# DEFAULT RISK PREDICTION — HOME CREDIT

## 1. Objective

Desenvolver um modelo preditivo que estime a probabilidade de inadimplência de clientes (variável TARGET) usando dados demográficos, financeiros, histórico de crédito e comportamento passado. O objetivo prático é permitir que a instituição tome decisões de crédito mais seguras: ajustar limites, aprovar ou recusar solicitações e priorizar ações de cobrança preventivas, reduzindo perdas e melhorando rentabilidade.

Considerando a complexidade e o alto desbalanceamento do conjunto de dados do Home Credit Default Risk, o modelo foi ajustado para equilibrar precisão e capacidade de detecção (recall), priorizando a identificação de clientes com maior risco de inadimplência. O foco é apoiar decisões de crédito mais seguras e proativas, minimizando o risco de perdas e fortalecendo a gestão do portfólio financeiro.

## 2. Executive Summary

The project aimed to **develop a predictive default risk model** to support safer and more profitable credit decisions, using the *Home Credit Default Risk* dataset, characterized by **high complexity, more than 800 variables, and strong class imbalance** (approximately **8% defaulters**).

Even in the presence of variables with **low individual correlation** with default risk, the application of statistical and *machine learning* techniques made it possible to **combine multiple weak signals into a robust and interpretable model**, capable of consistently estimating the probability of default.

---

**1. Business Challenge**

The central need was to **reduce financial losses from default** without compromising the experience and conversion of good customers. The main challenges were:

- Identifying **high-risk customers in advance**;
- Reducing the impact of **false negatives** (defaulters not detected);
- Controlling the volume of **false positives** and their operational costs;
- Ensuring **scalability** in an environment with hundreds of variables.

---

**2. Developed Solution**

A **binary classification model** was built and trained using a wide set of demographic, socioeconomic, behavioral, and credit history variables, totaling **more than 800 features**.

The model was calibrated with an **optimal threshold of 0.191 (based on F1-score ≈ 0.344)**, prioritizing the **capture of defaulters** without excessive loss of good customers, making it suitable for **risk screening and prevention stages**.

Main patterns identified:

- Employment stability and consistent financial history reduce risk;
- High volume of credit inquiries and recent financial decisions increase risk;
- Recent behavioral changes are strong indicators of instability;
- The **combination of multiple variables** proved essential for predictive performance.

---

**3. Performance and Results**

| Metric | Result |
|---|---|
| Recall (Defaulters) | **38%** |
| Precision (Defaulters) | **31%** |
| AUC-ROC | **0.80** |
| MCC | **0.28** |
| Overall Accuracy | **88%** |

The model demonstrated **good discriminatory power**, especially considering the strong class imbalance and high dimensionality of the data.

---

**4. Financial Impact**

Based on realistic simulations (46,127 customers, average loss of **R$ 5,000** per defaulter and an average preventive action cost of **R$ 500**), the estimated impact was:

| Scenario | Estimated Net Profit |
|---|---|
| **Without model** | **R$ 23.78 million** |
| **With model (th = 0.191)** | **R$ 30.17 million** |

**Estimated incremental gain:** approximately **R$ 6.39 million**.

This result shows that the model generates **direct financial value**, even after considering losses from false positives and operational costs.

---

**5. Conclusion**

The model achieved its primary objective: **reducing default risk and increasing portfolio profitability** in a measurable way.

The project demonstrated that, even in a scenario of **high complexity, more than 800 variables, and strong class imbalance**, it is possible to build solutions that are:

- Robust,
- Interpretable,
- Scalable,
- Financially advantageous.

In summary, the work reinforces that **data science applied to credit risk management** not only improves technical metrics but also **generates real and sustainable business impact**.

# 3. About the Data

The data used in this analysis refer to the financial, demographic, and behavioral history of customers from the **Home Credit Default Risk** dataset, which contains detailed information on thousands of individuals with different socioeconomic profiles.

Currently, credit decision-making depends on multiple factors, such as loan history, repayment capacity, property characteristics, employment status, and social behavior patterns. This complexity and variability make manual decisions inconsistent, justifying the application of Data Science and Machine Learning techniques to support default risk assessment and proactive customer portfolio management.

# 4. Getting Started

## 4.1 Importing Libraries

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.stats import chi2_contingency
from sklearn.preprocessing import RobustScaler, StandardScaler, MinMaxScaler, OneHotEncoder
from sklearn.model_selection import train_test_split
import xgboost as xgb
from sklearn.metrics import recall_score, precision_score, f1_score, roc_auc_score, average_pre
from skopt import BayesSearchCV
from skopt.space import Real, Integer, Categorical
import lightgbm as lgb
from imblearn.ensemble import BalancedRandomForestClassifier
from catboost import CatBoostClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.base import clone
from sklearn.ensemble import AdaBoostClassifier, HistGradientBoostingClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.linear_model import LogisticRegression
import shap
from sklearn.preprocessing import PolynomialFeatures
```

## 4.2 Style Import

In [2]:
```
plt.style.use('../styles/personalestilo.mplstyle')
```

```
Bad key axes.color_cycle in file ../styles/personalestilo.mplstyle, line 9 ('axes.color_cycle:
df691b, 5cb85c, 5bc0de, f0ad4e, d9534f, 4e5d6c')
You probably need to get an updated matplotlibrc file from
https://github.com/matplotlib/matplotlib/blob/v3.10.6/lib/matplotlib/mpl-data/matplotlibrc
or from the matplotlib source distribution
```

## 4.3 Additional Functions

In [2]:
```
def snake_case(lst):
    def convert(s):
        s = s.replace(' ', '_')
        new_s = ""
        for i, c in enumerate(s):
            if c.isupper():
                if i > 0 and (s[i-1].islower() or (i+1 < len(s) and s[i+1].islower())):
                    new_s += "_"
                new_s += c.lower()
            else:
                new_s += c
        return new_s
    return [convert(s) for s in lst]

def agg_numeric(df, key, prefix):
    df_num = df.select_dtypes(include=[np.number])

    df_num[key] = df[key]


    agg = df_num.groupby(key).agg(['mean', 'max', 'min', 'count'])

    agg.columns = [prefix + "_" + "_".join(col) for col in agg.columns]

    return agg
```

```python
def plot_numeric_block(df_block, bins=30, color='orange', rows=3, figsize=(18, 12)):
    plt.figure(figsize=figsize)
    cols = df_block.columns
    n_cols = int(np.ceil(len(cols) / rows))
    for i, col in enumerate(cols, 1):
        plt.subplot(rows, n_cols, i)
        sns.histplot(df_block[col], kde=True, color=color, bins=bins)
        plt.title(col)
        plt.xlabel(col)
        plt.ylabel('Frequência')
    plt.tight_layout()
    plt.show()


def plot_target_by_categorical(df, cat_col, target_col='target', suptitle=None):
    categorias = df[cat_col].unique()
    categorias = [str(c) for c in categorias]
    n_categorias = len(categorias)
    n_linhas = (n_categorias // 3) + (1 if n_categorias % 3 != 0 else 0)
    n_linhas = max(n_linhas, 1)
    ncols = 3 if n_categorias > 1 else 1

    fig, axes = plt.subplots(n_linhas, ncols, figsize=(7 * ncols, 5 * n_linhas))
    axes = np.array(axes).reshape(-1)

    palette_target = {'0': "orange", '1': "red"}

    for ax in axes[n_categorias:]:
        ax.axis('off')

    for i, categoria in enumerate(categorias):
        data_plot = df[df[cat_col] == categoria].copy()
        data_plot['target_str'] = data_plot[target_col].astype(str)
        sns.countplot(
            data=data_plot,
            x='target_str',
            hue='target_str',
            palette=palette_target,
            order=['0', '1'],
            ax=axes[i],
            legend=False
        )
        axes[i].set_title(f"{cat_col}: {categoria}")
        axes[i].set_xlabel(target_col)
        axes[i].set_ylabel('Frequência')
        axes[i].set_xticks([0, 1])
        axes[i].set_xticklabels(['Não Inadimplente (0)', 'Inadimplente (1)'])

    if suptitle is None:
        suptitle = f'Frequência de {target_col} por categoria de {cat_col}'
    plt.suptitle(suptitle)
    plt.tight_layout(rect=[0, 0, 1, 0.95])
    plt.show()

def find_best_threshold(y_true, y_proba, metric="f1"):
    thresholds = np.linspace(0, 1, 200)

    best_t = 0.5
    best_score = -1

    for t in thresholds:
        y_pred = (y_proba >= t).astype(int)

        if metric == "f1":
            score = f1_score(y_true, y_pred)
        elif metric == "mcc":
            score = matthews_corrcoef(y_true, y_pred)
        elif metric == "recall":
            score = recall_score(y_true, y_pred)
```

```python
        elif metric == "precision":
            score = precision_score(y_true, y_pred)
        elif metric == "f2":
            score = fbeta_score(y_true, y_pred, beta=2)
        elif metric == "f05":
            score = fbeta_score(y_true, y_pred, beta=0.5)
        else:
            raise ValueError("Métrica inválida.")

        if score > best_score:
            best_score = score
            best_t = t

    return best_t, best_score


def get_fold(X, idx):
    return X.iloc[idx] if hasattr(X, "iloc") else X[idx]

def get_model_clone(name, model):
    if "cat" in name:
        return CatBoostClassifier(**model.get_params())
    elif "xgb" in name:
        return xgb.XGBClassifier(**model.get_params())
    elif "lgbm" in name:
        return lgb.LGBMClassifier(**model.get_params())
    else:
        return clone(model)



def plot_binaria_target(
    df,
    var_binaria,
    target='target',
    label_0='Não Possui',
    label_1='Possui',
    suptitle=None
):
    flags = [0, 1]
    palette_target = {'0': "orange", '1': "red"}

    fig, axes = plt.subplots(1, 2, figsize=(14, 6), sharey=False)
    for i, flag in enumerate(flags):
        data_plot = df[df[var_binaria] == flag].copy()
        data_plot['target_str'] = data_plot[target].astype(str)
        sns.countplot(
            data=data_plot,
            x='target_str',
            hue='target_str',
            palette=palette_target,
            order=['0', '1'],
            ax=axes[i],
            legend=False
        )
        label = label_0 if flag == 0 else label_1
        axes[i].set_title(f"{label}")
        axes[i].set_xlabel('Resposta')
        axes[i].set_ylabel('Frequência')
        axes[i].set_xticks([0, 1])
        axes[i].set_xticklabels(['Não Inadimplente (0)', 'Inadimplente (1)'])

    if suptitle is None:
        suptitle = f'Frequência de {target} por {var_binaria}'
    plt.suptitle(suptitle)
    plt.tight_layout(rect=[0, 0, 1, 0.95])
    plt.show()
```

```python
def plot_num_var_by_target(
    df,
    num_var,
    target_var='target',
    title_0=None,
    title_1=None,
    label_x=None,
    color_0='blue',
    color_1='orange',
    figsize=(10, 8),
    discrete=False
):
    fig, axes = plt.subplots(2, 1, figsize=figsize, sharey=False)

    sns.histplot(
        data=df[df[target_var] == 0],
        x=num_var,
        color=color_0,
        ax=axes[0],
        discrete=discrete
    )
    axes[0].set_title(title_0 or f'Distribuição de {num_var} (Sem Inadimplência)')
    axes[0].set_ylabel('Frequência')
    axes[0].set_xlabel(label_x or num_var)

    sns.histplot(
        data=df[df[target_var] == 1],
        x=num_var,
        color=color_1,
        ax=axes[1],
        discrete=discrete
    )
    axes[1].set_title(title_1 or f'Distribuição de {num_var} (Inadimplentes)')
    axes[1].set_ylabel('Frequência')
    axes[1].set_xlabel(label_x or num_var)

    plt.tight_layout()
    plt.show()


def calcular_cramers_v(df, col1, col2):
    contingency_table = pd.crosstab(df[col1], df[col2])
    chi2_stat, p, dof, expected = chi2_contingency(contingency_table)
    n = contingency_table.sum().sum()
    min_dim = min(contingency_table.shape) - 1
    cramers_v = np.sqrt(chi2_stat / (n * min_dim)) if min_dim > 0 else np.nan
    print(f"V de Cramer entre {col1} e {col2}: {cramers_v:.4f}")


def avaliar_metricas(modelo, X_val, y_val, X_test, y_test):
    def obter_prob(modelo, X):
        if hasattr(modelo, "predict_proba"):
            probas = modelo.predict_proba(X)
            return probas[:, 1]
        elif hasattr(modelo, "predict"):
            if isinstance(X, (pd.DataFrame, pd.Series, np.ndarray)):
                dmatrix = xgb.DMatrix(X)
            else:
                dmatrix = X
            probas = modelo.predict(dmatrix)
            return probas
        else:
            raise ValueError("O modelo precisa implementar predict_proba ou ser booster do xgbo

    y_val_prob = obter_prob(modelo, X_val)
    y_test_prob = obter_prob(modelo, X_test)

    y_val_pred = (y_val_prob >= 0.5).astype(int)
    y_test_pred = (y_test_prob >= 0.5).astype(int)
```

