# Bank Loan Case Study

Prachi ranjan

# Project description

The project is about finding out patterns that indicate if a customer will have difficulty paying their installments. This information can be used to make decisions such as denying the loan, reducing the amount of loan, or lending at a higher interest rate to risky applicants. We analyze this data on the following points:

A. Identify Missing Data and Deal with it Appropriately
B. Identify Outliers in the Dataset
C. Analyze Data Imbalance
D. Perform Univariate, Segmented Univariate, and Bivariate Analysis
E. Identify Top Correlations for Different Scenarios

# Missing Data

**Task A:** Identify the missing data in the dataset and decide on an appropriate method to deal with it using Excel built-in functions and features.

- Using COUNT, IF and ISBLANK function to get number of null values for each column.
- Then we will calculate percentage of null values for each column.
- Using TRANSPOSE function we will convert rows to columns.
- We will drop the columns which has more than or equal to 50% null values.
- We will drop irrelevant columns for doing our analysis

Formulas:-

no_of_null_values: =COUNT(IF(ISBLANK(application_data!AW2:AW50000),application_data!$A:$A))

Transpose:  =TRANSPOSE(A1:DS3)

# Missing Data

| Column name | no_of_null_values | Percentage_of_null_values |
|---|---|---|
| COMMONAREA_AVG | 34960 | 70% |
| COMMONAREA_MODE | 34960 | 70% |
| COMMONAREA_MEDI | 34960 | 70% |
| NONLIVINGAPARTMENTS_AVG | 34714 | 69% |
| NONLIVINGAPARTMENTS_MODE | 34714 | 69% |
| NONLIVINGAPARTMENTS_MEDI | 34714 | 69% |
| LIVINGAPARTMENTS_AVG | 34226 | 68% |
| LIVINGAPARTMENTS_MODE | 34226 | 68% |
| LIVINGAPARTMENTS_MEDI | 34226 | 68% |
| FONDKAPREMONT_MODE | 34191 | 68% |
| FLOORSMIN_AVG | 33894 | 68% |
| FLOORSMIN_MODE | 33894 | 68% |
| FLOORSMIN_MEDI | 33894 | 68% |
| YEARS_BUILD_AVG | 33239 | 66% |
| YEARS_BUILD_MODE | 33239 | 66% |
| YEARS_BUILD_MEDI | 33239 | 66% |
| OWN_CAR_AGE | 32949 | 66% |
| LANDAREA_AVG | 29721 | 59% |
| LANDAREA_MODE | 29721 | 59% |
| LANDAREA_MEDI | 29721 | 59% |
| BASEMENTAREA_AVG | 29199 | 58% |
| BASEMENTAREA_MODE | 29199 | 58% |
| BASEMENTAREA_MEDI | 29199 | 58% |
| EXT_SOURCE_1 | 28172 | 56% |
| NONLIVINGAREA_AVG | 27572 | 55% |
| NONLIVINGAREA_MODE | 27572 | 55% |
| NONLIVINGAREA_MEDI | 27572 | 55% |
| ELEVATORS_AVG | 26651 | 53% |
| ELEVATORS_MODE | 26651 | 53% |
| ELEVATORS_MEDI | 26651 | 53% |
| WALLSMATERIAL_MODE | 25459 | 51% |
| APARTMENTS_AVG | 25385 | 51% |
| APARTMENTS_MODE | 25385 | 51% |
| APARTMENTS_MEDI | 25385 | 51% |
| ENTRANCES_AVG | 25195 | 50% |
| ENTRANCES_MODE | 25195 | 50% |
| ENTRANCES_MEDI | 25195 | 50% |
| LIVINGAREA_AVG | 25137 | 50% |
| LIVINGAREA_MODE | 25137 | 50% |
| LIVINGAREA_MEDI | 25137 | 50% |
| HOUSETYPE_MODE | 25075 | 50% |
| FLOORSMAX_AVG | 24875 | 50% |
| FLOORSMAX_MODE | 24875 | 50% |
| FLOORSMAX_MEDI | 24875 | 50% |

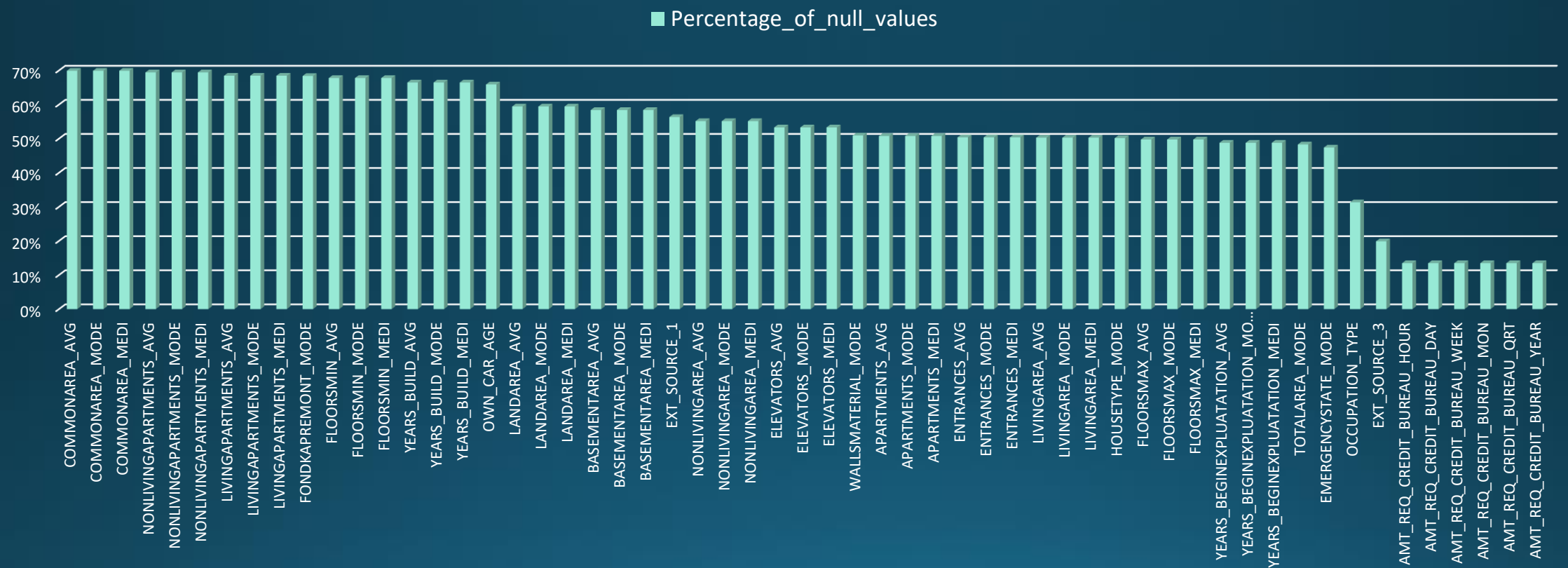
These are the columns which has null values more than or equal to 50%. These columns need to be dropped.

# Missing Data

| Column name | no_of_null_values | Percentage_of_null_values |
|---|---|---|
| FLAG_MOBIL | 0 | 0% |
| FLAG_EMP_PHONE | 0 | 0% |
| FLAG_WORK_PHONE | 0 | 0% |
| FLAG_CONT_MOBILE | 0 | 0% |
| FLAG_PHONE | 0 | 0% |
| FLAG_EMAIL | 0 | 0% |
| CNT_FAM_MEMBERS | 1 | 0% |
| REGION_RATING_CLIENT | 0 | 0% |
| REGION_RATING_CLIENT_W_CITY | 0 | 0% |
| EXT_SOURCE_2 | 126 | 0% |
| EXT_SOURCE_3 | 9944 | 20% |
| YEARS_BEGINEXPLUATATION_AVG | 24394 | 49% |
| YEARS_BEGINEXPLUATATION_MODE | 24394 | 49% |
| YEARS_BEGINEXPLUATATION_MEDI | 24394 | 49% |
| TOTALAREA_MODE | 24148 | 48% |
| EMERGENCYSTATE_MODE | 23698 | 47% |
| DAYS_LAST_PHONE_CHANGE | 1 | 0% |
| FLAG_DOCUMENT_2 | 0 | 0% |
| FLAG_DOCUMENT_3 | 0 | 0% |
| FLAG_DOCUMENT_4 | 0 | 0% |
| FLAG_DOCUMENT_5 | 0 | 0% |
| FLAG_DOCUMENT_6 | 0 | 0% |
| FLAG_DOCUMENT_7 | 0 | 0% |
| FLAG_DOCUMENT_8 | 0 | 0% |
| FLAG_DOCUMENT_9 | 0 | 0% |
| FLAG_DOCUMENT_10 | 0 | 0% |
| FLAG_DOCUMENT_11 | 0 | 0% |
| FLAG_DOCUMENT_12 | 0 | 0% |
| FLAG_DOCUMENT_13 | 0 | 0% |
| FLAG_DOCUMENT_14 | 0 | 0% |
| FLAG_DOCUMENT_15 | 0 | 0% |
| FLAG_DOCUMENT_16 | 0 | 0% |
| FLAG_DOCUMENT_17 | 0 | 0% |
| FLAG_DOCUMENT_18 | 0 | 0% |
| FLAG_DOCUMENT_19 | 0 | 0% |
| FLAG_DOCUMENT_20 | 0 | 0% |
| FLAG_DOCUMENT_21 | 0 | 0% |

These are the columns which have irrelevant data for analysis. These columns need to be dropped.

