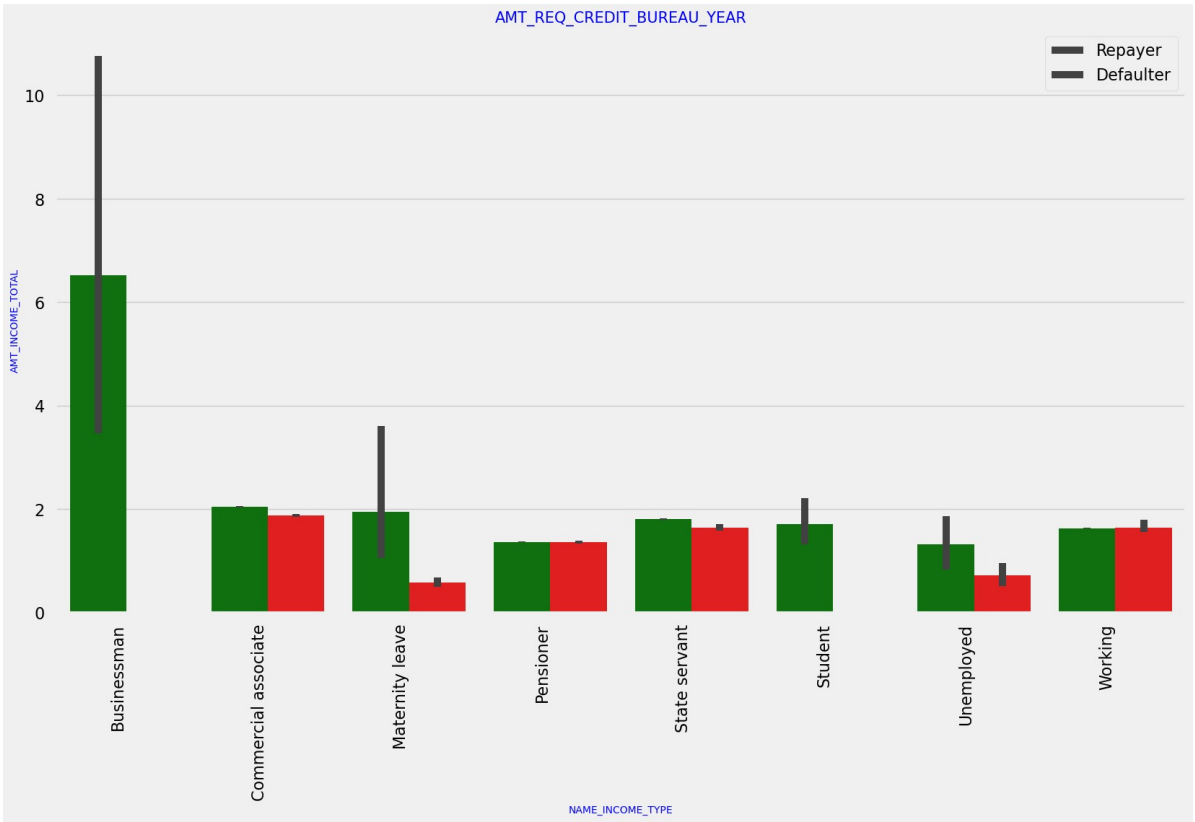


In [102]:
```
applicationDF.groupby('NAME_INCOME_TYPE')['AMT_INCOME_TOTAL'].describe()
```

Out[102]:

NAME_INCOME_TYPE	count	mean	std	min	25%	50%	75%	max
Businessman	10.0	6.525000	6.272260	1.8000	2.250	4.9500	8.43750	22.5000
Commercial associate	71617.0	2.029553	1.479742	0.2655	1.350	1.8000	2.25000	180.0009
Maternity leave	5.0	1.404000	1.268569	0.4950	0.675	0.9000	1.35000	3.6000
Pensioner	55362.0	1.364013	0.766503	0.2565	0.900	1.1700	1.66500	22.5000
State servant	21703.0	1.797380	1.008806	0.2700	1.125	1.5750	2.25000	31.5000
Student	18.0	1.705000	1.066447	0.8100	1.125	1.5750	1.78875	5.6250
Unemployed	22.0	1.105364	0.880551	0.2655	0.540	0.7875	1.35000	3.3750
Working	158774.0	1.631699	3.075777	0.2565	1.125	1.3500	2.02500	1170.0000

In [103]:
```
bivariate_bar("NAME_INCOME_TYPE","AMT_INCOME_TOTAL",applicationDF,"TARGET",(18
```



In [104]:
```
applicationDF.columns
```

Out[104]:
```
Index(['SK_ID_CURR', 'TARGET', 'NAME_CONTRACT_TYPE', 'CODE_GENDER', 'FLAG_OWN
_CAR', 'FLAG_OWN_REALTY', 'CNT_CHILDREN', 'AMT_INCOME_TOTAL', 'AMT_CREDIT', '
AMT_ANNUITY', 'AMT_GOODS_PRICE', 'NAME_TYPE_SUITE', 'NAME_INCOME_TYPE', 'NAME
_EDUCATION_TYPE', 'NAME_FAMILY_STATUS', 'NAME_HOUSING_TYPE', 'REGION_POPULATI
ON_RELATIVE', 'DAYS_BIRTH', 'DAYS_EMPLOYED', 'DAYS_REGISTRATION', 'DAYS_ID_PU
BLISH', 'OCCUPATION_TYPE', 'CNT_FAM_MEMBERS', 'REGION_RATING_CLIENT', 'REGION
_RATING_CLIENT_W_CITY', 'WEEKDAY_APPR_PROCESS_START', 'HOUR_APPR_PROCESS_STAR
T', 'REG_REGION_NOT_LIVE_REGION', 'REG_REGION_NOT_WORK_REGION', 'LIVE_REGION_
NOT_WORK_REGION', 'REG_CITY_NOT_LIVE_CITY', 'REG_CITY_NOT_WORK_CITY', 'LIVE_C
ITY_NOT_WORK_CITY', 'ORGANIZATION_TYPE', 'OBS_30_CNT_SOCIAL_CIRCLE', 'DEF_30_
CNT_SOCIAL_CIRCLE', 'OBS_60_CNT_SOCIAL_CIRCLE', 'DEF_60_CNT_SOCIAL_CIRCLE', '
DAYS_LAST_PHONE_CHANGE', 'FLAG_DOCUMENT_3', 'AMT_REQ_CREDIT_BUREAU_HOUR', 'AM
T_REQ_CREDIT_BUREAU_DAY', 'AMT_REQ_CREDIT_BUREAU_WEEK',
       'AMT_REQ_CREDIT_BUREAU_MON', 'AMT_REQ_CREDIT_BUREAU_QRT', 'AMT_REQ_CRE
DIT_BUREAU_YEAR', 'AMT_INCOME_RANGE', 'AMT_CREDIT_RANGE', 'AGE', 'AGE_GROUP',
'YEARS_EMPLOYED', 'EMPLOYMENT_YEAR'],
      dtype='object')
```