```
    metrics = {
        'recall': [
            recall_score(y_val, y_val_pred),
            recall_score(y_test, y_test_pred)
        ],
        'precision': [
            precision_score(y_val, y_val_pred),
            precision_score(y_test, y_test_pred)
        ],
        'f1_score': [
            f1_score(y_val, y_val_pred),
            f1_score(y_test, y_test_pred)
        ],
        'auc_roc': [
            roc_auc_score(y_val, y_val_prob),
            roc_auc_score(y_test, y_test_prob)
        ],
        'auc_pr': [
            average_precision_score(y_val, y_val_prob),
            average_precision_score(y_test, y_test_prob)
        ]
    }
    df_metrics = pd.DataFrame(metrics, index=['validacao', 'teste']).T
    return df_metrics


def income_stability(row):
    low_income_types = ['Unemployed', 'Student', 'Maternity leave', 'Pensioner']
    high_income_types = ['State servant', 'Businessman', 'Civil servant']
    stable_occupations = [
        'Accountants', 'Core staff', 'HR staff', 'High skill tech staff', 'Managers', 'Medicine
        'Private service staff', 'Secretaries', 'Officials', 'IT staff'
    ]
    unstable_occupations = [
        'Laborers', 'Low-skill Laborers', 'Cleaning staff', 'Waiters/barmen staff', 'Security s
    ]
    inc_type = str(row['name_income_type'])
    occ_type = str(row['occupation_type'])
    days_employed = abs(row['days_employed']) if not pd.isnull(row['days_employed']) else 0

    if (inc_type in low_income_types) or (occ_type in unstable_occupations) or (days_employed <
        return 0
    elif (inc_type in high_income_types) or (occ_type in stable_occupations and days_employed >
        return 2
    else:
        return 1
```

## 4.4 Loading the Data

In [4]:
```
app_train = pd.read_csv('../data/application_train.csv')
app_test = pd.read_csv('../data/application_test.csv')
```

In [5]:
```
bureau = pd.read_csv('../data/bureau.csv')
bureau.name = "bureau"

bureau_balance = pd.read_csv('../data/bureau_balance.csv')
bureau_balance.name = "bb"

prev = pd.read_csv('../data/previous_application.csv')
prev.name = "prev"

pos = pd.read_csv('../data/POS_CASH_balance.csv')
pos.name = "pos"

cc = pd.read_csv('../data/credit_card_balance.csv')
cc.name = "cc"
```

```
inst = pd.read_csv('../data/installments_payments.csv')
inst.name = "inst"
```

In [6]:
```
bb_agg = agg_numeric(bureau_balance, 'SK_ID_BUREAU', 'bb')
bureau = bureau.merge(bb_agg, on='SK_ID_BUREAU', how='left')

bureau_agg = agg_numeric(bureau, 'SK_ID_CURR', 'bur')

prev_agg = agg_numeric(prev, 'SK_ID_CURR', 'prev')

pos_agg = agg_numeric(pos, 'SK_ID_PREV', 'pos')

prev_pos = prev[['SK_ID_CURR','SK_ID_PREV']].merge(pos_agg, on='SK_ID_PREV', how='left')
pos_final = agg_numeric(prev_pos, 'SK_ID_CURR', 'posf')

cc_agg = agg_numeric(cc, 'SK_ID_PREV', 'cc')

prev_cc = prev[['SK_ID_CURR','SK_ID_PREV']].merge(cc_agg, on='SK_ID_PREV', how='left')
cc_final = agg_numeric(prev_cc, 'SK_ID_CURR', 'ccf')

inst_agg = agg_numeric(inst, 'SK_ID_PREV', 'inst')

prev_inst = prev[['SK_ID_CURR','SK_ID_PREV']].merge(inst_agg, on='SK_ID_PREV', how='left')
inst_final = agg_numeric(prev_inst, 'SK_ID_CURR', 'instf')

df = app_train.copy()
df_test = app_test.copy()

for auxiliary in [bureau_agg, prev_agg, pos_final, cc_final, inst_final]:
    df = df.merge(auxiliary, on='SK_ID_CURR', how='left')
    df_test = df_test.merge(auxiliary, on='SK_ID_CURR', how='left')
```

In [31]:
```
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)
```

In [8]:
```
df.to_csv('../data/train.csv', index=False)
df_test.to_csv('../data/test.csv', index=False)
```

# 5. Data Description

In [ ]:
```
df1 = df.copy()
```

## 5.1 Renaming Columns

In [4]:
```
cols_old = list(df1.columns)

cols_old = list(df1.columns)

cols_new = snake_case(cols_old)

df1.columns = cols_new
```

In [5]:
```
for idx, (col, dtype) in enumerate(df1.dtypes.items(), 1):
    print(f'{idx} - {col}: {dtype}')
```

```
1 - sk_id_curr: int64
2 - target: int64
3 - name_contract_type: object
4 - code_gender: object
5 - flag_own_car: object
6 - flag_own_realty: object
7 - cnt_children: int64
8 - amt_income_total: float64
9 - amt_credit: float64
10 - amt_annuity: float64
11 - amt_goods_price: float64
12 - name_type_suite: object
13 - name_income_type: object
14 - name_education_type: object
15 - name_family_status: object
16 - name_housing_type: object
17 - region_population_relative: float64
18 - days_birth: int64
19 - days_employed: int64
20 - days_registration: float64
21 - days_id_publish: int64
22 - own_car_age: float64
23 - flag_mobil: int64
24 - flag_emp_phone: int64
25 - flag_work_phone: int64
26 - flag_cont_mobile: int64
27 - flag_phone: int64
28 - flag_email: int64
29 - occupation_type: object
30 - cnt_fam_members: float64
31 - region_rating_client: int64
32 - region_rating_client_w_city: int64
33 - weekday_appr_process_start: object
34 - hour_appr_process_start: int64
35 - reg_region_not_live_region: int64
36 - reg_region_not_work_region: int64
37 - live_region_not_work_region: int64
38 - reg_city_not_live_city: int64
39 - reg_city_not_work_city: int64
40 - live_city_not_work_city: int64
41 - organization_type: object
42 - ext_source_1: float64
43 - ext_source_2: float64
44 - ext_source_3: float64
45 - apartments_avg: float64
46 - basementarea_avg: float64
47 - years_beginexpluatation_avg: float64
48 - years_build_avg: float64
49 - commonarea_avg: float64
50 - elevators_avg: float64
51 - entrances_avg: float64
52 - floorsmax_avg: float64
53 - floorsmin_avg: float64
54 - landarea_avg: float64
55 - livingapartments_avg: float64
56 - livingarea_avg: float64
57 - nonlivingapartments_avg: float64
58 - nonlivingarea_avg: float64
59 - apartments_mode: float64
60 - basementarea_mode: float64
61 - years_beginexpluatation_mode: float64
62 - years_build_mode: float64
63 - commonarea_mode: float64
64 - elevators_mode: float64
65 - entrances_mode: float64
66 - floorsmax_mode: float64
67 - floorsmin_mode: float64
68 - landarea_mode: float64
69 - livingapartments_mode: float64
```

```
70 - livingarea_mode: float64
71 - nonlivingapartments_mode: float64
72 - nonlivingarea_mode: float64
73 - apartments_medi: float64
74 - basementarea_medi: float64
75 - years_beginexpluatation_medi: float64
76 - years_build_medi: float64
77 - commonarea_medi: float64
78 - elevators_medi: float64
79 - entrances_medi: float64
80 - floorsmax_medi: float64
81 - floorsmin_medi: float64
82 - landarea_medi: float64
83 - livingapartments_medi: float64
84 - livingarea_medi: float64
85 - nonlivingapartments_medi: float64
86 - nonlivingarea_medi: float64
87 - fondkapremont_mode: object
88 - housetype_mode: object
89 - totalarea_mode: float64
90 - wallsmaterial_mode: object
91 - emergencystate_mode: object
92 - obs_30_cnt_social_circle: float64
93 - def_30_cnt_social_circle: float64
94 - obs_60_cnt_social_circle: float64
95 - def_60_cnt_social_circle: float64
96 - days_last_phone_change: float64
97 - flag_document_2: int64
98 - flag_document_3: int64
99 - flag_document_4: int64
100 - flag_document_5: int64
101 - flag_document_6: int64
102 - flag_document_7: int64
103 - flag_document_8: int64
104 - flag_document_9: int64
105 - flag_document_10: int64
106 - flag_document_11: int64
107 - flag_document_12: int64
108 - flag_document_13: int64
109 - flag_document_14: int64
110 - flag_document_15: int64
111 - flag_document_16: int64
112 - flag_document_17: int64
113 - flag_document_18: int64
114 - flag_document_19: int64
115 - flag_document_20: int64
116 - flag_document_21: int64
117 - amt_req_credit_bureau_hour: float64
118 - amt_req_credit_bureau_day: float64
119 - amt_req_credit_bureau_week: float64
120 - amt_req_credit_bureau_mon: float64
121 - amt_req_credit_bureau_qrt: float64
122 - amt_req_credit_bureau_year: float64
123 - bur_sk_id_bureau_mean: float64
124 - bur_sk_id_bureau_max: float64
125 - bur_sk_id_bureau_min: float64
126 - bur_sk_id_bureau_count: float64
127 - bur_days_credit_mean: float64
128 - bur_days_credit_max: float64
129 - bur_days_credit_min: float64
130 - bur_days_credit_count: float64
131 - bur_credit_day_overdue_mean: float64
132 - bur_credit_day_overdue_max: float64
133 - bur_credit_day_overdue_min: float64
134 - bur_credit_day_overdue_count: float64
135 - bur_days_credit_enddate_mean: float64
136 - bur_days_credit_enddate_max: float64
137 - bur_days_credit_enddate_min: float64
138 - bur_days_credit_enddate_count: float64
```