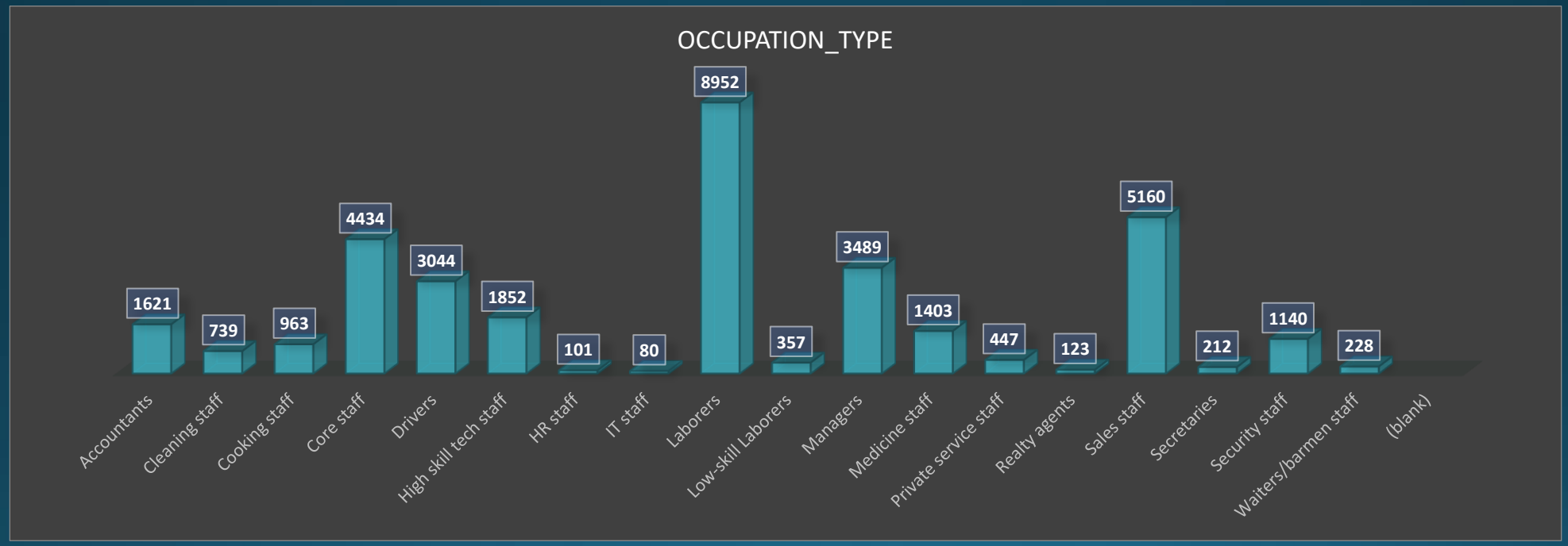
# Missing Data



# Missing Data

**Mode Imputations:-**

1. OCCUPATION_TYPE

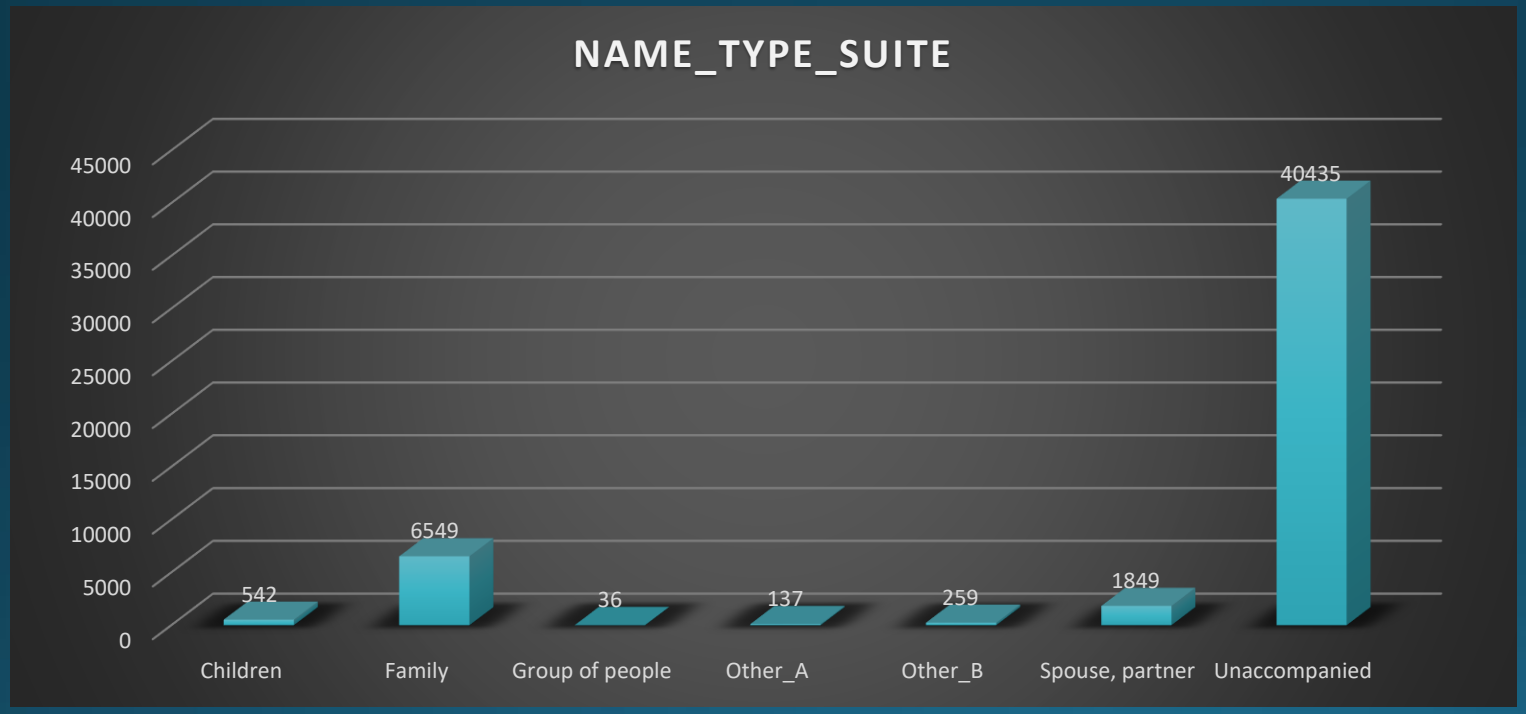



**Most Occurring Variable is Laborers. We will replace blanks with 8952.**

# Missing Data

**Mode Imputations:-**

2. NAME_TYPE_SUITE

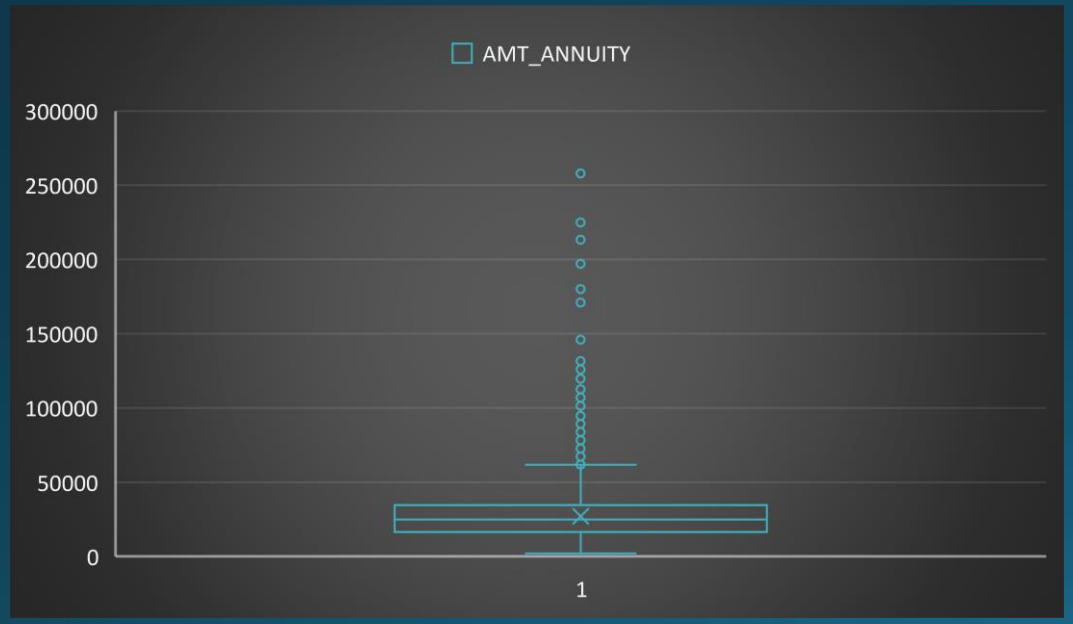



**Most Occurring Variable is Unaccompanied.**

# Missing Data

**Median Imputations:-**

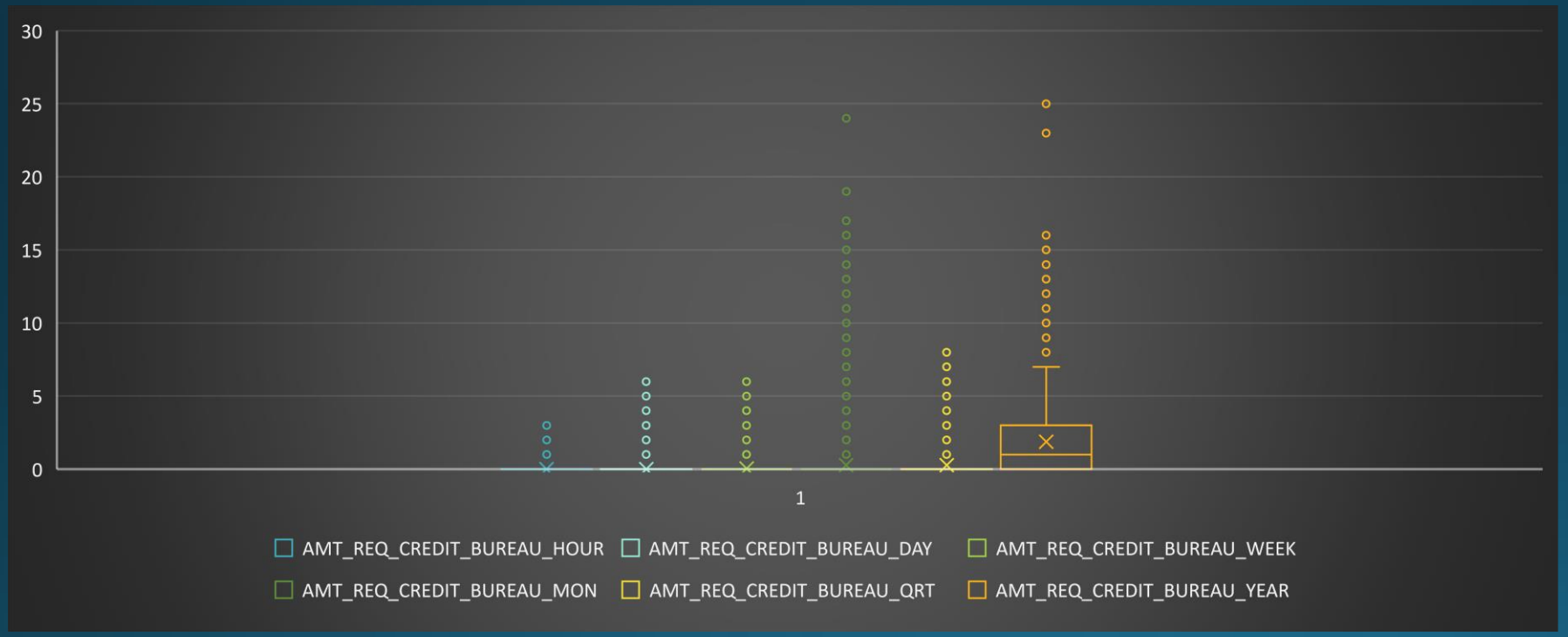
1. AMT_ANNUITY




2. AMT_GOODS_PRICE

# Missing Data

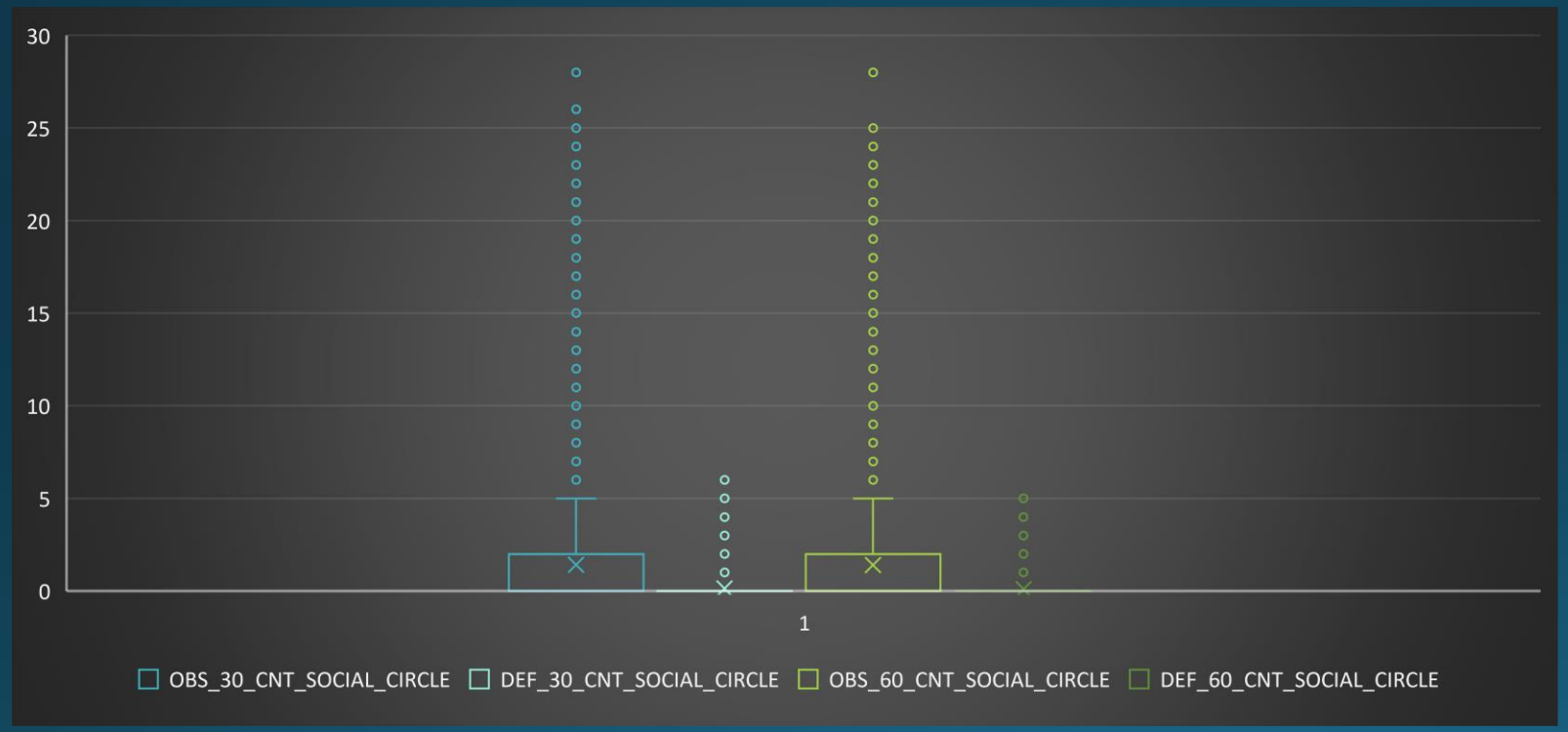
**Median Imputations:-**




3. AMT_REQ_CREDIT_BUREAU_HOUR
4. AMT_REQ_CREDIT_BUREAU_DAY
5. AMT_REQ_CREDIT_BUREAU_WEEK
6. AMT_REQ_CREDIT_BUREAU_MON
7. AMT_REQ_CREDIT_BUREAU_QRT
8. AMT_REQ_CREDIT_BUREAU_YEAR

# Missing Data

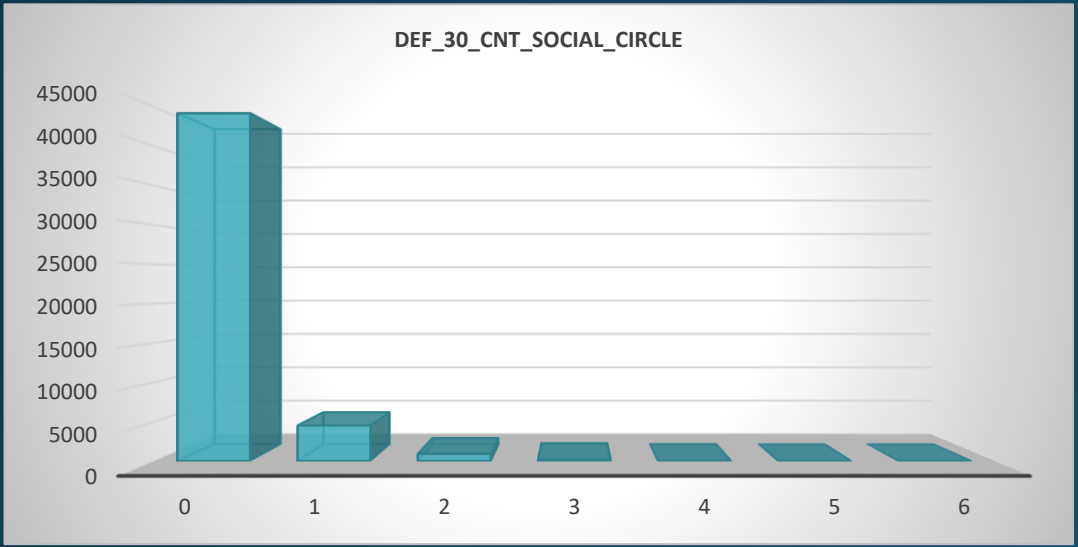
**Median/Mode Imputations:-**

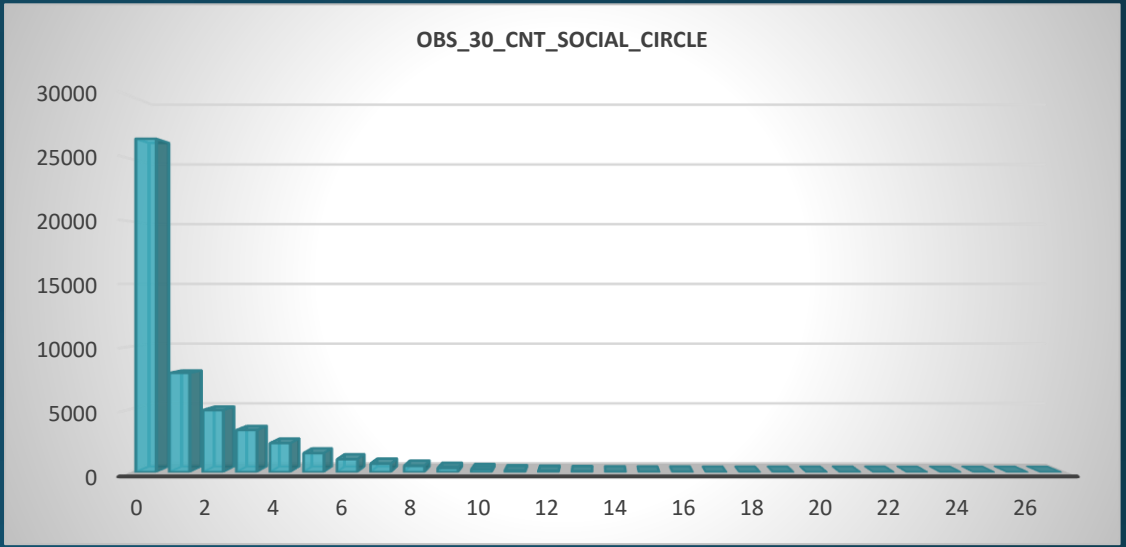


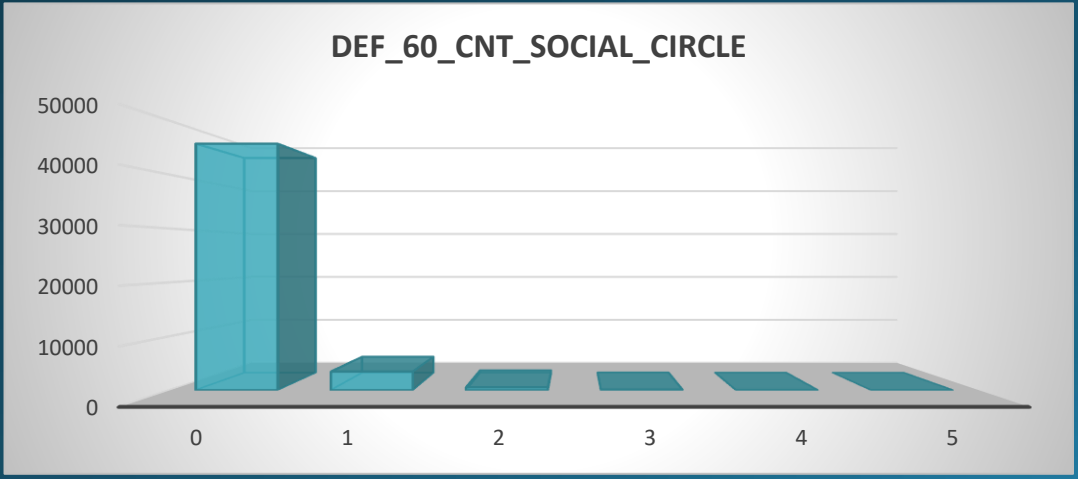

1. DEF_30_CNT_SOCIAL_CIRCLE
2. OBS_30_CNT_SOCIAL_CIRCLE
3. DEF_60_CNT_SOCIAL_CIRCLE
4. OBS_60_CNT_SOCIAL_CIRCLE

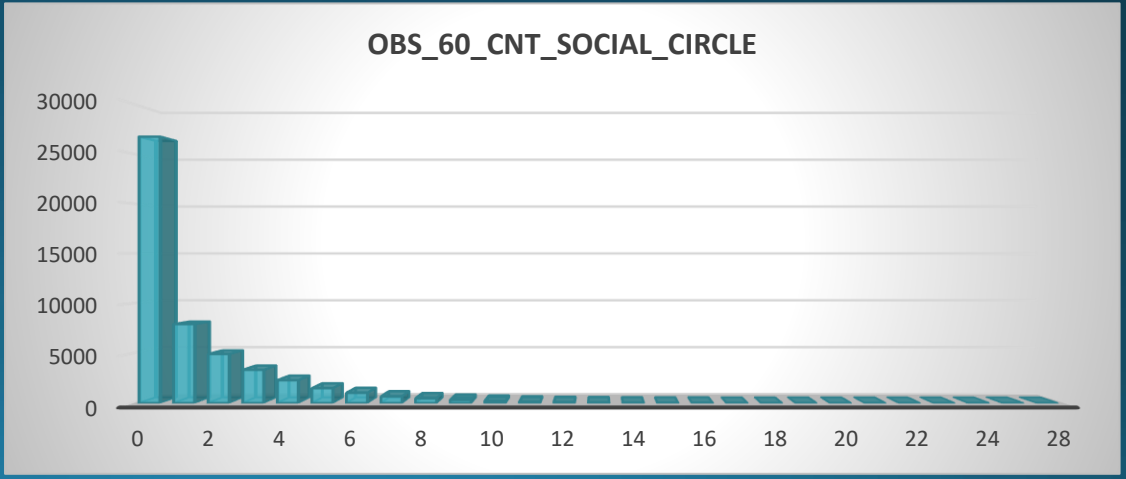
# Missing Data

## Median/Mode Imputations:-



# Missing Data

Previous_application datasets

| Column name | no_of_null_values | Percentage_of_null_values |
|---|---|---|
| RATE_INTEREST_PRIMARY | 49833 | 99.67% |
| RATE_INTEREST_PRIVILEGED | 49833 | 99.67% |
| AMT_DOWN_PAYMENT | 25197 | 50.40% |
| RATE_DOWN_PAYMENT | 25197 | 50.40% |

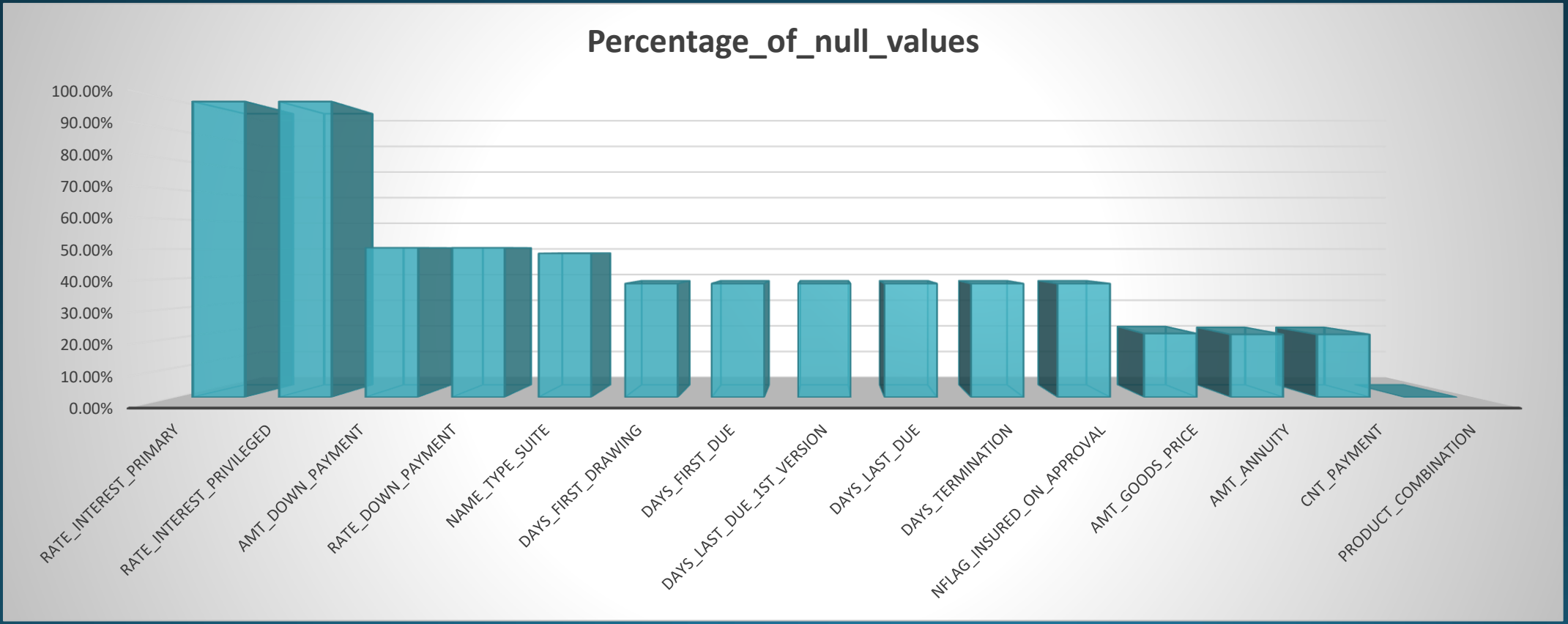
These are the columns which has null values more than or equal to 50%. These columns need to be dropped.

| Column name | no_of_null_values | Percentage_of_null_values |
|---|---|---|
| NAME_TYPE_SUITE | 24243 | 48.49% |
| PRODUCT_COMBINATION | 8 | 0.02% |
| WEEKDAY_APPR_PROCESS_START | 0 | 0.00% |
| HOUR_APPR_PROCESS_START | 0 | 0.00% |
| FLAG_LAST_APPL_PER_CONTRACT | 0 | 0.00% |
| NFLAG_LAST_APPL_IN_DAY | 0 | 0.00% |

These are the columns which have irrelevant data for analysis. These columns need to be dropped.

