Credit Exploratory Data Analysis

Objective

- When the company receives a loan application, the company must decide for loan approval based on the applicant's profile. Two types of risks are associated with the bank's decision:
    - If the applicant is likely to repay the loan, then not approving the loan results in a loss of business to the company
    - If the applicant is not likely to repay the loan, i.e. he/she is likely to default, then approving the loan may lead to a financial loss for the company.

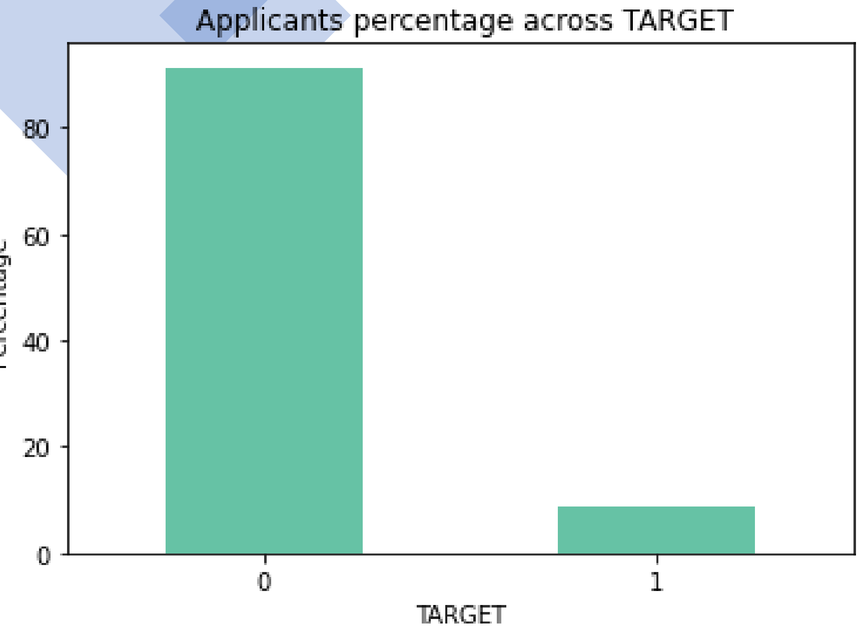
- This case study aims to identify patterns which indicate if a client has difficulty paying their installments which may be used for taking actions such as denying the loan, reducing the amount of loan, lending (to risky applicants) at a higher interest rate, etc. This will ensure that the consumers capable of repaying the loan are not rejected.

Approach

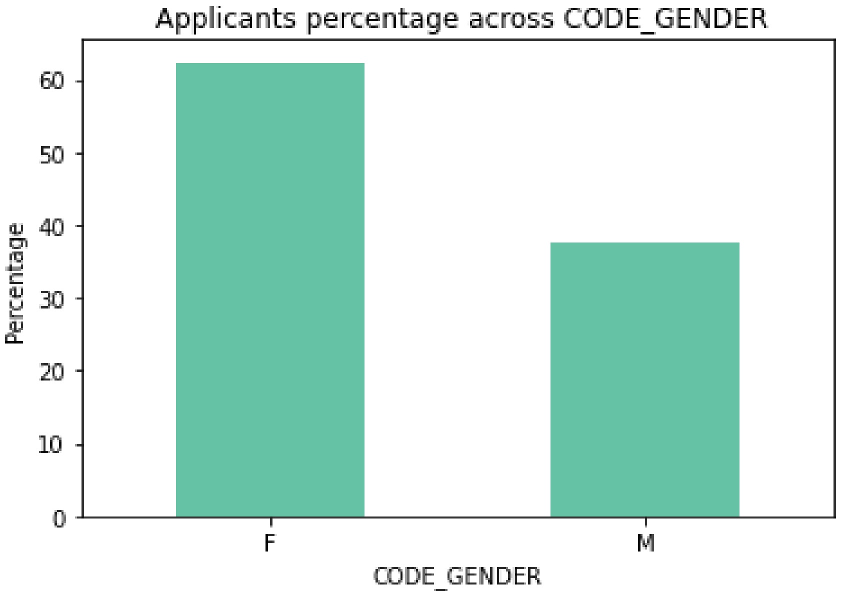
- The application dataset and previous application datasets are cleaned by:
  - Identifying columns with highest null percentages and dropping those columns, in some cases the rows are dropped or imputed with mean/median
  - Outliers in some columns are not removed, rather there are replaced with the upper / lower fence values.
  - Incorrect values like negative numbers in some columns are converted to absolute values.
- Analysis (univariate, bivariate and multivariate) is performed separately on both datasets
- Both datasets are merged to a single ‘Merged’ dataframe.
- Analysis (univariate, bivariate and multivariate) is performed on the ‘Merged’ dataframe

APPLICATIONS DATASET

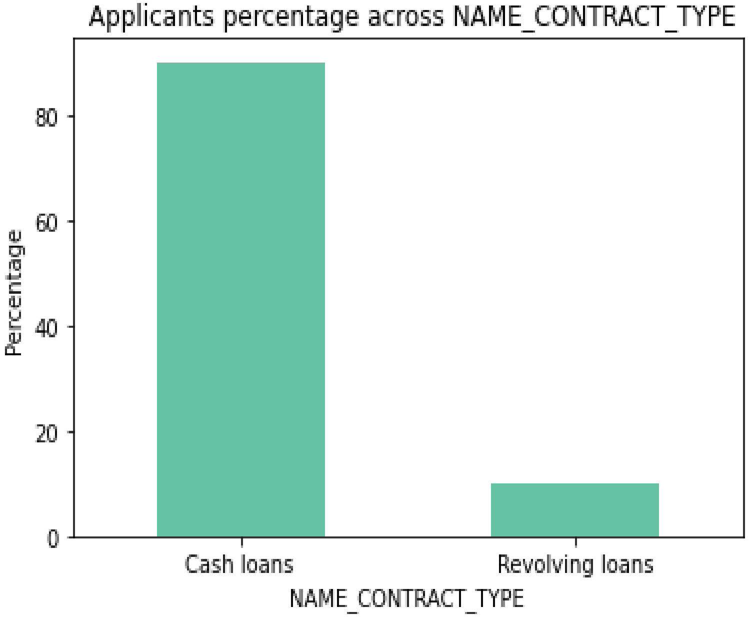
UNIVARIATE ANALYSIS



More than 90% of applicants are non-defaulters

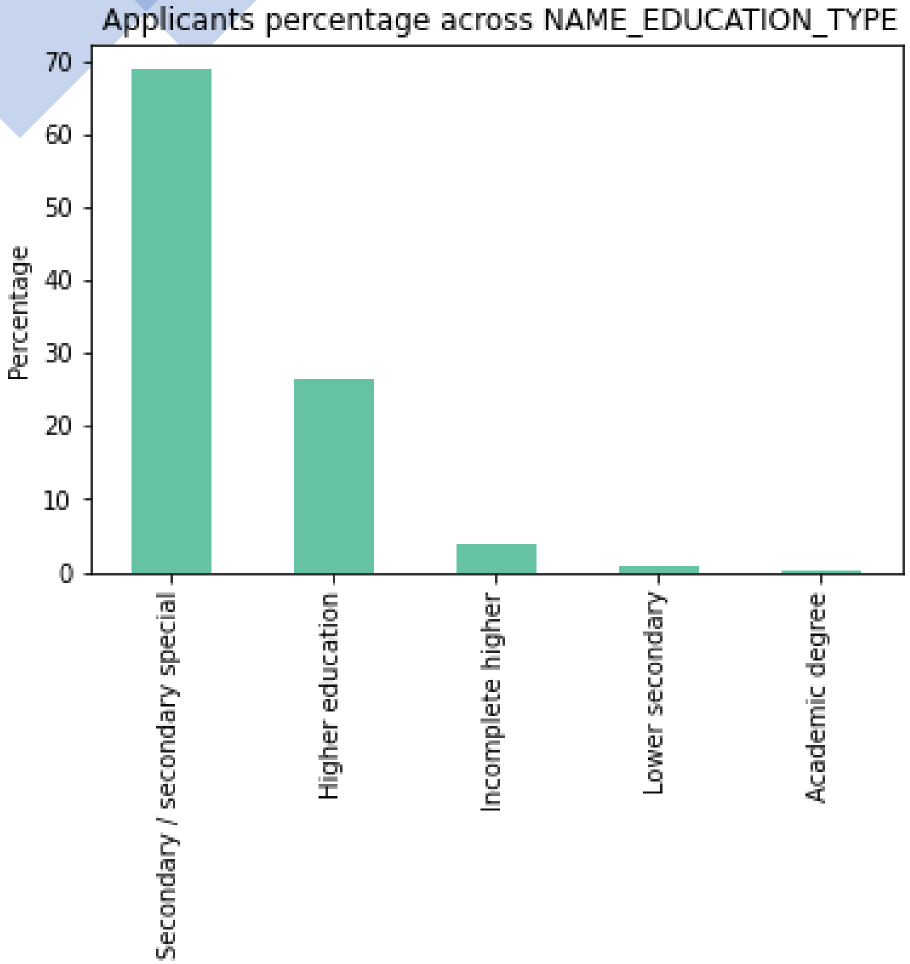


Females form the majority of loan applicants (>60%)