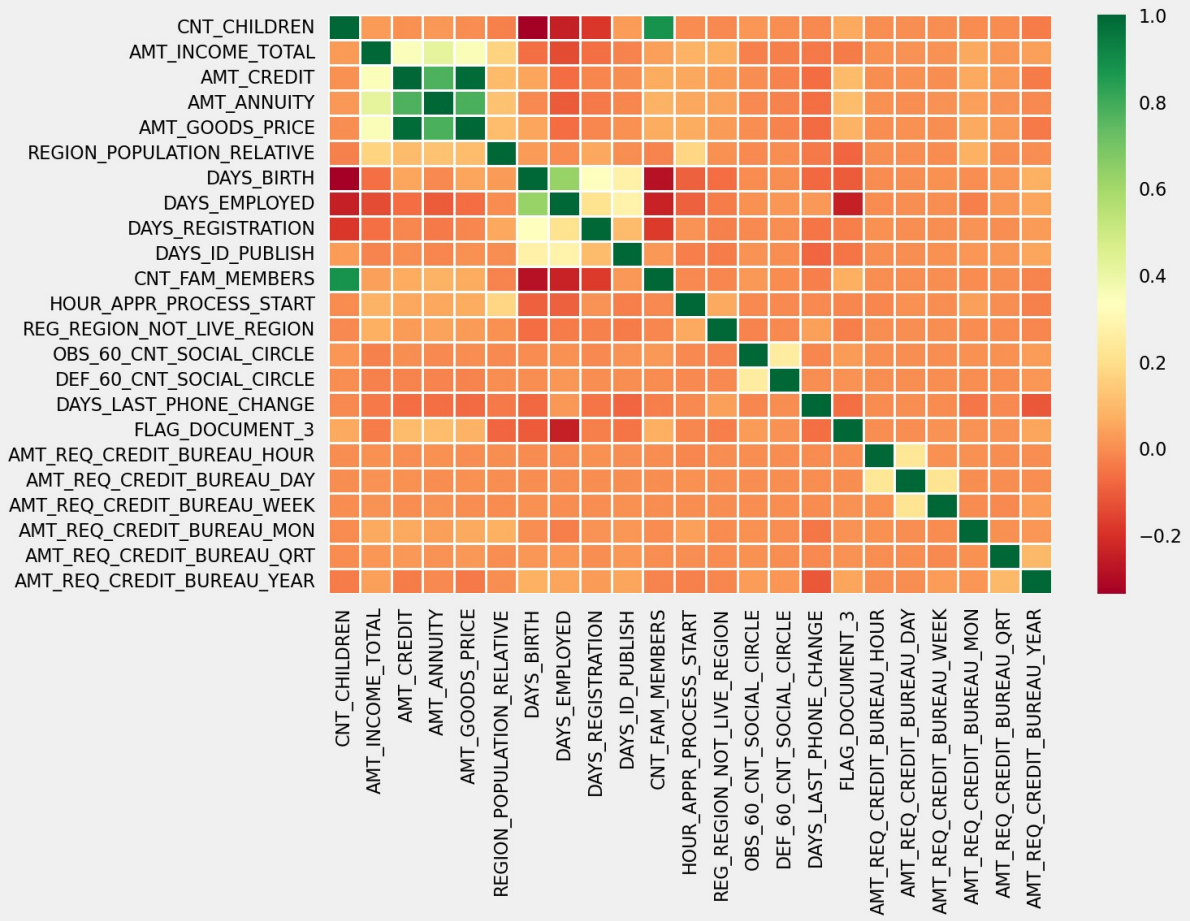
In [105]:
```
cols_for_correlation = ['NAME_CONTRACT_TYPE', 'CODE_GENDER', 'FLAG_OWN_CAR', '
                        'CNT_CHILDREN', 'AMT_INCOME_TOTAL', 'AMT_CREDIT', 'AMT
                        'NAME_TYPE_SUITE', 'NAME_INCOME_TYPE', 'NAME_EDUCATION
                        'NAME_HOUSING_TYPE', 'REGION_POPULATION_RELATIVE', 'DA
                        'DAYS_REGISTRATION', 'DAYS_ID_PUBLISH', 'OCCUPATION_TY
                        'REGION_RATING_CLIENT_W_CITY', 'WEEKDAY_APPR_PROCESS_S
                        'REG_REGION_NOT_LIVE_REGION', 'REG_REGION_NOT_WORK_REG
                        'REG_CITY_NOT_LIVE_CITY', 'REG_CITY_NOT_WORK_CITY', 'L
                        'OBS_60_CNT_SOCIAL_CIRCLE', 'DEF_60_CNT_SOCIAL_CIRCLE'
                        'AMT_REQ_CREDIT_BUREAU_HOUR', 'AMT_REQ_CREDIT_BUREAU_D
                        'AMT_REQ_CREDIT_BUREAU_MON', 'AMT_REQ_CREDIT_BUREAU_QR


Repayer_df = applicationDF.loc[applicationDF['TARGET']==0, cols_for_correlatio
Defaulter_df = applicationDF.loc[applicationDF['TARGET']==1, cols_for_correlat
```