# Missing Data

Previous_application datasets

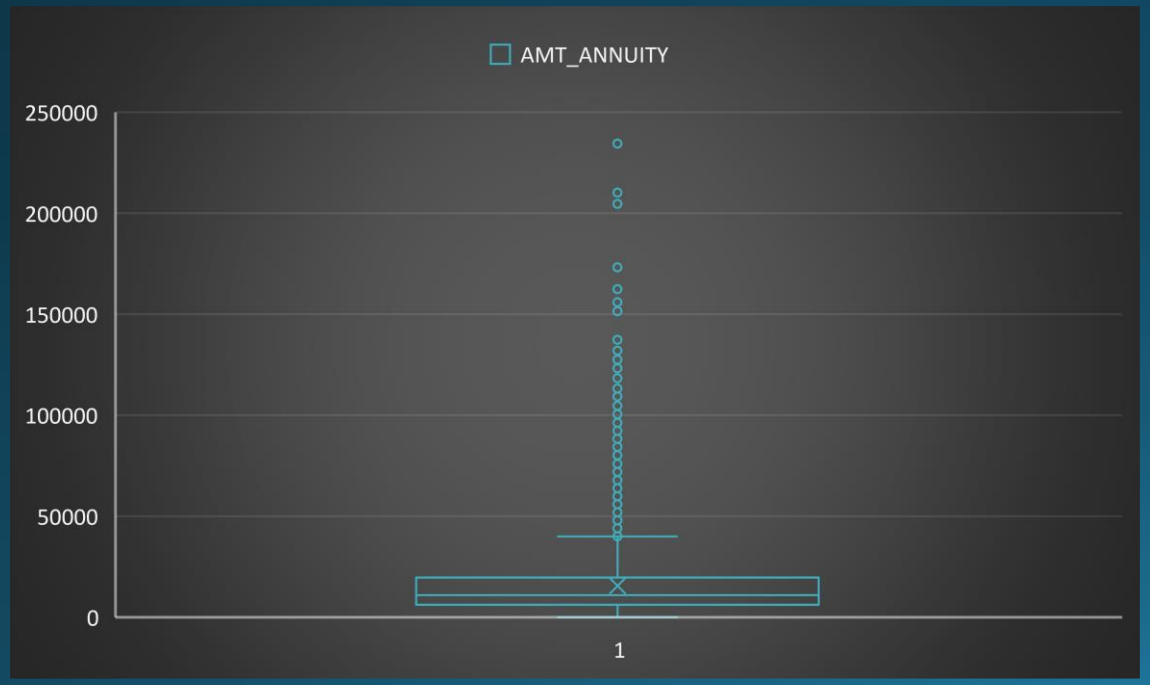


# Missing Data

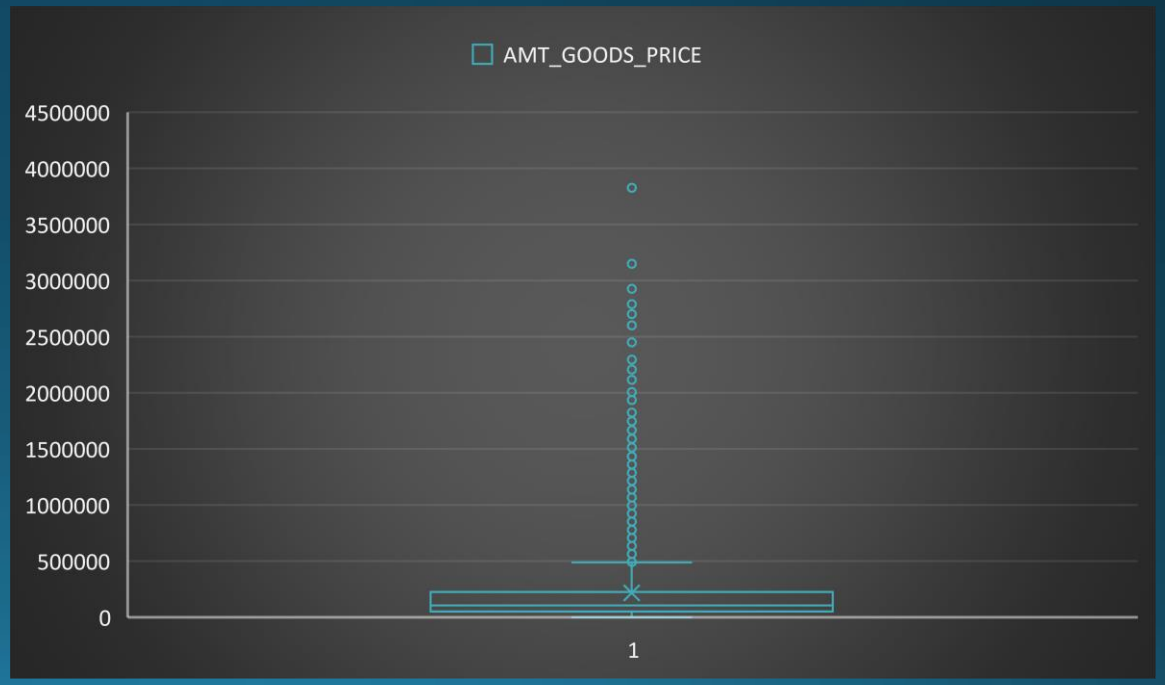
Previous_application datasets

**Median Imputations:-**

1. AMT_ANNUITY




2. AMT_GOODS_PRICE



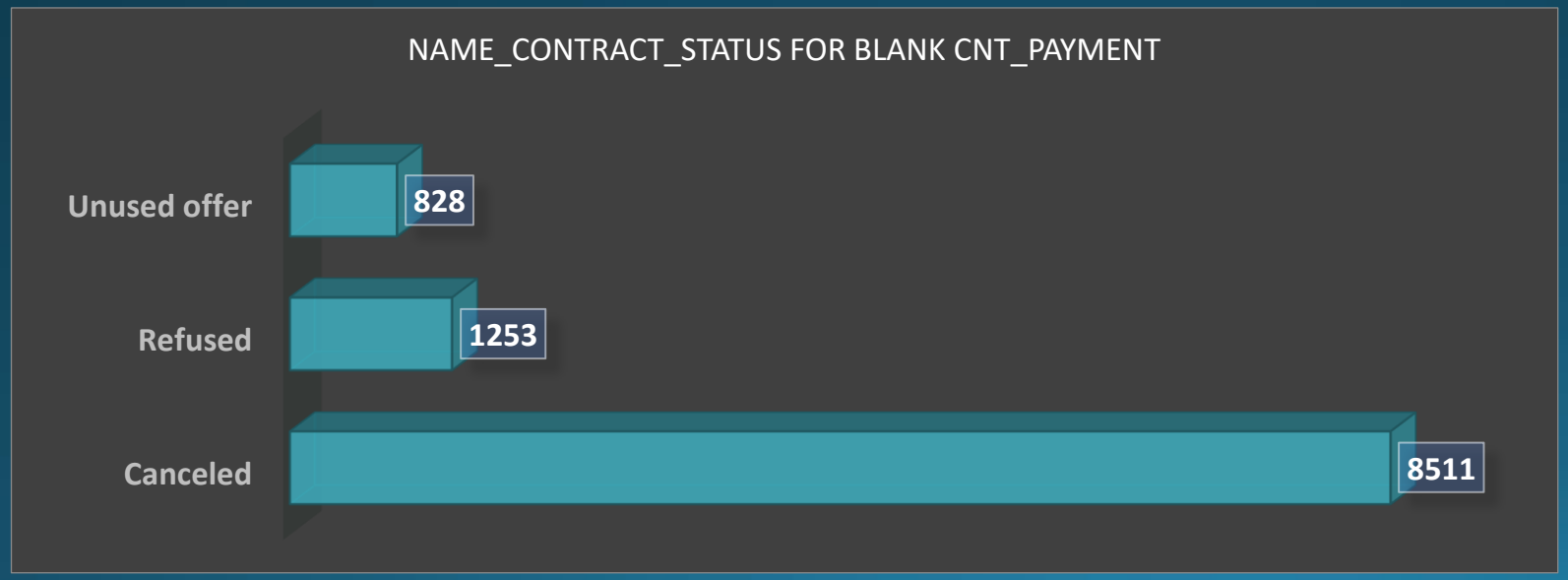
# Missing Data

Previous_application datasets

**Custom Imputations:-**

1. CNT_PAYMENT

Most of Blank cells of cnt_payments have contract_status as canceled, refused, unused offer. So it makes more sense replacing them with 0 rather than Mean or Median.

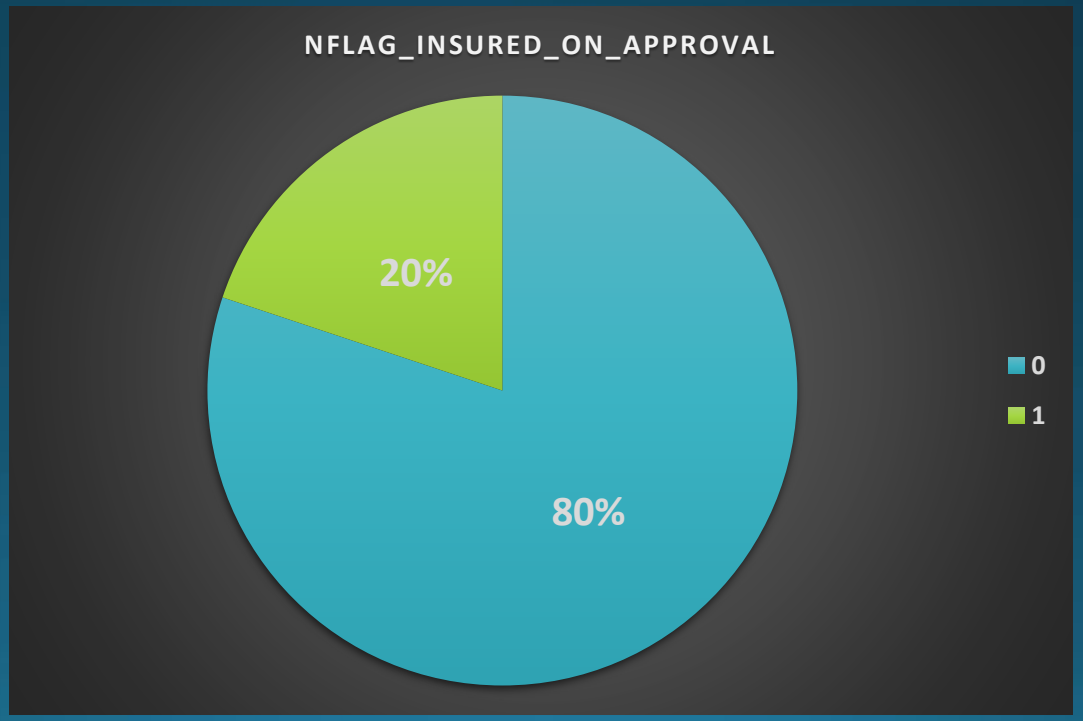


# Missing Data

Previous_application datasets

**Mode Imputations:-**

1. NFLAG_INSURED_ON_APPROVAL



# Outliers

**Task B:** Detect and identify outliers in the dataset using Excel statistical functions and features, focusing on numerical variables.

- First we will select numerical columns like AMT_INCOME_TOTAL and AMT_CREDIT.
- Calculate Quartile 1, Quartile 3, IQR, Upper Limit and Lower Limit.
- We will use Box Plot to highlight the outliers.

Formulas:-

Quartile 1 :  =QUARTILE(A:A,1 )

Quartile 3 : =QUARTILE(A:A,3)

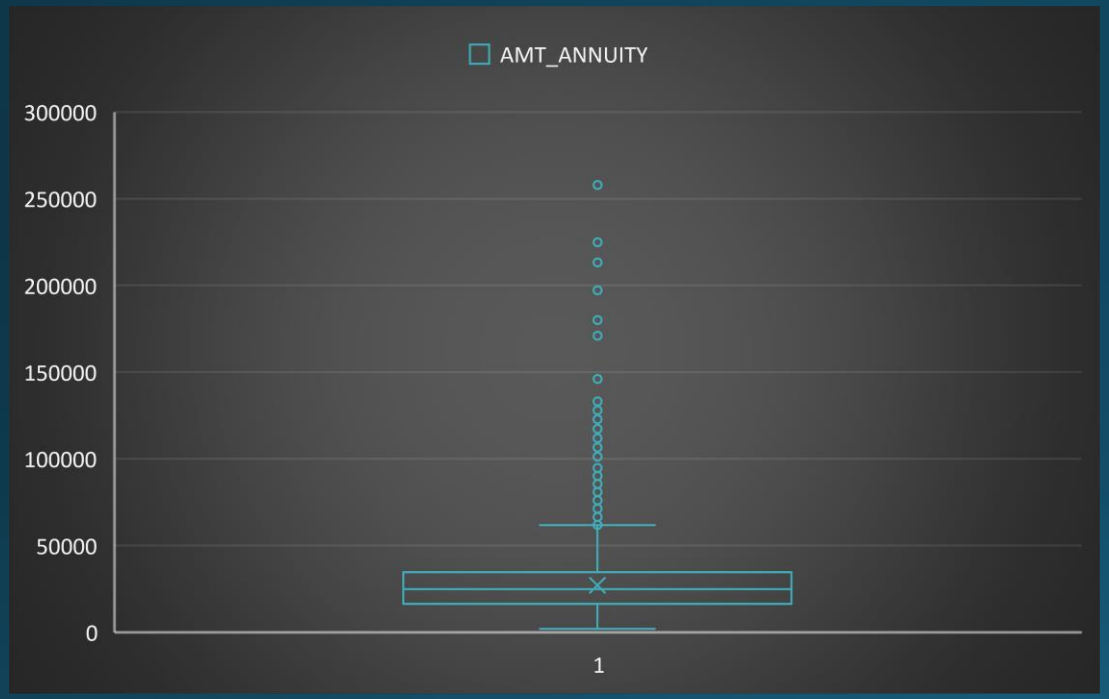
IQR = Quartile 3 - Quartile 1

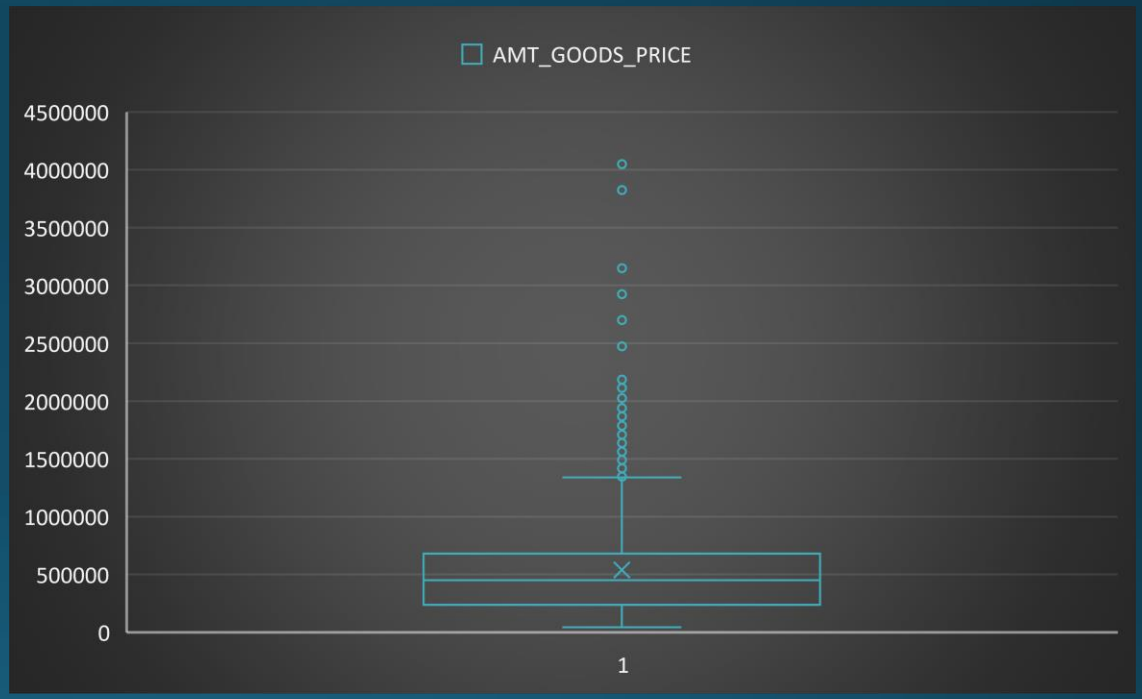
Upper Limit = Quartile 3 +  1.5*IQR

Lower Limit = Quartile 1 – 1.5IQR

| AMT_INCOME_TOTAL | |
|---|---|
| Quartile 1 | 112500 |
| Quartile 3 | 202500 |
| IQR | 90000 |
| Upper Limit | 337500 |
| Lower Limit | -22500 |

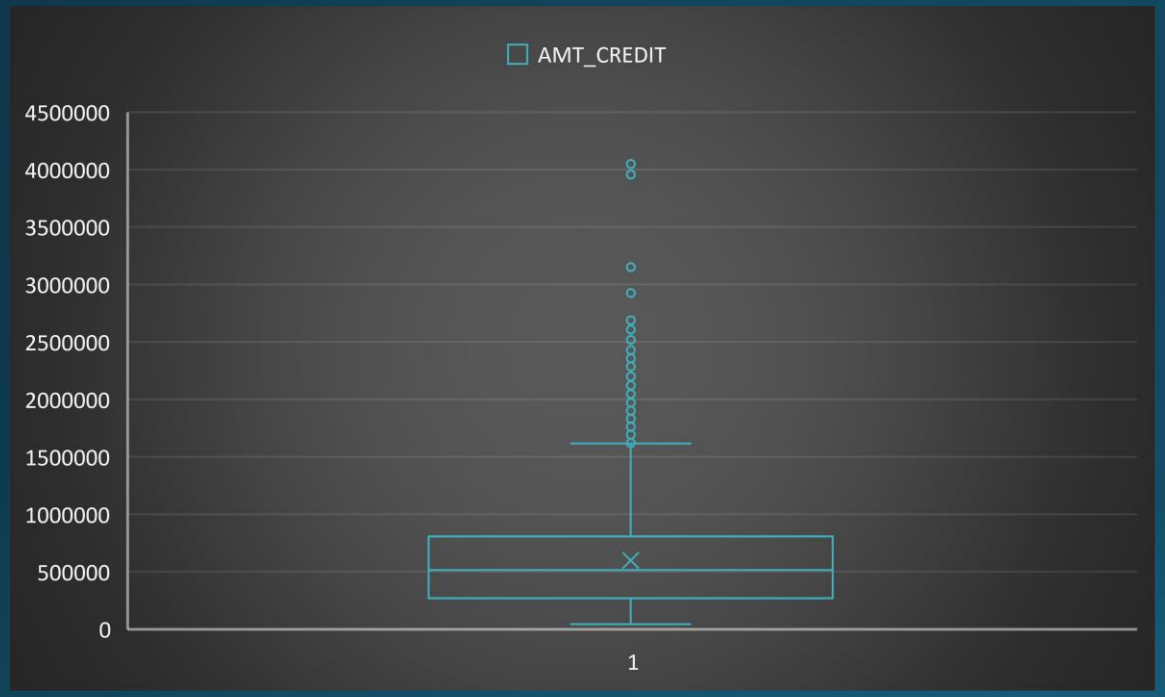
# Outliers

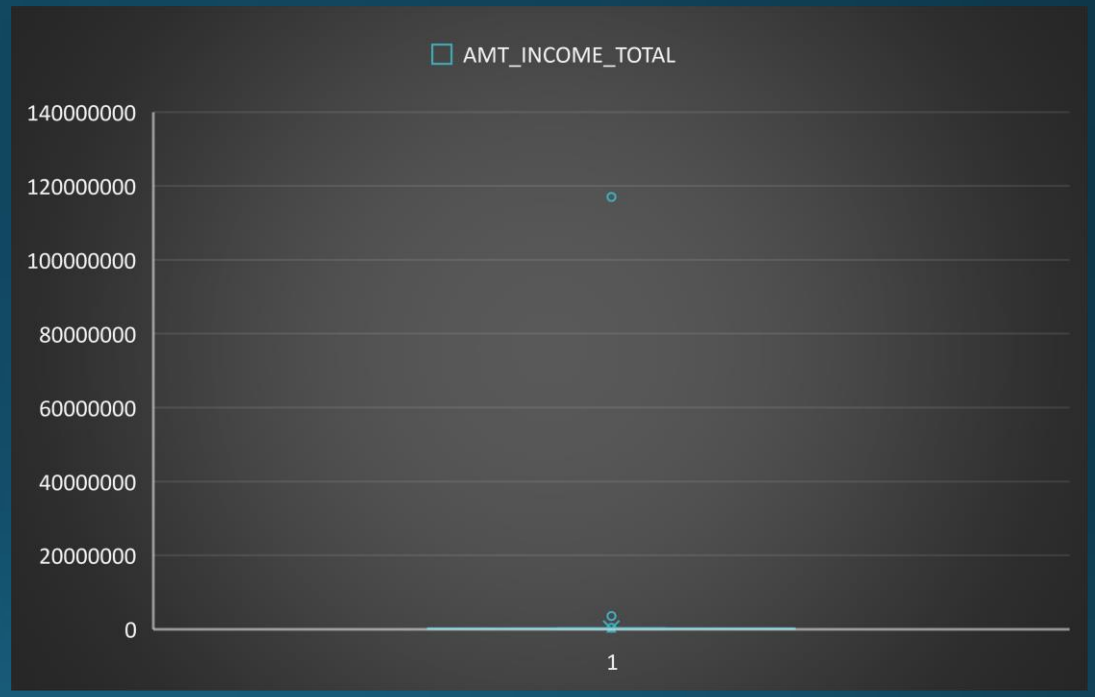



In the chart we can see there are few outliers in columns like AMT_ANNUITY and AMT_GOODS_PRICE.