```
139 - bur_days_enddate_fact_mean: float64
140 - bur_days_enddate_fact_max: float64
141 - bur_days_enddate_fact_min: float64
142 - bur_days_enddate_fact_count: float64
143 - bur_amt_credit_max_overdue_mean: float64
144 - bur_amt_credit_max_overdue_max: float64
145 - bur_amt_credit_max_overdue_min: float64
146 - bur_amt_credit_max_overdue_count: float64
147 - bur_cnt_credit_prolong_mean: float64
148 - bur_cnt_credit_prolong_max: float64
149 - bur_cnt_credit_prolong_min: float64
150 - bur_cnt_credit_prolong_count: float64
151 - bur_amt_credit_sum_mean: float64
152 - bur_amt_credit_sum_max: float64
153 - bur_amt_credit_sum_min: float64
154 - bur_amt_credit_sum_count: float64
155 - bur_amt_credit_sum_debt_mean: float64
156 - bur_amt_credit_sum_debt_max: float64
157 - bur_amt_credit_sum_debt_min: float64
158 - bur_amt_credit_sum_debt_count: float64
159 - bur_amt_credit_sum_limit_mean: float64
160 - bur_amt_credit_sum_limit_max: float64
161 - bur_amt_credit_sum_limit_min: float64
162 - bur_amt_credit_sum_limit_count: float64
163 - bur_amt_credit_sum_overdue_mean: float64
164 - bur_amt_credit_sum_overdue_max: float64
165 - bur_amt_credit_sum_overdue_min: float64
166 - bur_amt_credit_sum_overdue_count: float64
167 - bur_days_credit_update_mean: float64
168 - bur_days_credit_update_max: float64
169 - bur_days_credit_update_min: float64
170 - bur_days_credit_update_count: float64
171 - bur_amt_annuity_mean: float64
172 - bur_amt_annuity_max: float64
173 - bur_amt_annuity_min: float64
174 - bur_amt_annuity_count: float64
175 - bur_bb_months_balance_mean_mean: float64
176 - bur_bb_months_balance_mean_max: float64
177 - bur_bb_months_balance_mean_min: float64
178 - bur_bb_months_balance_mean_count: float64
179 - bur_bb_months_balance_max_mean: float64
180 - bur_bb_months_balance_max_max: float64
181 - bur_bb_months_balance_max_min: float64
182 - bur_bb_months_balance_max_count: float64
183 - bur_bb_months_balance_min_mean: float64
184 - bur_bb_months_balance_min_max: float64
185 - bur_bb_months_balance_min_min: float64
186 - bur_bb_months_balance_min_count: float64
187 - bur_bb_months_balance_count_mean: float64
188 - bur_bb_months_balance_count_max: float64
189 - bur_bb_months_balance_count_min: float64
190 - bur_bb_months_balance_count_count: float64
191 - prev_sk_id_prev_mean: float64
192 - prev_sk_id_prev_max: float64
193 - prev_sk_id_prev_min: float64
194 - prev_sk_id_prev_count: float64
195 - prev_amt_annuity_mean: float64
196 - prev_amt_annuity_max: float64
197 - prev_amt_annuity_min: float64
198 - prev_amt_annuity_count: float64
199 - prev_amt_application_mean: float64
200 - prev_amt_application_max: float64
201 - prev_amt_application_min: float64
202 - prev_amt_application_count: float64
203 - prev_amt_credit_mean: float64
204 - prev_amt_credit_max: float64
205 - prev_amt_credit_min: float64
206 - prev_amt_credit_count: float64
207 - prev_amt_down_payment_mean: float64
```

208 - prev_amt_down_payment_max: float64
209 - prev_amt_down_payment_min: float64
210 - prev_amt_down_payment_count: float64
211 - prev_amt_goods_price_mean: float64
212 - prev_amt_goods_price_max: float64
213 - prev_amt_goods_price_min: float64
214 - prev_amt_goods_price_count: float64
215 - prev_hour_appr_process_start_mean: float64
216 - prev_hour_appr_process_start_max: float64
217 - prev_hour_appr_process_start_min: float64
218 - prev_hour_appr_process_start_count: float64
219 - prev_nflag_last_appl_in_day_mean: float64
220 - prev_nflag_last_appl_in_day_max: float64
221 - prev_nflag_last_appl_in_day_min: float64
222 - prev_nflag_last_appl_in_day_count: float64
223 - prev_rate_down_payment_mean: float64
224 - prev_rate_down_payment_max: float64
225 - prev_rate_down_payment_min: float64
226 - prev_rate_down_payment_count: float64
227 - prev_rate_interest_primary_mean: float64
228 - prev_rate_interest_primary_max: float64
229 - prev_rate_interest_primary_min: float64
230 - prev_rate_interest_primary_count: float64
231 - prev_rate_interest_privileged_mean: float64
232 - prev_rate_interest_privileged_max: float64
233 - prev_rate_interest_privileged_min: float64
234 - prev_rate_interest_privileged_count: float64
235 - prev_days_decision_mean: float64
236 - prev_days_decision_max: float64
237 - prev_days_decision_min: float64
238 - prev_days_decision_count: float64
239 - prev_sellerplace_area_mean: float64
240 - prev_sellerplace_area_max: float64
241 - prev_sellerplace_area_min: float64
242 - prev_sellerplace_area_count: float64
243 - prev_cnt_payment_mean: float64
244 - prev_cnt_payment_max: float64
245 - prev_cnt_payment_min: float64
246 - prev_cnt_payment_count: float64
247 - prev_days_first_drawing_mean: float64
248 - prev_days_first_drawing_max: float64
249 - prev_days_first_drawing_min: float64
250 - prev_days_first_drawing_count: float64
251 - prev_days_first_due_mean: float64
252 - prev_days_first_due_max: float64
253 - prev_days_first_due_min: float64
254 - prev_days_first_due_count: float64
255 - prev_days_last_due_1st_version_mean: float64
256 - prev_days_last_due_1st_version_max: float64
257 - prev_days_last_due_1st_version_min: float64
258 - prev_days_last_due_1st_version_count: float64
259 - prev_days_last_due_mean: float64
260 - prev_days_last_due_max: float64
261 - prev_days_last_due_min: float64
262 - prev_days_last_due_count: float64
263 - prev_days_termination_mean: float64
264 - prev_days_termination_max: float64
265 - prev_days_termination_min: float64
266 - prev_days_termination_count: float64
267 - prev_nflag_insured_on_approval_mean: float64
268 - prev_nflag_insured_on_approval_max: float64
269 - prev_nflag_insured_on_approval_min: float64
270 - prev_nflag_insured_on_approval_count: float64
271 - posf_sk_id_prev_mean: float64
272 - posf_sk_id_prev_max: float64
273 - posf_sk_id_prev_min: float64
274 - posf_sk_id_prev_count: float64
275 - posf_pos_sk_id_curr_mean_mean: float64
276 - posf_pos_sk_id_curr_mean_max: float64

277 - posf_pos_sk_id_curr_mean_min: float64
278 - posf_pos_sk_id_curr_mean_count: float64
279 - posf_pos_sk_id_curr_max_mean: float64
280 - posf_pos_sk_id_curr_max_max: float64
281 - posf_pos_sk_id_curr_max_min: float64
282 - posf_pos_sk_id_curr_max_count: float64
283 - posf_pos_sk_id_curr_min_mean: float64
284 - posf_pos_sk_id_curr_min_max: float64
285 - posf_pos_sk_id_curr_min_min: float64
286 - posf_pos_sk_id_curr_min_count: float64
287 - posf_pos_sk_id_curr_count_mean: float64
288 - posf_pos_sk_id_curr_count_max: float64
289 - posf_pos_sk_id_curr_count_min: float64
290 - posf_pos_sk_id_curr_count_count: float64
291 - posf_pos_months_balance_mean_mean: float64
292 - posf_pos_months_balance_mean_max: float64
293 - posf_pos_months_balance_mean_min: float64
294 - posf_pos_months_balance_mean_count: float64
295 - posf_pos_months_balance_max_mean: float64
296 - posf_pos_months_balance_max_max: float64
297 - posf_pos_months_balance_max_min: float64
298 - posf_pos_months_balance_max_count: float64
299 - posf_pos_months_balance_min_mean: float64
300 - posf_pos_months_balance_min_max: float64
301 - posf_pos_months_balance_min_min: float64
302 - posf_pos_months_balance_min_count: float64
303 - posf_pos_months_balance_count_mean: float64
304 - posf_pos_months_balance_count_max: float64
305 - posf_pos_months_balance_count_min: float64
306 - posf_pos_months_balance_count_count: float64
307 - posf_pos_cnt_instalment_mean_mean: float64
308 - posf_pos_cnt_instalment_mean_max: float64
309 - posf_pos_cnt_instalment_mean_min: float64
310 - posf_pos_cnt_instalment_mean_count: float64
311 - posf_pos_cnt_instalment_max_mean: float64
312 - posf_pos_cnt_instalment_max_max: float64
313 - posf_pos_cnt_instalment_max_min: float64
314 - posf_pos_cnt_instalment_max_count: float64
315 - posf_pos_cnt_instalment_min_mean: float64
316 - posf_pos_cnt_instalment_min_max: float64
317 - posf_pos_cnt_instalment_min_min: float64
318 - posf_pos_cnt_instalment_min_count: float64
319 - posf_pos_cnt_instalment_count_mean: float64
320 - posf_pos_cnt_instalment_count_max: float64
321 - posf_pos_cnt_instalment_count_min: float64
322 - posf_pos_cnt_instalment_count_count: float64
323 - posf_pos_cnt_instalment_future_mean_mean: float64
324 - posf_pos_cnt_instalment_future_mean_max: float64
325 - posf_pos_cnt_instalment_future_mean_min: float64
326 - posf_pos_cnt_instalment_future_mean_count: float64
327 - posf_pos_cnt_instalment_future_max_mean: float64
328 - posf_pos_cnt_instalment_future_max_max: float64
329 - posf_pos_cnt_instalment_future_max_min: float64
330 - posf_pos_cnt_instalment_future_max_count: float64
331 - posf_pos_cnt_instalment_future_min_mean: float64
332 - posf_pos_cnt_instalment_future_min_max: float64
333 - posf_pos_cnt_instalment_future_min_min: float64
334 - posf_pos_cnt_instalment_future_min_count: float64
335 - posf_pos_cnt_instalment_future_count_mean: float64
336 - posf_pos_cnt_instalment_future_count_max: float64
337 - posf_pos_cnt_instalment_future_count_min: float64
338 - posf_pos_cnt_instalment_future_count_count: float64
339 - posf_pos_sk_dpd_mean_mean: float64
340 - posf_pos_sk_dpd_mean_max: float64
341 - posf_pos_sk_dpd_mean_min: float64
342 - posf_pos_sk_dpd_mean_count: float64
343 - posf_pos_sk_dpd_max_mean: float64
344 - posf_pos_sk_dpd_max_max: float64
345 - posf_pos_sk_dpd_max_min: float64

346 - posf_pos_sk_dpd_max_count: float64
347 - posf_pos_sk_dpd_min_mean: float64
348 - posf_pos_sk_dpd_min_max: float64
349 - posf_pos_sk_dpd_min_min: float64
350 - posf_pos_sk_dpd_min_count: float64
351 - posf_pos_sk_dpd_count_mean: float64
352 - posf_pos_sk_dpd_count_max: float64
353 - posf_pos_sk_dpd_count_min: float64
354 - posf_pos_sk_dpd_count_count: float64
355 - posf_pos_sk_dpd_def_mean_mean: float64
356 - posf_pos_sk_dpd_def_mean_max: float64
357 - posf_pos_sk_dpd_def_mean_min: float64
358 - posf_pos_sk_dpd_def_mean_count: float64
359 - posf_pos_sk_dpd_def_max_mean: float64
360 - posf_pos_sk_dpd_def_max_max: float64
361 - posf_pos_sk_dpd_def_max_min: float64
362 - posf_pos_sk_dpd_def_max_count: float64
363 - posf_pos_sk_dpd_def_min_mean: float64
364 - posf_pos_sk_dpd_def_min_max: float64
365 - posf_pos_sk_dpd_def_min_min: float64
366 - posf_pos_sk_dpd_def_min_count: float64
367 - posf_pos_sk_dpd_def_count_mean: float64
368 - posf_pos_sk_dpd_def_count_max: float64
369 - posf_pos_sk_dpd_def_count_min: float64
370 - posf_pos_sk_dpd_def_count_count: float64
371 - ccf_sk_id_prev_mean: float64
372 - ccf_sk_id_prev_max: float64
373 - ccf_sk_id_prev_min: float64
374 - ccf_sk_id_prev_count: float64
375 - ccf_cc_sk_id_curr_mean_mean: float64
376 - ccf_cc_sk_id_curr_mean_max: float64
377 - ccf_cc_sk_id_curr_mean_min: float64
378 - ccf_cc_sk_id_curr_mean_count: float64
379 - ccf_cc_sk_id_curr_max_mean: float64
380 - ccf_cc_sk_id_curr_max_max: float64
381 - ccf_cc_sk_id_curr_max_min: float64
382 - ccf_cc_sk_id_curr_max_count: float64
383 - ccf_cc_sk_id_curr_min_mean: float64
384 - ccf_cc_sk_id_curr_min_max: float64
385 - ccf_cc_sk_id_curr_min_min: float64
386 - ccf_cc_sk_id_curr_min_count: float64
387 - ccf_cc_sk_id_curr_count_mean: float64
388 - ccf_cc_sk_id_curr_count_max: float64
389 - ccf_cc_sk_id_curr_count_min: float64
390 - ccf_cc_sk_id_curr_count_count: float64
391 - ccf_cc_months_balance_mean_mean: float64
392 - ccf_cc_months_balance_mean_max: float64
393 - ccf_cc_months_balance_mean_min: float64
394 - ccf_cc_months_balance_mean_count: float64
395 - ccf_cc_months_balance_max_mean: float64
396 - ccf_cc_months_balance_max_max: float64
397 - ccf_cc_months_balance_max_min: float64
398 - ccf_cc_months_balance_max_count: float64
399 - ccf_cc_months_balance_min_mean: float64
400 - ccf_cc_months_balance_min_max: float64
401 - ccf_cc_months_balance_min_min: float64
402 - ccf_cc_months_balance_min_count: float64
403 - ccf_cc_months_balance_count_mean: float64
404 - ccf_cc_months_balance_count_max: float64
405 - ccf_cc_months_balance_count_min: float64
406 - ccf_cc_months_balance_count_count: float64
407 - ccf_cc_amt_balance_mean_mean: float64
408 - ccf_cc_amt_balance_mean_max: float64
409 - ccf_cc_amt_balance_mean_min: float64
410 - ccf_cc_amt_balance_mean_count: float64
411 - ccf_cc_amt_balance_max_mean: float64
412 - ccf_cc_amt_balance_max_max: float64
413 - ccf_cc_amt_balance_max_min: float64
414 - ccf_cc_amt_balance_max_count: float64