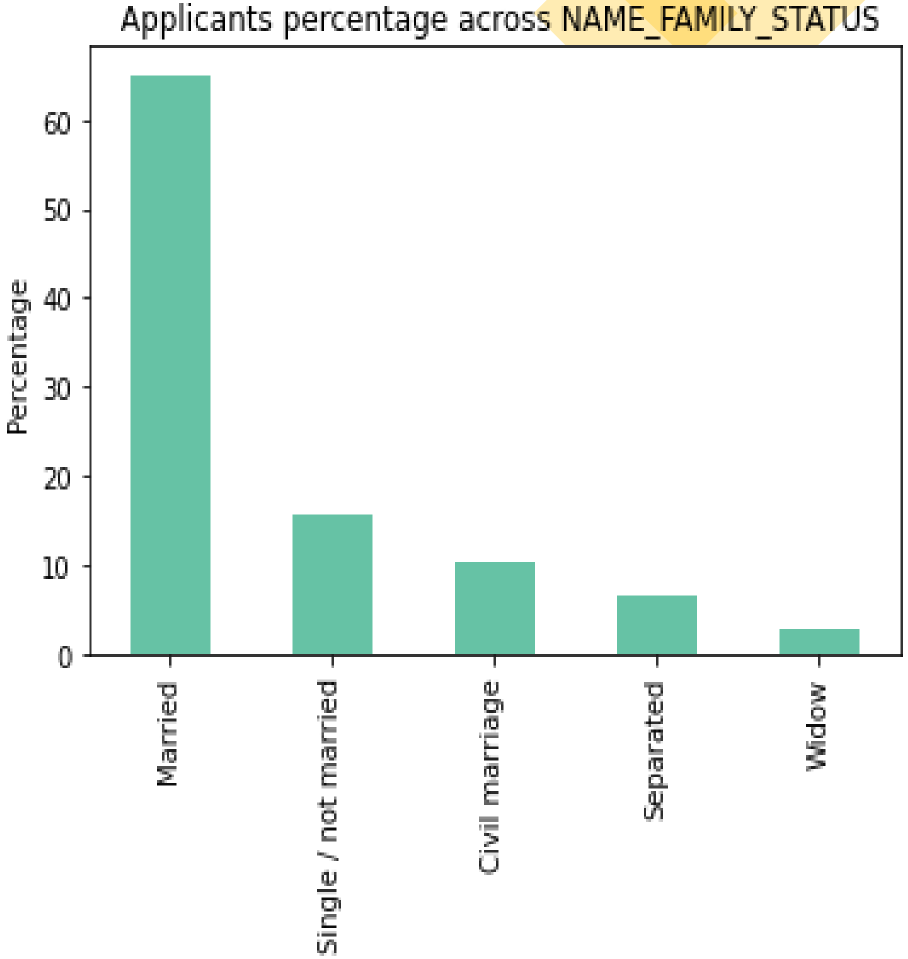


More than 80% of loans are cash loans

UNIVARIATE ANALYSIS

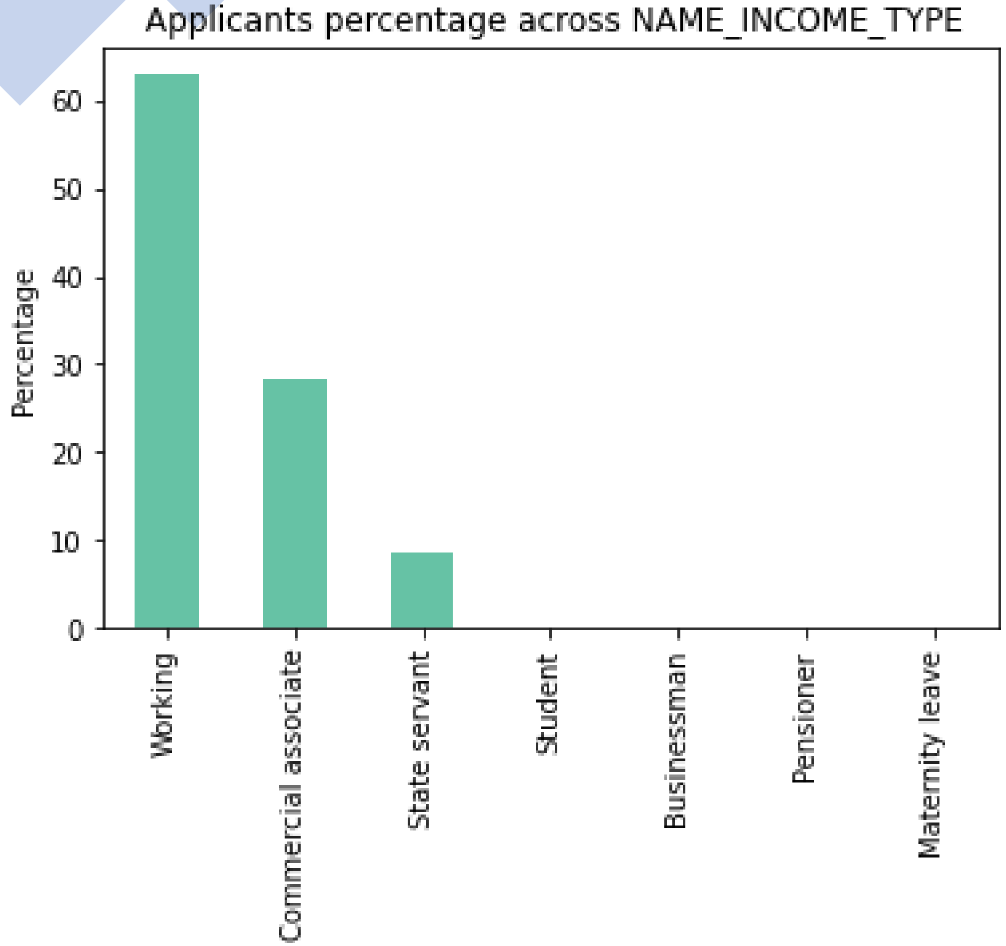


Almost 70% of applicants have secondary level education

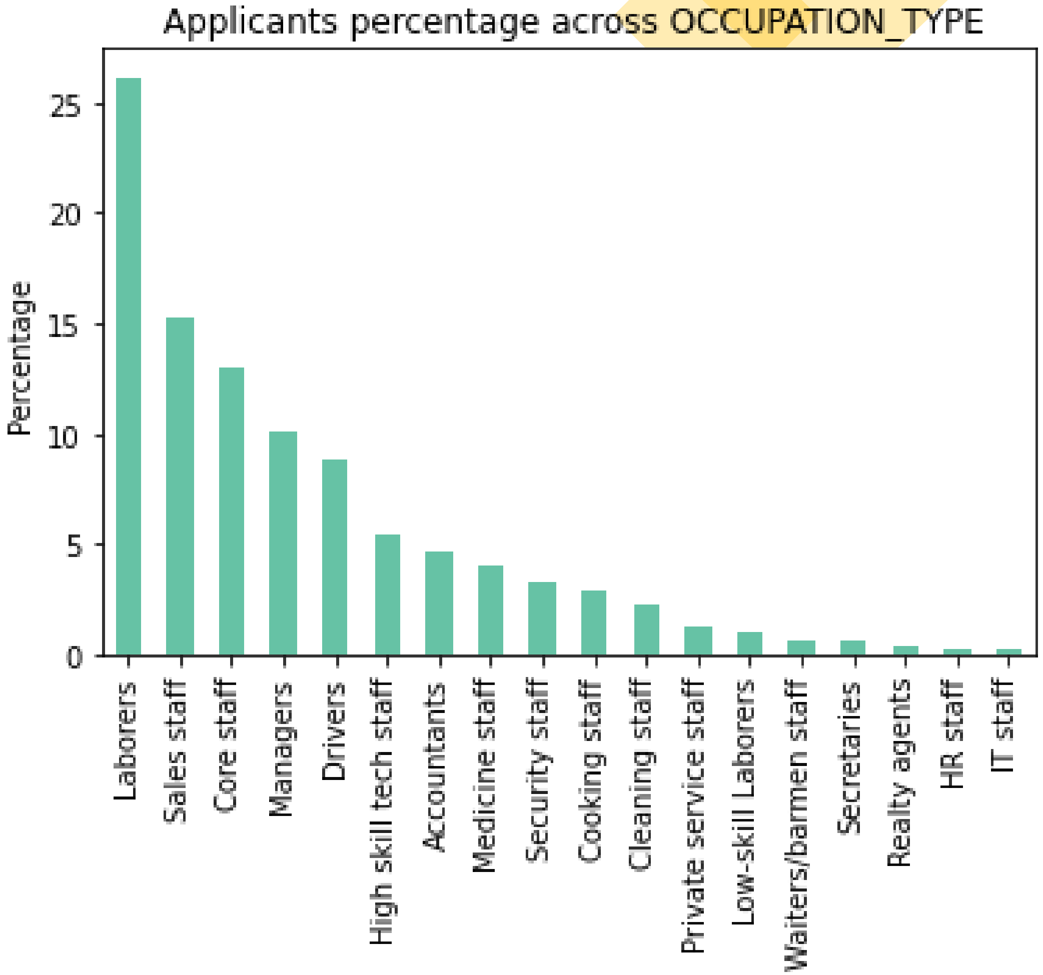


More than 60% of applicants are married whereas only about 18% are single

UNIVARIATE ANALYSIS

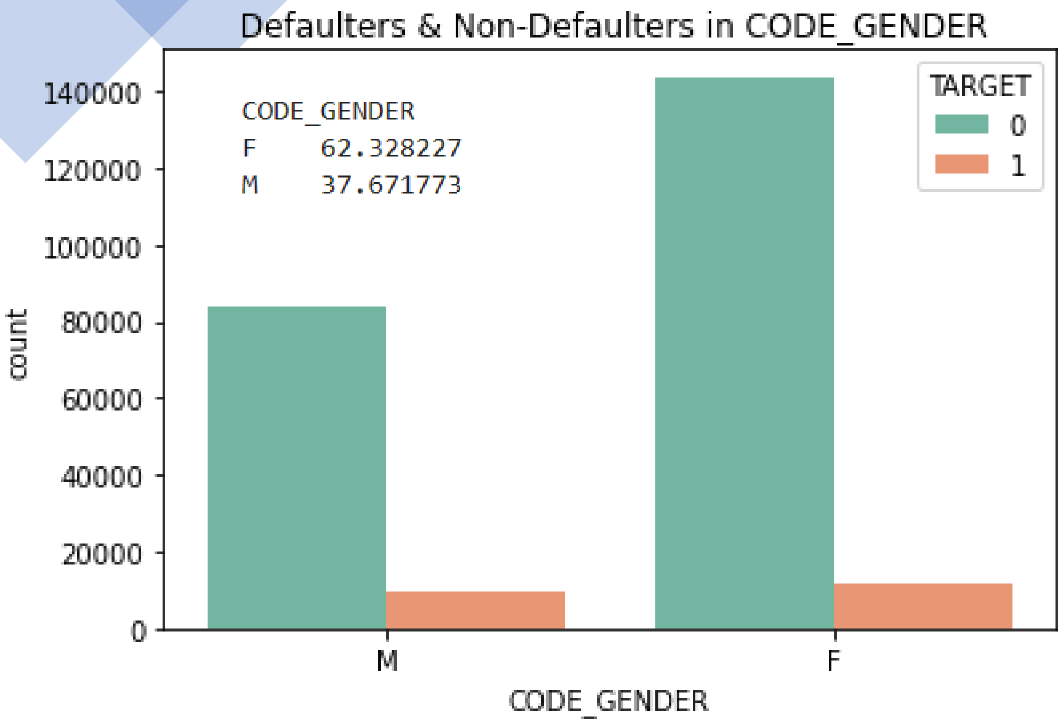


Majority of the applicants (>60%) are working, with negligible numbers in Student and Businessmen

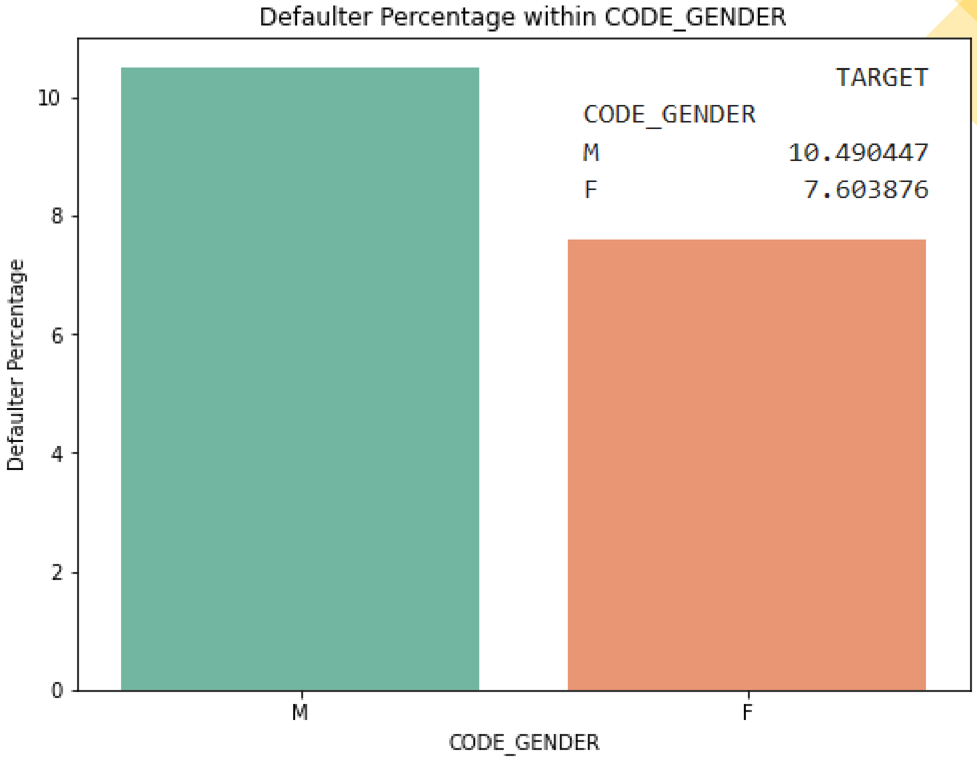


25% of applicants are laborers

BIVARIATE ANALYSIS



```
CODE_GENDER
F      62.328227
M      37.671773
```

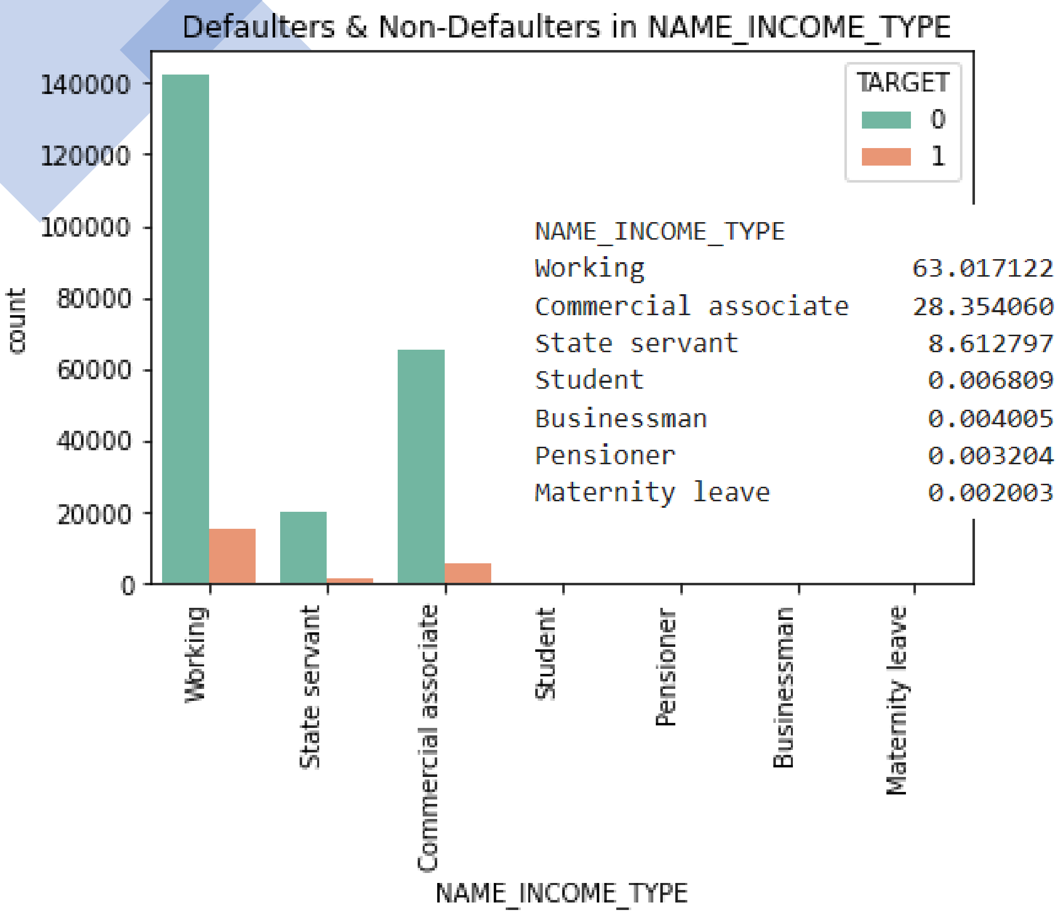


```
                        TARGET
CODE_GENDER
M                    10.490447
F                     7.603876
```

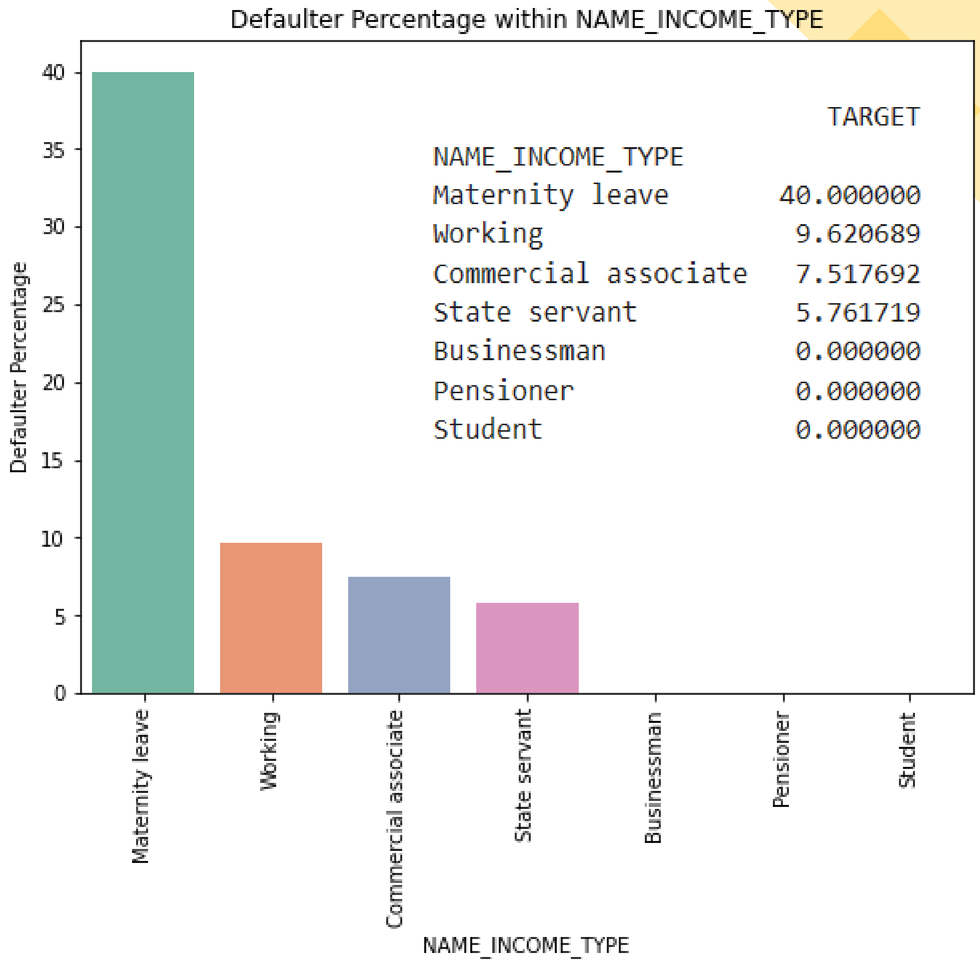
Even though more than 60% of the applicants are Females (as seen in the univariate analysis), the defaulter percentage in Males is very close to Females (7.6% vs 10.5%)

Recommendation : Going by the proportion of defaulters to applicants, it’s safer to give a loan to Females

BIVARIATE ANALYSIS



```
NAME_INCOME_TYPE
Working                 63.017122
Commercial associate    28.354060
State servant            8.612797
Student                  0.006809
Businessman              0.004005
Pensioner                0.003204
Maternity leave          0.002003
```

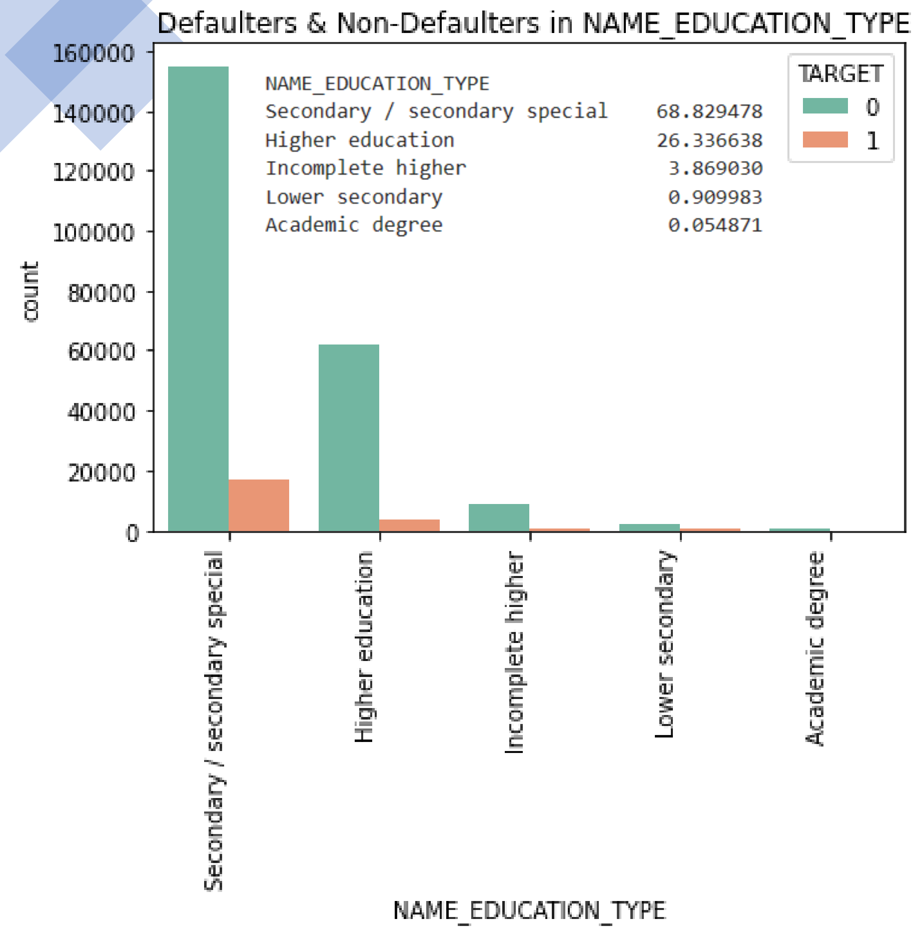


```
                         TARGET
NAME_INCOME_TYPE
Maternity leave       40.000000
Working                9.620689
Commercial associate   7.517692
State servant          5.761719
Businessman            0.000000
Pensioner              0.000000
Student                0.000000
```

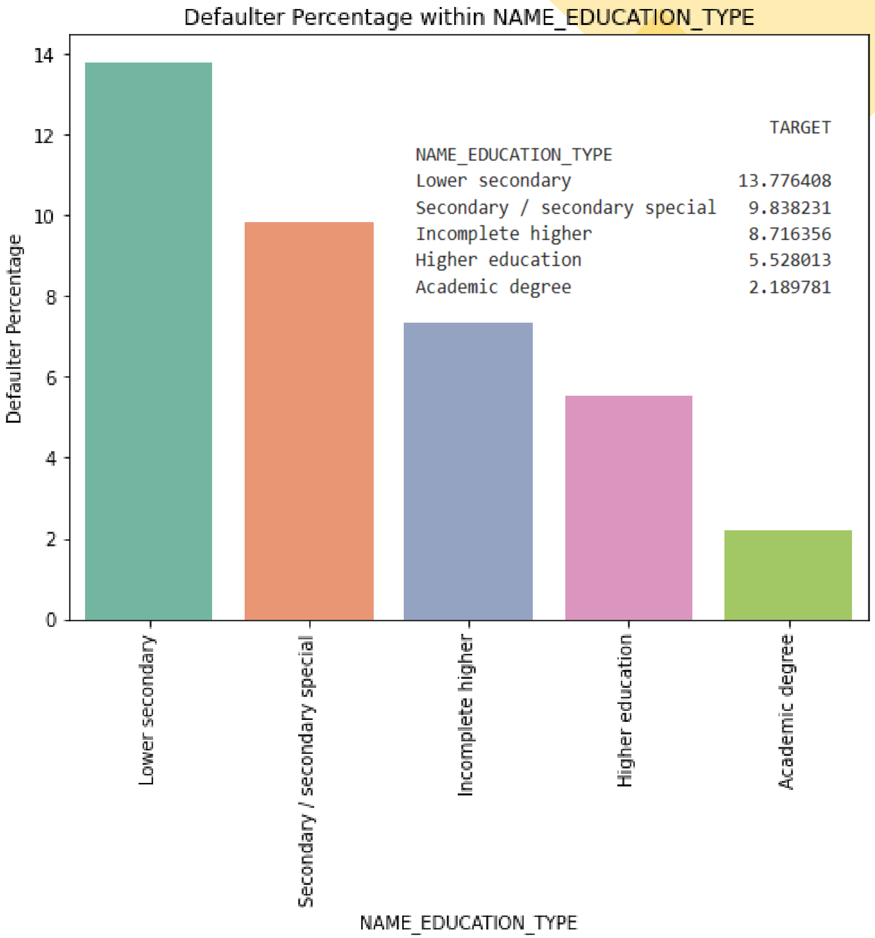
More than 60% of the applicants are in the Working category of income type (as seen in the univariate analysis), but the defaulter percentage within applicants on Maternity Leave is a clear majority (40%)