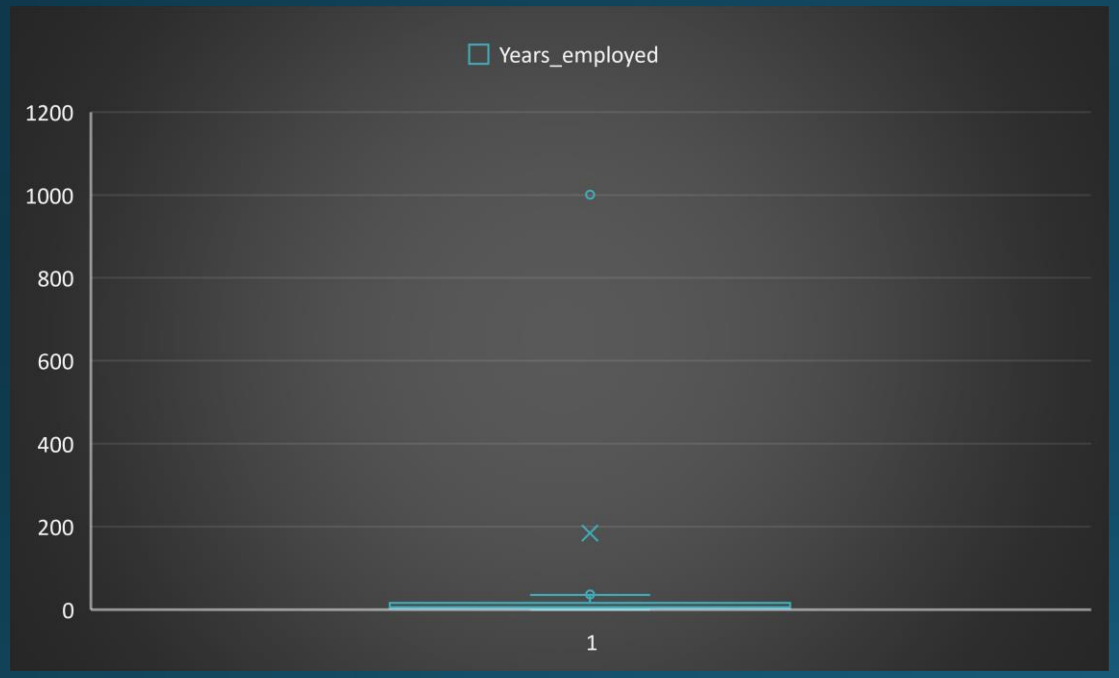
# Outliers

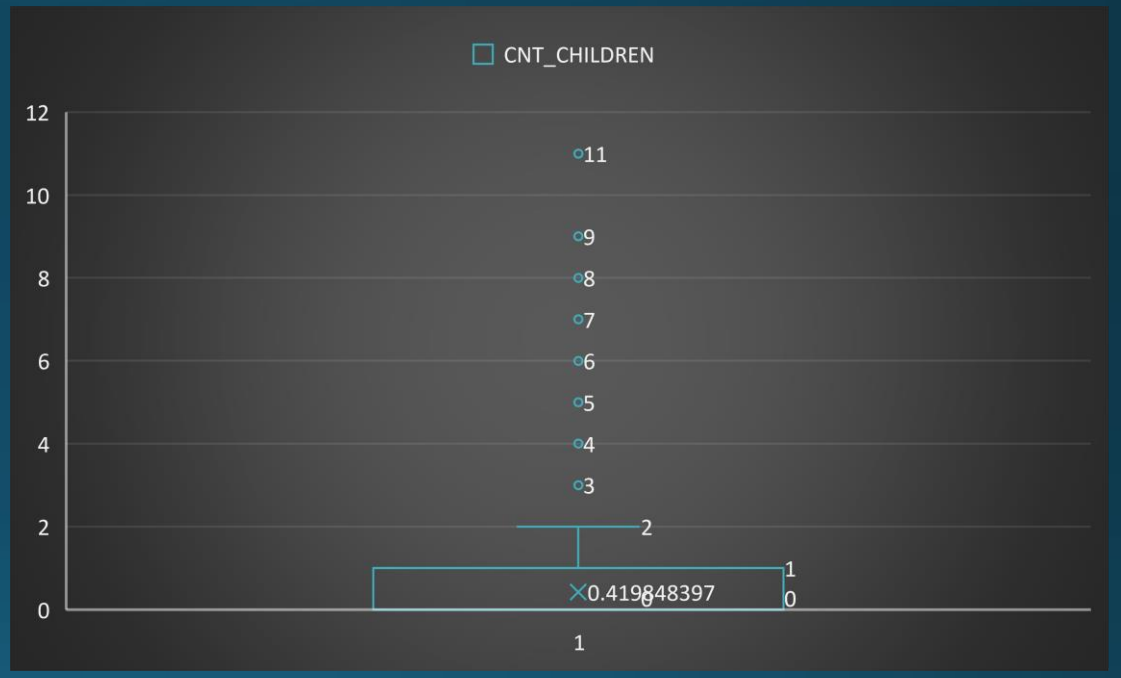



There are few outliers in columns like AMT_CREDIT and AMT_INCOME_TOTAL where amount is higher than normal. In AMT_INCOME_TOTAL one of extreme outlier is 117000000 but we will not remove because income of person varies. We will not remove outlier from AMT_CREDIT too.

# Outliers



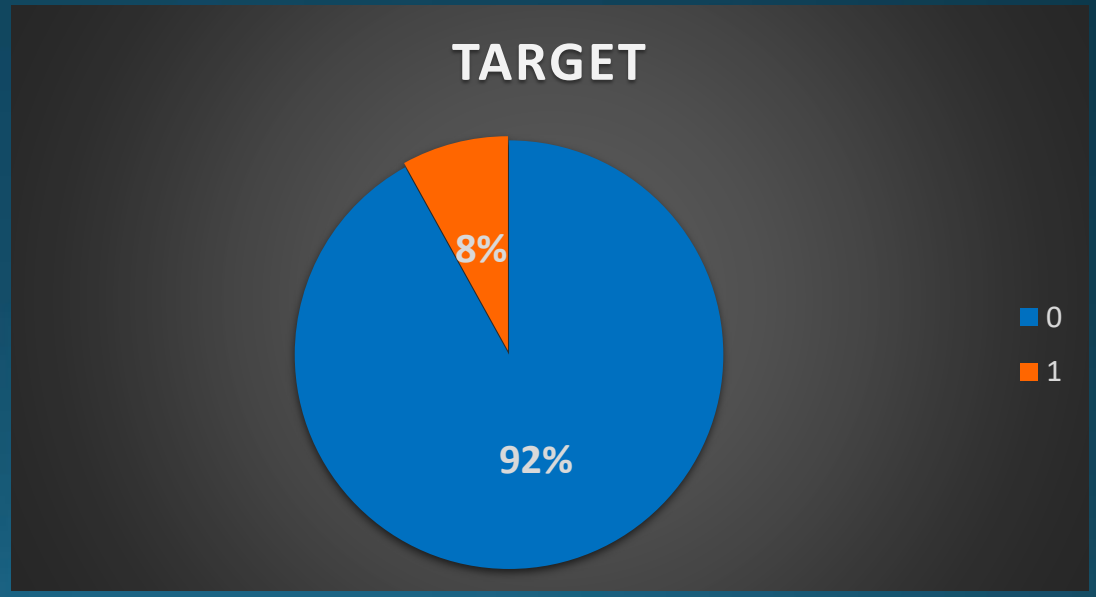

In Column Years_employed we can see people being employed for 1001 yrs which is not possible.
Column CNT_CHILDREN shows people are having 11 children which is impossible in today's age

# Data Imbalance

**Task C:** Determine if there is data imbalance in the loan application dataset and calculate the ratio of data imbalance using Excel functions.

TARGET COLUMN

| Row Labels | Count of TARGET |
|---|---|
| 0 | 45973 |
| 1 | 4026 |
| Grand Total | 49999 |




**Almost 92% clients are loan re-payers.**

**8% client are Defaulters.**

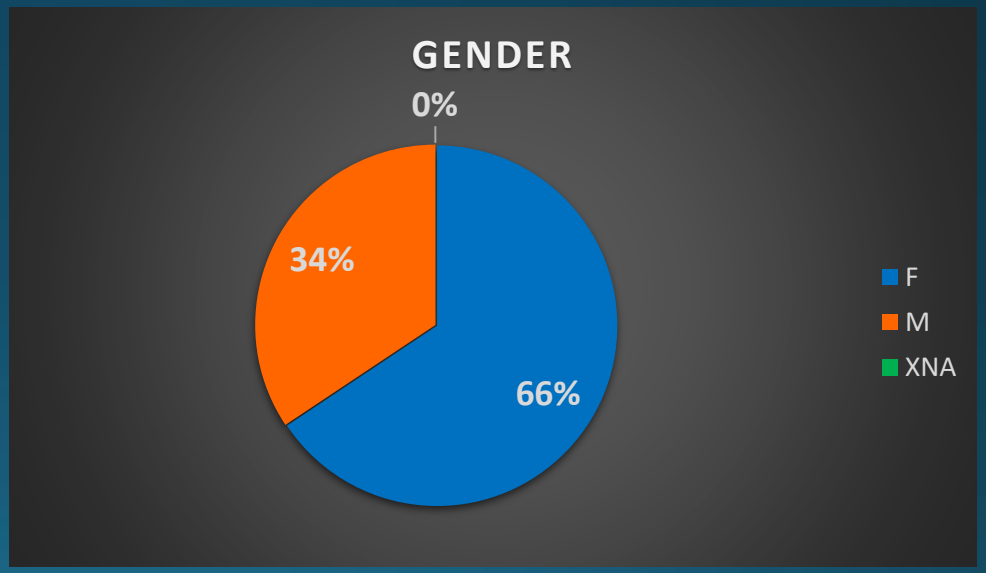
**0 – Payment on time**

**1 – Late Payment**

# Data Imbalance

## CODE_GENDER COLUMN

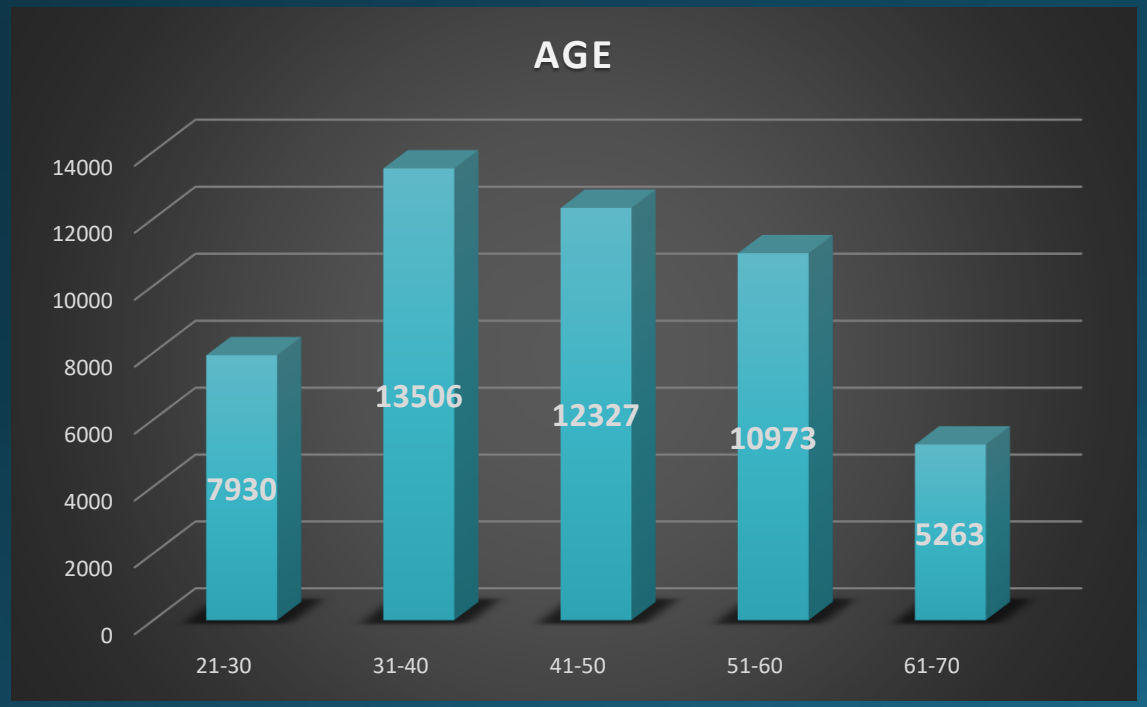
| GENDER | Count of CODE_GENDER |
|---|---|
| F | 32823 |
| M | 17174 |
| XNA | 2 |
| Grand Total | 49999 |

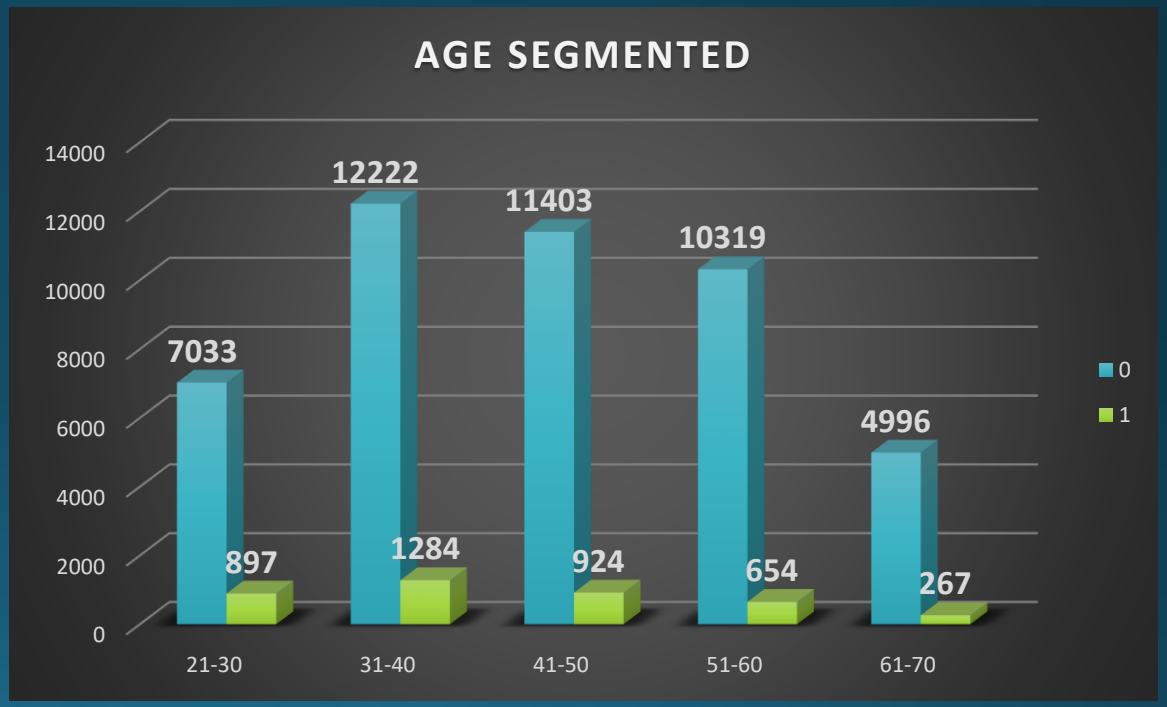



**Almost 66% client are Female and 34% clients are Male.**

# Univariate/Segmented Univariate Analysis

**Task D:** Perform univariate analysis to understand the distribution of individual variables, segmented univariate and bivariate analysis.

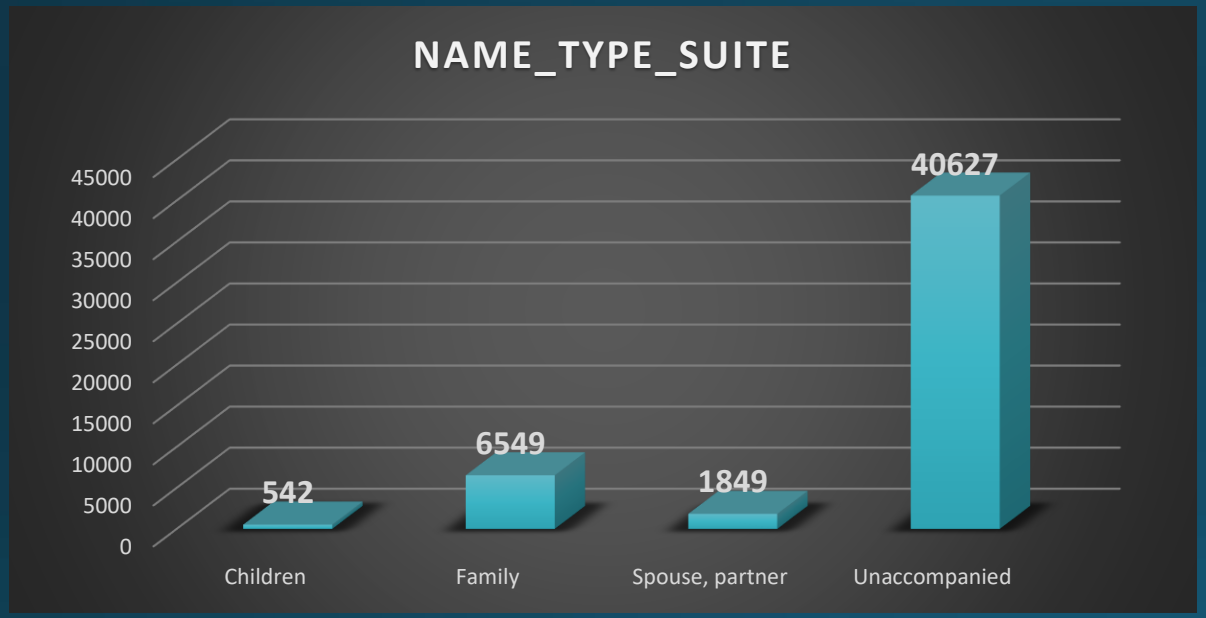


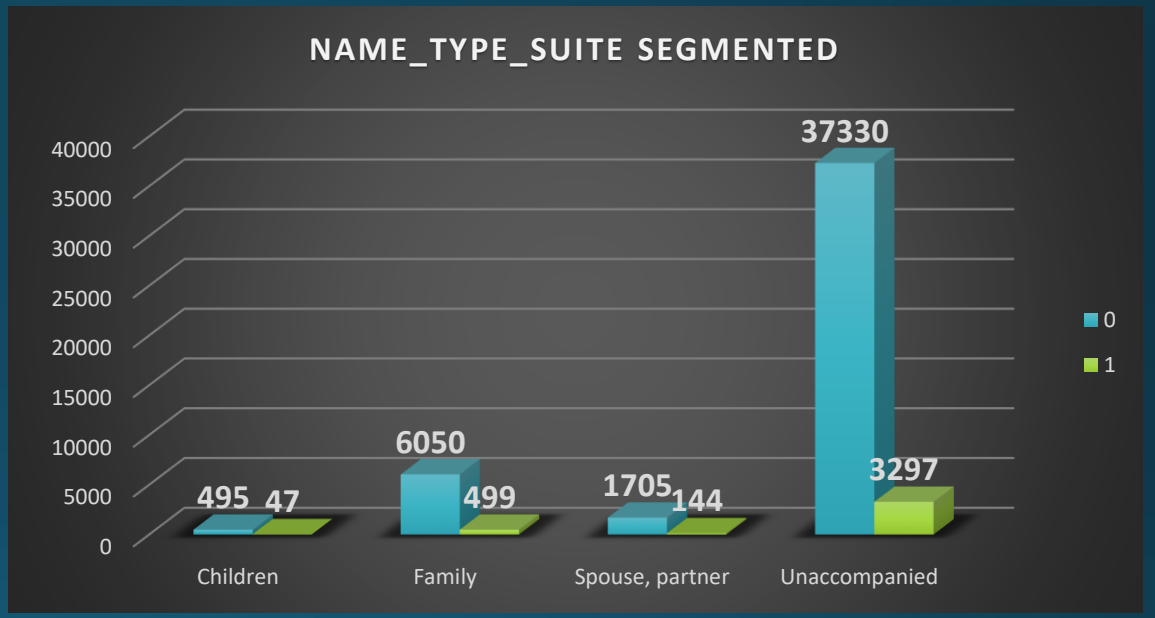




Majority of the Clients are in the age group 31-40.

we can see as age increases , chances of defaulter decreases.