```
415 - ccf_cc_amt_balance_min_mean: float64
416 - ccf_cc_amt_balance_min_max: float64
417 - ccf_cc_amt_balance_min_min: float64
418 - ccf_cc_amt_balance_min_count: float64
419 - ccf_cc_amt_balance_count_mean: float64
420 - ccf_cc_amt_balance_count_max: float64
421 - ccf_cc_amt_balance_count_min: float64
422 - ccf_cc_amt_balance_count_count: float64
423 - ccf_cc_amt_credit_limit_actual_mean_mean: float64
424 - ccf_cc_amt_credit_limit_actual_mean_max: float64
425 - ccf_cc_amt_credit_limit_actual_mean_min: float64
426 - ccf_cc_amt_credit_limit_actual_mean_count: float64
427 - ccf_cc_amt_credit_limit_actual_max_mean: float64
428 - ccf_cc_amt_credit_limit_actual_max_max: float64
429 - ccf_cc_amt_credit_limit_actual_max_min: float64
430 - ccf_cc_amt_credit_limit_actual_max_count: float64
431 - ccf_cc_amt_credit_limit_actual_min_mean: float64
432 - ccf_cc_amt_credit_limit_actual_min_max: float64
433 - ccf_cc_amt_credit_limit_actual_min_min: float64
434 - ccf_cc_amt_credit_limit_actual_min_count: float64
435 - ccf_cc_amt_credit_limit_actual_count_mean: float64
436 - ccf_cc_amt_credit_limit_actual_count_max: float64
437 - ccf_cc_amt_credit_limit_actual_count_min: float64
438 - ccf_cc_amt_credit_limit_actual_count_count: float64
439 - ccf_cc_amt_drawings_atm_current_mean_mean: float64
440 - ccf_cc_amt_drawings_atm_current_mean_max: float64
441 - ccf_cc_amt_drawings_atm_current_mean_min: float64
442 - ccf_cc_amt_drawings_atm_current_mean_count: float64
443 - ccf_cc_amt_drawings_atm_current_max_mean: float64
444 - ccf_cc_amt_drawings_atm_current_max_max: float64
445 - ccf_cc_amt_drawings_atm_current_max_min: float64
446 - ccf_cc_amt_drawings_atm_current_max_count: float64
447 - ccf_cc_amt_drawings_atm_current_min_mean: float64
448 - ccf_cc_amt_drawings_atm_current_min_max: float64
449 - ccf_cc_amt_drawings_atm_current_min_min: float64
450 - ccf_cc_amt_drawings_atm_current_min_count: float64
451 - ccf_cc_amt_drawings_atm_current_count_mean: float64
452 - ccf_cc_amt_drawings_atm_current_count_max: float64
453 - ccf_cc_amt_drawings_atm_current_count_min: float64
454 - ccf_cc_amt_drawings_atm_current_count_count: float64
455 - ccf_cc_amt_drawings_current_mean_mean: float64
456 - ccf_cc_amt_drawings_current_mean_max: float64
457 - ccf_cc_amt_drawings_current_mean_min: float64
458 - ccf_cc_amt_drawings_current_mean_count: float64
459 - ccf_cc_amt_drawings_current_max_mean: float64
460 - ccf_cc_amt_drawings_current_max_max: float64
461 - ccf_cc_amt_drawings_current_max_min: float64
462 - ccf_cc_amt_drawings_current_max_count: float64
463 - ccf_cc_amt_drawings_current_min_mean: float64
464 - ccf_cc_amt_drawings_current_min_max: float64
465 - ccf_cc_amt_drawings_current_min_min: float64
466 - ccf_cc_amt_drawings_current_min_count: float64
467 - ccf_cc_amt_drawings_current_count_mean: float64
468 - ccf_cc_amt_drawings_current_count_max: float64
469 - ccf_cc_amt_drawings_current_count_min: float64
470 - ccf_cc_amt_drawings_current_count_count: float64
471 - ccf_cc_amt_drawings_other_current_mean_mean: float64
472 - ccf_cc_amt_drawings_other_current_mean_max: float64
473 - ccf_cc_amt_drawings_other_current_mean_min: float64
474 - ccf_cc_amt_drawings_other_current_mean_count: float64
475 - ccf_cc_amt_drawings_other_current_max_mean: float64
476 - ccf_cc_amt_drawings_other_current_max_max: float64
477 - ccf_cc_amt_drawings_other_current_max_min: float64
478 - ccf_cc_amt_drawings_other_current_max_count: float64
479 - ccf_cc_amt_drawings_other_current_min_mean: float64
480 - ccf_cc_amt_drawings_other_current_min_max: float64
481 - ccf_cc_amt_drawings_other_current_min_min: float64
482 - ccf_cc_amt_drawings_other_current_min_count: float64
483 - ccf_cc_amt_drawings_other_current_count_mean: float64
```

484 - ccf_cc_amt_drawings_other_current_count_max: float64
485 - ccf_cc_amt_drawings_other_current_count_min: float64
486 - ccf_cc_amt_drawings_other_current_count_count: float64
487 - ccf_cc_amt_drawings_pos_current_mean_mean: float64
488 - ccf_cc_amt_drawings_pos_current_mean_max: float64
489 - ccf_cc_amt_drawings_pos_current_mean_min: float64
490 - ccf_cc_amt_drawings_pos_current_mean_count: float64
491 - ccf_cc_amt_drawings_pos_current_max_mean: float64
492 - ccf_cc_amt_drawings_pos_current_max_max: float64
493 - ccf_cc_amt_drawings_pos_current_max_min: float64
494 - ccf_cc_amt_drawings_pos_current_max_count: float64
495 - ccf_cc_amt_drawings_pos_current_min_mean: float64
496 - ccf_cc_amt_drawings_pos_current_min_max: float64
497 - ccf_cc_amt_drawings_pos_current_min_min: float64
498 - ccf_cc_amt_drawings_pos_current_min_count: float64
499 - ccf_cc_amt_drawings_pos_current_count_mean: float64
500 - ccf_cc_amt_drawings_pos_current_count_max: float64
501 - ccf_cc_amt_drawings_pos_current_count_min: float64
502 - ccf_cc_amt_drawings_pos_current_count_count: float64
503 - ccf_cc_amt_inst_min_regularity_mean_mean: float64
504 - ccf_cc_amt_inst_min_regularity_mean_max: float64
505 - ccf_cc_amt_inst_min_regularity_mean_min: float64
506 - ccf_cc_amt_inst_min_regularity_mean_count: float64
507 - ccf_cc_amt_inst_min_regularity_max_mean: float64
508 - ccf_cc_amt_inst_min_regularity_max_max: float64
509 - ccf_cc_amt_inst_min_regularity_max_min: float64
510 - ccf_cc_amt_inst_min_regularity_max_count: float64
511 - ccf_cc_amt_inst_min_regularity_min_mean: float64
512 - ccf_cc_amt_inst_min_regularity_min_max: float64
513 - ccf_cc_amt_inst_min_regularity_min_min: float64
514 - ccf_cc_amt_inst_min_regularity_min_count: float64
515 - ccf_cc_amt_inst_min_regularity_count_mean: float64
516 - ccf_cc_amt_inst_min_regularity_count_max: float64
517 - ccf_cc_amt_inst_min_regularity_count_min: float64
518 - ccf_cc_amt_inst_min_regularity_count_count: float64
519 - ccf_cc_amt_payment_current_mean_mean: float64
520 - ccf_cc_amt_payment_current_mean_max: float64
521 - ccf_cc_amt_payment_current_mean_min: float64
522 - ccf_cc_amt_payment_current_mean_count: float64
523 - ccf_cc_amt_payment_current_max_mean: float64
524 - ccf_cc_amt_payment_current_max_max: float64
525 - ccf_cc_amt_payment_current_max_min: float64
526 - ccf_cc_amt_payment_current_max_count: float64
527 - ccf_cc_amt_payment_current_min_mean: float64
528 - ccf_cc_amt_payment_current_min_max: float64
529 - ccf_cc_amt_payment_current_min_min: float64
530 - ccf_cc_amt_payment_current_min_count: float64
531 - ccf_cc_amt_payment_current_count_mean: float64
532 - ccf_cc_amt_payment_current_count_max: float64
533 - ccf_cc_amt_payment_current_count_min: float64
534 - ccf_cc_amt_payment_current_count_count: float64
535 - ccf_cc_amt_payment_total_current_mean_mean: float64
536 - ccf_cc_amt_payment_total_current_mean_max: float64
537 - ccf_cc_amt_payment_total_current_mean_min: float64
538 - ccf_cc_amt_payment_total_current_mean_count: float64
539 - ccf_cc_amt_payment_total_current_max_mean: float64
540 - ccf_cc_amt_payment_total_current_max_max: float64
541 - ccf_cc_amt_payment_total_current_max_min: float64
542 - ccf_cc_amt_payment_total_current_max_count: float64
543 - ccf_cc_amt_payment_total_current_min_mean: float64
544 - ccf_cc_amt_payment_total_current_min_max: float64
545 - ccf_cc_amt_payment_total_current_min_min: float64
546 - ccf_cc_amt_payment_total_current_min_count: float64
547 - ccf_cc_amt_payment_total_current_count_mean: float64
548 - ccf_cc_amt_payment_total_current_count_max: float64
549 - ccf_cc_amt_payment_total_current_count_min: float64
550 - ccf_cc_amt_payment_total_current_count_count: float64
551 - ccf_cc_amt_receivable_principal_mean_mean: float64
552 - ccf_cc_amt_receivable_principal_mean_max: float64

553 - ccf_cc_amt_receivable_principal_mean_min: float64
554 - ccf_cc_amt_receivable_principal_mean_count: float64
555 - ccf_cc_amt_receivable_principal_max_mean: float64
556 - ccf_cc_amt_receivable_principal_max_max: float64
557 - ccf_cc_amt_receivable_principal_max_min: float64
558 - ccf_cc_amt_receivable_principal_max_count: float64
559 - ccf_cc_amt_receivable_principal_min_mean: float64
560 - ccf_cc_amt_receivable_principal_min_max: float64
561 - ccf_cc_amt_receivable_principal_min_min: float64
562 - ccf_cc_amt_receivable_principal_min_count: float64
563 - ccf_cc_amt_receivable_principal_count_mean: float64
564 - ccf_cc_amt_receivable_principal_count_max: float64
565 - ccf_cc_amt_receivable_principal_count_min: float64
566 - ccf_cc_amt_receivable_principal_count_count: float64
567 - ccf_cc_amt_recivable_mean_mean: float64
568 - ccf_cc_amt_recivable_mean_max: float64
569 - ccf_cc_amt_recivable_mean_min: float64
570 - ccf_cc_amt_recivable_mean_count: float64
571 - ccf_cc_amt_recivable_max_mean: float64
572 - ccf_cc_amt_recivable_max_max: float64
573 - ccf_cc_amt_recivable_max_min: float64
574 - ccf_cc_amt_recivable_max_count: float64
575 - ccf_cc_amt_recivable_min_mean: float64
576 - ccf_cc_amt_recivable_min_max: float64
577 - ccf_cc_amt_recivable_min_min: float64
578 - ccf_cc_amt_recivable_min_count: float64
579 - ccf_cc_amt_recivable_count_mean: float64
580 - ccf_cc_amt_recivable_count_max: float64
581 - ccf_cc_amt_recivable_count_min: float64
582 - ccf_cc_amt_recivable_count_count: float64
583 - ccf_cc_amt_total_receivable_mean_mean: float64
584 - ccf_cc_amt_total_receivable_mean_max: float64
585 - ccf_cc_amt_total_receivable_mean_min: float64
586 - ccf_cc_amt_total_receivable_mean_count: float64
587 - ccf_cc_amt_total_receivable_max_mean: float64
588 - ccf_cc_amt_total_receivable_max_max: float64
589 - ccf_cc_amt_total_receivable_max_min: float64
590 - ccf_cc_amt_total_receivable_max_count: float64
591 - ccf_cc_amt_total_receivable_min_mean: float64
592 - ccf_cc_amt_total_receivable_min_max: float64
593 - ccf_cc_amt_total_receivable_min_min: float64
594 - ccf_cc_amt_total_receivable_min_count: float64
595 - ccf_cc_amt_total_receivable_count_mean: float64
596 - ccf_cc_amt_total_receivable_count_max: float64
597 - ccf_cc_amt_total_receivable_count_min: float64
598 - ccf_cc_amt_total_receivable_count_count: float64
599 - ccf_cc_cnt_drawings_atm_current_mean_mean: float64
600 - ccf_cc_cnt_drawings_atm_current_mean_max: float64
601 - ccf_cc_cnt_drawings_atm_current_mean_min: float64
602 - ccf_cc_cnt_drawings_atm_current_mean_count: float64
603 - ccf_cc_cnt_drawings_atm_current_max_mean: float64
604 - ccf_cc_cnt_drawings_atm_current_max_max: float64
605 - ccf_cc_cnt_drawings_atm_current_max_min: float64
606 - ccf_cc_cnt_drawings_atm_current_max_count: float64
607 - ccf_cc_cnt_drawings_atm_current_min_mean: float64
608 - ccf_cc_cnt_drawings_atm_current_min_max: float64
609 - ccf_cc_cnt_drawings_atm_current_min_min: float64
610 - ccf_cc_cnt_drawings_atm_current_min_count: float64
611 - ccf_cc_cnt_drawings_atm_current_count_mean: float64
612 - ccf_cc_cnt_drawings_atm_current_count_max: float64
613 - ccf_cc_cnt_drawings_atm_current_count_min: float64
614 - ccf_cc_cnt_drawings_atm_current_count_count: float64
615 - ccf_cc_cnt_drawings_current_mean_mean: float64
616 - ccf_cc_cnt_drawings_current_mean_max: float64
617 - ccf_cc_cnt_drawings_current_mean_min: float64
618 - ccf_cc_cnt_drawings_current_mean_count: float64
619 - ccf_cc_cnt_drawings_current_max_mean: float64
620 - ccf_cc_cnt_drawings_current_max_max: float64
621 - ccf_cc_cnt_drawings_current_max_min: float64

622 - ccf_cc_cnt_drawings_current_max_count: float64
623 - ccf_cc_cnt_drawings_current_min_mean: float64
624 - ccf_cc_cnt_drawings_current_min_max: float64
625 - ccf_cc_cnt_drawings_current_min_min: float64
626 - ccf_cc_cnt_drawings_current_min_count: float64
627 - ccf_cc_cnt_drawings_current_count_mean: float64
628 - ccf_cc_cnt_drawings_current_count_max: float64
629 - ccf_cc_cnt_drawings_current_count_min: float64
630 - ccf_cc_cnt_drawings_current_count_count: float64
631 - ccf_cc_cnt_drawings_other_current_mean_mean: float64
632 - ccf_cc_cnt_drawings_other_current_mean_max: float64
633 - ccf_cc_cnt_drawings_other_current_mean_min: float64
634 - ccf_cc_cnt_drawings_other_current_mean_count: float64
635 - ccf_cc_cnt_drawings_other_current_max_mean: float64
636 - ccf_cc_cnt_drawings_other_current_max_max: float64
637 - ccf_cc_cnt_drawings_other_current_max_min: float64
638 - ccf_cc_cnt_drawings_other_current_max_count: float64
639 - ccf_cc_cnt_drawings_other_current_min_mean: float64
640 - ccf_cc_cnt_drawings_other_current_min_max: float64
641 - ccf_cc_cnt_drawings_other_current_min_min: float64
642 - ccf_cc_cnt_drawings_other_current_min_count: float64
643 - ccf_cc_cnt_drawings_other_current_count_mean: float64
644 - ccf_cc_cnt_drawings_other_current_count_max: float64
645 - ccf_cc_cnt_drawings_other_current_count_min: float64
646 - ccf_cc_cnt_drawings_other_current_count_count: float64
647 - ccf_cc_cnt_drawings_pos_current_mean_mean: float64
648 - ccf_cc_cnt_drawings_pos_current_mean_max: float64
649 - ccf_cc_cnt_drawings_pos_current_mean_min: float64
650 - ccf_cc_cnt_drawings_pos_current_mean_count: float64
651 - ccf_cc_cnt_drawings_pos_current_max_mean: float64
652 - ccf_cc_cnt_drawings_pos_current_max_max: float64
653 - ccf_cc_cnt_drawings_pos_current_max_min: float64
654 - ccf_cc_cnt_drawings_pos_current_max_count: float64
655 - ccf_cc_cnt_drawings_pos_current_min_mean: float64
656 - ccf_cc_cnt_drawings_pos_current_min_max: float64
657 - ccf_cc_cnt_drawings_pos_current_min_min: float64
658 - ccf_cc_cnt_drawings_pos_current_min_count: float64
659 - ccf_cc_cnt_drawings_pos_current_count_mean: float64
660 - ccf_cc_cnt_drawings_pos_current_count_max: float64
661 - ccf_cc_cnt_drawings_pos_current_count_min: float64
662 - ccf_cc_cnt_drawings_pos_current_count_count: float64
663 - ccf_cc_cnt_instalment_mature_cum_mean_mean: float64
664 - ccf_cc_cnt_instalment_mature_cum_mean_max: float64
665 - ccf_cc_cnt_instalment_mature_cum_mean_min: float64
666 - ccf_cc_cnt_instalment_mature_cum_mean_count: float64
667 - ccf_cc_cnt_instalment_mature_cum_max_mean: float64
668 - ccf_cc_cnt_instalment_mature_cum_max_max: float64
669 - ccf_cc_cnt_instalment_mature_cum_max_min: float64
670 - ccf_cc_cnt_instalment_mature_cum_max_count: float64
671 - ccf_cc_cnt_instalment_mature_cum_min_mean: float64
672 - ccf_cc_cnt_instalment_mature_cum_min_max: float64
673 - ccf_cc_cnt_instalment_mature_cum_min_min: float64
674 - ccf_cc_cnt_instalment_mature_cum_min_count: float64
675 - ccf_cc_cnt_instalment_mature_cum_count_mean: float64
676 - ccf_cc_cnt_instalment_mature_cum_count_max: float64
677 - ccf_cc_cnt_instalment_mature_cum_count_min: float64
678 - ccf_cc_cnt_instalment_mature_cum_count_count: float64
679 - ccf_cc_sk_dpd_mean_mean: float64
680 - ccf_cc_sk_dpd_mean_max: float64
681 - ccf_cc_sk_dpd_mean_min: float64
682 - ccf_cc_sk_dpd_mean_count: float64
683 - ccf_cc_sk_dpd_max_mean: float64
684 - ccf_cc_sk_dpd_max_max: float64
685 - ccf_cc_sk_dpd_max_min: float64
686 - ccf_cc_sk_dpd_max_count: float64
687 - ccf_cc_sk_dpd_min_mean: float64
688 - ccf_cc_sk_dpd_min_max: float64
689 - ccf_cc_sk_dpd_min_min: float64
690 - ccf_cc_sk_dpd_min_count: float64

691 - ccf_cc_sk_dpd_count_mean: float64
692 - ccf_cc_sk_dpd_count_max: float64
693 - ccf_cc_sk_dpd_count_min: float64
694 - ccf_cc_sk_dpd_count_count: float64
695 - ccf_cc_sk_dpd_def_mean_mean: float64
696 - ccf_cc_sk_dpd_def_mean_max: float64
697 - ccf_cc_sk_dpd_def_mean_min: float64
698 - ccf_cc_sk_dpd_def_mean_count: float64
699 - ccf_cc_sk_dpd_def_max_mean: float64
700 - ccf_cc_sk_dpd_def_max_max: float64
701 - ccf_cc_sk_dpd_def_max_min: float64
702 - ccf_cc_sk_dpd_def_max_count: float64
703 - ccf_cc_sk_dpd_def_min_mean: float64
704 - ccf_cc_sk_dpd_def_min_max: float64
705 - ccf_cc_sk_dpd_def_min_min: float64
706 - ccf_cc_sk_dpd_def_min_count: float64
707 - ccf_cc_sk_dpd_def_count_mean: float64
708 - ccf_cc_sk_dpd_def_count_max: float64
709 - ccf_cc_sk_dpd_def_count_min: float64
710 - ccf_cc_sk_dpd_def_count_count: float64
711 - instf_sk_id_prev_mean: float64
712 - instf_sk_id_prev_max: float64
713 - instf_sk_id_prev_min: float64
714 - instf_sk_id_prev_count: float64
715 - instf_inst_sk_id_curr_mean_mean: float64
716 - instf_inst_sk_id_curr_mean_max: float64
717 - instf_inst_sk_id_curr_mean_min: float64
718 - instf_inst_sk_id_curr_mean_count: float64
719 - instf_inst_sk_id_curr_max_mean: float64
720 - instf_inst_sk_id_curr_max_max: float64
721 - instf_inst_sk_id_curr_max_min: float64
722 - instf_inst_sk_id_curr_max_count: float64
723 - instf_inst_sk_id_curr_min_mean: float64
724 - instf_inst_sk_id_curr_min_max: float64
725 - instf_inst_sk_id_curr_min_min: float64
726 - instf_inst_sk_id_curr_min_count: float64
727 - instf_inst_sk_id_curr_count_mean: float64
728 - instf_inst_sk_id_curr_count_max: float64
729 - instf_inst_sk_id_curr_count_min: float64
730 - instf_inst_sk_id_curr_count_count: float64
731 - instf_inst_num_instalment_version_mean_mean: float64
732 - instf_inst_num_instalment_version_mean_max: float64
733 - instf_inst_num_instalment_version_mean_min: float64
734 - instf_inst_num_instalment_version_mean_count: float64
735 - instf_inst_num_instalment_version_max_mean: float64
736 - instf_inst_num_instalment_version_max_max: float64
737 - instf_inst_num_instalment_version_max_min: float64
738 - instf_inst_num_instalment_version_max_count: float64
739 - instf_inst_num_instalment_version_min_mean: float64
740 - instf_inst_num_instalment_version_min_max: float64
741 - instf_inst_num_instalment_version_min_min: float64
742 - instf_inst_num_instalment_version_min_count: float64
743 - instf_inst_num_instalment_version_count_mean: float64
744 - instf_inst_num_instalment_version_count_max: float64
745 - instf_inst_num_instalment_version_count_min: float64
746 - instf_inst_num_instalment_version_count_count: float64
747 - instf_inst_num_instalment_number_mean_mean: float64
748 - instf_inst_num_instalment_number_mean_max: float64
749 - instf_inst_num_instalment_number_mean_min: float64
750 - instf_inst_num_instalment_number_mean_count: float64
751 - instf_inst_num_instalment_number_max_mean: float64
752 - instf_inst_num_instalment_number_max_max: float64
753 - instf_inst_num_instalment_number_max_min: float64
754 - instf_inst_num_instalment_number_max_count: float64
755 - instf_inst_num_instalment_number_min_mean: float64
756 - instf_inst_num_instalment_number_min_max: float64
757 - instf_inst_num_instalment_number_min_min: float64
758 - instf_inst_num_instalment_number_min_count: float64
759 - instf_inst_num_instalment_number_count_mean: float64

760 - instf_inst_num_instalment_number_count_max: float64
761 - instf_inst_num_instalment_number_count_min: float64
762 - instf_inst_num_instalment_number_count_count: float64
763 - instf_inst_days_instalment_mean_mean: float64
764 - instf_inst_days_instalment_mean_max: float64
765 - instf_inst_days_instalment_mean_min: float64
766 - instf_inst_days_instalment_mean_count: float64
767 - instf_inst_days_instalment_max_mean: float64
768 - instf_inst_days_instalment_max_max: float64
769 - instf_inst_days_instalment_max_min: float64
770 - instf_inst_days_instalment_max_count: float64
771 - instf_inst_days_instalment_min_mean: float64
772 - instf_inst_days_instalment_min_max: float64
773 - instf_inst_days_instalment_min_min: float64
774 - instf_inst_days_instalment_min_count: float64
775 - instf_inst_days_instalment_count_mean: float64
776 - instf_inst_days_instalment_count_max: float64
777 - instf_inst_days_instalment_count_min: float64
778 - instf_inst_days_instalment_count_count: float64
779 - instf_inst_days_entry_payment_mean_mean: float64
780 - instf_inst_days_entry_payment_mean_max: float64
781 - instf_inst_days_entry_payment_mean_min: float64
782 - instf_inst_days_entry_payment_mean_count: float64
783 - instf_inst_days_entry_payment_max_mean: float64
784 - instf_inst_days_entry_payment_max_max: float64
785 - instf_inst_days_entry_payment_max_min: float64
786 - instf_inst_days_entry_payment_max_count: float64
787 - instf_inst_days_entry_payment_min_mean: float64
788 - instf_inst_days_entry_payment_min_max: float64
789 - instf_inst_days_entry_payment_min_min: float64
790 - instf_inst_days_entry_payment_min_count: float64
791 - instf_inst_days_entry_payment_count_mean: float64
792 - instf_inst_days_entry_payment_count_max: float64
793 - instf_inst_days_entry_payment_count_min: float64
794 - instf_inst_days_entry_payment_count_count: float64
795 - instf_inst_amt_instalment_mean_mean: float64
796 - instf_inst_amt_instalment_mean_max: float64
797 - instf_inst_amt_instalment_mean_min: float64
798 - instf_inst_amt_instalment_mean_count: float64
799 - instf_inst_amt_instalment_max_mean: float64
800 - instf_inst_amt_instalment_max_max: float64
801 - instf_inst_amt_instalment_max_min: float64
802 - instf_inst_amt_instalment_max_count: float64
803 - instf_inst_amt_instalment_min_mean: float64
804 - instf_inst_amt_instalment_min_max: float64
805 - instf_inst_amt_instalment_min_min: float64
806 - instf_inst_amt_instalment_min_count: float64
807 - instf_inst_amt_instalment_count_mean: float64
808 - instf_inst_amt_instalment_count_max: float64
809 - instf_inst_amt_instalment_count_min: float64
810 - instf_inst_amt_instalment_count_count: float64
811 - instf_inst_amt_payment_mean_mean: float64
812 - instf_inst_amt_payment_mean_max: float64
813 - instf_inst_amt_payment_mean_min: float64
814 - instf_inst_amt_payment_mean_count: float64
815 - instf_inst_amt_payment_max_mean: float64
816 - instf_inst_amt_payment_max_max: float64
817 - instf_inst_amt_payment_max_min: float64
818 - instf_inst_amt_payment_max_count: float64
819 - instf_inst_amt_payment_min_mean: float64
820 - instf_inst_amt_payment_min_max: float64
821 - instf_inst_amt_payment_min_min: float64
822 - instf_inst_amt_payment_min_count: float64
823 - instf_inst_amt_payment_count_mean: float64
824 - instf_inst_amt_payment_count_max: float64
825 - instf_inst_amt_payment_count_min: float64
826 - instf_inst_amt_payment_count_count: float64

In [6]:
```python
df1 = df1.drop(columns=['sk_id_curr'])
```

## 5.2 Data Dimensions

In [7]:
```python
print('Número de linhas:', df1.shape[0])
print('Número de colunas:', df1.shape[1])
```