Recommendation : Going by the proportion of defaulters to applicants, it's safer to give a loan to Working people as they take up more than 60% of applications, yet their defaulter percentage is low. Also, Businessman, Pensioners and Students have 0% default rate

BIVARIATE ANALYSIS



```
NAME_EDUCATION_TYPE
Secondary / secondary special    68.829478
Higher education                 26.336638
Incomplete higher                 3.869030
Lower secondary                   0.909983
Academic degree                   0.054871
```

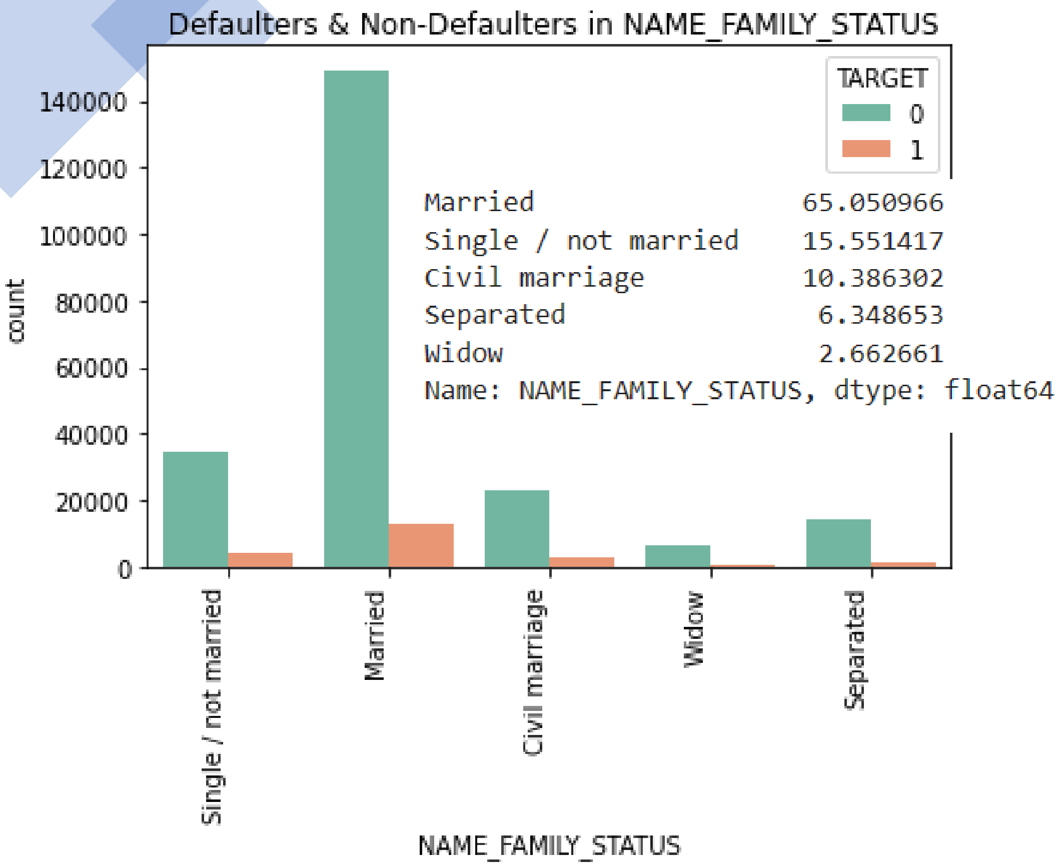


```
                                  TARGET
NAME_EDUCATION_TYPE
Lower secondary                13.776408
Secondary / secondary special   9.838231
Incomplete higher               8.716356
Higher education                5.528013
Academic degree                 2.189781
```

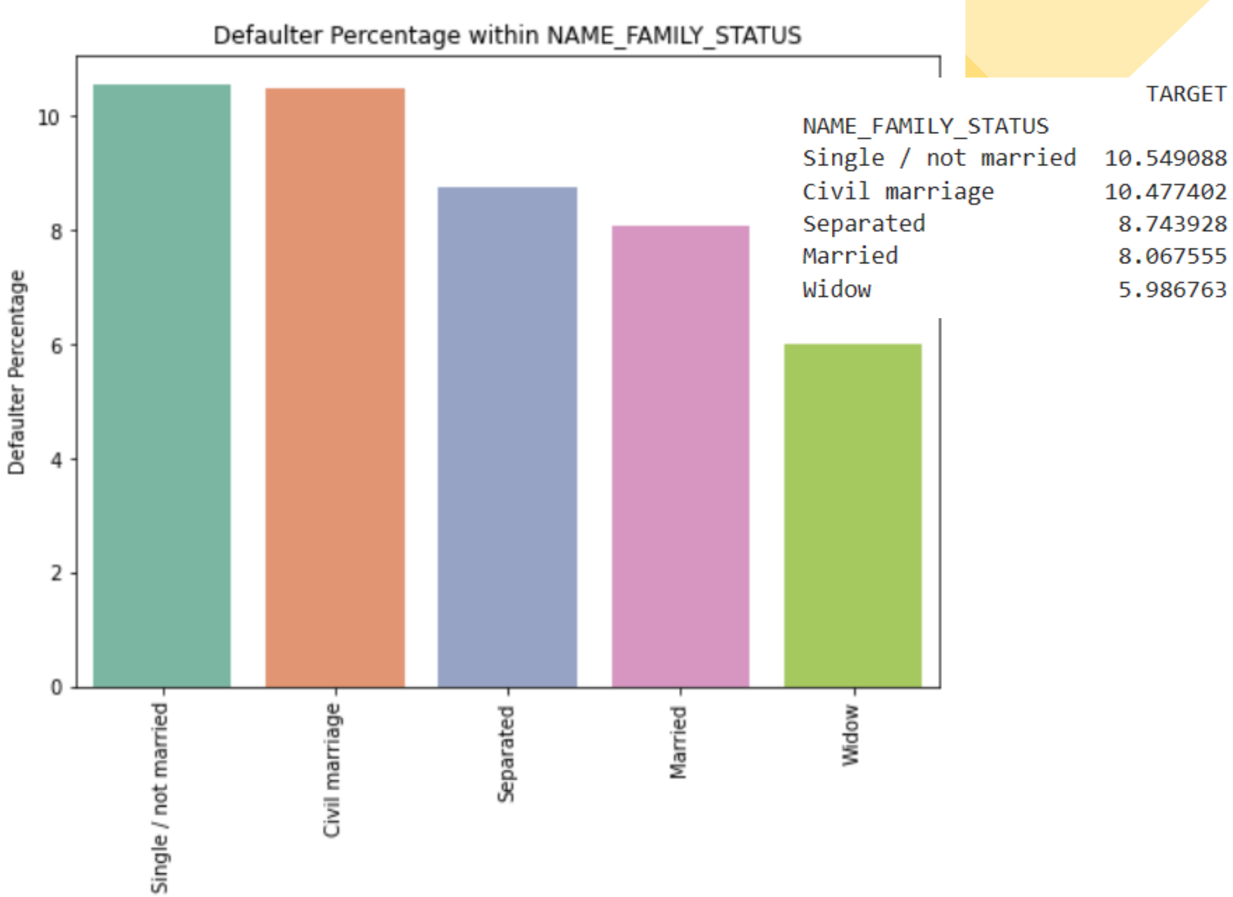
Almost 70% of the applicants have Secondary level education (as seen in the univariate analysis) as compared to Lower secondary which is less than 1%, but applicants within Lower Secondary category have a defaulting percent of 13.7%

Recommendation : Going by the proportion of defaulters to applicants, it's safer to give a loan to applicants with Secondary education or Higher education as they take up more than 95% of applications (combined), yet their defaulter percentage is only about 15% combined as compared to 13.7% amongst Lower Secondary

BIVARIATE ANALYSIS



```
Married                 65.050966
Single / not married    15.551417
Civil marriage          10.386302
Separated                6.348653
Widow                    2.662661
Name: NAME_FAMILY_STATUS, dtype: float64
```

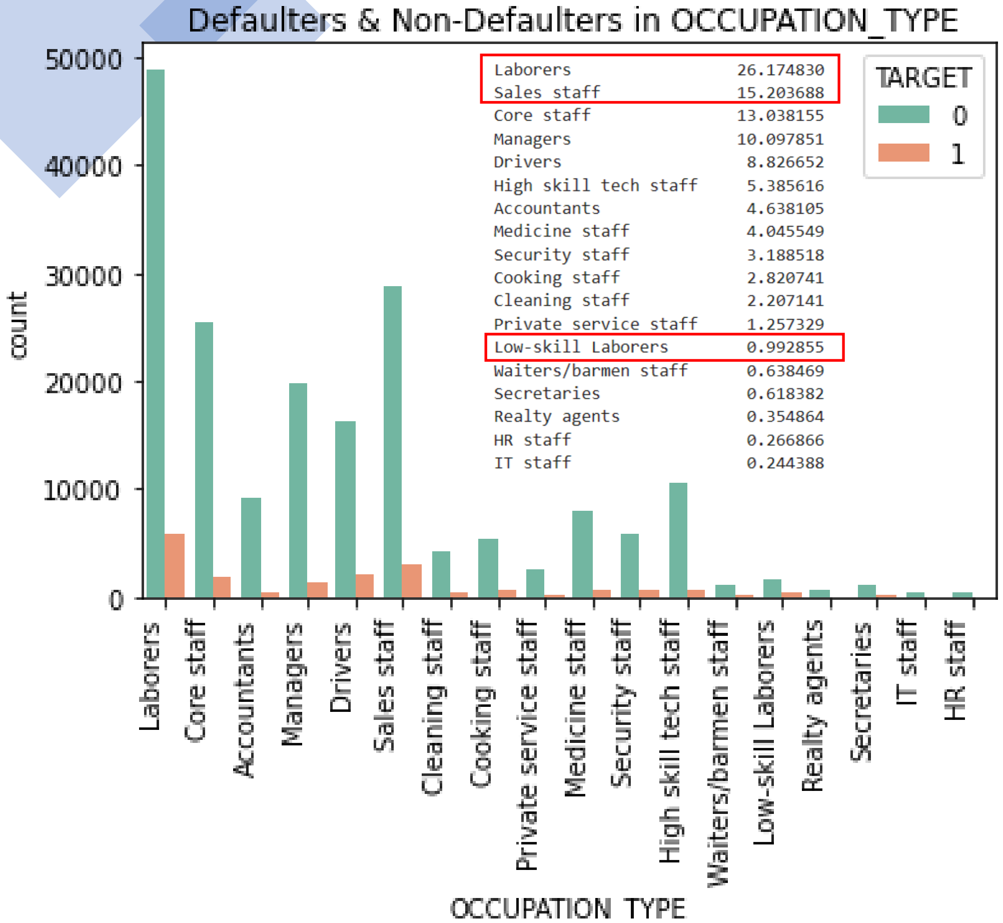


```
                         TARGET
NAME_FAMILY_STATUS
Single / not married  10.549088
Civil marriage        10.477402
Separated              8.743928
Married                8.067555
Widow                  5.986763
```

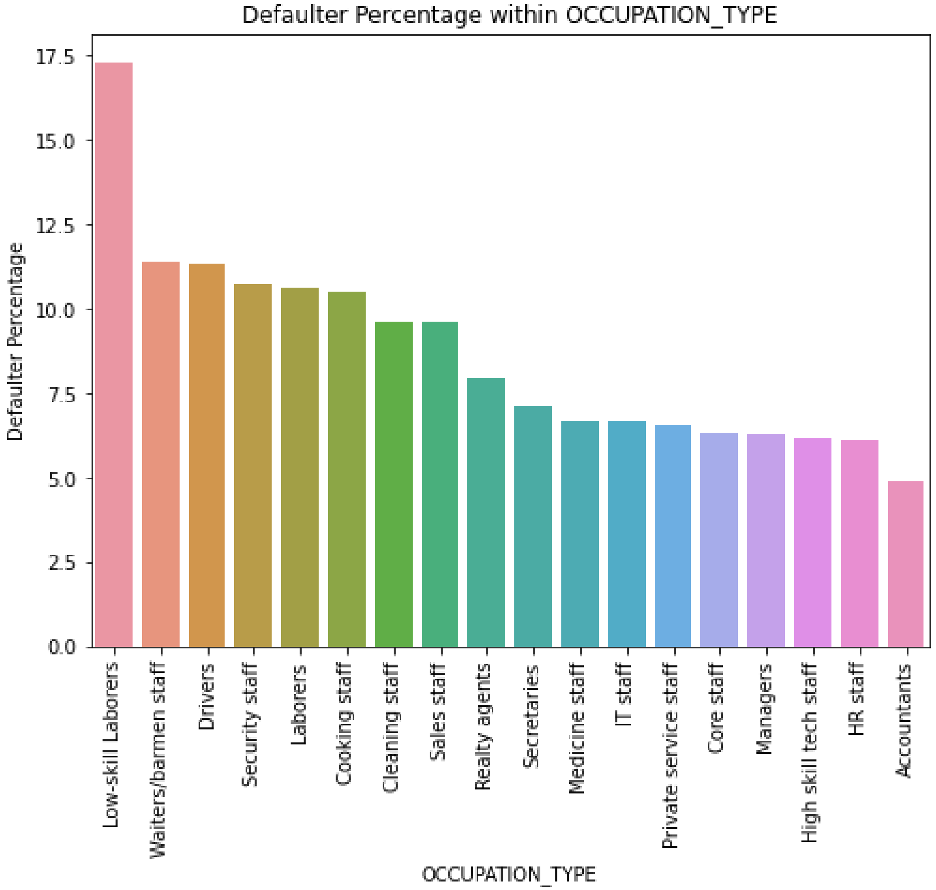
More than 65% of the applicants are Married (as seen in the univariate analysis) as compared to Single people who are 15%, but applicants who are Single, have a defaulting percent of 10.5%

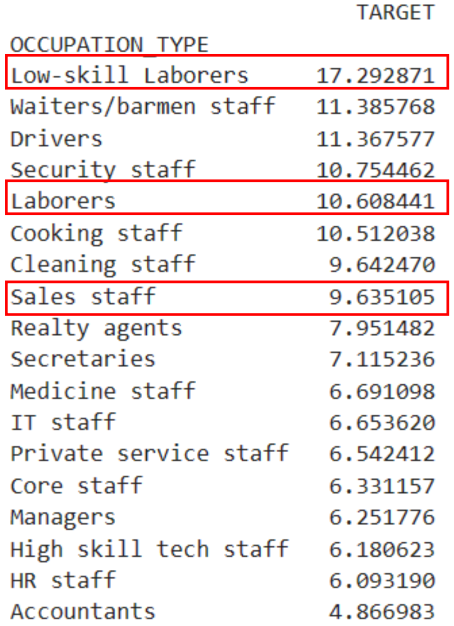
Recommendation : Going by the proportion of defaulters to applicants, it’s safer to give a loan to applicants who are Married as they take up more than 65% yet their defaulter percentage is only about 8% as compared to 10.5% amongst Single people who only take up 15% of applications.