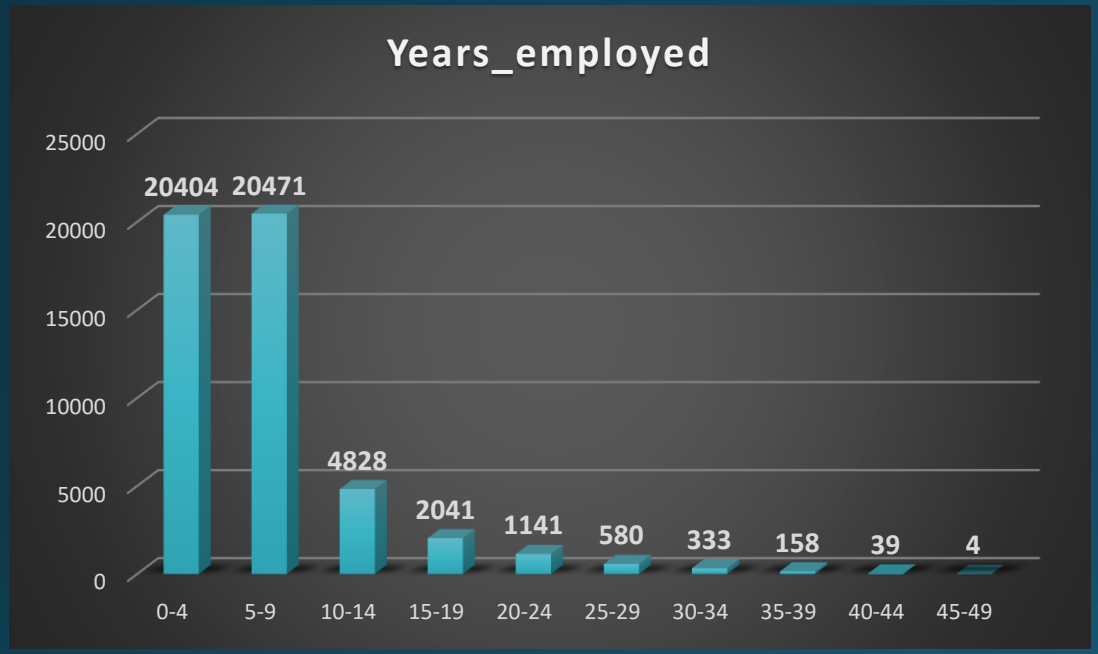
# Univariate/Segmented Univariate Analysis

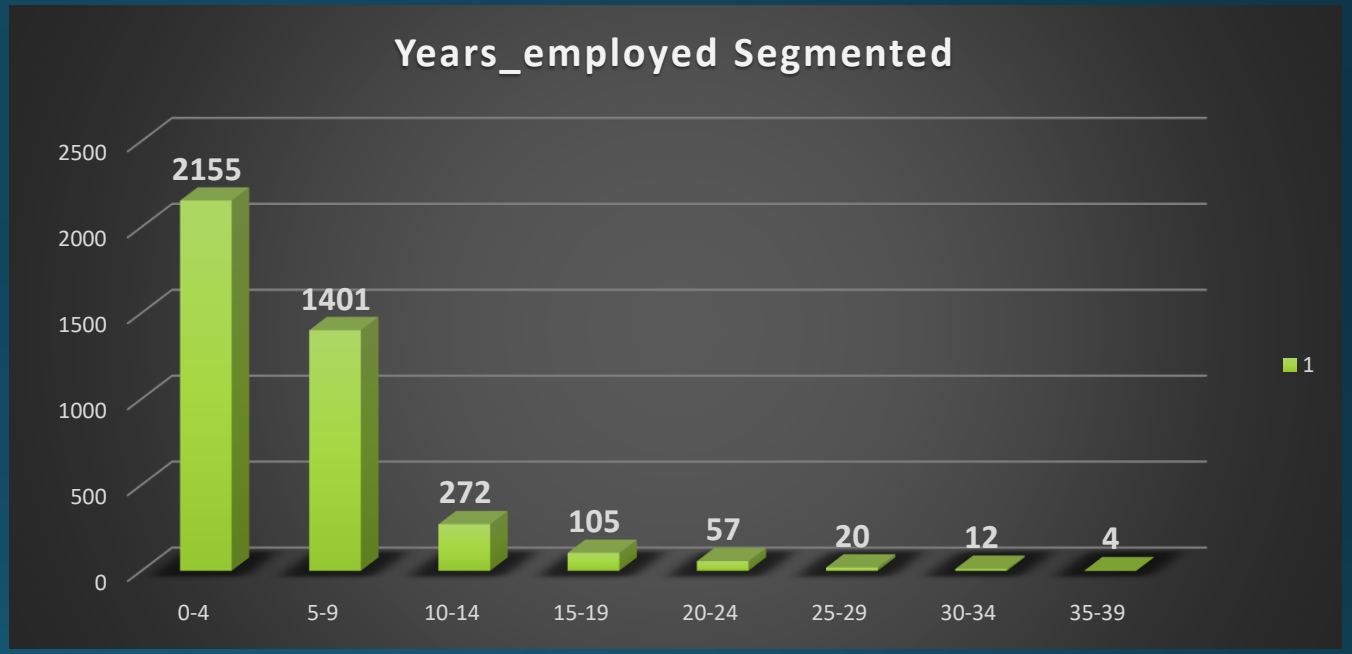



Majority of the Clients are Unaccompanied followed by Family.

# Univariate/Segmented Univariate Analysis

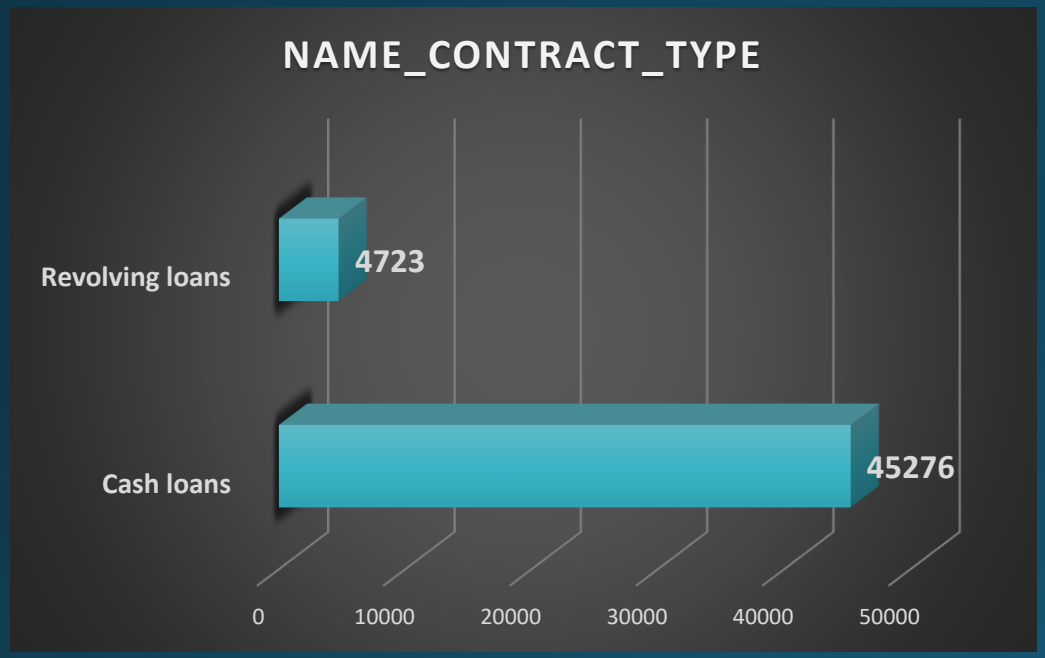


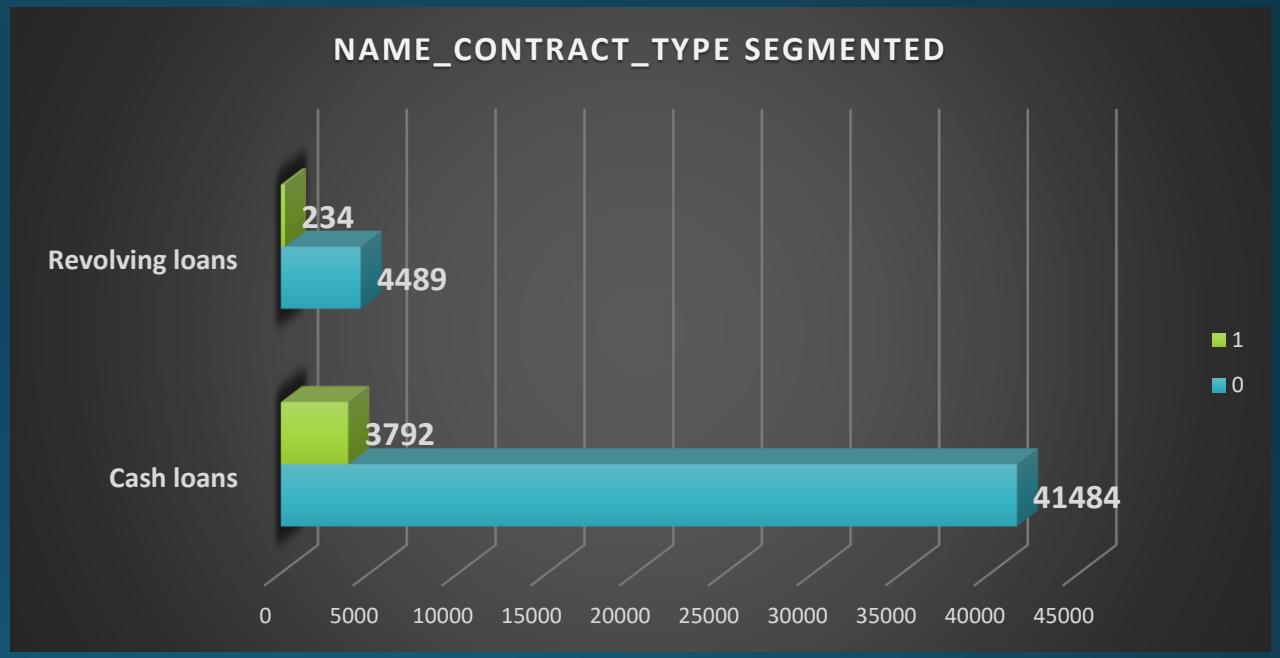




Majority of the Clients are having 0-9 years of experience.

we can see as experience increases , chances of defaulting decreases.

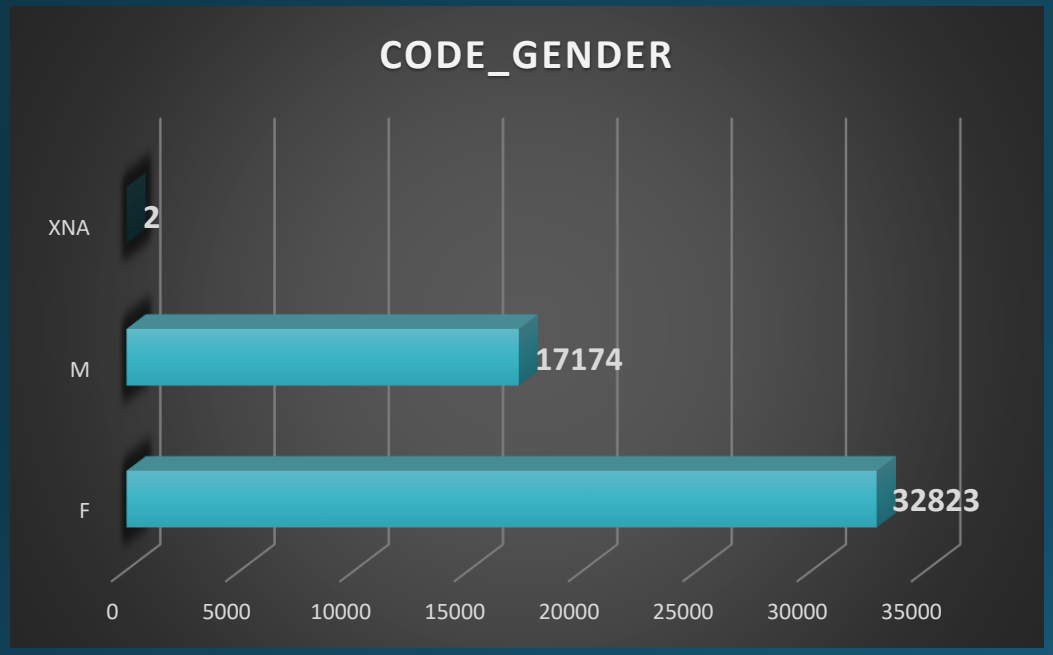
# Univariate/Segmented Univariate Analysis

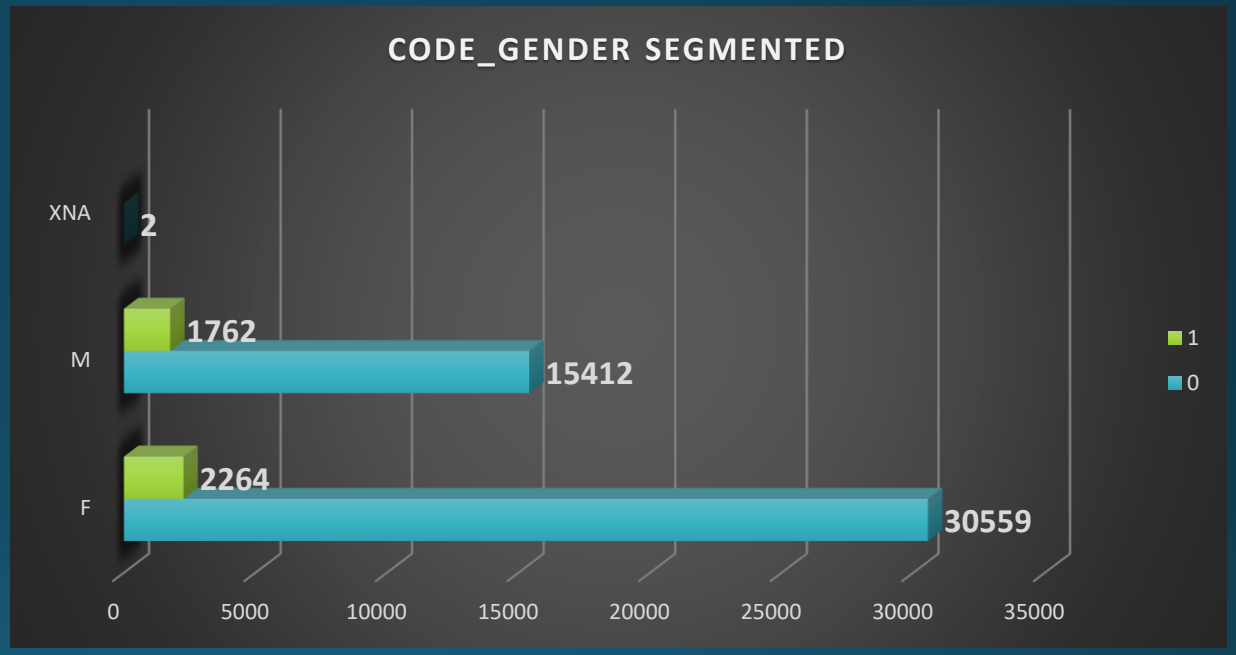



Majority of the Clients are taking Cash loans.

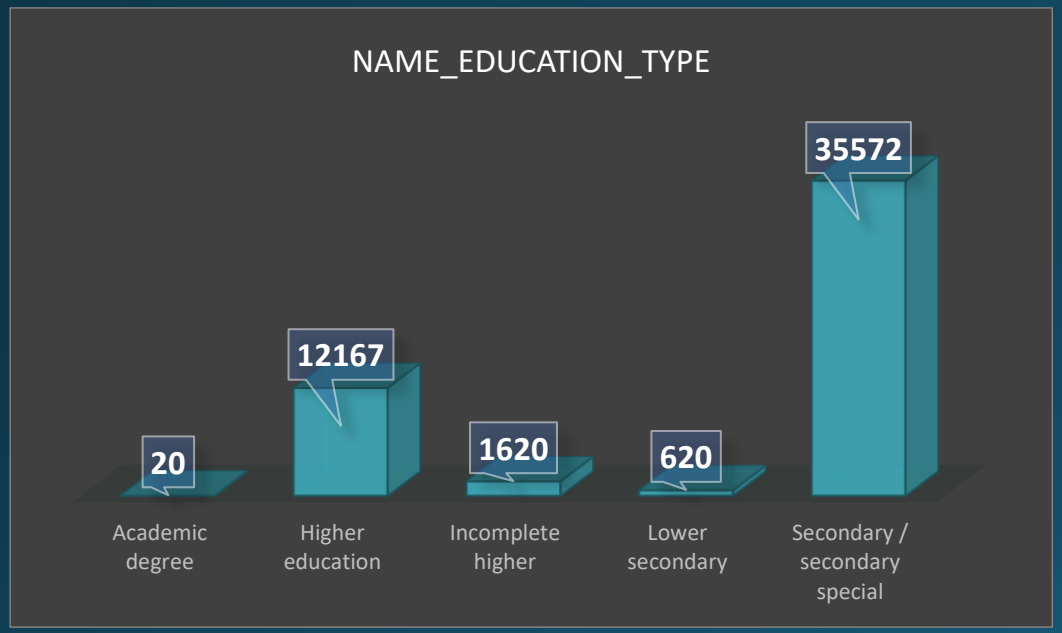
# Univariate/Segmented Univariate Analysis

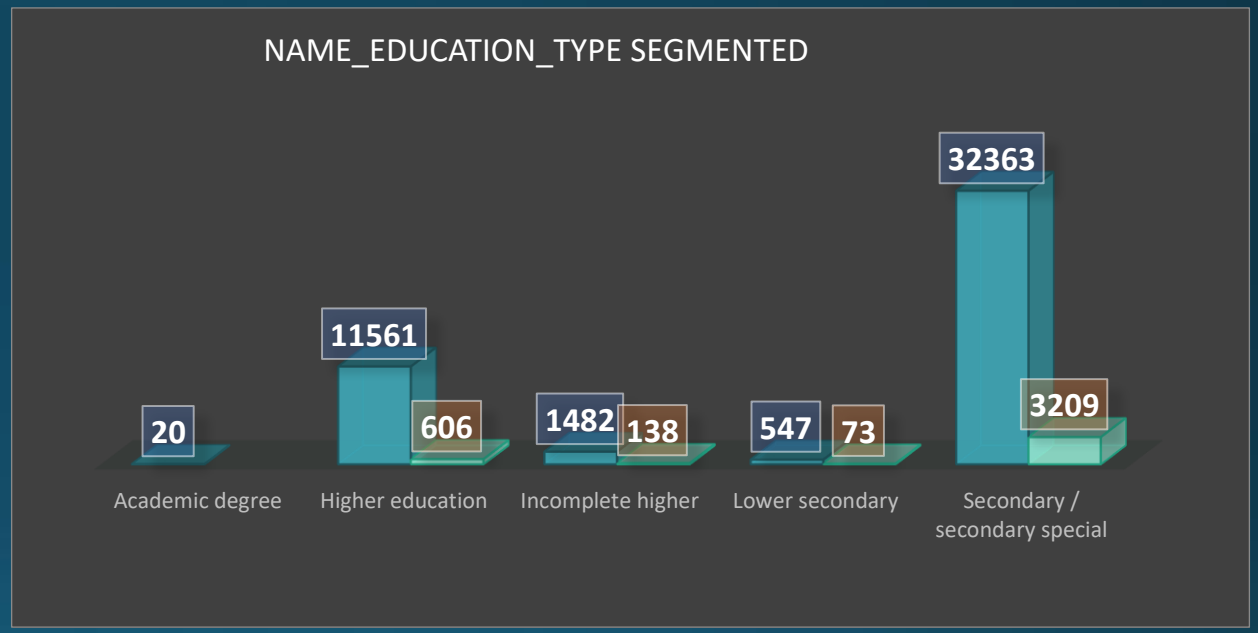



Male are less defaulters compared to Female.