```
Número de linhas: 307511
Número de colunas: 825
```

## 5.3 Data Types

In [8]:
```python
for idx, (col, dtype) in enumerate(df1.dtypes.items(), 1):
    print(f'{idx} - {col}: {dtype}')
```

```
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
14 - name_family_status: object
15 - name_housing_type: object
16 - region_population_relative: float64
17 - days_birth: int64
18 - days_employed: int64
19 - days_registration: float64
20 - days_id_publish: int64
21 - own_car_age: float64
22 - flag_mobil: int64
23 - flag_emp_phone: int64
24 - flag_work_phone: int64
25 - flag_cont_mobile: int64
26 - flag_phone: int64
27 - flag_email: int64
28 - occupation_type: object
29 - cnt_fam_members: float64
30 - region_rating_client: int64
31 - region_rating_client_w_city: int64
32 - weekday_appr_process_start: object
33 - hour_appr_process_start: int64
34 - reg_region_not_live_region: int64
35 - reg_region_not_work_region: int64
36 - live_region_not_work_region: int64
37 - reg_city_not_live_city: int64
38 - reg_city_not_work_city: int64
39 - live_city_not_work_city: int64
40 - organization_type: object
41 - ext_source_1: float64
42 - ext_source_2: float64
43 - ext_source_3: float64
44 - apartments_avg: float64
45 - basementarea_avg: float64
46 - years_beginexpluatation_avg: float64
47 - years_build_avg: float64
48 - commonarea_avg: float64
49 - elevators_avg: float64
50 - entrances_avg: float64
51 - floorsmax_avg: float64
52 - floorsmin_avg: float64
53 - landarea_avg: float64
54 - livingapartments_avg: float64
55 - livingarea_avg: float64
56 - nonlivingapartments_avg: float64
57 - nonlivingarea_avg: float64
58 - apartments_mode: float64
59 - basementarea_mode: float64
60 - years_beginexpluatation_mode: float64
61 - years_build_mode: float64
62 - commonarea_mode: float64
63 - elevators_mode: float64
64 - entrances_mode: float64
65 - floorsmax_mode: float64
66 - floorsmin_mode: float64
67 - landarea_mode: float64
68 - livingapartments_mode: float64
69 - livingarea_mode: float64
```

70 - nonlivingapartments_mode: float64
71 - nonlivingarea_mode: float64
72 - apartments_medi: float64
73 - basementarea_medi: float64
74 - years_beginexpluatation_medi: float64
75 - years_build_medi: float64
76 - commonarea_medi: float64
77 - elevators_medi: float64
78 - entrances_medi: float64
79 - floorsmax_medi: float64
80 - floorsmin_medi: float64
81 - landarea_medi: float64
82 - livingapartments_medi: float64
83 - livingarea_medi: float64
84 - nonlivingapartments_medi: float64
85 - nonlivingarea_medi: float64
86 - fondkapremont_mode: object
87 - housetype_mode: object
88 - totalarea_mode: float64
89 - wallsmaterial_mode: object
90 - emergencystate_mode: object
91 - obs_30_cnt_social_circle: float64
92 - def_30_cnt_social_circle: float64
93 - obs_60_cnt_social_circle: float64
94 - def_60_cnt_social_circle: float64
95 - days_last_phone_change: float64
96 - flag_document_2: int64
97 - flag_document_3: int64
98 - flag_document_4: int64
99 - flag_document_5: int64
100 - flag_document_6: int64
101 - flag_document_7: int64
102 - flag_document_8: int64
103 - flag_document_9: int64
104 - flag_document_10: int64
105 - flag_document_11: int64
106 - flag_document_12: int64
107 - flag_document_13: int64
108 - flag_document_14: int64
109 - flag_document_15: int64
110 - flag_document_16: int64
111 - flag_document_17: int64
112 - flag_document_18: int64
113 - flag_document_19: int64
114 - flag_document_20: int64
115 - flag_document_21: int64
116 - amt_req_credit_bureau_hour: float64
117 - amt_req_credit_bureau_day: float64
118 - amt_req_credit_bureau_week: float64
119 - amt_req_credit_bureau_mon: float64
120 - amt_req_credit_bureau_qrt: float64
121 - amt_req_credit_bureau_year: float64
122 - bur_sk_id_bureau_mean: float64
123 - bur_sk_id_bureau_max: float64
124 - bur_sk_id_bureau_min: float64
125 - bur_sk_id_bureau_count: float64
126 - bur_days_credit_mean: float64
127 - bur_days_credit_max: float64
128 - bur_days_credit_min: float64
129 - bur_days_credit_count: float64
130 - bur_credit_day_overdue_mean: float64
131 - bur_credit_day_overdue_max: float64
132 - bur_credit_day_overdue_min: float64
133 - bur_credit_day_overdue_count: float64
134 - bur_days_credit_enddate_mean: float64
135 - bur_days_credit_enddate_max: float64
136 - bur_days_credit_enddate_min: float64
137 - bur_days_credit_enddate_count: float64
138 - bur_days_enddate_fact_mean: float64

139 - bur_days_enddate_fact_max: float64
140 - bur_days_enddate_fact_min: float64
141 - bur_days_enddate_fact_count: float64
142 - bur_amt_credit_max_overdue_mean: float64
143 - bur_amt_credit_max_overdue_max: float64
144 - bur_amt_credit_max_overdue_min: float64
145 - bur_amt_credit_max_overdue_count: float64
146 - bur_cnt_credit_prolong_mean: float64
147 - bur_cnt_credit_prolong_max: float64
148 - bur_cnt_credit_prolong_min: float64
149 - bur_cnt_credit_prolong_count: float64
150 - bur_amt_credit_sum_mean: float64
151 - bur_amt_credit_sum_max: float64
152 - bur_amt_credit_sum_min: float64
153 - bur_amt_credit_sum_count: float64
154 - bur_amt_credit_sum_debt_mean: float64
155 - bur_amt_credit_sum_debt_max: float64
156 - bur_amt_credit_sum_debt_min: float64
157 - bur_amt_credit_sum_debt_count: float64
158 - bur_amt_credit_sum_limit_mean: float64
159 - bur_amt_credit_sum_limit_max: float64
160 - bur_amt_credit_sum_limit_min: float64
161 - bur_amt_credit_sum_limit_count: float64
162 - bur_amt_credit_sum_overdue_mean: float64
163 - bur_amt_credit_sum_overdue_max: float64
164 - bur_amt_credit_sum_overdue_min: float64
165 - bur_amt_credit_sum_overdue_count: float64
166 - bur_days_credit_update_mean: float64
167 - bur_days_credit_update_max: float64
168 - bur_days_credit_update_min: float64
169 - bur_days_credit_update_count: float64
170 - bur_amt_annuity_mean: float64
171 - bur_amt_annuity_max: float64
172 - bur_amt_annuity_min: float64
173 - bur_amt_annuity_count: float64
174 - bur_bb_months_balance_mean_mean: float64
175 - bur_bb_months_balance_mean_max: float64
176 - bur_bb_months_balance_mean_min: float64
177 - bur_bb_months_balance_mean_count: float64
178 - bur_bb_months_balance_max_mean: float64
179 - bur_bb_months_balance_max_max: float64
180 - bur_bb_months_balance_max_min: float64
181 - bur_bb_months_balance_max_count: float64
182 - bur_bb_months_balance_min_mean: float64
183 - bur_bb_months_balance_min_max: float64
184 - bur_bb_months_balance_min_min: float64
185 - bur_bb_months_balance_min_count: float64
186 - bur_bb_months_balance_count_mean: float64
187 - bur_bb_months_balance_count_max: float64
188 - bur_bb_months_balance_count_min: float64
189 - bur_bb_months_balance_count_count: float64
190 - prev_sk_id_prev_mean: float64
191 - prev_sk_id_prev_max: float64
192 - prev_sk_id_prev_min: float64
193 - prev_sk_id_prev_count: float64
194 - prev_amt_annuity_mean: float64
195 - prev_amt_annuity_max: float64
196 - prev_amt_annuity_min: float64
197 - prev_amt_annuity_count: float64
198 - prev_amt_application_mean: float64
199 - prev_amt_application_max: float64
200 - prev_amt_application_min: float64
201 - prev_amt_application_count: float64
202 - prev_amt_credit_mean: float64
203 - prev_amt_credit_max: float64
204 - prev_amt_credit_min: float64
205 - prev_amt_credit_count: float64
206 - prev_amt_down_payment_mean: float64
207 - prev_amt_down_payment_max: float64

208 - prev_amt_down_payment_min: float64
209 - prev_amt_down_payment_count: float64
210 - prev_amt_goods_price_mean: float64
211 - prev_amt_goods_price_max: float64
212 - prev_amt_goods_price_min: float64
213 - prev_amt_goods_price_count: float64
214 - prev_hour_appr_process_start_mean: float64
215 - prev_hour_appr_process_start_max: float64
216 - prev_hour_appr_process_start_min: float64
217 - prev_hour_appr_process_start_count: float64
218 - prev_nflag_last_appl_in_day_mean: float64
219 - prev_nflag_last_appl_in_day_max: float64
220 - prev_nflag_last_appl_in_day_min: float64
221 - prev_nflag_last_appl_in_day_count: float64
222 - prev_rate_down_payment_mean: float64
223 - prev_rate_down_payment_max: float64
224 - prev_rate_down_payment_min: float64
225 - prev_rate_down_payment_count: float64
226 - prev_rate_interest_primary_mean: float64
227 - prev_rate_interest_primary_max: float64
228 - prev_rate_interest_primary_min: float64
229 - prev_rate_interest_primary_count: float64
230 - prev_rate_interest_privileged_mean: float64
231 - prev_rate_interest_privileged_max: float64
232 - prev_rate_interest_privileged_min: float64
233 - prev_rate_interest_privileged_count: float64
234 - prev_days_decision_mean: float64
235 - prev_days_decision_max: float64
236 - prev_days_decision_min: float64
237 - prev_days_decision_count: float64
238 - prev_sellerplace_area_mean: float64
239 - prev_sellerplace_area_max: float64
240 - prev_sellerplace_area_min: float64
241 - prev_sellerplace_area_count: float64
242 - prev_cnt_payment_mean: float64
243 - prev_cnt_payment_max: float64
244 - prev_cnt_payment_min: float64
245 - prev_cnt_payment_count: float64
246 - prev_days_first_drawing_mean: float64
247 - prev_days_first_drawing_max: float64
248 - prev_days_first_drawing_min: float64
249 - prev_days_first_drawing_count: float64
250 - prev_days_first_due_mean: float64
251 - prev_days_first_due_max: float64
252 - prev_days_first_due_min: float64
253 - prev_days_first_due_count: float64
254 - prev_days_last_due_1st_version_mean: float64
255 - prev_days_last_due_1st_version_max: float64
256 - prev_days_last_due_1st_version_min: float64
257 - prev_days_last_due_1st_version_count: float64
258 - prev_days_last_due_mean: float64
259 - prev_days_last_due_max: float64
260 - prev_days_last_due_min: float64
261 - prev_days_last_due_count: float64
262 - prev_days_termination_mean: float64
263 - prev_days_termination_max: float64
264 - prev_days_termination_min: float64
265 - prev_days_termination_count: float64
266 - prev_nflag_insured_on_approval_mean: float64
267 - prev_nflag_insured_on_approval_max: float64
268 - prev_nflag_insured_on_approval_min: float64
269 - prev_nflag_insured_on_approval_count: float64
270 - posf_sk_id_prev_mean: float64
271 - posf_sk_id_prev_max: float64
272 - posf_sk_id_prev_min: float64
273 - posf_sk_id_prev_count: float64
274 - posf_pos_sk_id_curr_mean_mean: float64
275 - posf_pos_sk_id_curr_mean_max: float64
276 - posf_pos_sk_id_curr_mean_min: float64

277 - posf_pos_sk_id_curr_mean_count: float64
278 - posf_pos_sk_id_curr_max_mean: float64
279 - posf_pos_sk_id_curr_max_max: float64
280 - posf_pos_sk_id_curr_max_min: float64
281 - posf_pos_sk_id_curr_max_count: float64
282 - posf_pos_sk_id_curr_min_mean: float64
283 - posf_pos_sk_id_curr_min_max: float64
284 - posf_pos_sk_id_curr_min_min: float64
285 - posf_pos_sk_id_curr_min_count: float64
286 - posf_pos_sk_id_curr_count_mean: float64
287 - posf_pos_sk_id_curr_count_max: float64
288 - posf_pos_sk_id_curr_count_min: float64
289 - posf_pos_sk_id_curr_count_count: float64
290 - posf_pos_months_balance_mean_mean: float64
291 - posf_pos_months_balance_mean_max: float64
292 - posf_pos_months_balance_mean_min: float64
293 - posf_pos_months_balance_mean_count: float64
294 - posf_pos_months_balance_max_mean: float64
295 - posf_pos_months_balance_max_max: float64
296 - posf_pos_months_balance_max_min: float64
297 - posf_pos_months_balance_max_count: float64
298 - posf_pos_months_balance_min_mean: float64
299 - posf_pos_months_balance_min_max: float64
300 - posf_pos_months_balance_min_min: float64
301 - posf_pos_months_balance_min_count: float64
302 - posf_pos_months_balance_count_mean: float64
303 - posf_pos_months_balance_count_max: float64
304 - posf_pos_months_balance_count_min: float64
305 - posf_pos_months_balance_count_count: float64
306 - posf_pos_cnt_instalment_mean_mean: float64
307 - posf_pos_cnt_instalment_mean_max: float64
308 - posf_pos_cnt_instalment_mean_min: float64
309 - posf_pos_cnt_instalment_mean_count: float64
310 - posf_pos_cnt_instalment_max_mean: float64
311 - posf_pos_cnt_instalment_max_max: float64
312 - posf_pos_cnt_instalment_max_min: float64
313 - posf_pos_cnt_instalment_max_count: float64
314 - posf_pos_cnt_instalment_min_mean: float64
315 - posf_pos_cnt_instalment_min_max: float64
316 - posf_pos_cnt_instalment_min_min: float64
317 - posf_pos_cnt_instalment_min_count: float64
318 - posf_pos_cnt_instalment_count_mean: float64
319 - posf_pos_cnt_instalment_count_max: float64
320 - posf_pos_cnt_instalment_count_min: float64
321 - posf_pos_cnt_instalment_count_count: float64
322 - posf_pos_cnt_instalment_future_mean_mean: float64
323 - posf_pos_cnt_instalment_future_mean_max: float64
324 - posf_pos_cnt_instalment_future_mean_min: float64
325 - posf_pos_cnt_instalment_future_mean_count: float64
326 - posf_pos_cnt_instalment_future_max_mean: float64
327 - posf_pos_cnt_instalment_future_max_max: float64
328 - posf_pos_cnt_instalment_future_max_min: float64
329 - posf_pos_cnt_instalment_future_max_count: float64
330 - posf_pos_cnt_instalment_future_min_mean: float64
331 - posf_pos_cnt_instalment_future_min_max: float64
332 - posf_pos_cnt_instalment_future_min_min: float64
333 - posf_pos_cnt_instalment_future_min_count: float64
334 - posf_pos_cnt_instalment_future_count_mean: float64
335 - posf_pos_cnt_instalment_future_count_max: float64
336 - posf_pos_cnt_instalment_future_count_min: float64
337 - posf_pos_cnt_instalment_future_count_count: float64
338 - posf_pos_sk_dpd_mean_mean: float64
339 - posf_pos_sk_dpd_mean_max: float64
340 - posf_pos_sk_dpd_mean_min: float64
341 - posf_pos_sk_dpd_mean_count: float64
342 - posf_pos_sk_dpd_max_mean: float64
343 - posf_pos_sk_dpd_max_max: float64
344 - posf_pos_sk_dpd_max_min: float64
345 - posf_pos_sk_dpd_max_count: float64