BIVARIATE ANALYSIS



```
Laborers                 26.174830
Sales staff              15.203688
Core staff               13.038155
Managers                 10.097851
Drivers                   8.826652
High skill tech staff     5.385616
Accountants               4.638105
Medicine staff            4.045549
Security staff            3.188518
Cooking staff             2.820741
Cleaning staff            2.207141
Private service staff     1.257329
Low-skill Laborers        0.992855
Waiters/barmen staff      0.638469
Secretaries               0.618382
Realty agents             0.354864
HR staff                  0.266866
IT staff                  0.244388
```



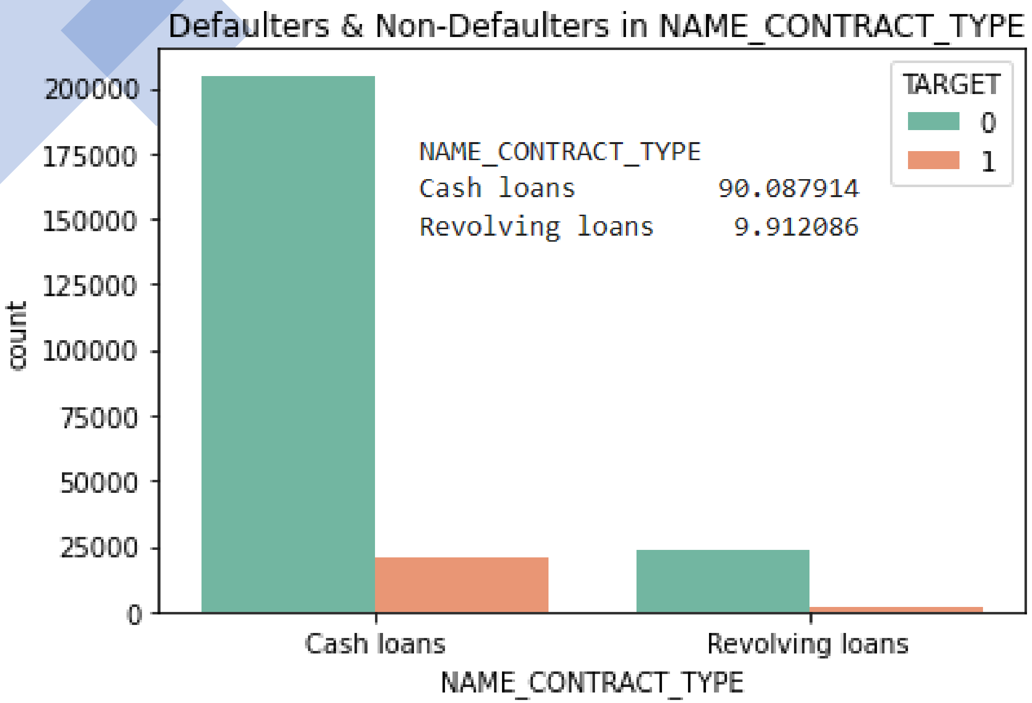


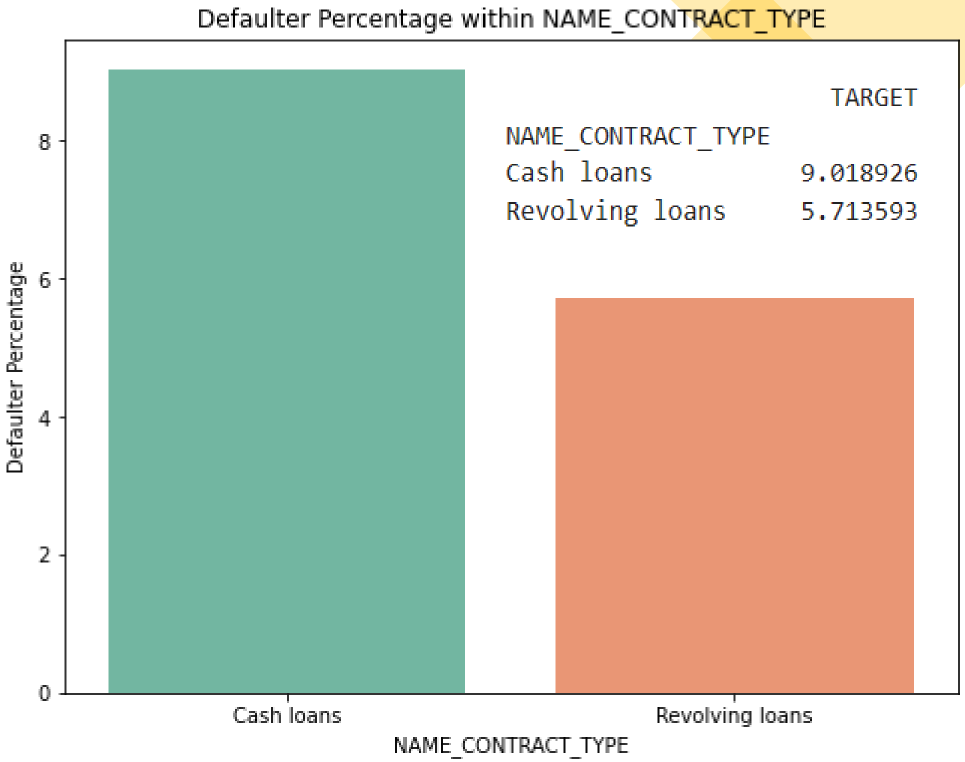
```
                                TARGET
OCCUPATION_TYPE
Low-skill Laborers           17.292871
Waiters/barmen staff         11.385768
Drivers                      11.367577
Security staff               10.754462
Laborers                     10.608441
Cooking staff                10.512038
Cleaning staff                9.642470
Sales staff                   9.635105
Realty agents                 7.951482
Secretaries                   7.115236
Medicine staff                6.691098
IT staff                      6.653620
Private service staff         6.542412
Core staff                    6.331157
Managers                      6.251776
High skill tech staff         6.180623
HR staff                      6.093190
Accountants                   4.866983
```

More than (40% combined) of the applicants are either Laborers or Sales Staff (as seen in the univariate analysis) as compared to Low Skilled Laborers who are <1%, but applicants who are Low Skilled Laborers, have the highest defaulting percent of 17.2% in it's category

Recommendation : Going by the proportion of defaulters to applicants, it's safer to give a loan to applicants who are Laborers or Sales Staff as they take up more than 40% applications, yet their defaulter percentage is only about 20% as compared to 17.2% amongst Low Skilled Laborers who only take up <1% of applications. Accountants are the least defaulters with about 4.86% default %

BIVARIATE ANALYSIS

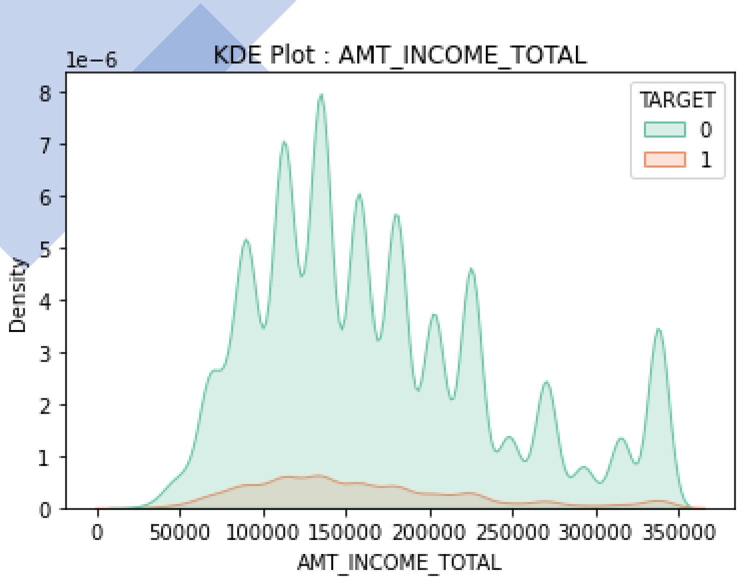




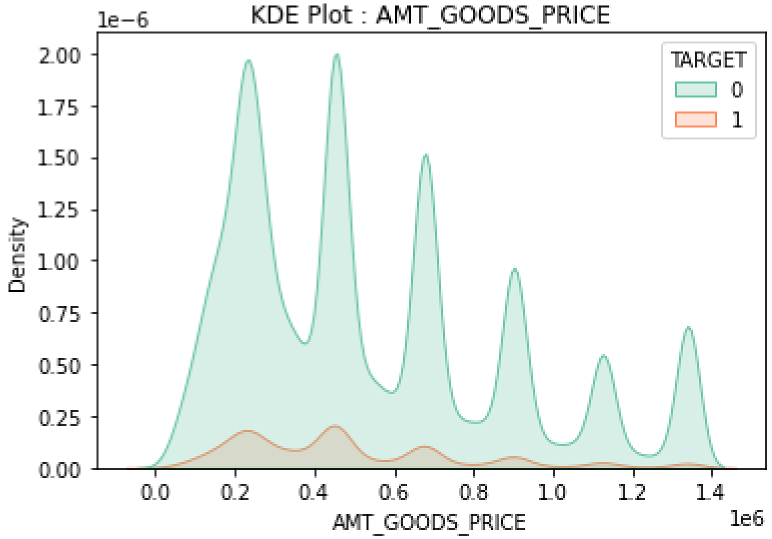
More than 90% of the applications are either Cash Loan (as seen in the univariate analysis) as compared to Revolving Loans who are <10%, but the defaulting rate is 9% for Cash Loans and close to it, 6% for Revolving Loans

Recommendation : Going by the proportion of defaulters to applicants, it's safer to give Cash Loans as the default rate for its proportion to number of applications is low.

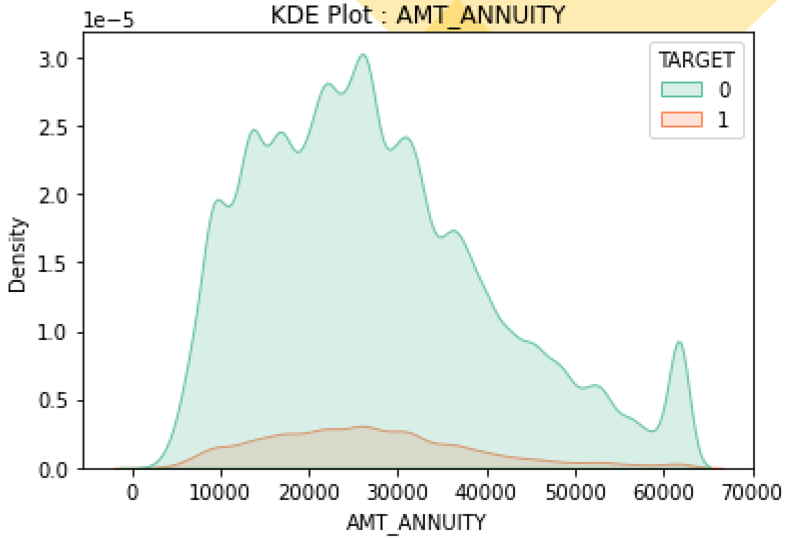
BIVARIATE ANALYSIS



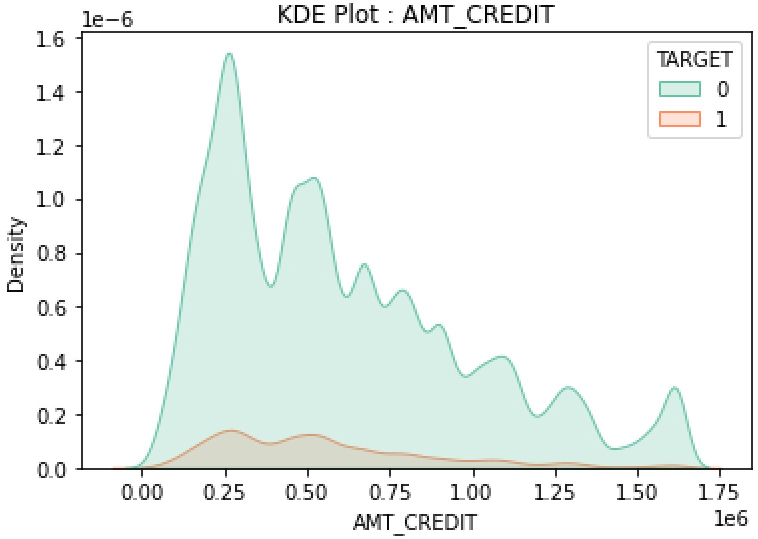
KDE Plot : AMT_INCOME_TOTAL



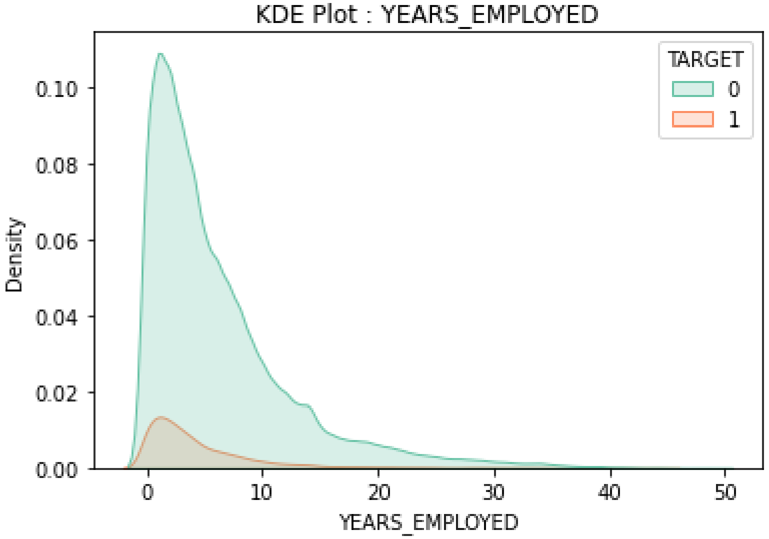
KDE Plot : AMT_GOODS_PRICE



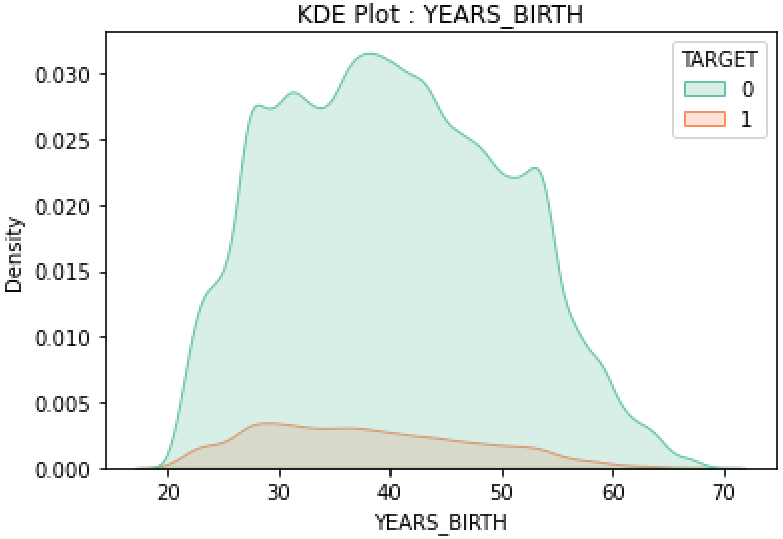
KDE Plot : AMT_ANNUITY



KDE Plot : AMT_CREDIT



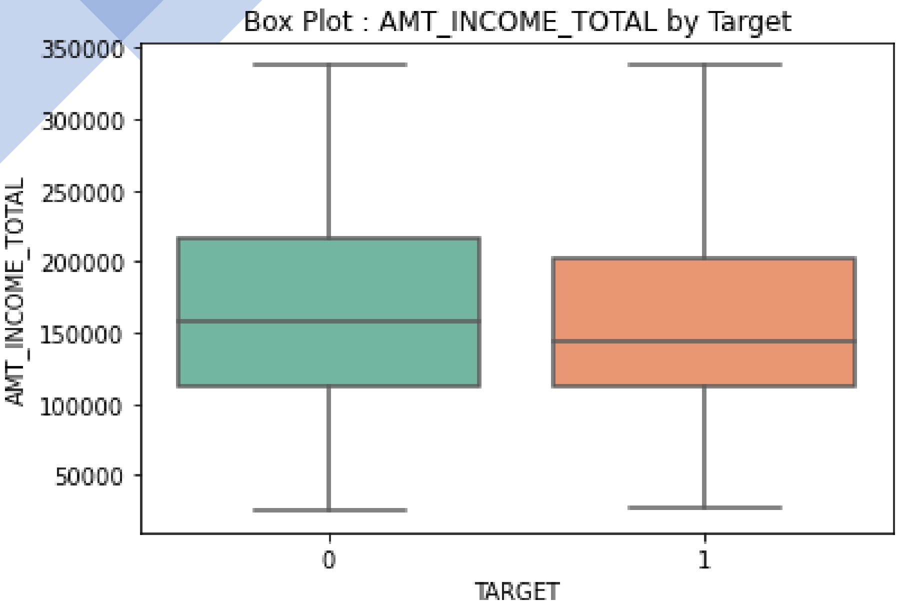
KDE Plot : YEARS_EMPLOYED

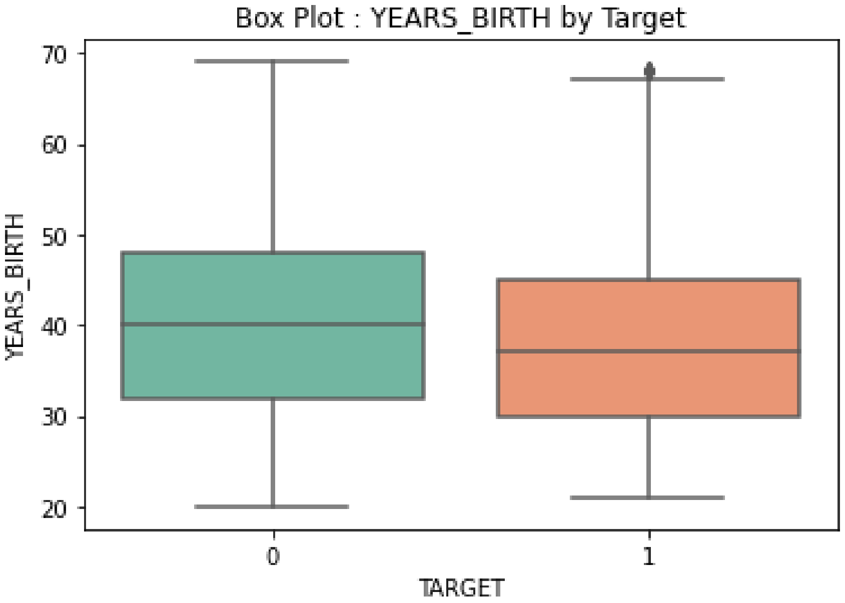


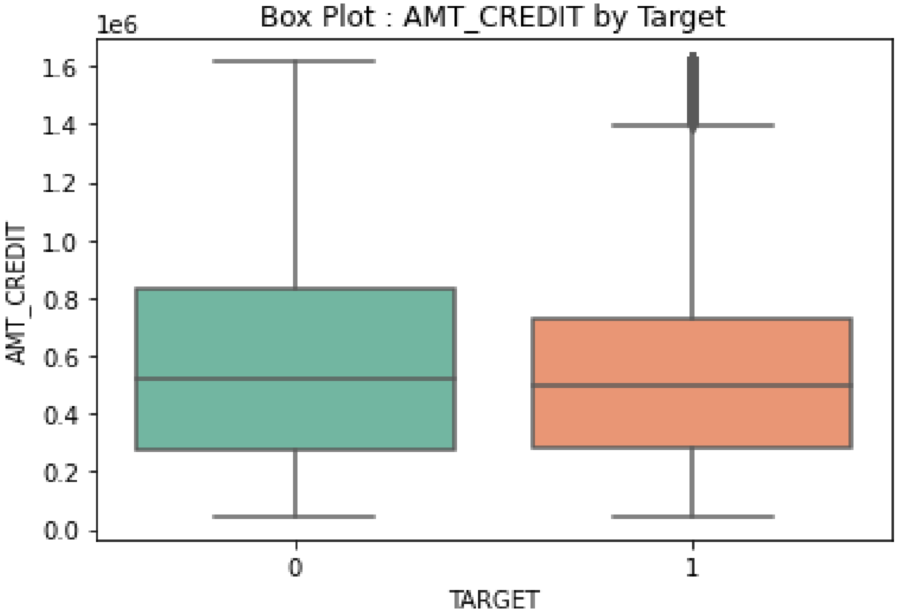
KDE Plot : YEARS_BIRTH

- There is no range of values in any of the plots where only non-defaulters are present
- Income Amount and Goods Price have peaks and valleys at various points : signifying many high values and few low values
- The Years Employed are significantly higher in the range 0-5 years and then reduces significantly.
  - Recommendation : People with years employed between 0-5 have highest non-defaulters, they can be targeted