# Univariate/Segmented Univariate Analysis

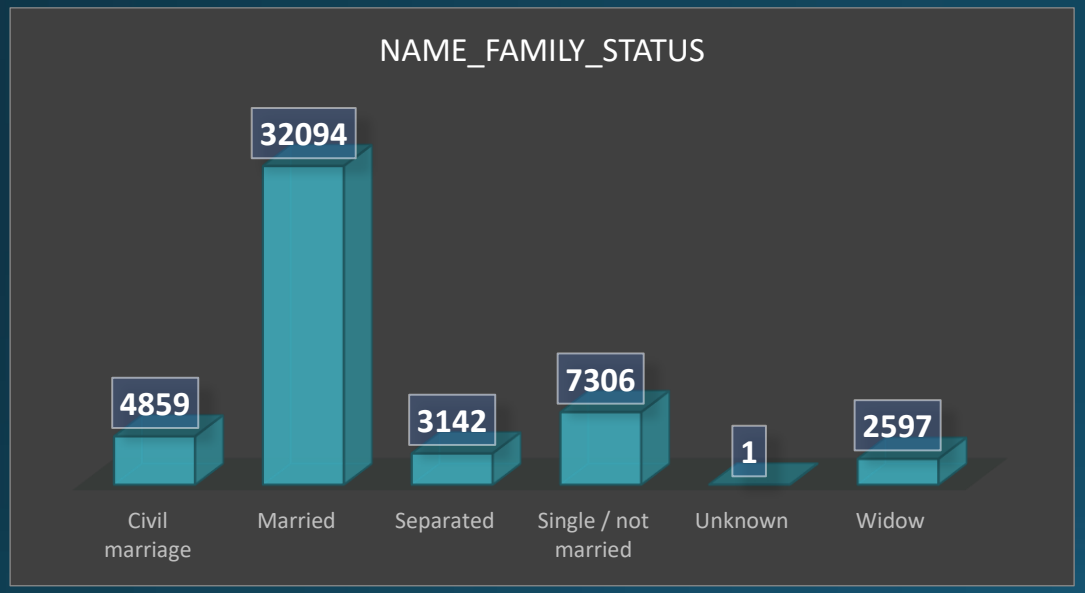


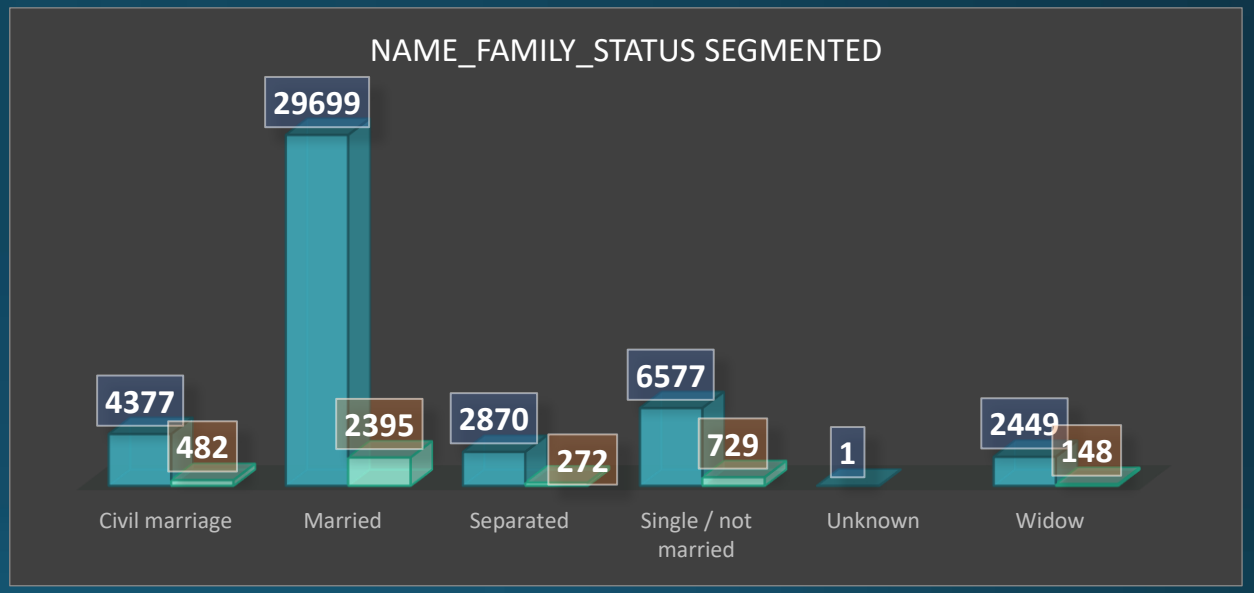




The numbers of loans taken by Clients with Secondary special Education is the highest and Academic degree is the lowest

Least default: Academic degree
Highest default: Secondary special

# Univariate/Segmented Univariate Analysis

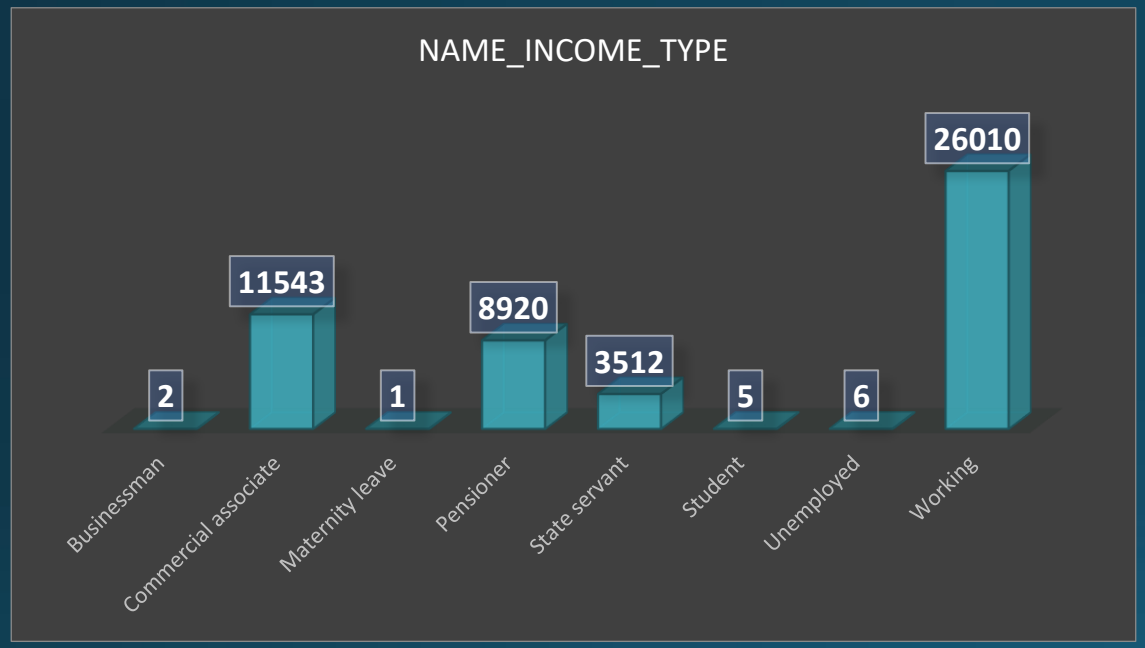


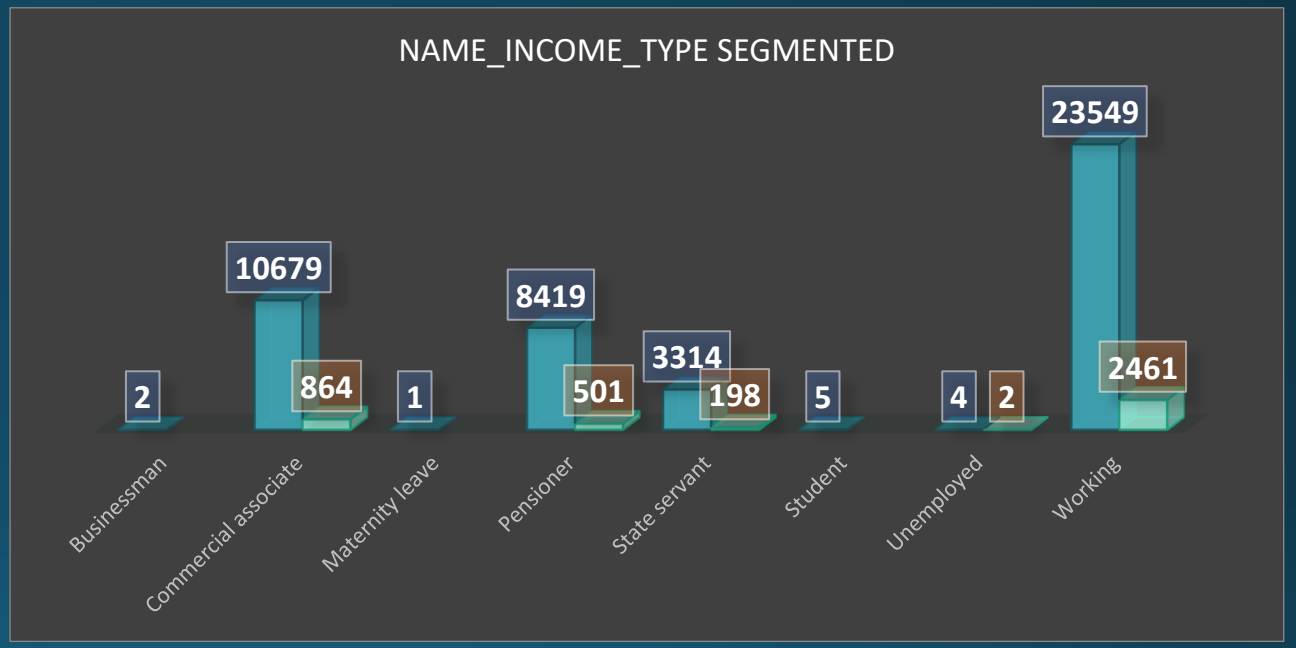




The number of loans taken by Married clients are the highest and clients who are widows are the least if we ignore unknown.

Least Defaulter: Widow
Highest Defaulter : Married

# Univariate/Segmented Univariate Analysis

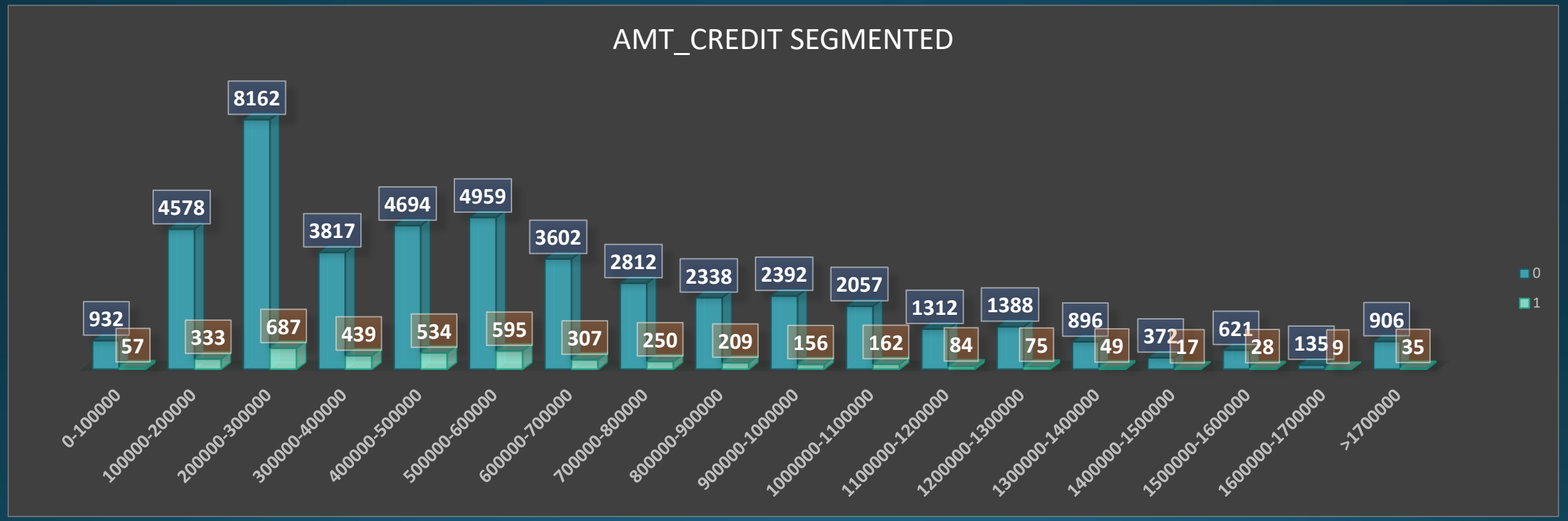



Bank target those groups whose income type is working.

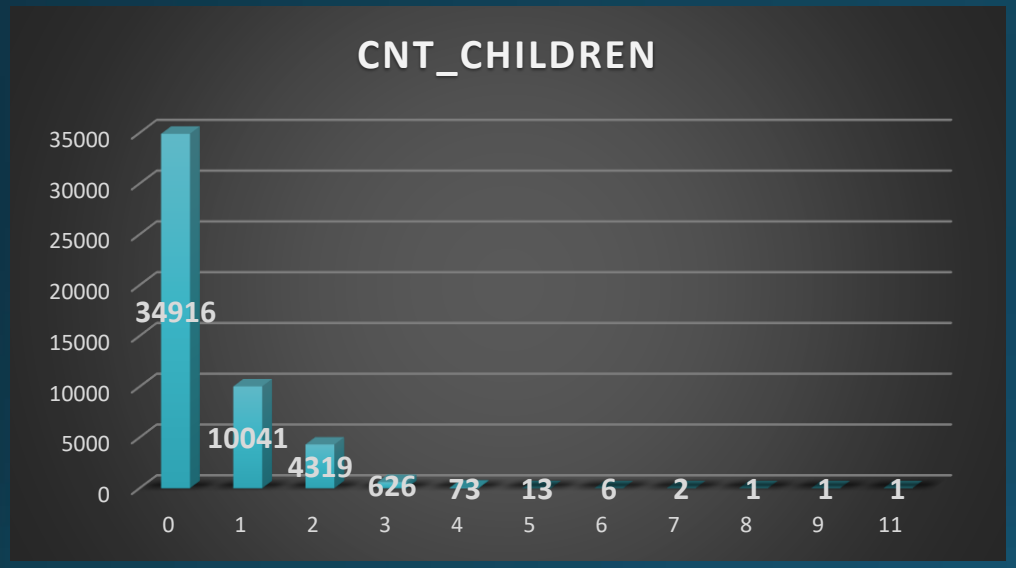
Least default: Client who is Businessman or student or at Maternity leave.
Highest default: Client who is working

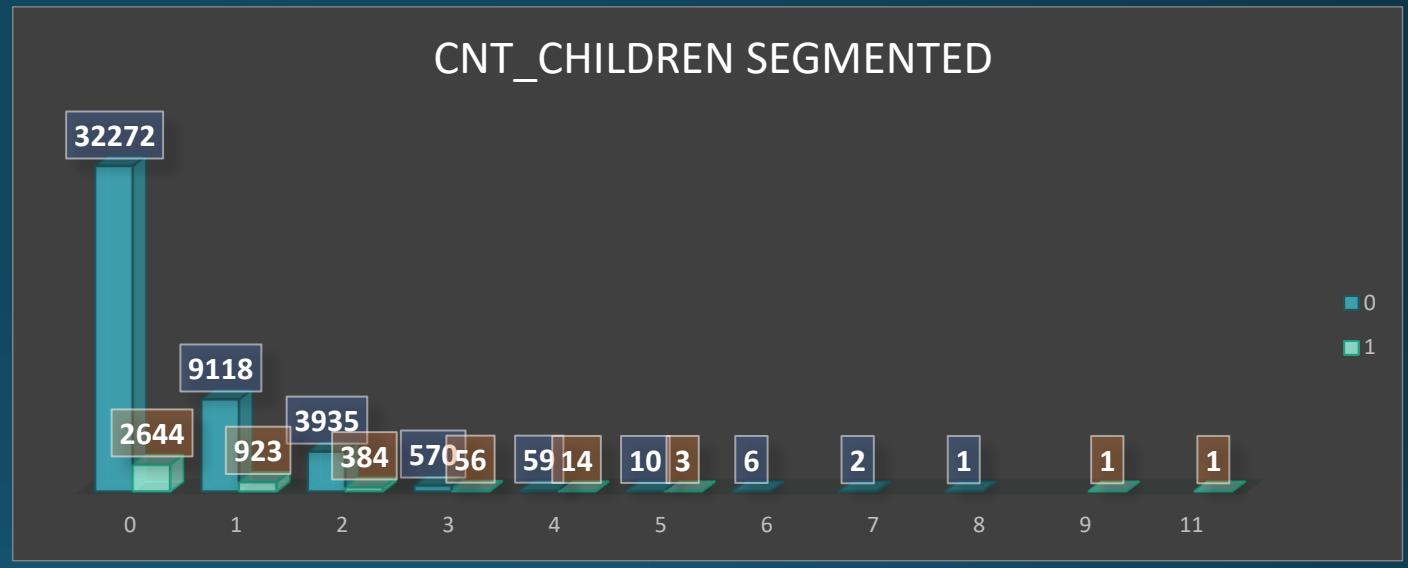
# Univariate/Segmented Univariate Analysis




Majority of the Clients took the loan between 2L – 3L.

# Univariate/Segmented Univariate Analysis

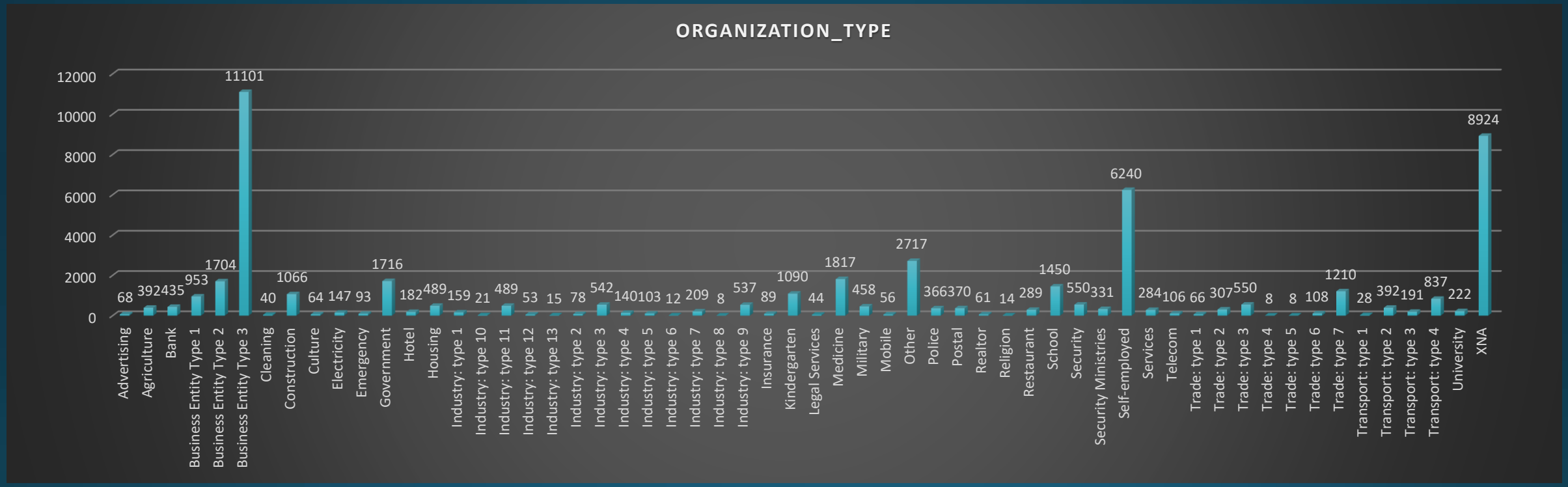



The highest number of loans are taken by Clients who does not have a child

As number of children increases, number of client who took loan decreases.