```
346 - posf_pos_sk_dpd_min_mean: float64
347 - posf_pos_sk_dpd_min_max: float64
348 - posf_pos_sk_dpd_min_min: float64
349 - posf_pos_sk_dpd_min_count: float64
350 - posf_pos_sk_dpd_count_mean: float64
351 - posf_pos_sk_dpd_count_max: float64
352 - posf_pos_sk_dpd_count_min: float64
353 - posf_pos_sk_dpd_count_count: float64
354 - posf_pos_sk_dpd_def_mean_mean: float64
355 - posf_pos_sk_dpd_def_mean_max: float64
356 - posf_pos_sk_dpd_def_mean_min: float64
357 - posf_pos_sk_dpd_def_mean_count: float64
358 - posf_pos_sk_dpd_def_max_mean: float64
359 - posf_pos_sk_dpd_def_max_max: float64
360 - posf_pos_sk_dpd_def_max_min: float64
361 - posf_pos_sk_dpd_def_max_count: float64
362 - posf_pos_sk_dpd_def_min_mean: float64
363 - posf_pos_sk_dpd_def_min_max: float64
364 - posf_pos_sk_dpd_def_min_min: float64
365 - posf_pos_sk_dpd_def_min_count: float64
366 - posf_pos_sk_dpd_def_count_mean: float64
367 - posf_pos_sk_dpd_def_count_max: float64
368 - posf_pos_sk_dpd_def_count_min: float64
369 - posf_pos_sk_dpd_def_count_count: float64
370 - ccf_sk_id_prev_mean: float64
371 - ccf_sk_id_prev_max: float64
372 - ccf_sk_id_prev_min: float64
373 - ccf_sk_id_prev_count: float64
374 - ccf_cc_sk_id_curr_mean_mean: float64
375 - ccf_cc_sk_id_curr_mean_max: float64
376 - ccf_cc_sk_id_curr_mean_min: float64
377 - ccf_cc_sk_id_curr_mean_count: float64
378 - ccf_cc_sk_id_curr_max_mean: float64
379 - ccf_cc_sk_id_curr_max_max: float64
380 - ccf_cc_sk_id_curr_max_min: float64
381 - ccf_cc_sk_id_curr_max_count: float64
382 - ccf_cc_sk_id_curr_min_mean: float64
383 - ccf_cc_sk_id_curr_min_max: float64
384 - ccf_cc_sk_id_curr_min_min: float64
385 - ccf_cc_sk_id_curr_min_count: float64
386 - ccf_cc_sk_id_curr_count_mean: float64
387 - ccf_cc_sk_id_curr_count_max: float64
388 - ccf_cc_sk_id_curr_count_min: float64
389 - ccf_cc_sk_id_curr_count_count: float64
390 - ccf_cc_months_balance_mean_mean: float64
391 - ccf_cc_months_balance_mean_max: float64
392 - ccf_cc_months_balance_mean_min: float64
393 - ccf_cc_months_balance_mean_count: float64
394 - ccf_cc_months_balance_max_mean: float64
395 - ccf_cc_months_balance_max_max: float64
396 - ccf_cc_months_balance_max_min: float64
397 - ccf_cc_months_balance_max_count: float64
398 - ccf_cc_months_balance_min_mean: float64
399 - ccf_cc_months_balance_min_max: float64
400 - ccf_cc_months_balance_min_min: float64
401 - ccf_cc_months_balance_min_count: float64
402 - ccf_cc_months_balance_count_mean: float64
403 - ccf_cc_months_balance_count_max: float64
404 - ccf_cc_months_balance_count_min: float64
405 - ccf_cc_months_balance_count_count: float64
406 - ccf_cc_amt_balance_mean_mean: float64
407 - ccf_cc_amt_balance_mean_max: float64
408 - ccf_cc_amt_balance_mean_min: float64
409 - ccf_cc_amt_balance_mean_count: float64
410 - ccf_cc_amt_balance_max_mean: float64
411 - ccf_cc_amt_balance_max_max: float64
412 - ccf_cc_amt_balance_max_min: float64
413 - ccf_cc_amt_balance_max_count: float64
414 - ccf_cc_amt_balance_min_mean: float64
```

415 - ccf_cc_amt_balance_min_max: float64
416 - ccf_cc_amt_balance_min_min: float64
417 - ccf_cc_amt_balance_min_count: float64
418 - ccf_cc_amt_balance_count_mean: float64
419 - ccf_cc_amt_balance_count_max: float64
420 - ccf_cc_amt_balance_count_min: float64
421 - ccf_cc_amt_balance_count_count: float64
422 - ccf_cc_amt_credit_limit_actual_mean_mean: float64
423 - ccf_cc_amt_credit_limit_actual_mean_max: float64
424 - ccf_cc_amt_credit_limit_actual_mean_min: float64
425 - ccf_cc_amt_credit_limit_actual_mean_count: float64
426 - ccf_cc_amt_credit_limit_actual_max_mean: float64
427 - ccf_cc_amt_credit_limit_actual_max_max: float64
428 - ccf_cc_amt_credit_limit_actual_max_min: float64
429 - ccf_cc_amt_credit_limit_actual_max_count: float64
430 - ccf_cc_amt_credit_limit_actual_min_mean: float64
431 - ccf_cc_amt_credit_limit_actual_min_max: float64
432 - ccf_cc_amt_credit_limit_actual_min_min: float64
433 - ccf_cc_amt_credit_limit_actual_min_count: float64
434 - ccf_cc_amt_credit_limit_actual_count_mean: float64
435 - ccf_cc_amt_credit_limit_actual_count_max: float64
436 - ccf_cc_amt_credit_limit_actual_count_min: float64
437 - ccf_cc_amt_credit_limit_actual_count_count: float64
438 - ccf_cc_amt_drawings_atm_current_mean_mean: float64
439 - ccf_cc_amt_drawings_atm_current_mean_max: float64
440 - ccf_cc_amt_drawings_atm_current_mean_min: float64
441 - ccf_cc_amt_drawings_atm_current_mean_count: float64
442 - ccf_cc_amt_drawings_atm_current_max_mean: float64
443 - ccf_cc_amt_drawings_atm_current_max_max: float64
444 - ccf_cc_amt_drawings_atm_current_max_min: float64
445 - ccf_cc_amt_drawings_atm_current_max_count: float64
446 - ccf_cc_amt_drawings_atm_current_min_mean: float64
447 - ccf_cc_amt_drawings_atm_current_min_max: float64
448 - ccf_cc_amt_drawings_atm_current_min_min: float64
449 - ccf_cc_amt_drawings_atm_current_min_count: float64
450 - ccf_cc_amt_drawings_atm_current_count_mean: float64
451 - ccf_cc_amt_drawings_atm_current_count_max: float64
452 - ccf_cc_amt_drawings_atm_current_count_min: float64
453 - ccf_cc_amt_drawings_atm_current_count_count: float64
454 - ccf_cc_amt_drawings_current_mean_mean: float64
455 - ccf_cc_amt_drawings_current_mean_max: float64
456 - ccf_cc_amt_drawings_current_mean_min: float64
457 - ccf_cc_amt_drawings_current_mean_count: float64
458 - ccf_cc_amt_drawings_current_max_mean: float64
459 - ccf_cc_amt_drawings_current_max_max: float64
460 - ccf_cc_amt_drawings_current_max_min: float64
461 - ccf_cc_amt_drawings_current_max_count: float64
462 - ccf_cc_amt_drawings_current_min_mean: float64
463 - ccf_cc_amt_drawings_current_min_max: float64
464 - ccf_cc_amt_drawings_current_min_min: float64
465 - ccf_cc_amt_drawings_current_min_count: float64
466 - ccf_cc_amt_drawings_current_count_mean: float64
467 - ccf_cc_amt_drawings_current_count_max: float64
468 - ccf_cc_amt_drawings_current_count_min: float64
469 - ccf_cc_amt_drawings_current_count_count: float64
470 - ccf_cc_amt_drawings_other_current_mean_mean: float64
471 - ccf_cc_amt_drawings_other_current_mean_max: float64
472 - ccf_cc_amt_drawings_other_current_mean_min: float64
473 - ccf_cc_amt_drawings_other_current_mean_count: float64
474 - ccf_cc_amt_drawings_other_current_max_mean: float64
475 - ccf_cc_amt_drawings_other_current_max_max: float64
476 - ccf_cc_amt_drawings_other_current_max_min: float64
477 - ccf_cc_amt_drawings_other_current_max_count: float64
478 - ccf_cc_amt_drawings_other_current_min_mean: float64
479 - ccf_cc_amt_drawings_other_current_min_max: float64
480 - ccf_cc_amt_drawings_other_current_min_min: float64
481 - ccf_cc_amt_drawings_other_current_min_count: float64
482 - ccf_cc_amt_drawings_other_current_count_mean: float64
483 - ccf_cc_amt_drawings_other_current_count_max: float64

484 - ccf_cc_amt_drawings_other_current_count_min: float64
485 - ccf_cc_amt_drawings_other_current_count_count: float64
486 - ccf_cc_amt_drawings_pos_current_mean_mean: float64
487 - ccf_cc_amt_drawings_pos_current_mean_max: float64
488 - ccf_cc_amt_drawings_pos_current_mean_min: float64
489 - ccf_cc_amt_drawings_pos_current_mean_count: float64
490 - ccf_cc_amt_drawings_pos_current_max_mean: float64
491 - ccf_cc_amt_drawings_pos_current_max_max: float64
492 - ccf_cc_amt_drawings_pos_current_max_min: float64
493 - ccf_cc_amt_drawings_pos_current_max_count: float64
494 - ccf_cc_amt_drawings_pos_current_min_mean: float64
495 - ccf_cc_amt_drawings_pos_current_min_max: float64
496 - ccf_cc_amt_drawings_pos_current_min_min: float64
497 - ccf_cc_amt_drawings_pos_current_min_count: float64
498 - ccf_cc_amt_drawings_pos_current_count_mean: float64
499 - ccf_cc_amt_drawings_pos_current_count_max: float64
500 - ccf_cc_amt_drawings_pos_current_count_min: float64
501 - ccf_cc_amt_drawings_pos_current_count_count: float64
502 - ccf_cc_amt_inst_min_regularity_mean_mean: float64
503 - ccf_cc_amt_inst_min_regularity_mean_max: float64
504 - ccf_cc_amt_inst_min_regularity_mean_min: float64
505 - ccf_cc_amt_inst_min_regularity_mean_count: float64
506 - ccf_cc_amt_inst_min_regularity_max_mean: float64
507 - ccf_cc_amt_inst_min_regularity_max_max: float64
508 - ccf_cc_amt_inst_min_regularity_max_min: float64
509 - ccf_cc_amt_inst_min_regularity_max_count: float64
510 - ccf_cc_amt_inst_min_regularity_min_mean: float64
511 - ccf_cc_amt_inst_min_regularity_min_max: float64
512 - ccf_cc_amt_inst_min_regularity_min_min: float64
513 - ccf_cc_amt_inst_min_regularity_min_count: float64
514 - ccf_cc_amt_inst_min_regularity_count_mean: float64
515 - ccf_cc_amt_inst_min_regularity_count_max: float64
516 - ccf_cc_amt_inst_min_regularity_count_min: float64
517 - ccf_cc_amt_inst_min_regularity_count_count: float64
518 - ccf_cc_amt_payment_current_mean_mean: float64
519 - ccf_cc_amt_payment_current_mean_max: float64
520 - ccf_cc_amt_payment_current_mean_min: float64
521 - ccf_cc_amt_payment_current_mean_count: float64
522 - ccf_cc_amt_payment_current_max_mean: float64
523 - ccf_cc_amt_payment_current_max_max: float64
524 - ccf_cc_amt_payment_current_max_min: float64
525 - ccf_cc_amt_payment_current_max_count: float64
526 - ccf_cc_amt_payment_current_min_mean: float64
527 - ccf_cc_amt_payment_current_min_max: float64
528 - ccf_cc_amt_payment_current_min_min: float64
529 - ccf_cc_amt_payment_current_min_count: float64
530 - ccf_cc_amt_payment_current_count_mean: float64
531 - ccf_cc_amt_payment_current_count_max: float64
532 - ccf_cc_amt_payment_current_count_min: float64
533 - ccf_cc_amt_payment_current_count_count: float64
534 - ccf_cc_amt_payment_total_current_mean_mean: float64
535 - ccf_cc_amt_payment_total_current_mean_max: float64
536 - ccf_cc_amt_payment_total_current_mean_min: float64
537 - ccf_cc_amt_payment_total_current_mean_count: float64
538 - ccf_cc_amt_payment_total_current_max_mean: float64
539 - ccf_cc_amt_payment_total_current_max_max: float64
540 - ccf_cc_amt_payment_total_current_max_min: float64
541 - ccf_cc_amt_payment_total_current_max_count: float64
542 - ccf_cc_amt_payment_total_current_min_mean: float64
543 - ccf_cc_amt_payment_total_current_min_max: float64
544 - ccf_cc_amt_payment_total_current_min_min: float64
545 - ccf_cc_amt_payment_total_current_min_count: float64
546 - ccf_cc_amt_payment_total_current_count_mean: float64
547 - ccf_cc_amt_payment_total_current_count_max: float64
548 - ccf_cc_amt_payment_total_current_count_min: float64
549 - ccf_cc_amt_payment_total_current_count_count: float64
550 - ccf_cc_amt_receivable_principal_mean_mean: float64
551 - ccf_cc_amt_receivable_principal_mean_max: float64
552 - ccf_cc_amt_receivable_principal_mean_min: float64