In [106]:
```
corr_repayer = Repayer_df.corr()

corr_repayer = corr_repayer.where(np.triu(np.ones(corr_repayer.shape),k=1).ast

corr_df_repayer = corr_repayer.unstack().reset_index()
corr_df_repayer.columns =['VAR1','VAR2','Correlation']
corr_df_repayer.dropna(subset = ["Correlation"], inplace = True)

corr_df_repayer["Correlation"]=corr_df_repayer["Correlation"].abs()

corr_df_repayer.sort_values(by='Correlation', ascending=False, inplace=True)

corr_df_repayer.head(10)
```

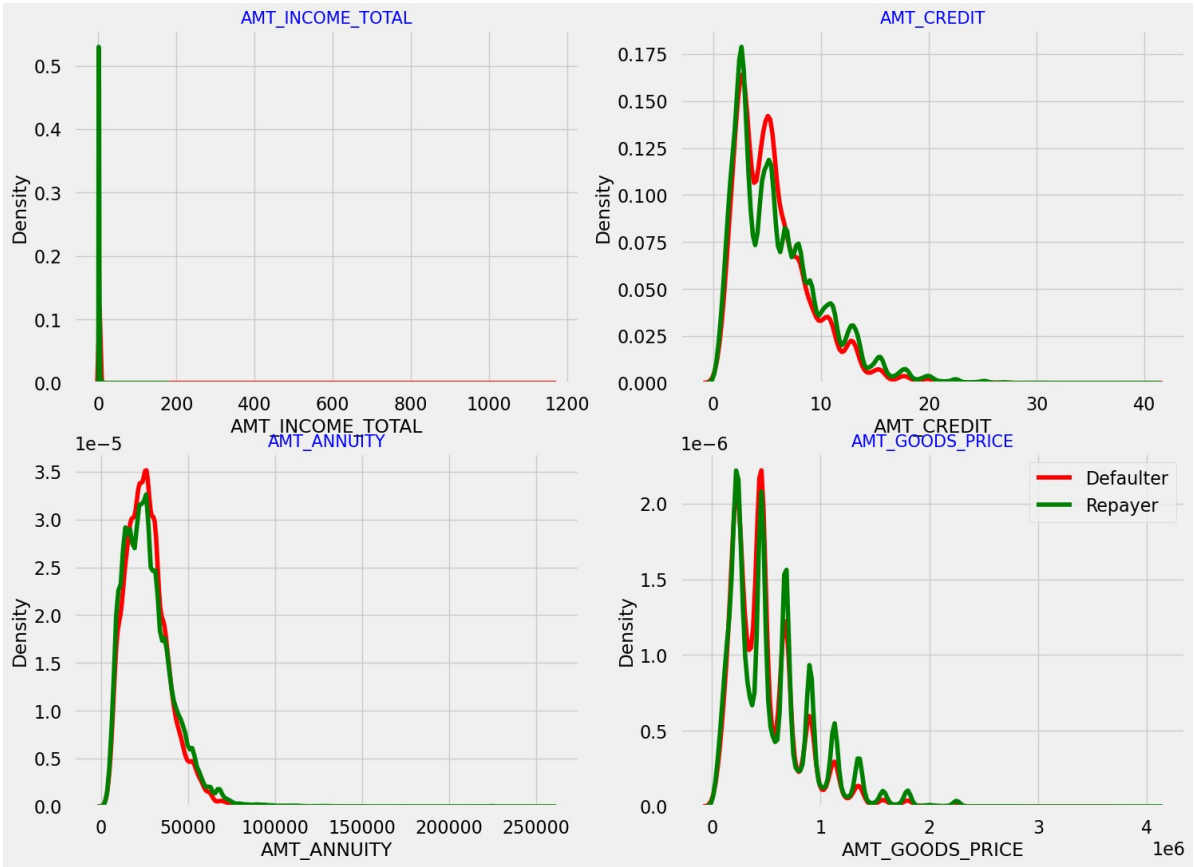
Out[106]:

	VAR1	VAR2	Correlation
94	AMT_GOODS_PRICE	AMT_CREDIT	0.987250
230	CNT_FAM_MEMBERS	CNT_CHILDREN	0.878571
95	AMT_GOODS_PRICE	AMT_ANNUITY	0.776686
71	AMT_ANNUITY	AMT_CREDIT	0.771309
167	DAYS_EMPLOYED	DAYS_BIRTH	0.626114
70	AMT_ANNUITY	AMT_INCOME_TOTAL	0.418953
93	AMT_GOODS_PRICE	AMT_INCOME_TOTAL	0.349462
47	AMT_CREDIT	AMT_INCOME_TOTAL	0.342799
138	DAYS_BIRTH	CNT_CHILDREN	0.336966
190	DAYS_REGISTRATION	DAYS_BIRTH	0.333151

In [107]:
```
fig=plt.figure()
ax=sns.heatmap(Repayer_df.corr(), cmap ='RdYlGn',annot=False , linewidth =1)
```