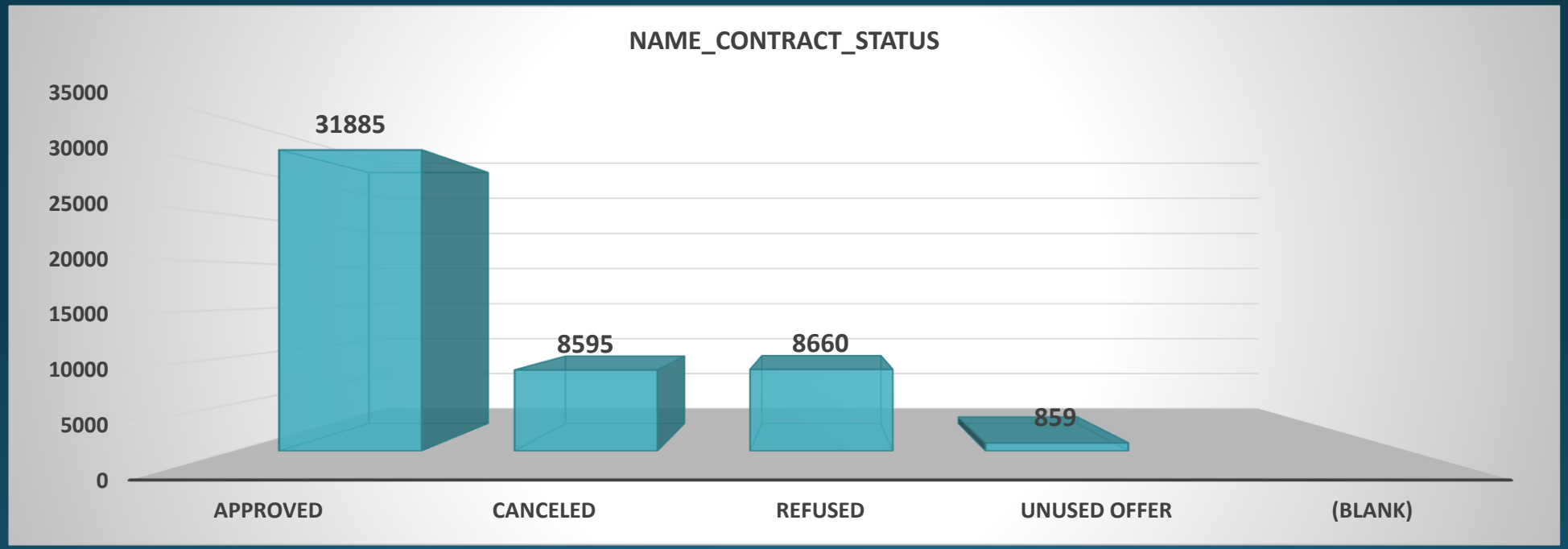
# Univariate/Segmented Univariate Analysis




Clients who are working in business Entity type of Organization took the highest number of loans.

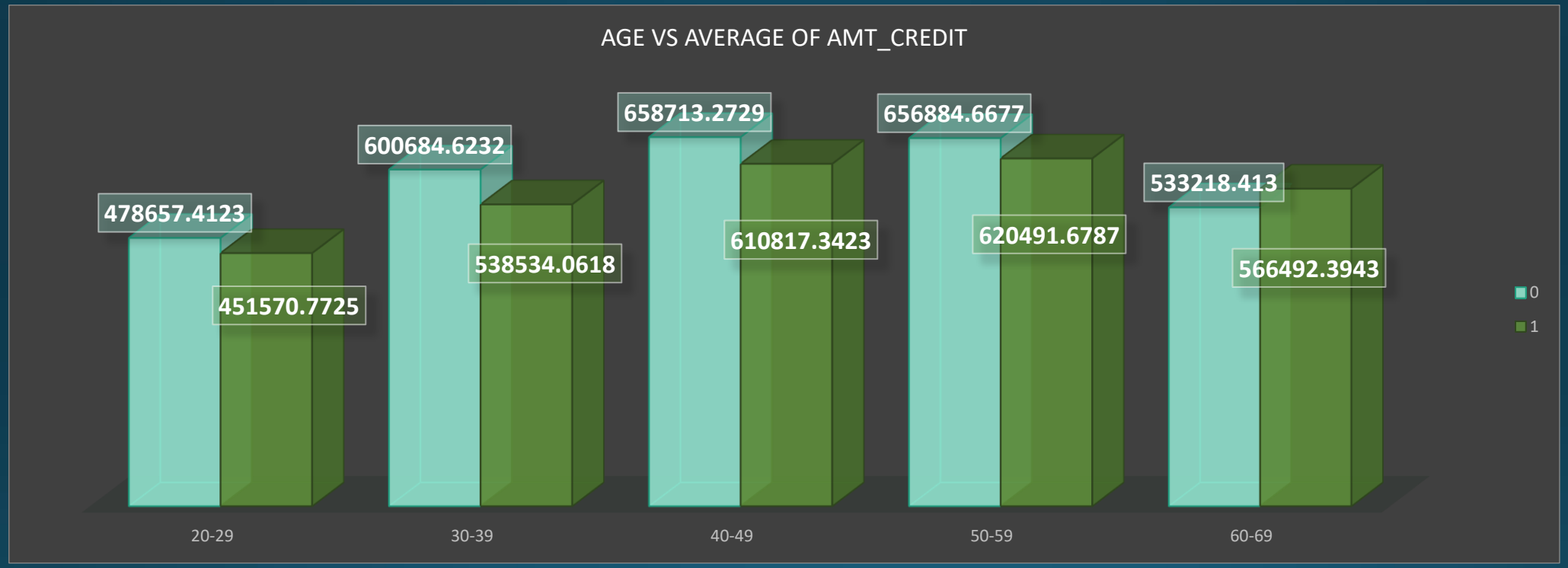
# Univariate/Segmented Univariate Analysis

Previous_application datasets



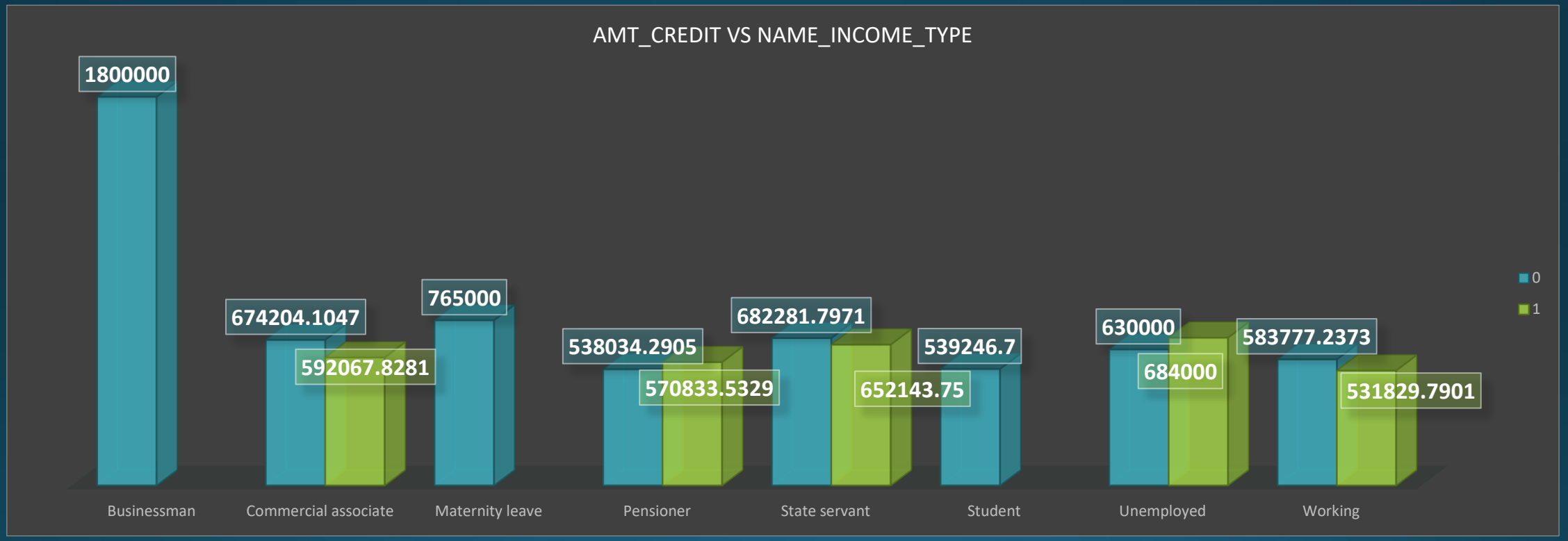

More number of Clients were approved for loans previously.

# Bivariate Analysis




Age group  40-49 took the highest amount of loan but age group 50-59 are defaulter with highest amount of loan.

# Bivariate Analysis




As we see Businessman took the highest amount of loan and did the payment on time. Clients who are unemployed have highest amount of loan which they didn't repay on time.

# Correlations

**Task E:** Segment the dataset based on different scenarios (e.g., clients with payment difficulties and all other cases) and identify the top correlations for each segmented data using Excel functions.

Top Correlation Coefficients for Payment difficulties are:-

| Correlation between Columns | Value |
|---|---|
| AMT_CREDIT - AMT_GOODS_PRICE | 0.982267963 |
| OBS_60_CNT_SOCIAL_CIRCLE - OBS_30_CNT_SOCIAL_CIRCLE | 0.998065853 |
| DEF_60_CNT_SOCIAL_CIRCLE - DEF_30_CNT_SOCIAL_CIRCLE | 0.89051161 |
| REG_REGION_NOT_WORK_REGION - LIVE_REGION_NOT_WORK_REGION | 0.806743886 |
| REG_CITY_NOT_WORK_CITY - LIVE_CITY_NOT_WORK_CITY | 0.783754676 |
| AMT_CREDIT - AMT_ANNUITY | 0.749665201 |
| AMT_GOODS_PRICE - AMT_ANNUITY | 0.74950403 |

# Correlations

| | CNT_CHILDREN | AMT_INCOME_TOTAL | AMT_CREDIT | AMT_ANNUITY | AMT_GOODS_PRICE | REGION_POPULATION_RELATIVE | DAYS_BIRTH | DAYS_EMP | DAYS_REG | DAYS_ID_ | HOUR_AP | REG_REGI | REG_REGI | LIVE_REGI | REG_CITY_ | REG_CITY_ | LIVE_CITY | OBS_30_C | DEF_30_C | OBS_60_C | DEF_60_C | AMT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CNT_CHILDREN | 1 | 0.010110177 | 0.007601905 | 0.029172977 | -0.001079665 | -0.020359154 | 0.2496732 | -0.1893 | 0.15211 | -0.0424 | -0.0069 | -0.0157 | -0.0057 | -0.0004 | 0.00175 | 0.04892 | 0.05818 | 0.01793 | -0.0136 | 0.01515 | -0.0185 | -0. |
| AMT_INCOME_TOTAL | 0.010110177 | 1 | 0.015271444 | 0.018004594 | 0.013269502 | -0.006180303 | 0.009033662 | -0.0116 | -0.0096 | -0.0091 | 0.01448 | 0.00059 | 0.00167 | 0.00223 | -0.006 | -0.0104 | -0.008 | -0.0113 | -0.008 | -0.0112 | -0.0067 | -0. |
| AMT_CREDIT | 0.007601905 | 0.015271444 | 1 | 0.749665201 | 0.982267963 | 0.067775624 | -0.142506035 | 0.01604 | -0.0428 | -0.0438 | 0.0454 | 0.00646 | 0.02354 | 0.0346 | -0.0523 | -0.0391 | -0.0067 | 0.03347 | -0.0249 | 0.03444 | -0.029 | 0.0 |
| AMT_ANNUITY | 0.029172977 | 0.018004594 | 0.749665201 | 1 | 0.74950403 | 0.073123998 | -0.008751713 | -0.0796 | 0.02158 | -0.0213 | 0.04489 | 0.03176 | 0.06569 | 0.07424 | -0.0177 | 0.00218 | 0.01356 | 0.01382 | -0.0345 | 0.0141 | -0.0405 | 0. |
| AMT_GOODS_PRICE | -0.001079665 | 0.013269502 | 0.982267963 | 0.74950403 | 1 | 0.076635488 | -0.141005898 | 0.02024 | -0.0433 | -0.0497 | 0.05746 | 0.00708 | 0.02502 | 0.03542 | -0.0527 | -0.044 | -0.0131 | 0.03272 | -0.0191 | 0.03388 | -0.0206 | 0.0 |
| REGION_POPULATION_RE | -0.020359154 | -0.006180303 | 0.067775624 | 0.073123998 | 0.076635488 | 1 | -0.016468731 | 0.00774 | -0.0461 | -0.0051 | 0.15605 | -0.0031 | 0.01917 | 0.05954 | -0.0349 | -0.0433 | -0.0252 | -0.0089 | 0.02781 | -0.0071 | 0.02714 | 0.0 |
| DAYS_BIRTH | 0.2496732 | 0.009033662 | -0.142506035 | -0.008751713 | -0.141005898 | -0.016468731 | 1 | -0.5815 | 0.28844 | 0.2479 | 0.05789 | 0.03961 | 0.07551 | 0.05449 | 0.14911 | 0.22635 | 0.1434 | -0.0112 | -0.0208 | -0.0126 | -0.0258 | 0. |
| DAYS_EMPLOYED | -0.189324184 | -0.011555963 | 0.016039571 | -0.079556008 | 0.020235348 | 0.007742909 | -0.581479041 | 1 | -0.1887 | -0.2301 | -0.0521 | -0.0353 | -0.0849 | -0.0723 | -0.0882 | -0.2463 | -0.2006 | 0.00352 | 0.02986 | 0.00421 | 0.02389 | - |
| DAYS_REGISTRATION | 0.152113117 | -0.009561152 | -0.042844404 | 0.021581654 | -0.043320226 | -0.046130288 | 0.288437837 | -0.1887 | 1 | 0.09029 | -0.0578 | 0.01585 | 0.01639 | 0.01358 | 0.05557 | 0.10076 | 0.06982 | -0.0058 | 0.001 | -0.0059 | -0.0064 | 0.0 |
| DAYS_ID_PUBLISH | -0.042360717 | -0.009122006 | -0.043771901 | -0.02132109 | -0.049723232 | -0.005118563 | 0.247896571 | -0.2301 | 0.09029 | 1 | 0.00552 | 0.02415 | 0.04111 | 0.02957 | 0.0641 | 0.08301 | 0.03844 | -0.0273 | -0.0284 | -0.0262 | -0.0279 | 0.0 |
| HOUR_APPR_PROCESS_ST | -0.006884357 | 0.014482013 | 0.045396384 | 0.044891881 | 0.057462759 | 0.156049669 | 0.057891695 | -0.0521 | -0.0578 | 0.00552 | 1 | 0.04942 | 0.07615 | 0.06606 | 0.00552 | 0.0032 | -0.0118 | -0.0197 | 0.01767 | -0.0195 | 0.01752 | -0. |
| REG_REGION_NOT_LIVE_R | -0.015713279 | 0.000594885 | 0.006456715 | 0.031759358 | 0.007079035 | -0.003105241 | 0.039614727 | -0.0353 | 0.01585 | 0.02415 | 0.04942 | 1 | 0.5255 | 0.10053 | 0.33817 | 0.14759 | -0.0037 | -0.032 | 0.00849 | -0.032 | 0.00582 | - |
| REG_REGION_NOT_WORK | -0.005665093 | 0.001665752 | 0.023536318 | 0.065686571 | 0.025016178 | 0.019170075 | 0.075512807 | -0.0849 | 0.01639 | 0.04111 | 0.07615 | 0.5255 | 1 | 0.80674 | 0.18375 | 0.22868 | 0.16908 | -0.0321 | 0.00152 | -0.0316 | 0.00493 | 0. |
| LIVE_REGION_NOT_WORK | -0.000389253 | 0.002228043 | 0.034604167 | 0.074238732 | 0.035424194 | 0.059536379 | 0.054493345 | -0.0723 | 0.01358 | 0.02957 | 0.06606 | 0.10053 | 0.80674 | 1 | 0.02608 | 0.1578 | 0.21787 | -0.0208 | -0.0061 | -0.02 | 8.7E-05 | 0.0 |
| REG_CITY_NOT_LIVE_CITY | 0.001745098 | -0.005992314 | -0.052261708 | -0.017702478 | -0.052733855 | -0.034931305 | 0.149110346 | -0.0882 | 0.05557 | 0.0641 | 0.00552 | 0.33817 | 0.18375 | 0.02608 | 1 | 0.4673 | -0.015 | -0.0499 | 0.00342 | -0.0504 | 0.00258 | -0. |
| REG_CITY_NOT_WORK_CI | 0.048916581 | -0.010357192 | -0.039113138 | 0.002176683 | -0.04398108 | -0.043285987 | 0.226350689 | -0.2463 | 0.10076 | 0.08301 | 0.0032 | 0.14759 | 0.22868 | 0.1578 | 0.4673 | 1 | 0.78375 | -0.0421 | -0.0156 | -0.0416 | -0.0137 | 0.0 |
| LIVE_CITY_NOT_WORK_CI | 0.058183771 | -0.008036091 | -0.006664341 | 0.013562938 | -0.013057846 | -0.025223619 | 0.143399639 | -0.2006 | 0.06982 | 0.03844 | -0.0118 | -0.0037 | 0.16908 | 0.21787 | -0.015 | 0.78375 | 1 | -0.0241 | -0.0279 | -0.023 | -0.0246 | 0.0 |
| OBS_30_CNT_SOCIAL_CIR | 0.01793193 | -0.011280916 | 0.033466173 | 0.013819016 | 0.032723967 | -0.008875436 | -0.011150233 | 0.00352 | -0.0058 | -0.0273 | -0.0197 | -0.032 | -0.0321 | -0.0208 | -0.0499 | -0.0421 | -0.0241 | 1 | 0.36507 | 0.99807 | 0.29795 | -0. |
| DEF_30_CNT_SOCIAL_CIR | -0.01361871 | -0.007979437 | -0.024946679 | -0.034545374 | -0.019096612 | 0.027805916 | -0.020838794 | 0.02986 | 0.001 | -0.0284 | 0.01767 | 0.00849 | 0.00152 | -0.0061 | 0.00342 | -0.0156 | -0.0279 | 0.36507 | 1 | 0.36806 | 0.89051 | 0.0 |
| OBS_60_CNT_SOCIAL_CIR | 0.015145875 | -0.011211173 | 0.034439308 | 0.014098626 | 0.033879184 | -0.007065002 | -0.01257029 | 0.00421 | -0.0059 | -0.0262 | -0.0195 | -0.032 | -0.0316 | -0.02 | -0.0504 | -0.0416 | -0.023 | 0.99807 | 0.36806 | 1 | 0.30142 | -0. |
| DEF_60_CNT_SOCIAL_CIR | -0.018505702 | -0.006726958 | -0.029007236 | -0.040471029 | -0.020592919 | 0.027142318 | -0.025756651 | 0.02389 | -0.0064 | -0.0279 | 0.01752 | 0.00582 | 0.00493 | 8.7E-05 | 0.00258 | -0.0137 | -0.0246 | 0.29795 | 0.89051 | 0.30142 | 1 | -0. |
| AMT_REQ_CREDIT_BUREA | -0.000287596 | -0.001104179 | 0.017806362 | 0.037397493 | 0.01526195 | 0.009356216 | 0.024898705 | -0.003 | 0.00638 | 0.01408 | -0.0331 | -0.011 | 0.0227 | 0.03195 | -0.0011 | 0.01833 | 0.01426 | -0.0141 | 0.00273 | -0.0136 | -0.0132 | |
| AMT_REQ_CREDIT_BUREA | -0.030605254 | -0.00144685 | -0.008518401 | -0.018688343 | -0.006319208 | -0.003833539 | -0.02267042 | 0.04948 | -0.0015 | -0.0064 | 0.00141 | 0.0042 | 0.01115 | 0.00701 | -0.0191 | -0.0053 | 0.00077 | -0.017 | 0.01224 | -0.0174 | -0.0103 | 0. |
| AMT_REQ_CREDIT_BUREA | -0.030604048 | -0.002218606 | 0.000125371 | 0.03472145 | 0.000114491 | 0.012064245 | -0.009660982 | 0.02039 | -0.0182 | 0.01954 | -0.0091 | 0.00723 | -0.0188 | -0.0322 | -0.0042 | 0.00463 | 0.01057 | 0.00584 | -0.0116 | 0.00556 | -0.0039 | 0.0 |
| AMT_REQ_CREDIT_BUREA | 0.008160996 | -0.000864018 | 0.083408196 | 0.071295225 | 0.078908703 | 0.075395596 | -0.007277397 | -0.0331 | -0.0015 | -0.0379 | 0.06634 | 0.05155 | -0.0159 | 0.04081 | -0.0356 | -0.0447 | -0.0202 | 0.01608 | 0.00809 | 0.01698 | 0.01303 | - |
| AMT_REQ_CREDIT_BUREA | -0.011520595 | -0.003749228 | -0.019361311 | -0.001630664 | -0.020367636 | 0.015310168 | -0.008783235 | 0.01788 | -0.0063 | -0.0327 | -0.0117 | -0.0105 | -0.011 | -0.0141 | -3E-05 | -0.049 | -0.0377 | 0.03484 | 0.0201 | 0.0364 | 0.02535 | 0. |
| AMT_REQ_CREDIT_BUREA | -0.03080113 | -0.005100984 | -0.016459973 | 0.001569273 | -0.023475441 | 0.024023928 | -0.090127316 | 0.01769 | -0.0251 | -0.0816 | -0.0379 | -0.034 | -0.0293 | -0.014 | -0.0202 | -0.026 | -0.0061 | 0.05052 | 0.02102 | 0.05071 | 0.02063 | 0.0 |