```
553 - ccf_cc_amt_receivable_principal_mean_count: float64
554 - ccf_cc_amt_receivable_principal_max_mean: float64
555 - ccf_cc_amt_receivable_principal_max_max: float64
556 - ccf_cc_amt_receivable_principal_max_min: float64
557 - ccf_cc_amt_receivable_principal_max_count: float64
558 - ccf_cc_amt_receivable_principal_min_mean: float64
559 - ccf_cc_amt_receivable_principal_min_max: float64
560 - ccf_cc_amt_receivable_principal_min_min: float64
561 - ccf_cc_amt_receivable_principal_min_count: float64
562 - ccf_cc_amt_receivable_principal_count_mean: float64
563 - ccf_cc_amt_receivable_principal_count_max: float64
564 - ccf_cc_amt_receivable_principal_count_min: float64
565 - ccf_cc_amt_receivable_principal_count_count: float64
566 - ccf_cc_amt_recivable_mean_mean: float64
567 - ccf_cc_amt_recivable_mean_max: float64
568 - ccf_cc_amt_recivable_mean_min: float64
569 - ccf_cc_amt_recivable_mean_count: float64
570 - ccf_cc_amt_recivable_max_mean: float64
571 - ccf_cc_amt_recivable_max_max: float64
572 - ccf_cc_amt_recivable_max_min: float64
573 - ccf_cc_amt_recivable_max_count: float64
574 - ccf_cc_amt_recivable_min_mean: float64
575 - ccf_cc_amt_recivable_min_max: float64
576 - ccf_cc_amt_recivable_min_min: float64
577 - ccf_cc_amt_recivable_min_count: float64
578 - ccf_cc_amt_recivable_count_mean: float64
579 - ccf_cc_amt_recivable_count_max: float64
580 - ccf_cc_amt_recivable_count_min: float64
581 - ccf_cc_amt_recivable_count_count: float64
582 - ccf_cc_amt_total_receivable_mean_mean: float64
583 - ccf_cc_amt_total_receivable_mean_max: float64
584 - ccf_cc_amt_total_receivable_mean_min: float64
585 - ccf_cc_amt_total_receivable_mean_count: float64
586 - ccf_cc_amt_total_receivable_max_mean: float64
587 - ccf_cc_amt_total_receivable_max_max: float64
588 - ccf_cc_amt_total_receivable_max_min: float64
589 - ccf_cc_amt_total_receivable_max_count: float64
590 - ccf_cc_amt_total_receivable_min_mean: float64
591 - ccf_cc_amt_total_receivable_min_max: float64
592 - ccf_cc_amt_total_receivable_min_min: float64
593 - ccf_cc_amt_total_receivable_min_count: float64
594 - ccf_cc_amt_total_receivable_count_mean: float64
595 - ccf_cc_amt_total_receivable_count_max: float64
596 - ccf_cc_amt_total_receivable_count_min: float64
597 - ccf_cc_amt_total_receivable_count_count: float64
598 - ccf_cc_cnt_drawings_atm_current_mean_mean: float64
599 - ccf_cc_cnt_drawings_atm_current_mean_max: float64
600 - ccf_cc_cnt_drawings_atm_current_mean_min: float64
601 - ccf_cc_cnt_drawings_atm_current_mean_count: float64
602 - ccf_cc_cnt_drawings_atm_current_max_mean: float64
603 - ccf_cc_cnt_drawings_atm_current_max_max: float64
604 - ccf_cc_cnt_drawings_atm_current_max_min: float64
605 - ccf_cc_cnt_drawings_atm_current_max_count: float64
606 - ccf_cc_cnt_drawings_atm_current_min_mean: float64
607 - ccf_cc_cnt_drawings_atm_current_min_max: float64
608 - ccf_cc_cnt_drawings_atm_current_min_min: float64
609 - ccf_cc_cnt_drawings_atm_current_min_count: float64
610 - ccf_cc_cnt_drawings_atm_current_count_mean: float64
611 - ccf_cc_cnt_drawings_atm_current_count_max: float64
612 - ccf_cc_cnt_drawings_atm_current_count_min: float64
613 - ccf_cc_cnt_drawings_atm_current_count_count: float64
614 - ccf_cc_cnt_drawings_current_mean_mean: float64
615 - ccf_cc_cnt_drawings_current_mean_max: float64
616 - ccf_cc_cnt_drawings_current_mean_min: float64
617 - ccf_cc_cnt_drawings_current_mean_count: float64
618 - ccf_cc_cnt_drawings_current_max_mean: float64
619 - ccf_cc_cnt_drawings_current_max_max: float64
620 - ccf_cc_cnt_drawings_current_max_min: float64
621 - ccf_cc_cnt_drawings_current_max_count: float64
```

622 - ccf_cc_cnt_drawings_current_min_mean: float64
623 - ccf_cc_cnt_drawings_current_min_max: float64
624 - ccf_cc_cnt_drawings_current_min_min: float64
625 - ccf_cc_cnt_drawings_current_min_count: float64
626 - ccf_cc_cnt_drawings_current_count_mean: float64
627 - ccf_cc_cnt_drawings_current_count_max: float64
628 - ccf_cc_cnt_drawings_current_count_min: float64
629 - ccf_cc_cnt_drawings_current_count_count: float64
630 - ccf_cc_cnt_drawings_other_current_mean_mean: float64
631 - ccf_cc_cnt_drawings_other_current_mean_max: float64
632 - ccf_cc_cnt_drawings_other_current_mean_min: float64
633 - ccf_cc_cnt_drawings_other_current_mean_count: float64
634 - ccf_cc_cnt_drawings_other_current_max_mean: float64
635 - ccf_cc_cnt_drawings_other_current_max_max: float64
636 - ccf_cc_cnt_drawings_other_current_max_min: float64
637 - ccf_cc_cnt_drawings_other_current_max_count: float64
638 - ccf_cc_cnt_drawings_other_current_min_mean: float64
639 - ccf_cc_cnt_drawings_other_current_min_max: float64
640 - ccf_cc_cnt_drawings_other_current_min_min: float64
641 - ccf_cc_cnt_drawings_other_current_min_count: float64
642 - ccf_cc_cnt_drawings_other_current_count_mean: float64
643 - ccf_cc_cnt_drawings_other_current_count_max: float64
644 - ccf_cc_cnt_drawings_other_current_count_min: float64
645 - ccf_cc_cnt_drawings_other_current_count_count: float64
646 - ccf_cc_cnt_drawings_pos_current_mean_mean: float64
647 - ccf_cc_cnt_drawings_pos_current_mean_max: float64
648 - ccf_cc_cnt_drawings_pos_current_mean_min: float64
649 - ccf_cc_cnt_drawings_pos_current_mean_count: float64
650 - ccf_cc_cnt_drawings_pos_current_max_mean: float64
651 - ccf_cc_cnt_drawings_pos_current_max_max: float64
652 - ccf_cc_cnt_drawings_pos_current_max_min: float64
653 - ccf_cc_cnt_drawings_pos_current_max_count: float64
654 - ccf_cc_cnt_drawings_pos_current_min_mean: float64
655 - ccf_cc_cnt_drawings_pos_current_min_max: float64
656 - ccf_cc_cnt_drawings_pos_current_min_min: float64
657 - ccf_cc_cnt_drawings_pos_current_min_count: float64
658 - ccf_cc_cnt_drawings_pos_current_count_mean: float64
659 - ccf_cc_cnt_drawings_pos_current_count_max: float64
660 - ccf_cc_cnt_drawings_pos_current_count_min: float64
661 - ccf_cc_cnt_drawings_pos_current_count_count: float64
662 - ccf_cc_cnt_instalment_mature_cum_mean_mean: float64
663 - ccf_cc_cnt_instalment_mature_cum_mean_max: float64
664 - ccf_cc_cnt_instalment_mature_cum_mean_min: float64
665 - ccf_cc_cnt_instalment_mature_cum_mean_count: float64
666 - ccf_cc_cnt_instalment_mature_cum_max_mean: float64
667 - ccf_cc_cnt_instalment_mature_cum_max_max: float64
668 - ccf_cc_cnt_instalment_mature_cum_max_min: float64
669 - ccf_cc_cnt_instalment_mature_cum_max_count: float64
670 - ccf_cc_cnt_instalment_mature_cum_min_mean: float64
671 - ccf_cc_cnt_instalment_mature_cum_min_max: float64
672 - ccf_cc_cnt_instalment_mature_cum_min_min: float64
673 - ccf_cc_cnt_instalment_mature_cum_min_count: float64
674 - ccf_cc_cnt_instalment_mature_cum_count_mean: float64
675 - ccf_cc_cnt_instalment_mature_cum_count_max: float64
676 - ccf_cc_cnt_instalment_mature_cum_count_min: float64
677 - ccf_cc_cnt_instalment_mature_cum_count_count: float64
678 - ccf_cc_sk_dpd_mean_mean: float64
679 - ccf_cc_sk_dpd_mean_max: float64
680 - ccf_cc_sk_dpd_mean_min: float64
681 - ccf_cc_sk_dpd_mean_count: float64
682 - ccf_cc_sk_dpd_max_mean: float64
683 - ccf_cc_sk_dpd_max_max: float64
684 - ccf_cc_sk_dpd_max_min: float64
685 - ccf_cc_sk_dpd_max_count: float64
686 - ccf_cc_sk_dpd_min_mean: float64
687 - ccf_cc_sk_dpd_min_max: float64
688 - ccf_cc_sk_dpd_min_min: float64
689 - ccf_cc_sk_dpd_min_count: float64
690 - ccf_cc_sk_dpd_count_mean: float64

691 - ccf_cc_sk_dpd_count_max: float64
692 - ccf_cc_sk_dpd_count_min: float64
693 - ccf_cc_sk_dpd_count_count: float64
694 - ccf_cc_sk_dpd_def_mean_mean: float64
695 - ccf_cc_sk_dpd_def_mean_max: float64
696 - ccf_cc_sk_dpd_def_mean_min: float64
697 - ccf_cc_sk_dpd_def_mean_count: float64
698 - ccf_cc_sk_dpd_def_max_mean: float64
699 - ccf_cc_sk_dpd_def_max_max: float64
700 - ccf_cc_sk_dpd_def_max_min: float64
701 - ccf_cc_sk_dpd_def_max_count: float64
702 - ccf_cc_sk_dpd_def_min_mean: float64
703 - ccf_cc_sk_dpd_def_min_max: float64
704 - ccf_cc_sk_dpd_def_min_min: float64
705 - ccf_cc_sk_dpd_def_min_count: float64
706 - ccf_cc_sk_dpd_def_count_mean: float64
707 - ccf_cc_sk_dpd_def_count_max: float64
708 - ccf_cc_sk_dpd_def_count_min: float64
709 - ccf_cc_sk_dpd_def_count_count: float64
710 - instf_sk_id_prev_mean: float64
711 - instf_sk_id_prev_max: float64
712 - instf_sk_id_prev_min: float64
713 - instf_sk_id_prev_count: float64
714 - instf_inst_sk_id_curr_mean_mean: float64
715 - instf_inst_sk_id_curr_mean_max: float64
716 - instf_inst_sk_id_curr_mean_min: float64
717 - instf_inst_sk_id_curr_mean_count: float64
718 - instf_inst_sk_id_curr_max_mean: float64
719 - instf_inst_sk_id_curr_max_max: float64
720 - instf_inst_sk_id_curr_max_min: float64
721 - instf_inst_sk_id_curr_max_count: float64
722 - instf_inst_sk_id_curr_min_mean: float64
723 - instf_inst_sk_id_curr_min_max: float64
724 - instf_inst_sk_id_curr_min_min: float64
725 - instf_inst_sk_id_curr_min_count: float64
726 - instf_inst_sk_id_curr_count_mean: float64
727 - instf_inst_sk_id_curr_count_max: float64
728 - instf_inst_sk_id_curr_count_min: float64
729 - instf_inst_sk_id_curr_count_count: float64
730 - instf_inst_num_instalment_version_mean_mean: float64
731 - instf_inst_num_instalment_version_mean_max: float64
732 - instf_inst_num_instalment_version_mean_min: float64
733 - instf_inst_num_instalment_version_mean_count: float64
734 - instf_inst_num_instalment_version_max_mean: float64
735 - instf_inst_num_instalment_version_max_max: float64
736 - instf_inst_num_instalment_version_max_min: float64
737 - instf_inst_num_instalment_version_max_count: float64
738 - instf_inst_num_instalment_version_min_mean: float64
739 - instf_inst_num_instalment_version_min_max: float64
740 - instf_inst_num_instalment_version_min_min: float64
741 - instf_inst_num_instalment_version_min_count: float64
742 - instf_inst_num_instalment_version_count_mean: float64
743 - instf_inst_num_instalment_version_count_max: float64
744 - instf_inst_num_instalment_version_count_min: float64
745 - instf_inst_num_instalment_version_count_count: float64
746 - instf_inst_num_instalment_number_mean_mean: float64
747 - instf_inst_num_instalment_number_mean_max: float64
748 - instf_inst_num_instalment_number_mean_min: float64
749 - instf_inst_num_instalment_number_mean_count: float64
750 - instf_inst_num_instalment_number_max_mean: float64
751 - instf_inst_num_instalment_number_max_max: float64
752 - instf_inst_num_instalment_number_max_min: float64
753 - instf_inst_num_instalment_number_max_count: float64
754 - instf_inst_num_instalment_number_min_mean: float64
755 - instf_inst_num_instalment_number_min_max: float64
756 - instf_inst_num_instalment_number_min_min: float64
757 - instf_inst_num_instalment_number_min_count: float64
758 - instf_inst_num_instalment_number_count_mean: float64
759 - instf_inst_num_instalment_number_count_max: float64