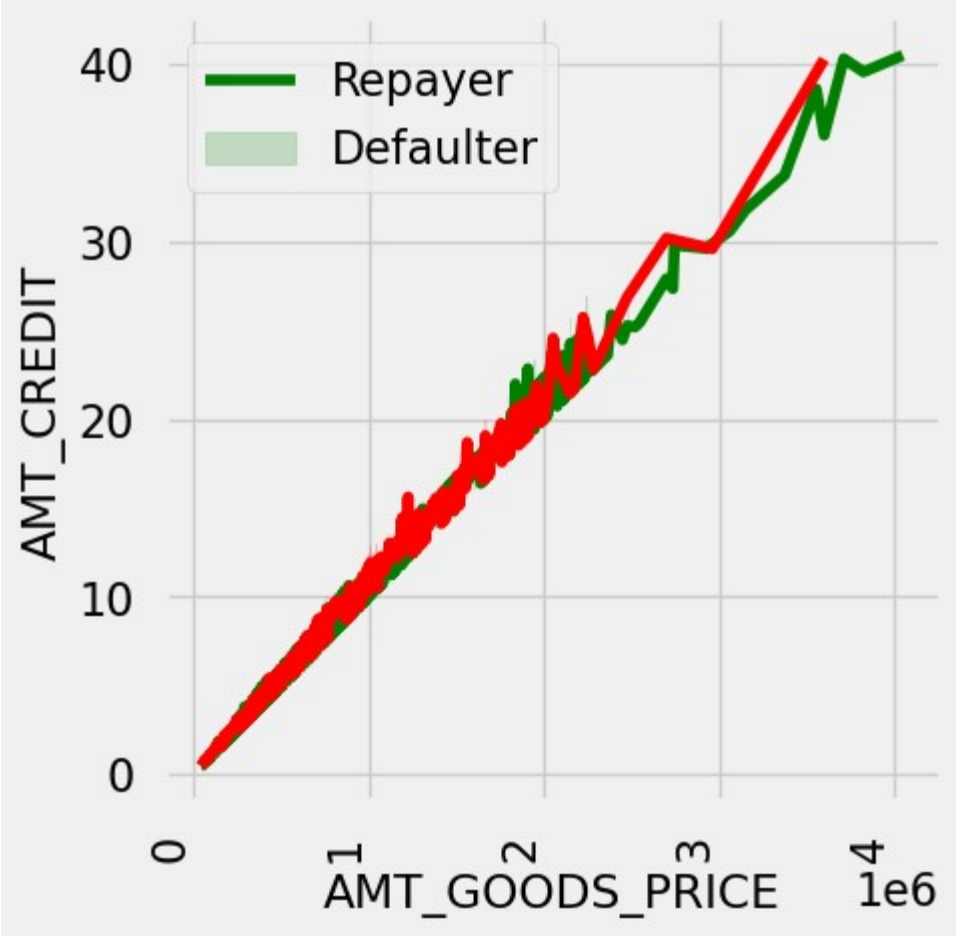


In [108]:
```
amount = applicationDF[[ 'AMT_INCOME_TOTAL','AMT_CREDIT','AMT_ANNUITY', 'AMT_G

fig = plt.figure(figsize=(16,12))

for i in enumerate(amount):
    plt.subplot(2,2,i[0]+1)
    sns.distplot(Defaulter_df[i[1]], hist=False, color='r',label ="Defaulter")
    sns.distplot(Repayer_df[i[1]], hist=False, color='g', label ="Repayer")
    plt.title(i[1], fontdict={'fontsize' : 15, 'fontweight' : 5, 'color' : 'Bl

plt.legend()

plt.show()
```

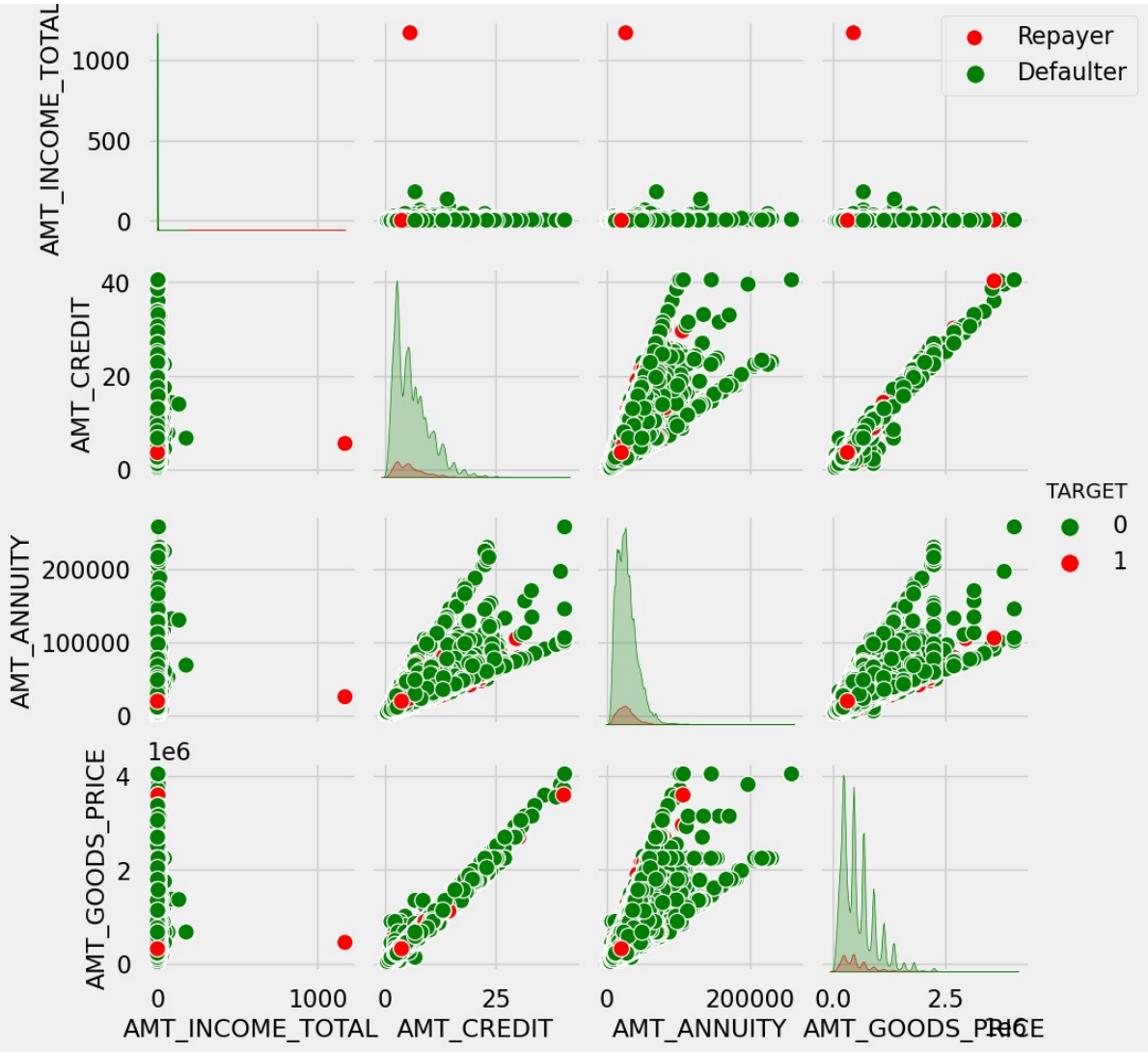


In [109]:
```
bivariate_rel('AMT_GOODS_PRICE','AMT_CREDIT', applicationDF,"TARGET","line",['
```

```
<Figure size 1500x600 with 0 Axes>
```