BIVARIATE ANALYSIS







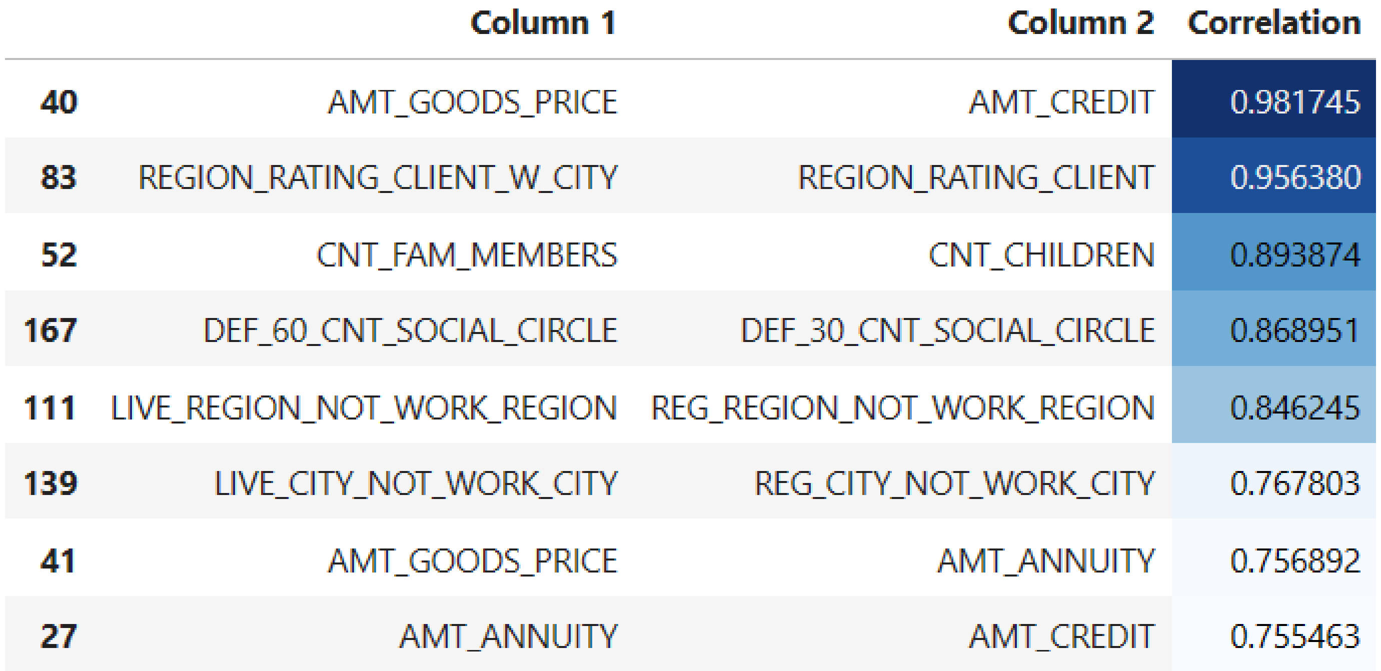
- The median income of defaulters is lower than non-defaulters and is around 1.4lakhs

- The median age of defaulters is lower than non-defaulters and is around 37-38 years of age. This is expected as they have lower incomes since they have been employed for a lesser duration

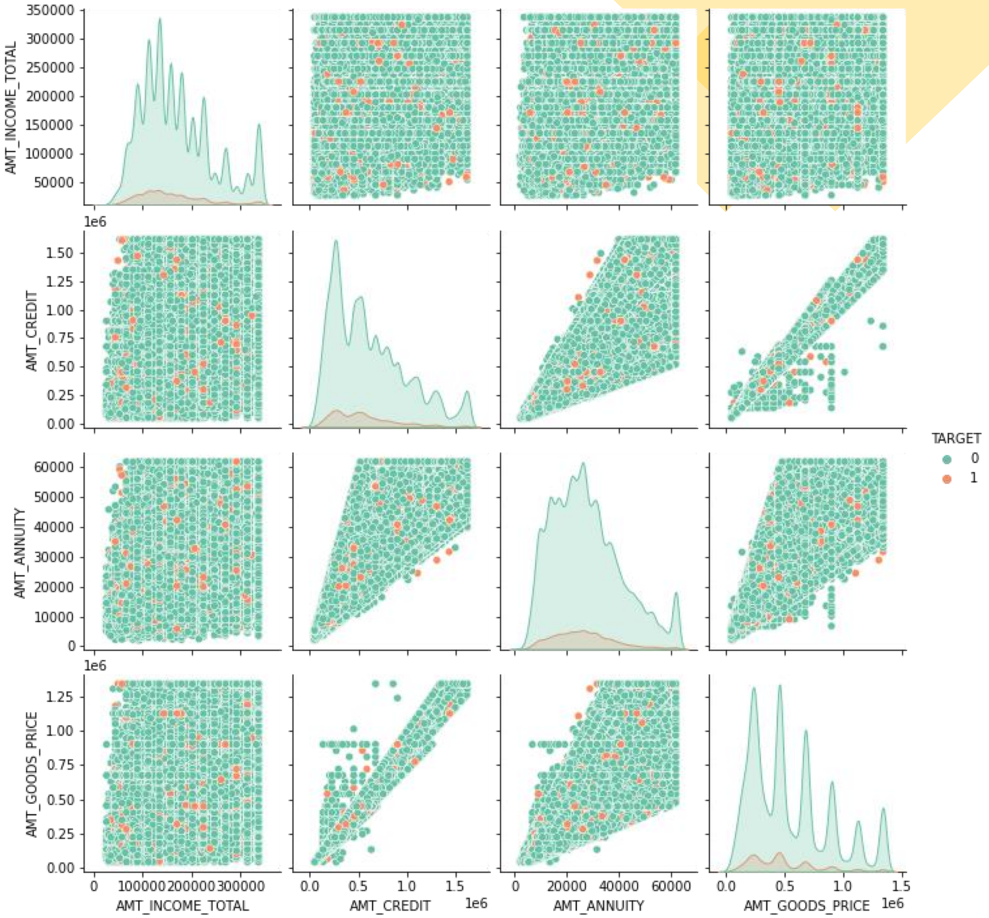
- The median loan amount appears to be almost the same, although the 75th percentile is around 8 lakhs for non-defaulters and around 7 lakhs for defaulters.

MULTIVARIATE ANALYSIS

DEFAULTERS



	Column 1	Column 2	Correlation
40	AMT_GOODS_PRICE	AMT_CREDIT	0.981745
83	REGION_RATING_CLIENT_W_CITY	REGION_RATING_CLIENT	0.956380
52	CNT_FAM_MEMBERS	CNT_CHILDREN	0.893874
167	DEF_60_CNT_SOCIAL_CIRCLE	DEF_30_CNT_SOCIAL_CIRCLE	0.868951
111	LIVE_REGION_NOT_WORK_REGION	REG_REGION_NOT_WORK_REGION	0.846245
139	LIVE_CITY_NOT_WORK_CITY	REG_CITY_NOT_WORK_CITY	0.767803
41	AMT_GOODS_PRICE	AMT_ANNUITY	0.756892
27	AMT_ANNUITY	AMT_CREDIT	0.755463



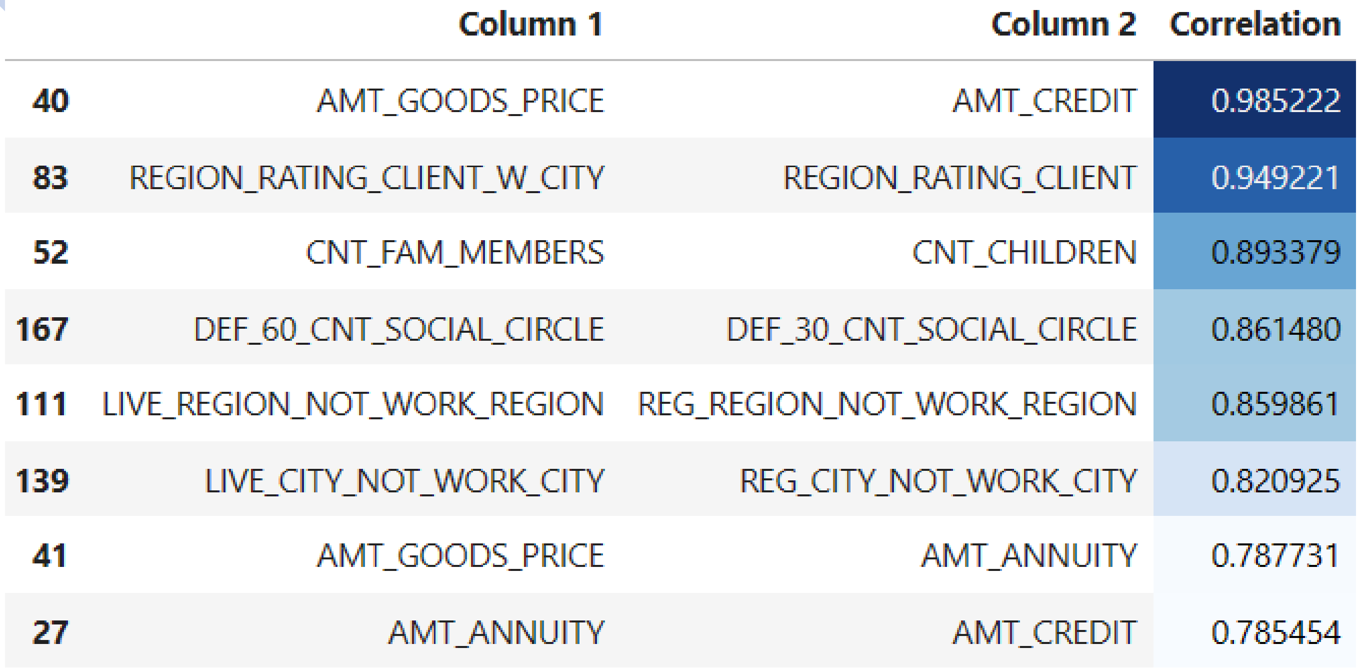
Credit Amount has the highest correlation with Goods Price of 0.98

Credit amount also has a high correlation with Annuity Amount of 0.75

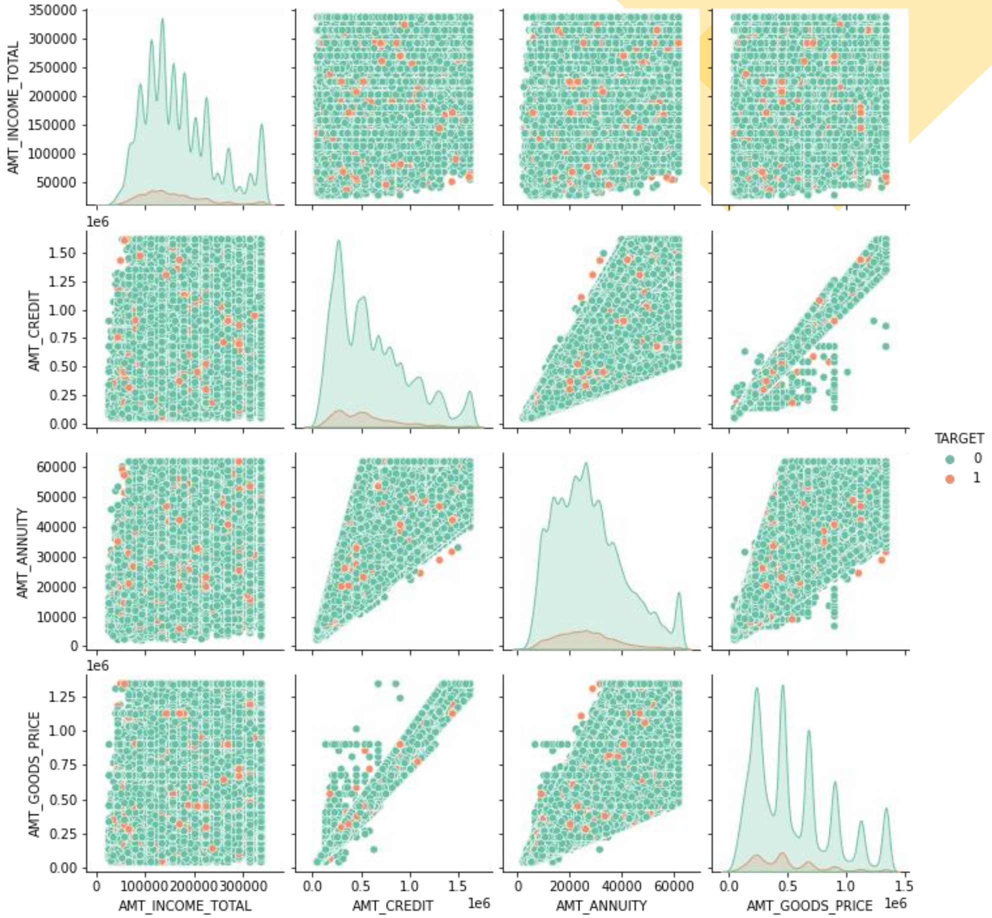
Good Price also has a high correlation with Annuity Amount of 0.75

MULTIVARIATE ANALYSIS

NON - DEFAULTERS



	Column 1	Column 2	Correlation
40	AMT_GOODS_PRICE	AMT_CREDIT	0.985222
83	REGION_RATING_CLIENT_W_CITY	REGION_RATING_CLIENT	0.949221
52	CNT_FAM_MEMBERS	CNT_CHILDREN	0.893379
167	DEF_60_CNT_SOCIAL_CIRCLE	DEF_30_CNT_SOCIAL_CIRCLE	0.861480
111	LIVE_REGION_NOT_WORK_REGION	REG_REGION_NOT_WORK_REGION	0.859861
139	LIVE_CITY_NOT_WORK_CITY	REG_CITY_NOT_WORK_CITY	0.820925
41	AMT_GOODS_PRICE	AMT_ANNUITY	0.787731
27	AMT_ANNUITY	AMT_CREDIT	0.785454



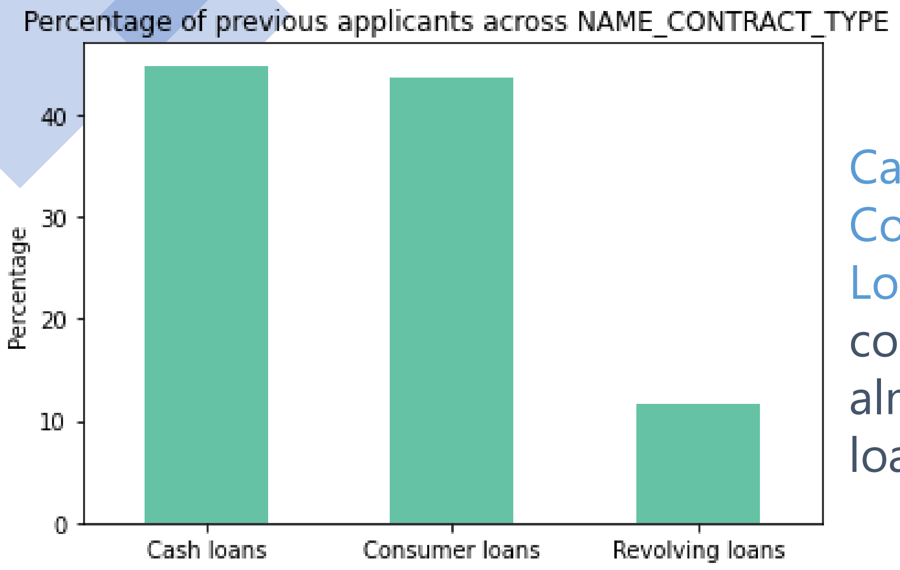
Credit Amount has the highest correlation with Goods Price of 0.98