# Correlations

Top Correlation Coefficients for Re-payers are:-

| Correlation between Columns | Value |
|---|---|
| OBS_60_CNT_SOCIAL_CIRCLE - OBS_30_CNT_SOCIAL_CIRCLE | 0.998357563 |
| AMT_GOODS_PRICE - AMT_CREDIT | 0.986051701 |
| LIVE_REGION_NOT_WORK_REGION - REG_REGION_NOT_WORK_REGION | 0.861374946 |
| DEF_60_CNT_SOCIAL_CIRCLE - DEF_30_CNT_SOCIAL_CIRCLE | 0.850995792 |
| REG_CITY_NOT_WORK_CITY - LIVE_CITY_NOT_WORK_CITY | 0.825358079 |
| AMT_ANNUITY - AMT_GOODS_PRICE | 0.774006842 |
| AMT_ANNUITY - AMT_CREDIT | 0.770772818 |

# Correlations

Top Correlation Coefficients for Re-payers are:-

| | CNT_CHILDREN | AMT_INCOME_TO | AMT_CREDIT | AMT_ANNUITY | AMT_GOODS_PRIC | REGION_POPULATION_RELA | DAYS_BIRTH | DAYS_EMPLOY | DAYS_REGISTRATI | DAYS_ID_PUB | HOUR_A | REG_RE | REG_RE | LIVE_RE | REG_CIT | REG_CIT | LIVE_CIT | OBS_30_ | DEF_30_ | OBS_60_ | DEF_60_ | AMT_RE | AMT_RE | AMT_RE | AMT_RE | AMT_RE | AMT_REQ_CRED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CNT_CHILDREN | 1 | 0.036319722 | 0.005705458 | 0.02638396 | 0.001046405 | -0.024912809 | 0.335876269 | -0.243591518 | 0.183072478 | -0.03253722 | -0.0053 | -0.0104 | 0.0138 | 0.0217 | 0.0201 | 0.071 | 0.0679 | 0.0162 | -0.0028 | 0.0163 | -0.0033 | 0.0026 | 0.0012 | 0.0043 | -0.0116 | -0.0047 | -0.035734 |
| AMT_INCOME_TOTAL | 0.036319722 | 1 | 0.377965752 | 0.451135167 | 0.383650216 | 0.181941261 | 0.073769425 | -0.162702675 | 0.06893375 | 0.032286356 | 0.0854 | 0.0789 | 0.1571 | 0.1477 | 0.0099 | 0.0152 | 0.0197 | -0.033 | -0.032 | -0.033 | -0.0325 | 0.0081 | 0.0095 | 0.0095 | 0.0749 | 0.0158 | 0.031323 |
| AMT_CREDIT | 0.005705458 | 0.377965752 | 1 | 0.770772818 | 0.986051701 | 0.095539444 | -0.051084182 | -0.077367219 | 0.008053758 | -0.00829019 | 0.0565 | 0.0278 | 0.0561 | 0.0544 | -0.0214 | -0.014 | 0.004 | 0.0009 | -0.0135 | 0.0012 | -0.0186 | 4E-05 | 0.0135 | 0.0054 | 0.064 | 0.0268 | -0.031568 |
| AMT_ANNUITY | 0.02638396 | 0.451135167 | 0.770772818 | 1 | 0.774006842 | 0.11727925 | 0.009311417 | -0.113005288 | 0.03460901 | 0.00942697 | 0.0536 | 0.0462 | 0.0825 | 0.0749 | -0.0053 | 0.0016 | 0.0112 | -0.01 | -0.0197 | -0.0097 | -0.023 | 0.0101 | 0.0092 | 0.0189 | 0.038 | 0.0101 | -0.004173 |
| AMT_GOODS_PRICE | 0.001046405 | 0.383650216 | 0.986051701 | 0.774006842 | 1 | 0.098899174 | -0.048664402 | -0.075069056 | 0.011016938 | -0.00944125 | 0.0651 | 0.0304 | 0.0575 | 0.0547 | -0.0204 | -0.0145 | 0.0029 | 0.0006 | -0.0152 | 0.0009 | -0.0197 | 0.0008 | 0.0137 | 0.0058 | 0.0658 | 0.0276 | -0.034352 |
| REGION_POPULATION_RELATIVE | -0.024912809 | 0.181941261 | 0.095539444 | 0.11727925 | 0.098899174 | 1 | -0.030435419 | -0.006610653 | -0.058501361 | -0.00223629 | 0.1676 | -0.0032 | 0.0631 | 0.0874 | -0.0461 | -0.0383 | -0.0113 | -0.0191 | 0.0089 | -0.018 | 0.0033 | -0.0031 | -0.0003 | 0.0026 | 0.0707 | -0.0097 | 0.004652 |
| DAYS_BIRTH | 0.335876269 | 0.073769425 | -0.05108418 | 0.009311417 | -0.048664402 | -0.030435419 | 1 | -0.615289378 | 0.335028046 | 0.270073313 | 0.0964 | 0.0604 | 0.0959 | 0.0699 | 0.1833 | 0.2361 | 0.1492 | 0.0123 | 0.0007 | 0.0123 | 0.0022 | 0.0015 | 0.002 | -0.0024 | -0.0025 | -0.0215 | -0.070267 |
| DAYS_EMPLOYED | -0.243591518 | -0.162702675 | -0.07736722 | -0.113005288 | -0.075069056 | -0.006610653 | -0.615289378 | 1 | -0.204370881 | -0.27222439 | -0.0924 | -0.0364 | -0.1073 | -0.0956 | -0.0926 | -0.2541 | -0.2177 | 0.0057 | 0.017 | 0.0055 | 0.0165 | -0.0043 | 0.0016 | -0.0065 | -0.033 | 0.0146 | 0.044183 |
| DAYS_REGISTRATION | 0.183072478 | 0.06893375 | 0.008053758 | 0.03460901 | 0.011016938 | -0.058501361 | 0.335028046 | -0.204370881 | 1 | 0.103548902 | -0.0024 | 0.0279 | 0.0347 | 0.0233 | 0.0678 | 0.0916 | 0.0612 | 0.011 | 0.0034 | 0.0113 | 0.0063 | -0.0037 | -0.0034 | 0.0007 | -0.0107 | 0.0031 | -0.02295 |
| DAYS_ID_PUBLISH | -0.032537221 | 0.032286356 | -0.00829019 | 0.00942697 | -0.009441255 | -0.002236288 | 0.270073313 | -0.27222439 | 0.103548902 | 1 | 0.038 | 0.0332 | 0.0478 | 0.0338 | 0.0751 | 0.102 | 0.0633 | -0.0119 | 0.0023 | -0.0122 | 0.0026 | 0.0028 | 0.0035 | -0.0047 | -0.0132 | -0.0246 | -0.044692 |
| HOUR_APPR_PROCESS_START | -0.005272551 | 0.08543156 | 0.056524809 | 0.053564989 | 0.065133303 | 0.167612161 | 0.09638927 | -0.092357978 | -0.002396446 | 0.037971336 | 1 | 0.0512 | 0.0736 | 0.0598 | 0.0197 | 0.0269 | 0.0151 | -0.008 | -0.0024 | -0.008 | -0.0061 | -0.0074 | 0.0103 | -0.0067 | 0.0288 | -0.0005 | -0.0250 |
| REG_REGION_NOT_LIVE_REGION | -0.010383386 | 0.078942904 | 0.027812773 | 0.046175655 | 0.030367622 | -0.003185217 | 0.060427036 | -0.03641311 | 0.027839954 | 0.033228477 | 0.0512 | 1 | 0.4496 | 0.0805 | 0.3351 | 0.1426 | 0.0035 | -0.0151 | -0.0083 | -0.0151 | -0.0094 | -0.0025 | -0.0058 | -0.0018 | -0.0086 | -0.0003 | -0.019525 |
| REG_REGION_NOT_WORK_REGIO | 0.013794691 | 0.157051351 | 0.05609686 | 0.082502425 | 0.057545564 | 0.063145413 | 0.095315233 | -0.107331487 | 0.034657988 | 0.047811506 | 0.0736 | 0.4496 | 1 | 0.8614 | 0.1519 | 0.2368 | 0.1922 | -0.0252 | -0.0089 | -0.0254 | -0.0137 | 5E-06 | 0.0008 | 0.0033 | 0.0042 | -0.0088 | -0.02753 |
| LIVE_REGION_NOT_WORK_REGIO | 0.021685073 | 0.147730123 | 0.05443061 | 0.074870093 | 0.054653311 | 0.087419766 | 0.06388551 | -0.095573749 | 0.023280394 | 0.033751626 | 0.0538 | 0.0805 | 0.8614 | 1 | 0.0216 | 0.1839 | 0.2338 | -0.0202 | -0.0069 | -0.0204 | -0.012 | 0.0025 | 0.0029 | 0.0054 | 0.0099 | -0.0124 | -0.022490 |
| REG_CITY_NOT_LIVE_CITY | 0.020101944 | 0.009927686 | -0.02137243 | -0.005276721 | -0.020436382 | -0.046089149 | 0.183304735 | -0.092557531 | 0.067811428 | 0.075080051 | 0.0197 | 0.3351 | 0.1519 | 0.0216 | 1 | 0.4414 | 0.0292 | -0.0053 | 0.0055 | -0.0055 | 0.0055 | 0.0005 | 8E-05 | -0.0011 | -0.0136 | -2E-05 | -0.006661 |
| REG_CITY_NOT_WORK_CITY | 0.070971057 | 0.015150008 | -0.01400736 | 0.001628799 | -0.01449832 | -0.038253612 | 0.236134428 | -0.254060105 | 0.091595217 | 0.102001817 | 0.0269 | 0.1426 | 0.2368 | 0.1839 | 0.4414 | 1 | 0.8254 | -0.006 | 0.001 | -0.006 | 0.0033 | 0.0043 | -0.0002 | 0.0022 | -0.0124 | -0.0039 | -0.011358 |
| LIVE_CITY_NOT_WORK_CITY | 0.067882194 | 0.019663673 | 0.00397996 | 0.011203272 | 0.002861594 | -0.011278612 | 0.149167938 | -0.217741277 | 0.061153259 | 0.063319024 | 0.0151 | 0.0035 | 0.1922 | 0.2338 | 0.0292 | 0.8254 | 1 | -0.0052 | -0.0022 | -0.0051 | -0.0002 | 0.004 | -0.0012 | 0.0024 | -0.0046 | -0.0052 | -0.012945 |
| OBS_30_CNT_SOCIAL_CIRCLE | 0.016180299 | -0.033045993 | 0.000876364 | -0.009992103 | 0.000634386 | -0.01906908 | 0.012287026 | 0.005650192 | 0.010977833 | -0.01185404 | -0.008 | -0.0151 | -0.0252 | -0.0202 | -0.0053 | -0.006 | -0.0052 | 1 | 0.3062 | 0.9984 | 0.2292 | 0.0024 | 0.001 | -0.0043 | 0.0082 | 0.0088 | 0.034161 |
| DEF_30_CNT_SOCIAL_CIRCLE | -0.00282133 | -0.032012977 | -0.01350943 | -0.019746021 | -0.015155074 | 0.008905591 | 0.000683769 | 0.017033326 | 0.003448989 | 0.002312725 | -0.0024 | -0.0083 | -0.0089 | -0.0069 | 0.0055 | 0.001 | -0.0022 | 0.3062 | 1 | 0.3086 | 0.851 | -0.0044 | 0.0037 | -0.005 | 0.0077 | 0.0054 | 0.014506 |
| OBS_60_CNT_SOCIAL_CIRCLE | 0.016334894 | -0.03301707 | 0.001184762 | -0.009675846 | 0.000856455 | -0.018012695 | 0.01229458 | 0.005511276 | 0.011295659 | -0.01215588 | -0.008 | -0.0151 | -0.0254 | -0.0204 | -0.0055 | -0.006 | -0.0051 | 0.9984 | 0.3086 | 1 | 0.2313 | 0.0026 | 0.0009 | -0.0049 | 0.0081 | 0.0087 | 0.034573 |
| DEF_60_CNT_SOCIAL_CIRCLE | -0.003330304 | -0.032535174 | -0.01856734 | -0.023010616 | -0.019693391 | 0.003253593 | 0.002207122 | 0.016516022 | 0.006282428 | 0.002642424 | -0.0061 | -0.0094 | -0.0137 | -0.012 | 0.0055 | 0.0033 | -0.0002 | 0.2292 | 0.851 | 0.2313 | 1 | -0.0032 | 0.0028 | -0.0057 | 0.004 | 0.0083 | 0.015204 |
| AMT_REQ_CREDIT_BUREAU_HOU | 0.00261709 | 0.008122955 | 3.65328E-05 | 0.0101408 | 0.000827804 | -0.003132124 | 0.001486295 | -0.00429349 | -0.003689166 | 0.002824211 | -0.0074 | -0.0025 | 5E-06 | 0.0025 | 0.0005 | 0.0043 | 0.004 | 0.0024 | -0.0044 | 0.0026 | -0.0032 | 1 | 0.2308 | 0.0121 | 0.0095 | 0.0035 | 0.004095 |
| AMT_REQ_CREDIT_BUREAU_DAY | 0.001198938 | 0.009477681 | 0.013486353 | 0.009156839 | 0.013665416 | -0.000338841 | 0.001983866 | 0.001618187 | -0.00338406 | 0.003514735 | 0.0103 | -0.0058 | 0.0008 | 0.0023 | 8E-05 | -0.0002 | -0.0012 | 0.001 | 0.0037 | 0.0009 | 0.0028 | 0.2308 | 1 | 0.2491 | -0.0007 | -0.0079 | -0.00085 |
| AMT_REQ_CREDIT_BUREAU_WEEK | 0.004327432 | 0.009487825 | 0.005374948 | 0.018909774 | 0.005848551 | 0.002644642 | -0.002401164 | -0.00648155 | 0.000659813 | -0.00466588 | -0.0067 | -0.0018 | 0.0033 | 0.0054 | -0.0011 | 0.0022 | 0.0024 | -0.0043 | -0.005 | -0.0049 | -0.0057 | 0.0121 | 0.2491 | 1 | -0.0106 | -0.0146 | 0.024737 |
| AMT_REQ_CREDIT_BUREAU_MON | -0.011607819 | 0.074854679 | 0.063975989 | 0.037985476 | 0.065821049 | 0.070736631 | -0.002452976 | -0.032954589 | -0.010724839 | -0.01323263 | 0.0288 | -0.0086 | 0.0042 | 0.0093 | -0.0136 | -0.0124 | -0.0046 | 0.0082 | 0.0077 | 0.0081 | 0.004 | 0.0095 | -0.0007 | -0.0106 | 1 | 0.0119 | 0.019331 |
| AMT_REQ_CREDIT_BUREAU_QRT | -0.00473083 | 0.015777535 | 0.026793294 | 0.010059213 | 0.027627409 | -0.009694599 | -0.021522968 | 0.014577401 | 0.003127351 | -0.02458808 | -0.0005 | -0.0003 | -0.0088 | -0.0124 | -2E-05 | -0.0039 | -0.0052 | 0.0088 | 0.0054 | 0.0087 | 0.0083 | 0.0035 | -0.0079 | -0.0146 | 0.0119 | 1 | 0.121744 |
| AMT_REQ_CREDIT_BUREAU_YEAR | -0.035734888 | 0.031323516 | -0.03156833 | -0.004173747 | -0.034352324 | 0.004652396 | -0.070267716 | 0.044183816 | -0.02296176 | -0.04469288 | -0.0251 | -0.0195 | -0.0275 | -0.0225 | -0.0067 | -0.012 | -0.0129 | 0.0342 | 0.0145 | 0.0346 | 0.0152 | 0.0041 | -0.0009 | 0.0247 | 0.0193 | 0.1217 | |

# Conclusions

- Most of the clients are loan re-payers.
- The Bank generally lends more loan to Female as compared to Male but Male are less defaulters compared to Female.
- As age and experience increases , chances of defaulter decreases.
- Most of the clients are taking cash loans.
- Educated clients tend to less defaulter compared to clients with lower education such as secondary special education so Bank should prefer clients with having such education status.
- As number of children increases, number of client who take loan decreases.
- The Bank should be more cautious when lending money to clients who are unemployed because they are the most defaulters with highest amount of credit.
- As age increases amount taken by Clients are considerably high but with higher age defaulter percentage is lower. These are least risky and more profitable for Bank.

# Conclusions

We have lots of data. Few of the pivot table and charts are not supported by Google sheet. Please download the file in Excel(.XLSX) form

Google Drive Link:

Bank Loan Case Study