In [110]:
```
amount = applicationDF[[ 'AMT_INCOME_TOTAL','AMT_CREDIT',
                         'AMT_ANNUITY', 'AMT_GOODS_PRICE','TARGET']]
amount = amount[(amount["AMT_GOODS_PRICE"].notnull()) & (amount["AMT_ANNUITY"]
ax= sns.pairplot(amount,hue="TARGET",palette=["g","r"])
ax.fig.legend(labels=['Repayer','Defaulter'])
plt.show()
```



In [111]:
```
loan_process_df = pd.merge(applicationDF,previousDF,how = 'inner',on='SK_ID_CU
loan_process_df.head()
```

Out[111]:

	SK_ID_CURR	TARGET	NAME_CONTRACT_TYPE_x	CODE_GENDER	FLAG_OWN_CAR	FLAG_
0	100002	1	Cash loans	M	N	
1	100003	0	Cash loans	F	N	
2	100003	0	Cash loans	F	N	
3	100003	0	Cash loans	F	N	
4	100004	0	Revolving loans	M	Y	

In [112]:
```
loan_process_df.shape
```

Out[112]: (1413701, 74)

In [113]:
```
loan_process_df.size
```

Out[113]: 104613874

In [114]:
```
loan_process_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1413701 entries, 0 to 1413700
Data columns (total 74 columns):
 #   Column                        Non-Null Count    Dtype
---  ------                        --------------    -----
 0   SK_ID_CURR                    1413701 non-null  int64
 1   TARGET                        1413701 non-null  int64
 2   NAME_CONTRACT_TYPE_x          1413701 non-null  category
 3   CODE_GENDER                   1413701 non-null  category
 4   FLAG_OWN_CAR                  1413701 non-null  category
 5   FLAG_OWN_REALTY               1413701 non-null  category
 6   CNT_CHILDREN                  1413701 non-null  int64
 7   AMT_INCOME_TOTAL              1413701 non-null  float64
 8   AMT_CREDIT_x                  1413701 non-null  float64
 9   AMT_ANNUITY_x                 1413608 non-null  float64
 10  AMT_GOODS_PRICE_x             1412493 non-null  float64
 11  NAME_TYPE_SUITE               1413701 non-null  category
 12  NAME_INCOME_TYPE              1413701 non-null  category
 13  NAME_EDUCATION_TYPE           1413701 non-null  category
 14  NAME_FAMILY_STATUS            1413701 non-null  category
 15  NAME_HOUSING_TYPE             1413701 non-null  category
 16  REGION_POPULATION_RELATIVE    1413701 non-null  float64
 17  DAYS_BIRTH                    1413701 non-null  int64
 18  DAYS_EMPLOYED                 1413701 non-null  int64
 19  DAYS_REGISTRATION             1413701 non-null  float64
 20  DAYS_ID_PUBLISH               1413701 non-null  int64
 21  OCCUPATION_TYPE               1413701 non-null  category
 22  CNT_FAM_MEMBERS               1413701 non-null  float64
 23  REGION_RATING_CLIENT          1413701 non-null  category
 24  REGION_RATING_CLIENT_W_CITY   1413701 non-null  category
 25  WEEKDAY_APPR_PROCESS_START    1413701 non-null  category
 26  HOUR_APPR_PROCESS_START       1413701 non-null  int64
 27  REG_REGION_NOT_LIVE_REGION    1413701 non-null  int64
 28  REG_REGION_NOT_WORK_REGION    1413701 non-null  category
 29  LIVE_REGION_NOT_WORK_REGION   1413701 non-null  category
 30  REG_CITY_NOT_LIVE_CITY        1413701 non-null  category
 31  REG_CITY_NOT_WORK_CITY        1413701 non-null  category
 32  LIVE_CITY_NOT_WORK_CITY       1413701 non-null  category
 33  ORGANIZATION_TYPE             1413701 non-null  category
 34  OBS_30_CNT_SOCIAL_CIRCLE      1410555 non-null  float64
 35  DEF_30_CNT_SOCIAL_CIRCLE      1410555 non-null  float64
 36  OBS_60_CNT_SOCIAL_CIRCLE      1410555 non-null  float64
 37  DEF_60_CNT_SOCIAL_CIRCLE      1410555 non-null  float64
 38  DAYS_LAST_PHONE_CHANGE        1413701 non-null  float64
 39  FLAG_DOCUMENT_3               1413701 non-null  int64
 40  AMT_REQ_CREDIT_BUREAU_HOUR    1413701 non-null  float64
 41  AMT_REQ_CREDIT_BUREAU_DAY     1413701 non-null  float64
 42  AMT_REQ_CREDIT_BUREAU_WEEK    1413701 non-null  float64
 43  AMT_REQ_CREDIT_BUREAU_MON     1413701 non-null  float64
 44  AMT_REQ_CREDIT_BUREAU_QRT     1413701 non-null  float64
 45  AMT_REQ_CREDIT_BUREAU_YEAR    1413701 non-null  float64
 46  AMT_INCOME_RANGE              1413024 non-null  category
 47  AMT_CREDIT_RANGE              1413701 non-null  category
 48  AGE                           1413701 non-null  int64
```

```
 49  AGE_GROUP                   1413701 non-null  category
 50  YEARS_EMPLOYED              1413701 non-null  int64
 51  EMPLOYMENT_YEAR             1032756 non-null  category
 52  SK_ID_PREV                  1413701 non-null  int64
 53  NAME_CONTRACT_TYPE_y        1413701 non-null  category
 54  AMT_ANNUITY_y               1106483 non-null  float64
 55  AMT_APPLICATION             1413701 non-null  float64
 56  AMT_CREDIT_y                1413700 non-null  float64
 57  AMT_GOODS_PRICE_y           1413701 non-null  float64
 58  NAME_CASH_LOAN_PURPOSE      1413701 non-null  category
 59  NAME_CONTRACT_STATUS        1413701 non-null  category
 60  DAYS_DECISION               1413701 non-null  int64
 61  NAME_PAYMENT_TYPE           1413701 non-null  category
 62  CODE_REJECT_REASON          1413701 non-null  category
 63  NAME_CLIENT_TYPE            1413701 non-null  category
 64  NAME_GOODS_CATEGORY         1413701 non-null  category
 65  NAME_PORTFOLIO              1413701 non-null  category
 66  NAME_PRODUCT_TYPE           1413701 non-null  category
 67  CHANNEL_TYPE                1413701 non-null  category
 68  SELLERPLACE_AREA            1413701 non-null  int64
 69  NAME_SELLER_INDUSTRY        1413701 non-null  category
 70  CNT_PAYMENT                 1413701 non-null  float64
 71  NAME_YIELD_GROUP            1413701 non-null  category
 72  PRODUCT_COMBINATION         1413388 non-null  category
 73  DAYS_DECISION_GROUP         1413701 non-null  category
dtypes: category(37), float64(23), int64(14)
memory usage: 459.8 MB
```