Credit amount also has a high correlation with Annuity Amount of 0.78

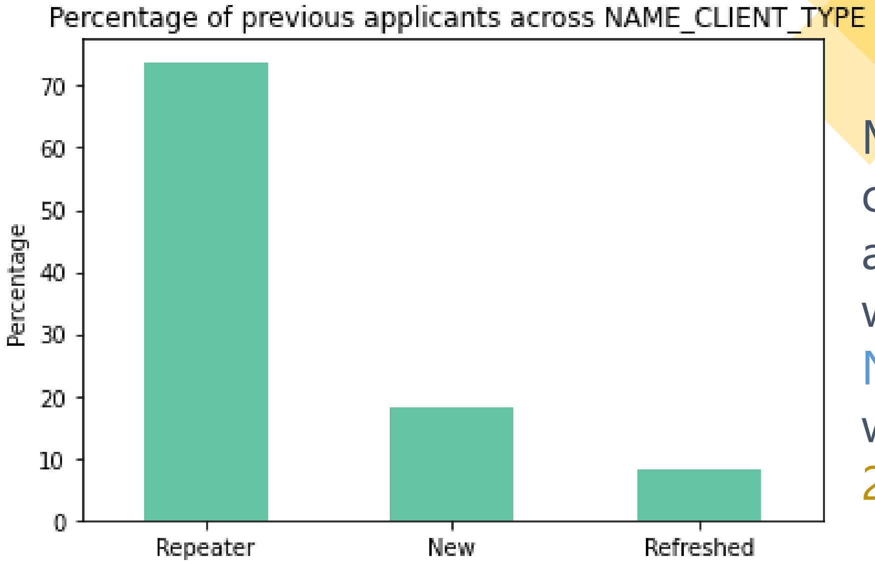
Good Price also has a high correlation with Annuity Amount of 0.78

PREVIOUS APPLICATION DATASET

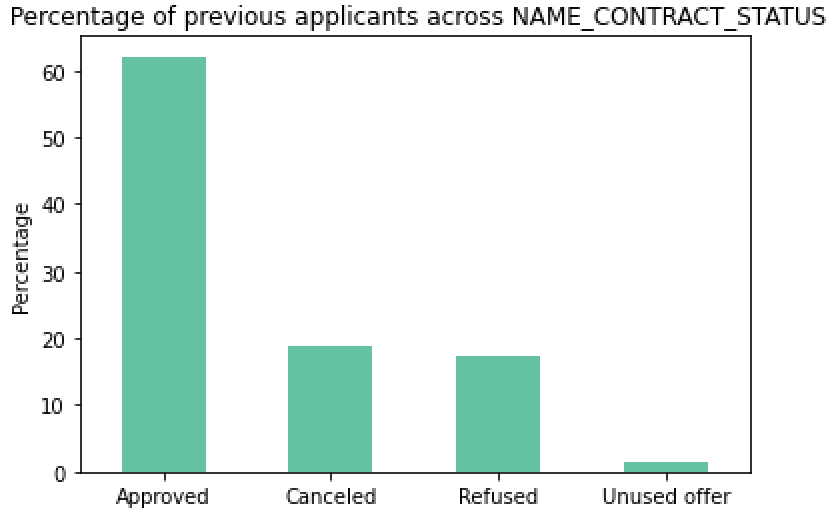
UNIVARIATE ANALYSIS



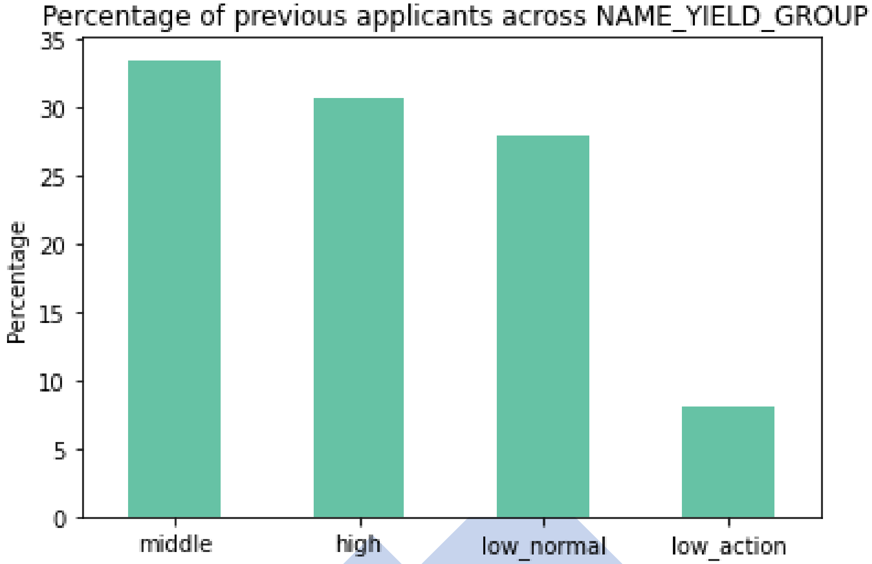
Cash Loans and Consumer Loans both constitute almost 45% loan types



More than 70% of previous applications were Repeaters. New applicants were around 20%

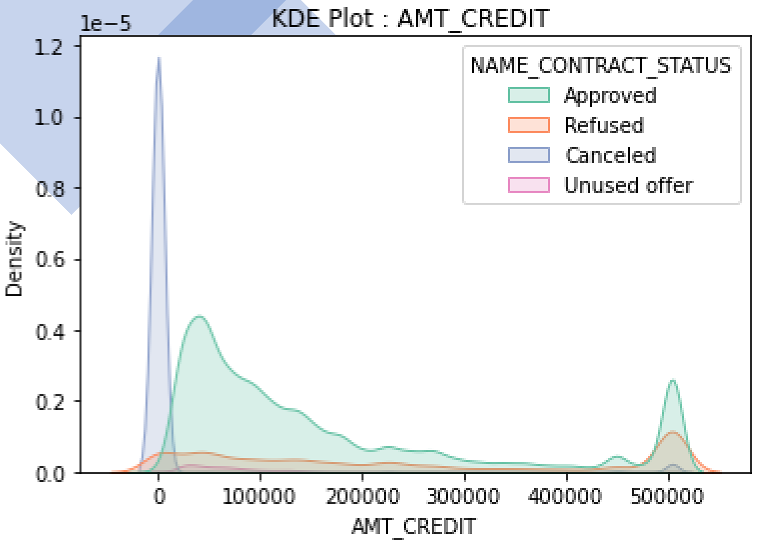


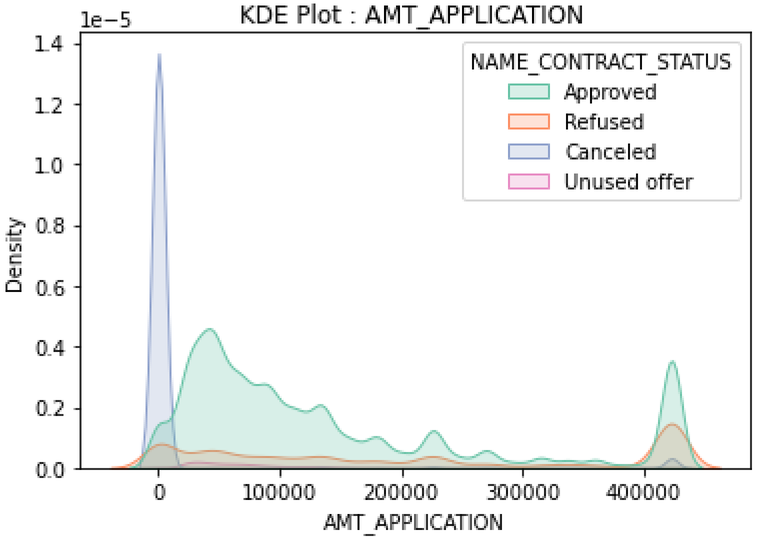
More than 60% of previous applications were Approved

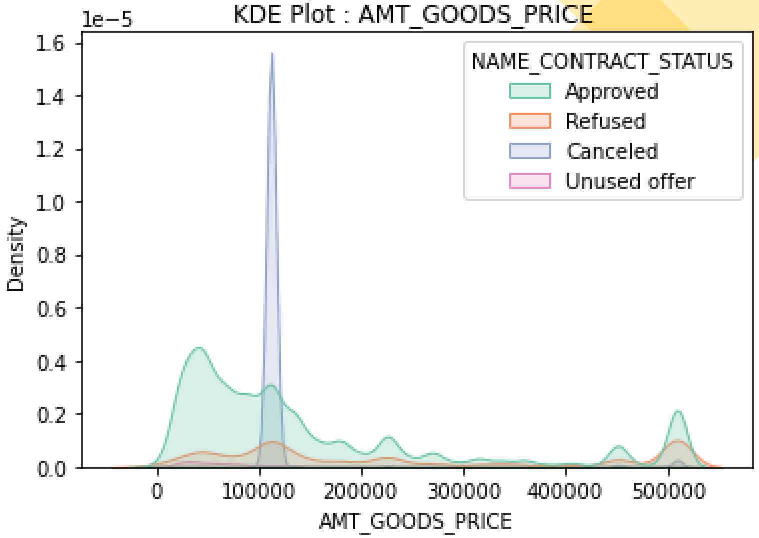


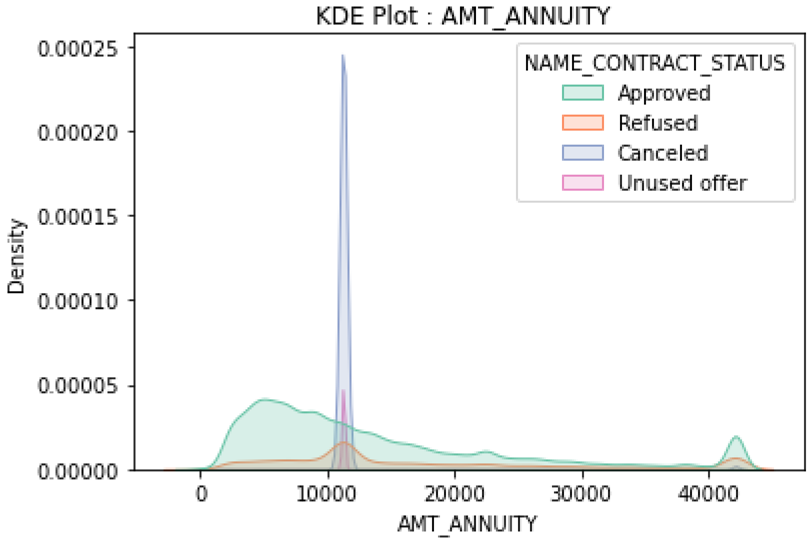
The interest rates of middle, high and low normal categories are almost equal (28-32%) of total previous applications

BIVARIATE ANALYSIS



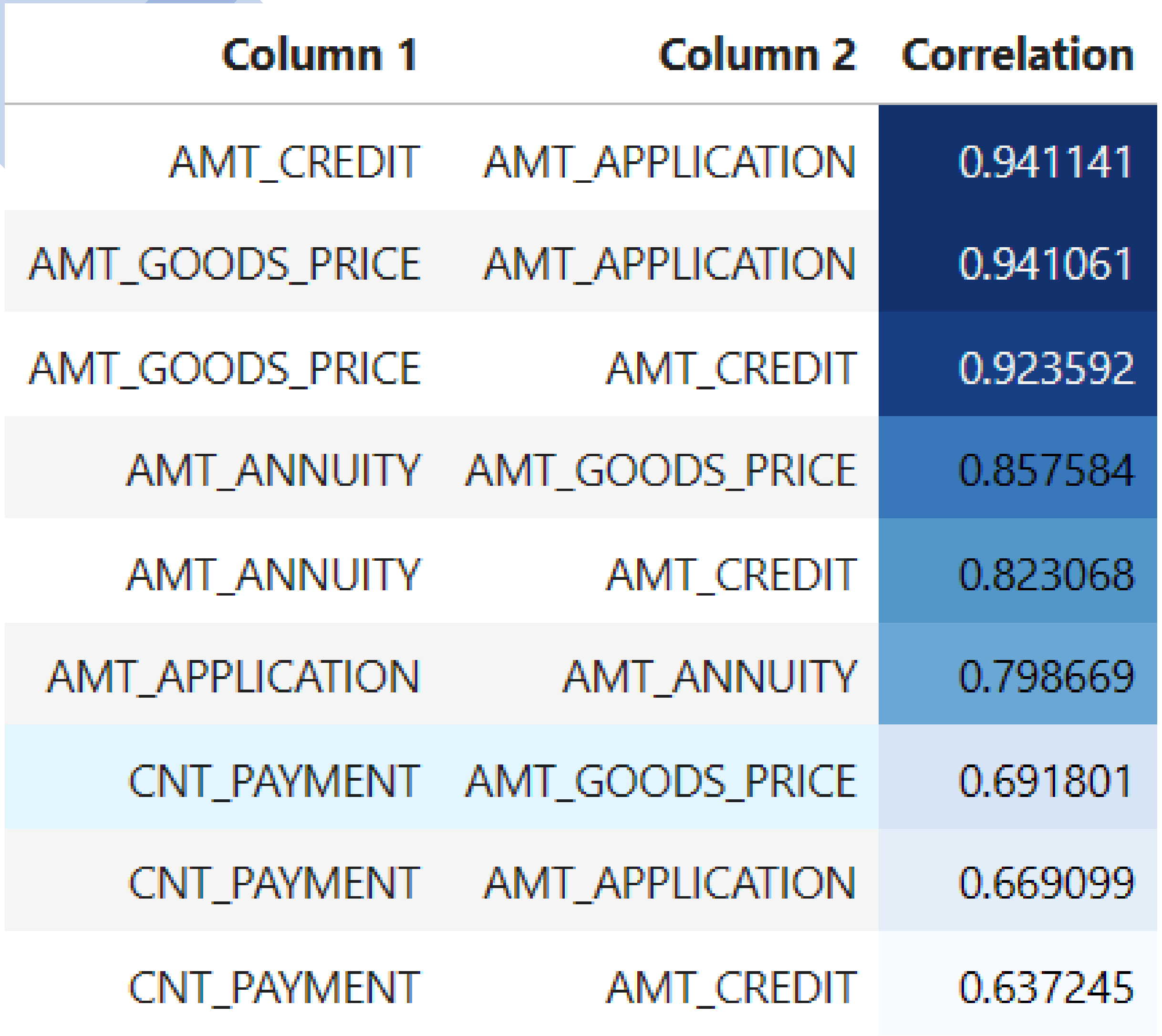




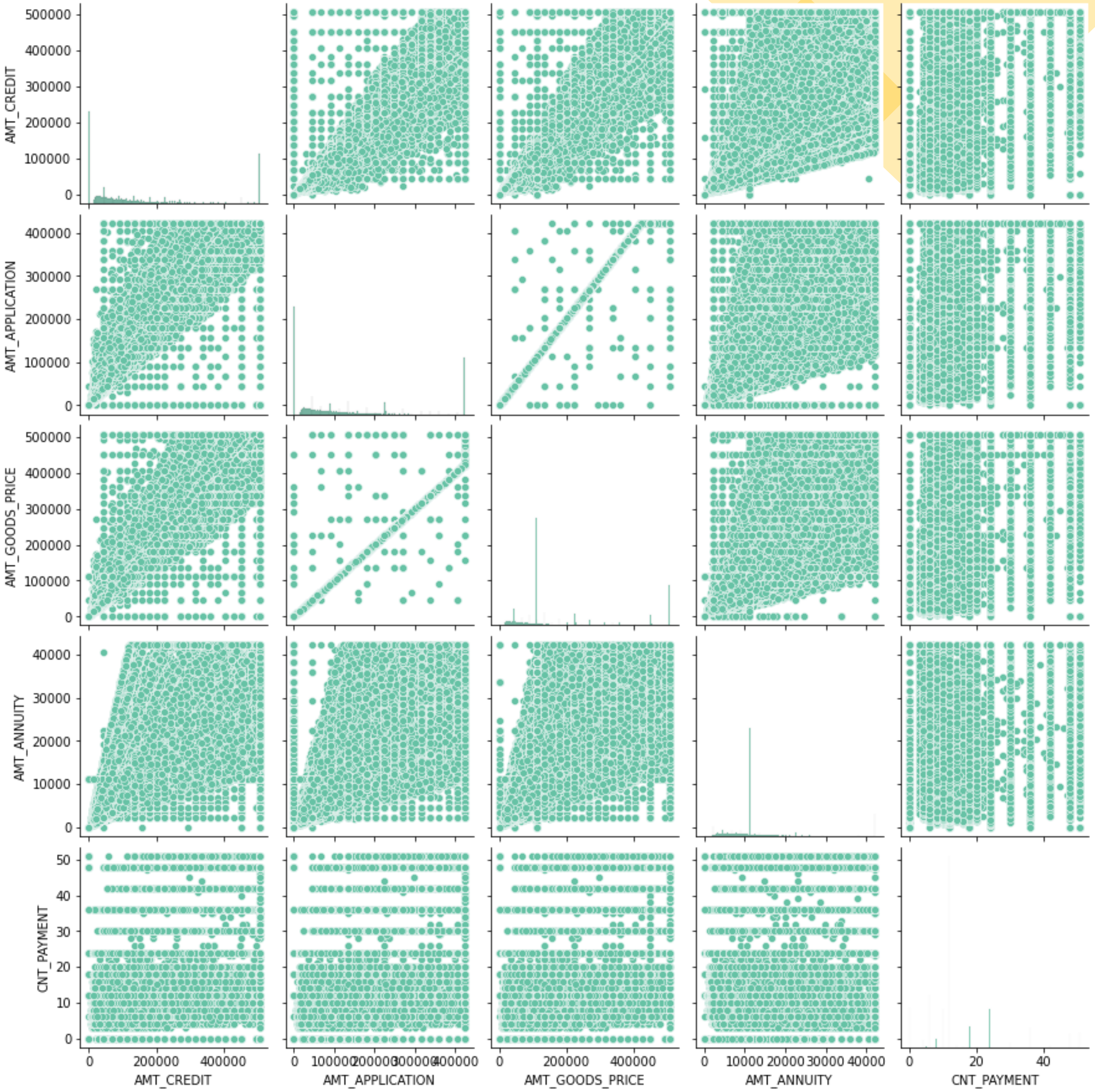


- The previous applications that were Cancelled appear in only a small range of amounts across all categories, as seen in the graphs
- The Approved applications are distributed fairly across all amounts across all categories, although the approvals become less towards the 4 Lakh range and then increase again for 5 Lakh
- For Amount credited and Amount requested (AMT_CREDIT, AMT_APPLICATION) , Refusals appear more at the 5 Lakh and 4.5 Lakh peaks respectively
- For goods price, the Refusals are more at two peaks, 1.2 Lakhs and just over 5 Lakhs
- For annuity amount, Refusals are more that two peaks, 1.2 Lakhs and just over 4 Lakhs
- Unused offers appear only for a small range in Annuity amount, mainly at around 1.2 Lakhs

MULTIVARIATE ANALYSIS



Column 1	Column 2	Correlation
AMT_CREDIT	AMT_APPLICATION	0.941141
AMT_GOODS_PRICE	AMT_APPLICATION	0.941061
AMT_GOODS_PRICE	AMT_CREDIT	0.923592
AMT_ANNUITY	AMT_GOODS_PRICE	0.857584
AMT_ANNUITY	AMT_CREDIT	0.823068
AMT_APPLICATION	AMT_ANNUITY	0.798669
CNT_PAYMENT	AMT_GOODS_PRICE	0.691801
CNT_PAYMENT	AMT_APPLICATION	0.669099
CNT_PAYMENT	AMT_CREDIT	0.637245

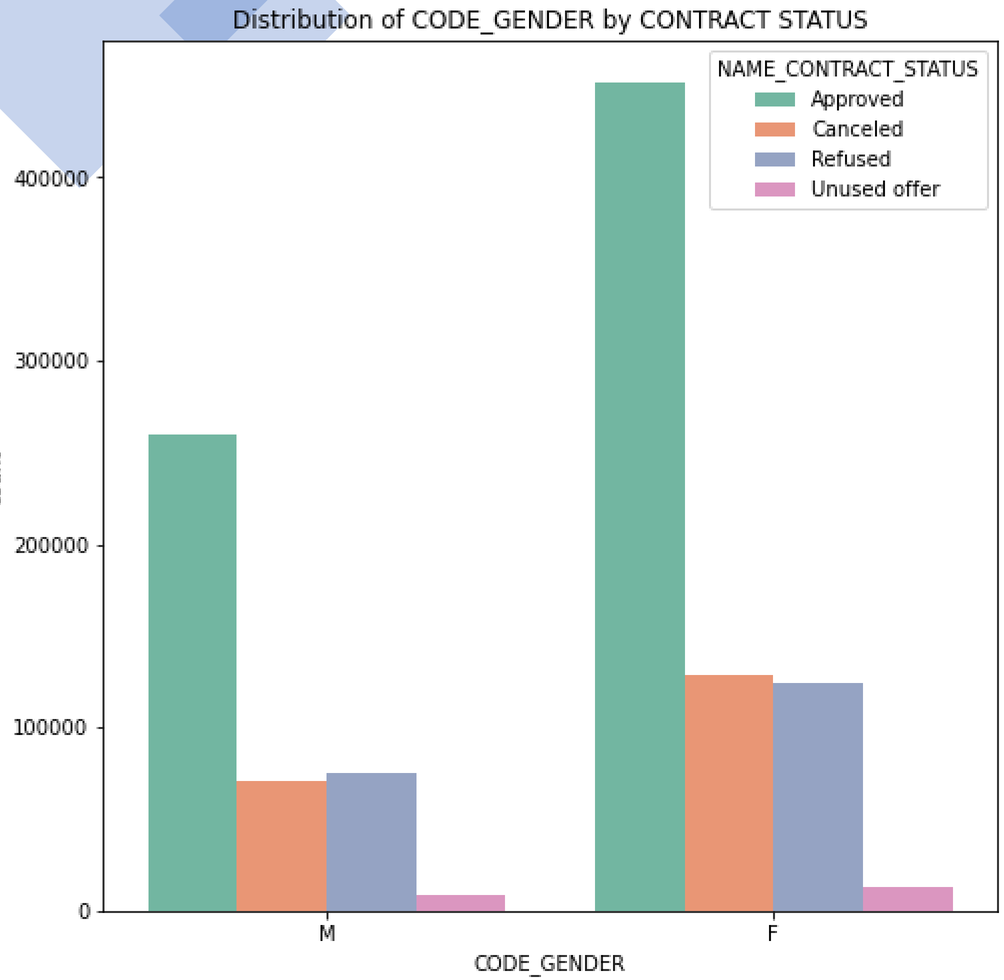


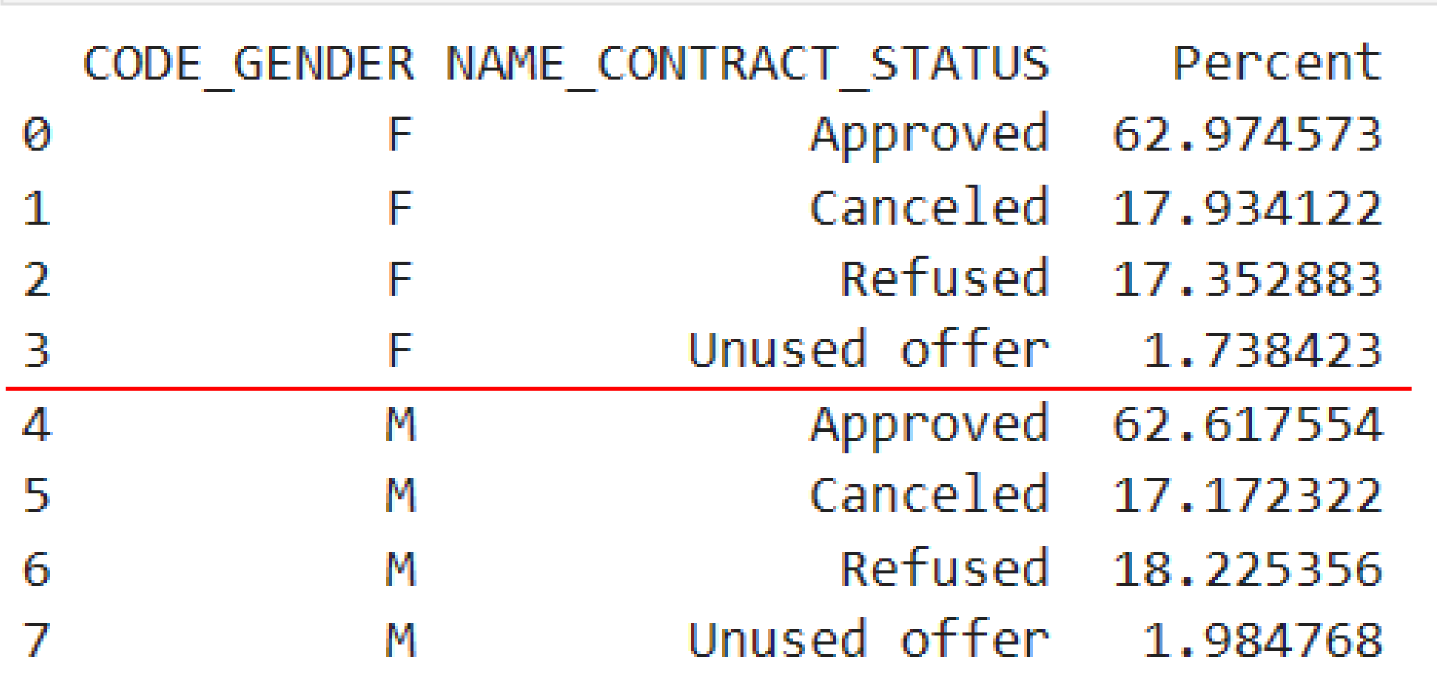
Credit Amount has the highest correlation with Application Amount of 0.94

Goods Price also has a highest correlation with Application Amount of 0.94

MERGED DATASET

BIVARIATE ANALYSIS





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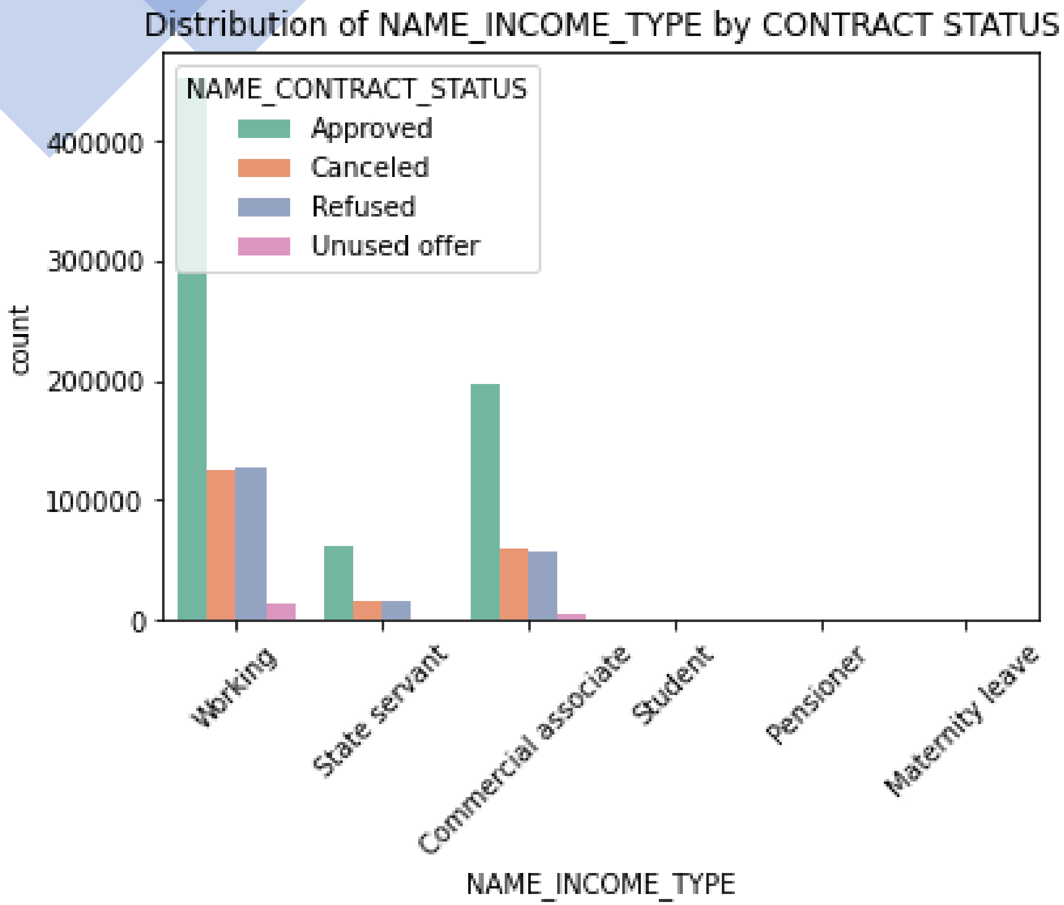
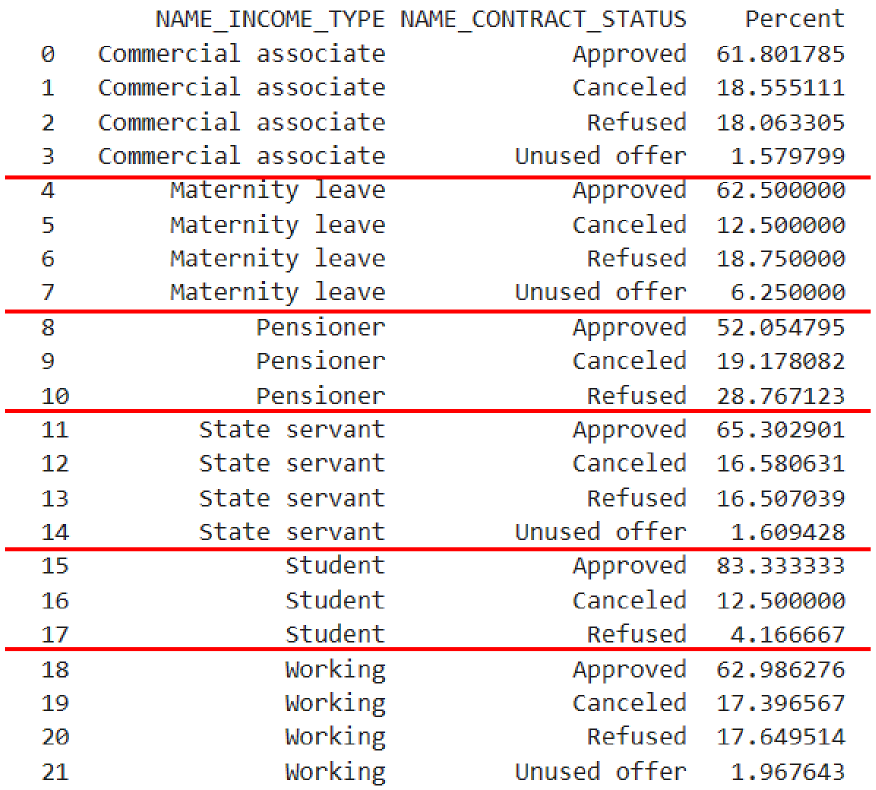
  CODE_GENDER NAME_CONTRACT_STATUS    Percent
0           F             Approved  62.974573
1           F             Canceled  17.934122
2           F              Refused  17.352883
3           F         Unused offer   1.738423
4           M             Approved  62.617554
5           M             Canceled  17.172322
6           M              Refused  18.225356
7           M         Unused offer   1.984768
```

The contract statuses of previous applications is fairly equal across both Genders





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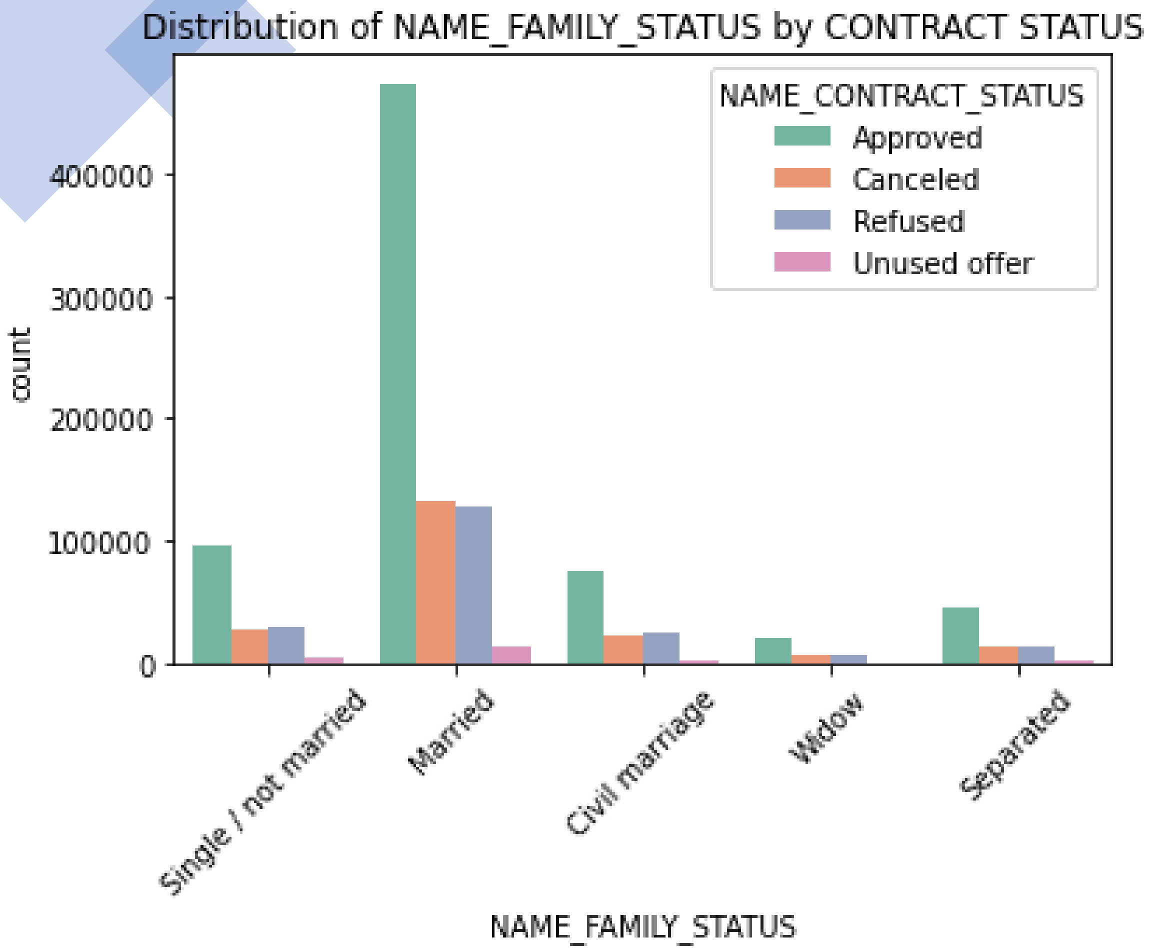
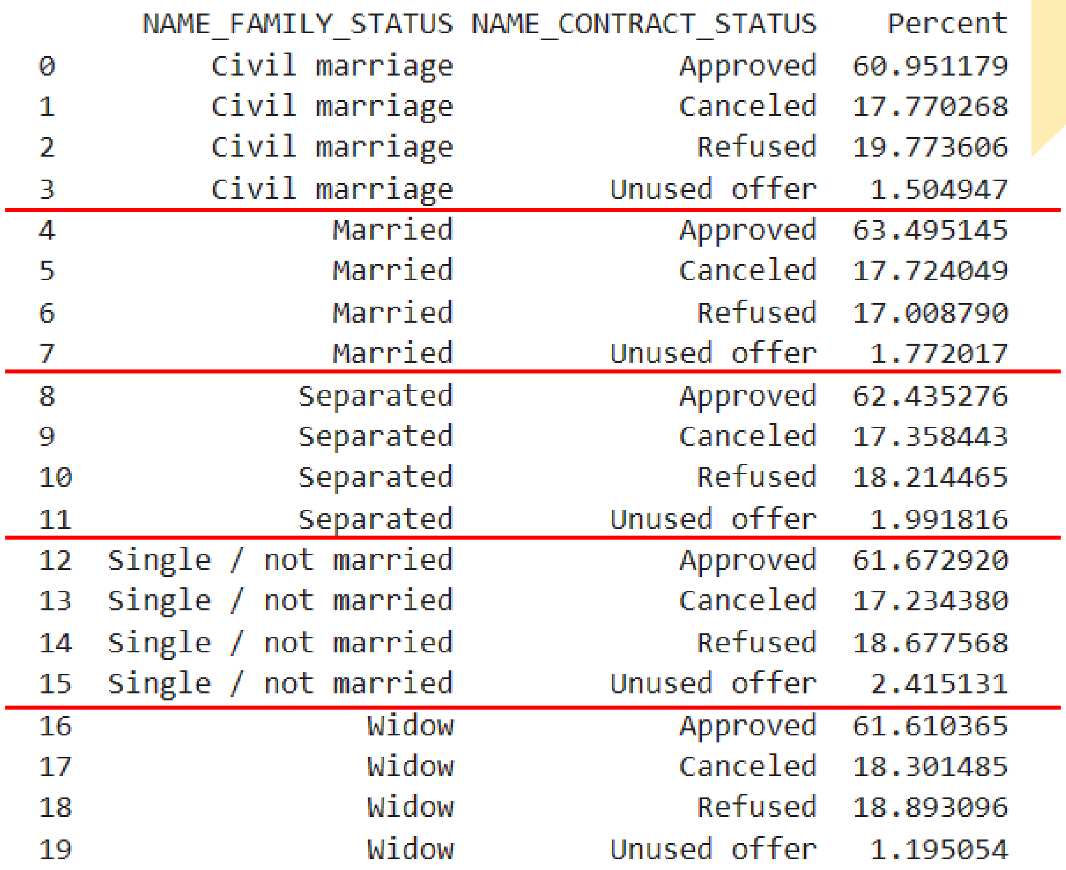
         NAME_INCOME_TYPE NAME_CONTRACT_STATUS    Percent
0    Commercial associate             Approved  61.801785
1    Commercial associate             Canceled  18.555111
2    Commercial associate              Refused  18.063305
3    Commercial associate         Unused offer   1.579799
4         Maternity leave             Approved  62.500000
5         Maternity leave             Canceled  12.500000
6         Maternity leave              Refused  18.750000
7         Maternity leave         Unused offer   6.250000
8               Pensioner             Approved  52.054795
9               Pensioner             Canceled  19.178082
10              Pensioner              Refused  28.767123
11          State servant             Approved  65.302901
12          State servant             Canceled  16.580631
13          State servant              Refused  16.507039
14          State servant         Unused offer   1.609428
15                Student             Approved  83.333333
16                Student             Canceled  12.500000
17                Student              Refused   4.166667
18                Working             Approved  62.986276
19                Working             Canceled  17.396567
20                Working              Refused  17.649514
21                Working         Unused offer   1.967643
```