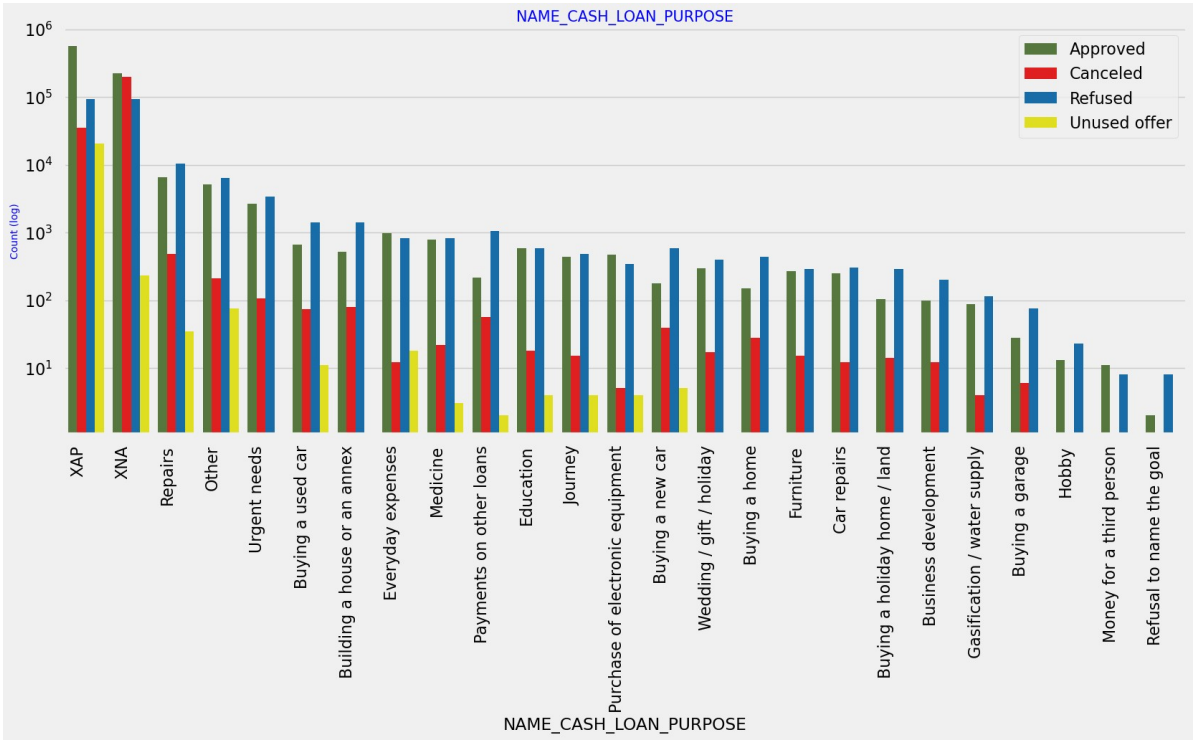
In [115]:
```
loan_process_df.describe()
```

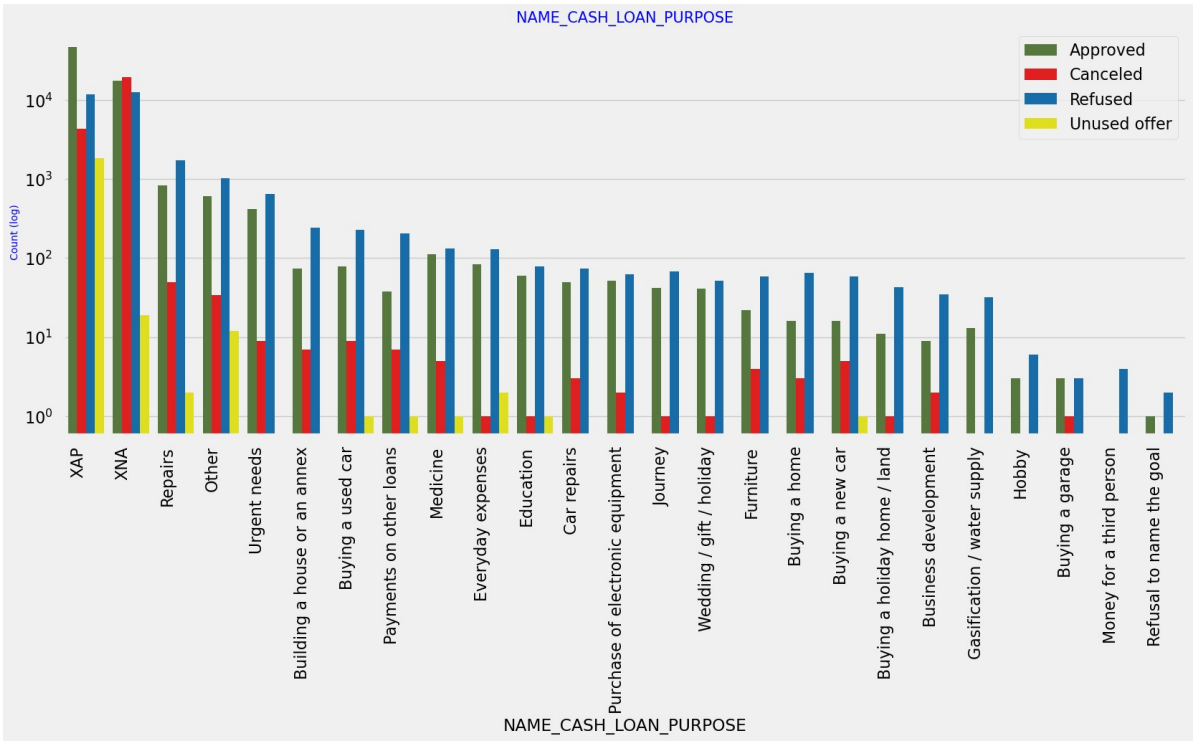
Out[115]:

	SK_ID_CURR	TARGET	CNT_CHILDREN	AMT_INCOME_TOTAL	AMT_CREDIT_x	AMT
count	1.413701e+06	1.413701e+06	1.413701e+06	1.413701e+06	1.413701e+06	1
mean	2.784813e+05	8.655296e-02	4.048933e-01	1.733160e+00	5.875537e+00	2
std	1.028118e+05	2.811789e-01	7.173454e-01	1.985734e+00	3.849173e+00	1
min	1.000020e+05	0.000000e+00	0.000000e+00	2.565000e-01	4.500000e-01	1
25%	1.893640e+05	0.000000e+00	0.000000e+00	1.125000e+00	2.700000e+00	1
50%	2.789920e+05	0.000000e+00	0.000000e+00	1.575000e+00	5.084955e+00	2
75%	3.675560e+05	0.000000e+00	1.000000e+00	2.070000e+00	8.079840e+00	3
max	4.562550e+05	1.000000e+00	1.900000e+01	1.170000e+03	4.050000e+01	2

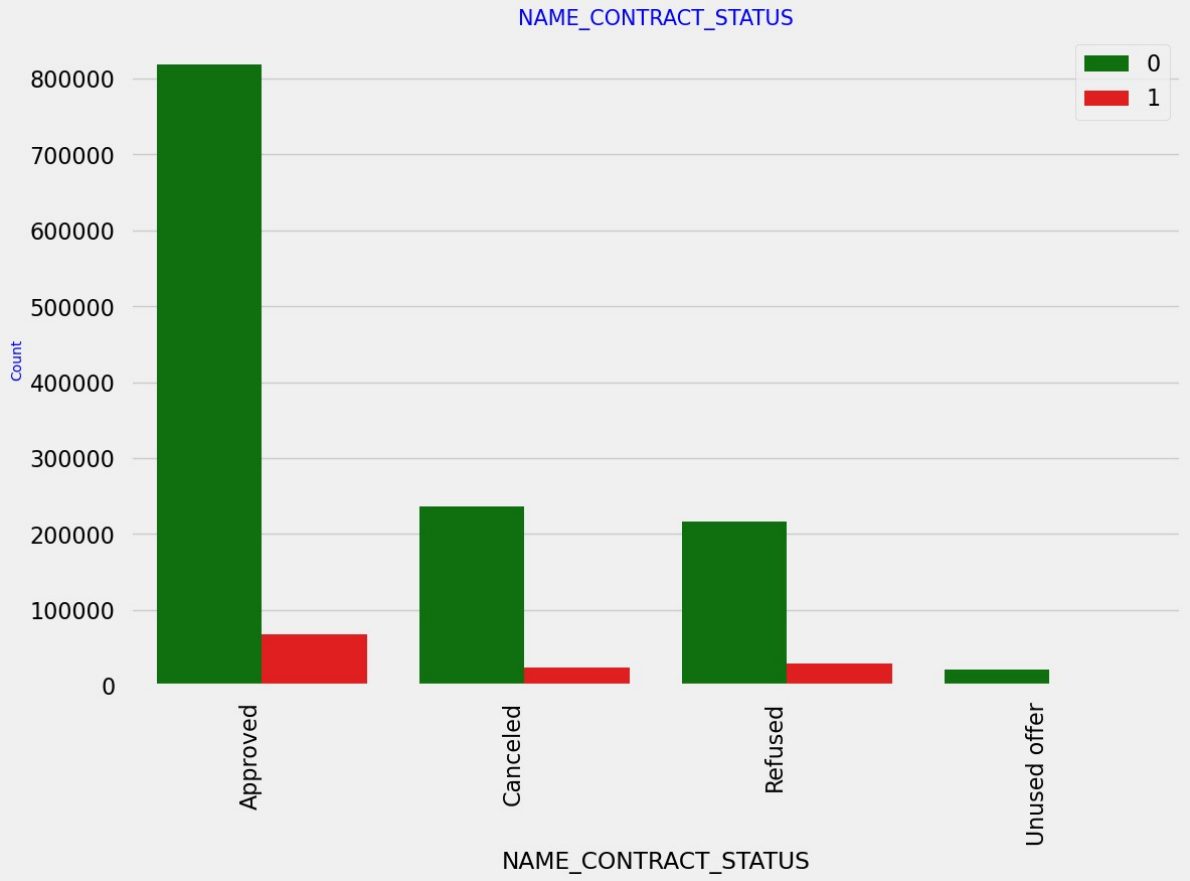
In [116]:
```
L0 = loan_process_df[loan_process_df['TARGET']==0]
L1 = loan_process_df[loan_process_df['TARGET']==1]
```