The Approved rate is the highest for Student at 83%, Refused rate is the lowest for student at 4% and Cancellation rate is lowest at 12.5% in previous applications

Recommendation : Based on previous applications, since Students have the highest approved rate, lowest refused rate and lowest cancellation rate, they are a safe Income Type to target for giving loans





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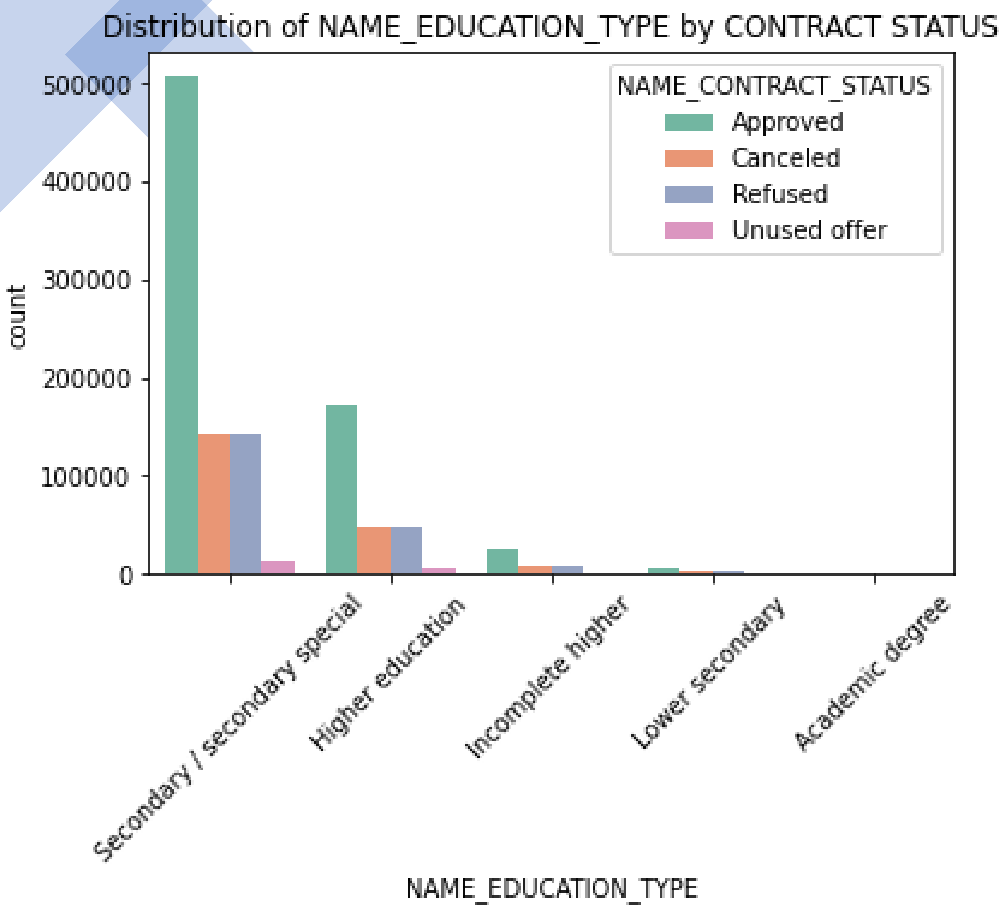
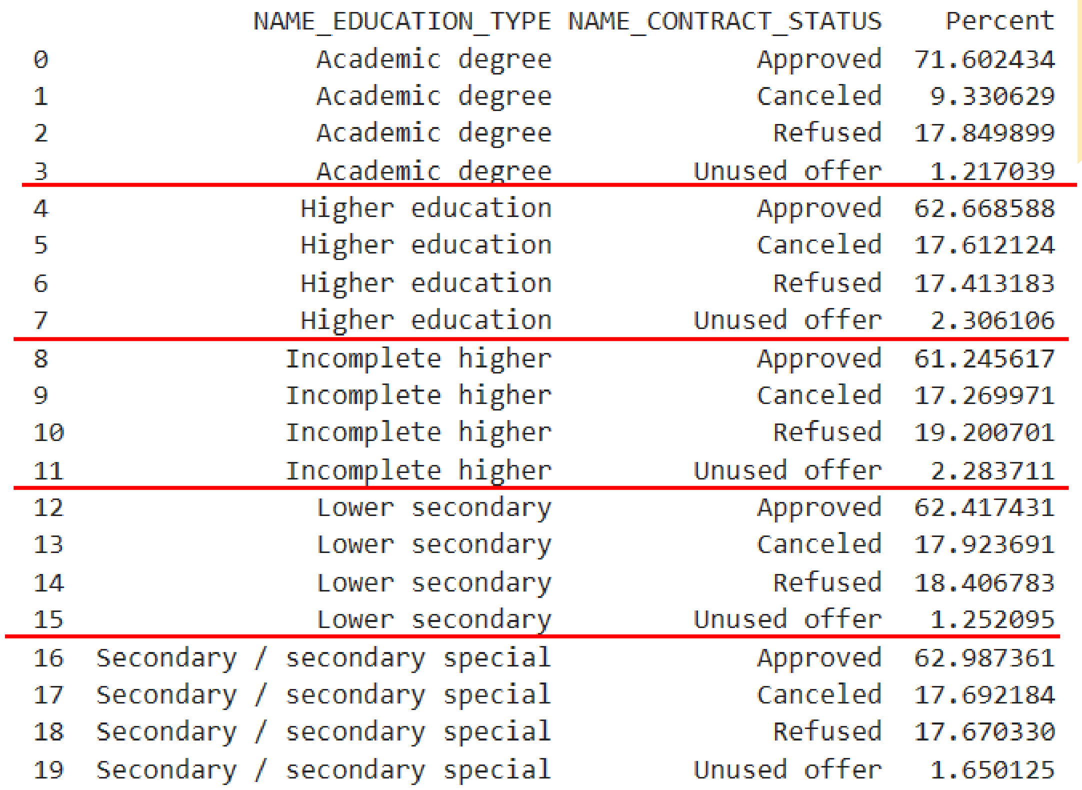
      NAME_FAMILY_STATUS NAME_CONTRACT_STATUS    Percent
0         Civil marriage             Approved  60.951179
1         Civil marriage             Canceled  17.770268
2         Civil marriage              Refused  19.773606
3         Civil marriage         Unused offer   1.504947
4                Married             Approved  63.495145
5                Married             Canceled  17.724049
6                Married              Refused  17.008790
7                Married         Unused offer   1.772017
8              Separated             Approved  62.435276
9              Separated             Canceled  17.358443
10             Separated              Refused  18.214465
11             Separated         Unused offer   1.991816
12  Single / not married             Approved  61.672920
13  Single / not married             Canceled  17.234380
14  Single / not married              Refused  18.677568
15  Single / not married         Unused offer   2.415131
16                 Widow             Approved  61.610365
17                 Widow             Canceled  18.301485
18                 Widow              Refused  18.893096
19                 Widow         Unused offer   1.195054
```

The contract statuses of previous applications is fairly equal across all family statuses





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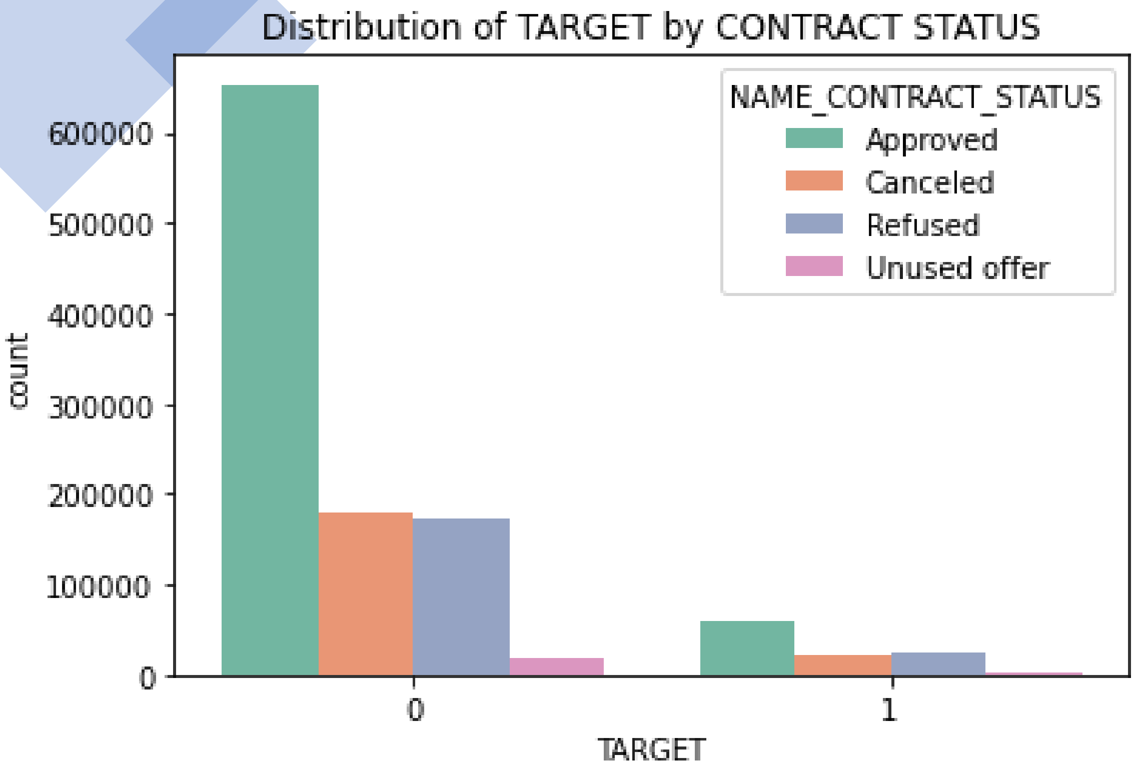
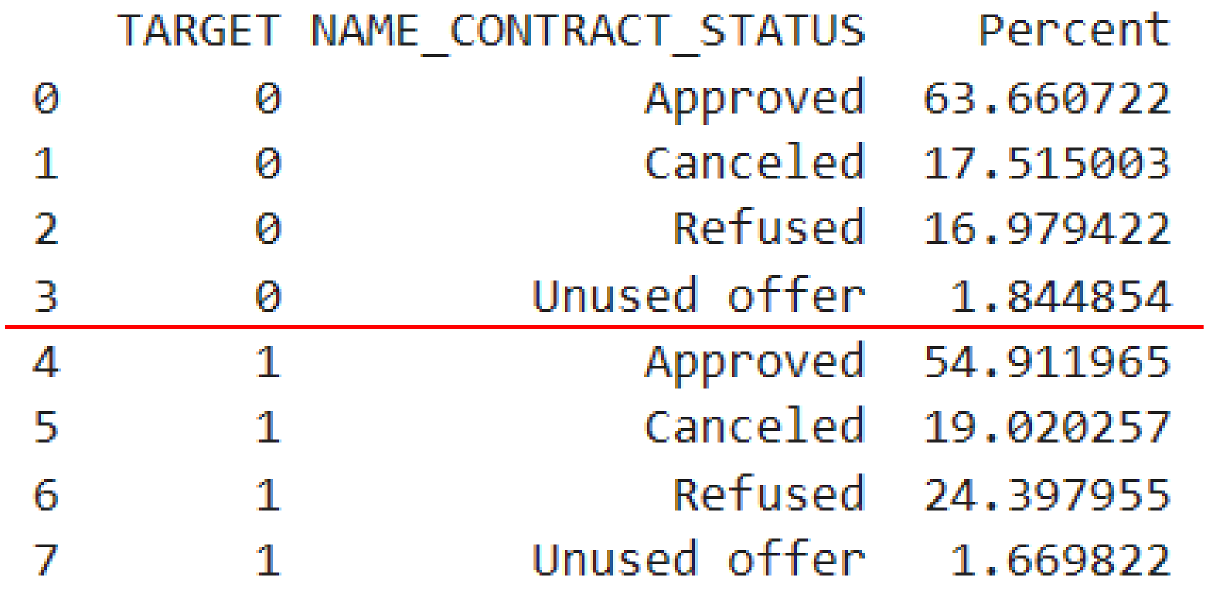
       NAME_EDUCATION_TYPE NAME_CONTRACT_STATUS    Percent
0          Academic degree             Approved  71.602434
1          Academic degree             Canceled   9.330629
2          Academic degree              Refused  17.849899
3          Academic degree         Unused offer   1.217039
4         Higher education             Approved  62.668588
5         Higher education             Canceled  17.612124
6         Higher education              Refused  17.413183
7         Higher education         Unused offer   2.306106
8        Incomplete higher             Approved  61.245617
9        Incomplete higher             Canceled  17.269971
10       Incomplete higher              Refused  19.200701
11       Incomplete higher         Unused offer   2.283711
12         Lower secondary             Approved  62.417431
13         Lower secondary             Canceled  17.923691
14         Lower secondary              Refused  18.406783
15         Lower secondary         Unused offer   1.252095
16  Secondary / secondary special      Approved  62.987361
17  Secondary / secondary special      Canceled  17.692184
18  Secondary / secondary special       Refused  17.670330
19  Secondary / secondary special  Unused offer   1.650125
```

Applicants with Academic degrees have the highest Approval rate of 71% and the lowest cancelled rate of 9% amongst previous applications

Recommendation : Applicants with Academic degrees cancel the least and due to high Approved rate in previous applications, they can be targeted





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   TARGET NAME_CONTRACT_STATUS    Percent
0       0             Approved  63.660722
1       0             Canceled  17.515003
2       0              Refused  16.979422
3       0         Unused offer   1.844854
4       1             Approved  54.911965
5       1             Canceled  19.020257
6       1              Refused  24.397955
7       1         Unused offer   1.669822
```

As expected, the Approval rate for defaulters is lesser at 55% and the Refusal rate is higher at 24%