In [117]:
```
univariate_merged("NAME_CASH_LOAN_PURPOSE",L0,"NAME_CONTRACT_STATUS",["#548235

univariate_merged("NAME_CASH_LOAN_PURPOSE",L1,"NAME_CONTRACT_STATUS",["#548235
```



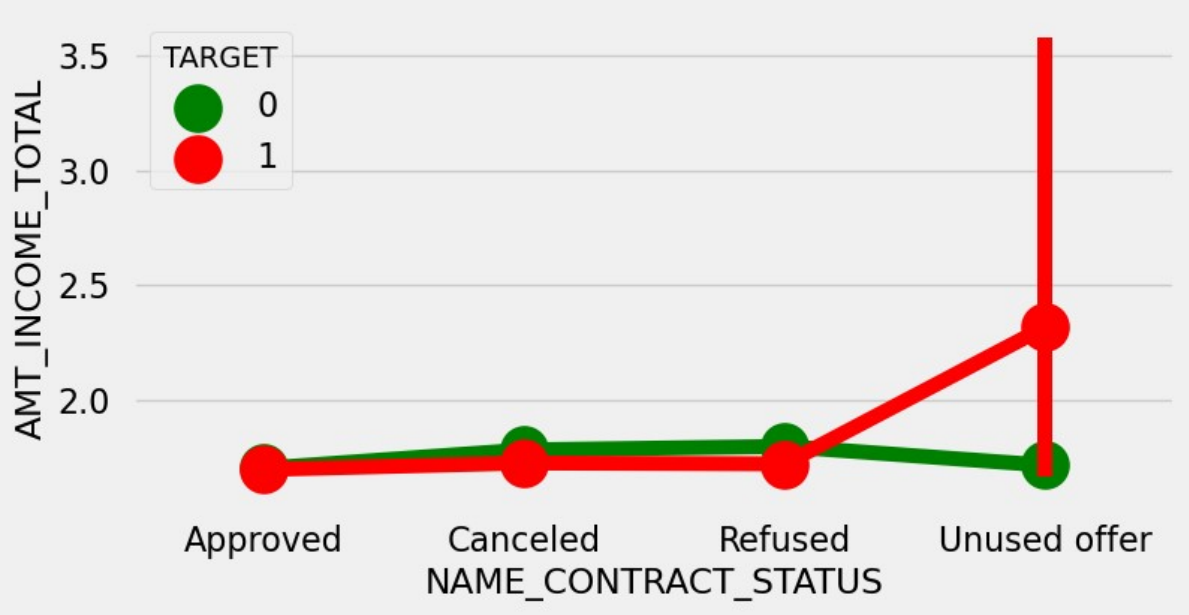


In [118]:
```
univariate_merged("NAME_CONTRACT_STATUS",loan_process_df,"TARGET",['g','r'],Fa
g = loan_process_df.groupby("NAME_CONTRACT_STATUS")["TARGET"]
df1 = pd.concat([g.value_counts(),round(g.value_counts(normalize=True).mul(100
df1['Percentage'] = df1['Percentage'].astype(str) +"%"
print (df1)
```

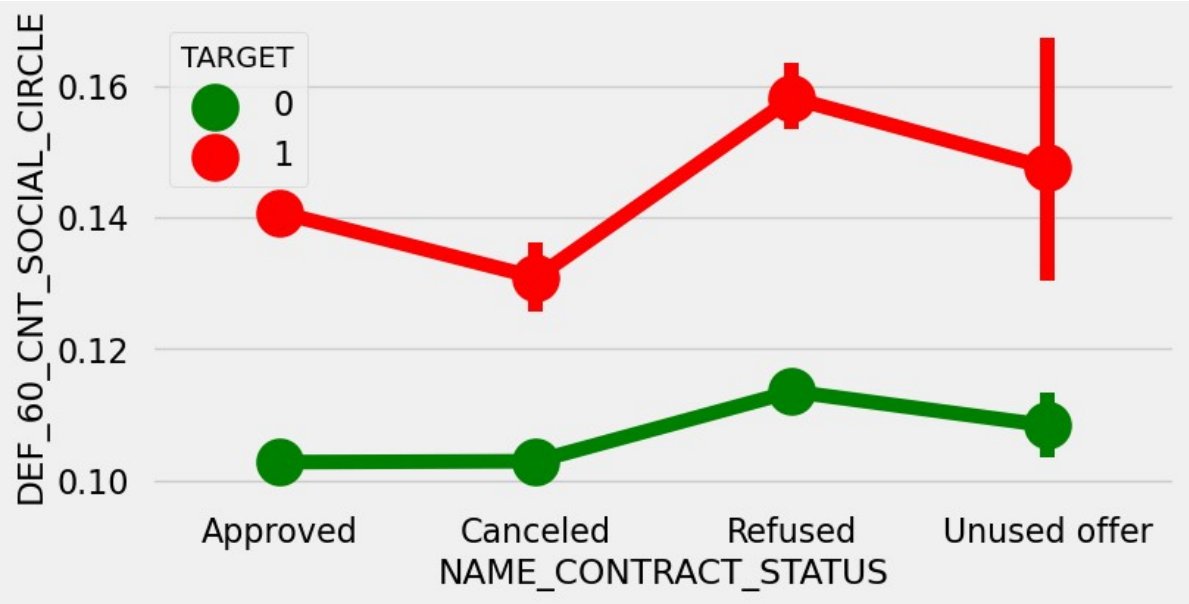


		Counts	Percentage
NAME_CONTRACT_STATUS	TARGET		
Approved	0	818856	92.41%
	1	67243	7.59%
Canceled	0	235641	90.83%
	1	23800	9.17%
Refused	0	215952	88.0%
	1	29438	12.0%
Unused offer	0	20892	91.75%
	1	1879	8.25%

In [119]:
```
merged_pointplot("NAME_CONTRACT_STATUS",'AMT_INCOME_TOTAL')
```



In [120]:
```
merged_pointplot("NAME_CONTRACT_STATUS",'DEF_60_CNT_SOCIAL_CIRCLE')
```



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