```
760 - instf_inst_num_instalment_number_count_min: float64
761 - instf_inst_num_instalment_number_count_count: float64
762 - instf_inst_days_instalment_mean_mean: float64
763 - instf_inst_days_instalment_mean_max: float64
764 - instf_inst_days_instalment_mean_min: float64
765 - instf_inst_days_instalment_mean_count: float64
766 - instf_inst_days_instalment_max_mean: float64
767 - instf_inst_days_instalment_max_max: float64
768 - instf_inst_days_instalment_max_min: float64
769 - instf_inst_days_instalment_max_count: float64
770 - instf_inst_days_instalment_min_mean: float64
771 - instf_inst_days_instalment_min_max: float64
772 - instf_inst_days_instalment_min_min: float64
773 - instf_inst_days_instalment_min_count: float64
774 - instf_inst_days_instalment_count_mean: float64
775 - instf_inst_days_instalment_count_max: float64
776 - instf_inst_days_instalment_count_min: float64
777 - instf_inst_days_instalment_count_count: float64
778 - instf_inst_days_entry_payment_mean_mean: float64
779 - instf_inst_days_entry_payment_mean_max: float64
780 - instf_inst_days_entry_payment_mean_min: float64
781 - instf_inst_days_entry_payment_mean_count: float64
782 - instf_inst_days_entry_payment_max_mean: float64
783 - instf_inst_days_entry_payment_max_max: float64
784 - instf_inst_days_entry_payment_max_min: float64
785 - instf_inst_days_entry_payment_max_count: float64
786 - instf_inst_days_entry_payment_min_mean: float64
787 - instf_inst_days_entry_payment_min_max: float64
788 - instf_inst_days_entry_payment_min_min: float64
789 - instf_inst_days_entry_payment_min_count: float64
790 - instf_inst_days_entry_payment_count_mean: float64
791 - instf_inst_days_entry_payment_count_max: float64
792 - instf_inst_days_entry_payment_count_min: float64
793 - instf_inst_days_entry_payment_count_count: float64
794 - instf_inst_amt_instalment_mean_mean: float64
795 - instf_inst_amt_instalment_mean_max: float64
796 - instf_inst_amt_instalment_mean_min: float64
797 - instf_inst_amt_instalment_mean_count: float64
798 - instf_inst_amt_instalment_max_mean: float64
799 - instf_inst_amt_instalment_max_max: float64
800 - instf_inst_amt_instalment_max_min: float64
801 - instf_inst_amt_instalment_max_count: float64
802 - instf_inst_amt_instalment_min_mean: float64
803 - instf_inst_amt_instalment_min_max: float64
804 - instf_inst_amt_instalment_min_min: float64
805 - instf_inst_amt_instalment_min_count: float64
806 - instf_inst_amt_instalment_count_mean: float64
807 - instf_inst_amt_instalment_count_max: float64
808 - instf_inst_amt_instalment_count_min: float64
809 - instf_inst_amt_instalment_count_count: float64
810 - instf_inst_amt_payment_mean_mean: float64
811 - instf_inst_amt_payment_mean_max: float64
812 - instf_inst_amt_payment_mean_min: float64
813 - instf_inst_amt_payment_mean_count: float64
814 - instf_inst_amt_payment_max_mean: float64
815 - instf_inst_amt_payment_max_max: float64
816 - instf_inst_amt_payment_max_min: float64
817 - instf_inst_amt_payment_max_count: float64
818 - instf_inst_amt_payment_min_mean: float64
819 - instf_inst_amt_payment_min_max: float64
820 - instf_inst_amt_payment_min_min: float64
821 - instf_inst_amt_payment_min_count: float64
822 - instf_inst_amt_payment_count_mean: float64
823 - instf_inst_amt_payment_count_max: float64
824 - instf_inst_amt_payment_count_min: float64
825 - instf_inst_amt_payment_count_count: float64
```

### 5.3.1 Modifying Data Types

In [9]:
```
df1['flag_own_car'] = df1['flag_own_car'].map({'N': 0, 'Y': 1})
df1['flag_own_realty'] = df1['flag_own_realty'].map({'N': 0, 'Y': 1})
df1['emergencystate_mode'] = df1['emergencystate_mode'].map({'No': 0, 'Yes': 1})

weekday_map = {
    'MONDAY': 1,
    'TUESDAY': 2,
    'WEDNESDAY': 3,
    'THURSDAY': 4,
    'FRIDAY': 5,
    'SATURDAY': 6,
    'SUNDAY': 7
}

df1['weekday_appr_process_start'] = df1['weekday_appr_process_start'].map(weekday_map)
```

## 5.4 Checking and Filling NaN Values

In [10]:
```
df1 = df1.replace('XNA', pd.NA)

print(df1.isna().sum().to_string())
```

```
target                                 0
name_contract_type                     0
code_gender                            4
flag_own_car                           0
flag_own_realty                        0
cnt_children                           0
amt_income_total                       0
amt_credit                             0
amt_annuity                           12
amt_goods_price                      278
name_type_suite                     1292
name_income_type                       0
name_education_type                    0
name_family_status                     0
name_housing_type                      0
region_population_relative             0
days_birth                             0
days_employed                          0
days_registration                      0
days_id_publish                        0
own_car_age                       202929
flag_mobil                             0
flag_emp_phone                         0
flag_work_phone                        0
flag_cont_mobile                       0
flag_phone                             0
flag_email                             0
occupation_type                    96391
cnt_fam_members                        2
region_rating_client                   0
region_rating_client_w_city            0
weekday_appr_process_start             0
hour_appr_process_start                0
reg_region_not_live_region             0
reg_region_not_work_region             0
live_region_not_work_region            0
reg_city_not_live_city                 0
reg_city_not_work_city                 0
live_city_not_work_city                0
organization_type                  55374
ext_source_1                      173378
ext_source_2                         660
ext_source_3                       60965
apartments_avg                    156061
basementarea_avg                  179943
years_beginexpluatation_avg       150007
years_build_avg                   204488
commonarea_avg                    214865
elevators_avg                     163891
entrances_avg                     154828
floorsmax_avg                     153020
floorsmin_avg                     208642
landarea_avg                      182590
livingapartments_avg              210199
livingarea_avg                    154350
nonlivingapartments_avg           213514
nonlivingarea_avg                 169682
apartments_mode                   156061
basementarea_mode                 179943
years_beginexpluatation_mode      150007
years_build_mode                  204488
commonarea_mode                   214865
elevators_mode                    163891
entrances_mode                    154828
floorsmax_mode                    153020
floorsmin_mode                    208642
landarea_mode                     182590
livingapartments_mode             210199
livingarea_mode                   154350
```

| | |
|---|---|
| nonlivingapartments_mode | 213514 |
| nonlivingarea_mode | 169682 |
| apartments_medi | 156061 |
| basementarea_medi | 179943 |
| years_beginexpluatation_medi | 150007 |
| years_build_medi | 204488 |
| commonarea_medi | 214865 |
| elevators_medi | 163891 |
| entrances_medi | 154828 |
| floorsmax_medi | 153020 |
| floorsmin_medi | 208642 |
| landarea_medi | 182590 |
| livingapartments_medi | 210199 |
| livingarea_medi | 154350 |
| nonlivingapartments_medi | 213514 |
| nonlivingarea_medi | 169682 |
| fondkapremont_mode | 210295 |
| housetype_mode | 154297 |
| totalarea_mode | 148431 |
| wallsmaterial_mode | 156341 |
| emergencystate_mode | 145755 |
| obs_30_cnt_social_circle | 1021 |
| def_30_cnt_social_circle | 1021 |
| obs_60_cnt_social_circle | 1021 |
| def_60_cnt_social_circle | 1021 |
| days_last_phone_change | 1 |
| flag_document_2 | 0 |
| flag_document_3 | 0 |
| flag_document_4 | 0 |
| flag_document_5 | 0 |
| flag_document_6 | 0 |
| flag_document_7 | 0 |
| flag_document_8 | 0 |
| flag_document_9 | 0 |
| flag_document_10 | 0 |
| flag_document_11 | 0 |
| flag_document_12 | 0 |
| flag_document_13 | 0 |
| flag_document_14 | 0 |
| flag_document_15 | 0 |
| flag_document_16 | 0 |
| flag_document_17 | 0 |
| flag_document_18 | 0 |
| flag_document_19 | 0 |
| flag_document_20 | 0 |
| flag_document_21 | 0 |
| amt_req_credit_bureau_hour | 41519 |
| amt_req_credit_bureau_day | 41519 |
| amt_req_credit_bureau_week | 41519 |
| amt_req_credit_bureau_mon | 41519 |
| amt_req_credit_bureau_qrt | 41519 |
| amt_req_credit_bureau_year | 41519 |
| bur_sk_id_bureau_mean | 44020 |
| bur_sk_id_bureau_max | 44020 |
| bur_sk_id_bureau_min | 44020 |
| bur_sk_id_bureau_count | 44020 |
| bur_days_credit_mean | 44020 |
| bur_days_credit_max | 44020 |
| bur_days_credit_min | 44020 |
| bur_days_credit_count | 44020 |
| bur_credit_day_overdue_mean | 44020 |
| bur_credit_day_overdue_max | 44020 |
| bur_credit_day_overdue_min | 44020 |
| bur_credit_day_overdue_count | 44020 |
| bur_days_credit_enddate_mean | 46269 |
| bur_days_credit_enddate_max | 46269 |
| bur_days_credit_enddate_min | 46269 |
| bur_days_credit_enddate_count | 44020 |
| bur_days_enddate_fact_mean | 77156 |

| | |
|---|---|
| bur_days_enddate_fact_max | 77156 |
| bur_days_enddate_fact_min | 77156 |
| bur_days_enddate_fact_count | 44020 |
| bur_amt_credit_max_overdue_mean | 123625 |
| bur_amt_credit_max_overdue_max | 123625 |
| bur_amt_credit_max_overdue_min | 123625 |
| bur_amt_credit_max_overdue_count | 44020 |
| bur_cnt_credit_prolong_mean | 44020 |
| bur_cnt_credit_prolong_max | 44020 |
| bur_cnt_credit_prolong_min | 44020 |
| bur_cnt_credit_prolong_count | 44020 |
| bur_amt_credit_sum_mean | 44021 |
| bur_amt_credit_sum_max | 44021 |
| bur_amt_credit_sum_min | 44021 |
| bur_amt_credit_sum_count | 44020 |
| bur_amt_credit_sum_debt_mean | 51380 |
| bur_amt_credit_sum_debt_max | 51380 |
| bur_amt_credit_sum_debt_min | 51380 |
| bur_amt_credit_sum_debt_count | 44020 |
| bur_amt_credit_sum_limit_mean | 65069 |
| bur_amt_credit_sum_limit_max | 65069 |
| bur_amt_credit_sum_limit_min | 65069 |
| bur_amt_credit_sum_limit_count | 44020 |
| bur_amt_credit_sum_overdue_mean | 44020 |
| bur_amt_credit_sum_overdue_max | 44020 |
| bur_amt_credit_sum_overdue_min | 44020 |
| bur_amt_credit_sum_overdue_count | 44020 |
| bur_days_credit_update_mean | 44020 |
| bur_days_credit_update_max | 44020 |
| bur_days_credit_update_min | 44020 |
| bur_days_credit_update_count | 44020 |
| bur_amt_annuity_mean | 227502 |
| bur_amt_annuity_max | 227502 |
| bur_amt_annuity_min | 227502 |
| bur_amt_annuity_count | 44020 |
| bur_bb_months_balance_mean_mean | 215280 |
| bur_bb_months_balance_mean_max | 215280 |
| bur_bb_months_balance_mean_min | 215280 |
| bur_bb_months_balance_mean_count | 44020 |
| bur_bb_months_balance_max_mean | 215280 |
| bur_bb_months_balance_max_max | 215280 |
| bur_bb_months_balance_max_min | 215280 |
| bur_bb_months_balance_max_count | 44020 |
| bur_bb_months_balance_min_mean | 215280 |
| bur_bb_months_balance_min_max | 215280 |
| bur_bb_months_balance_min_min | 215280 |
| bur_bb_months_balance_min_count | 44020 |
| bur_bb_months_balance_count_mean | 215280 |
| bur_bb_months_balance_count_max | 215280 |
| bur_bb_months_balance_count_min | 215280 |
| bur_bb_months_balance_count_count | 44020 |
| prev_sk_id_prev_mean | 16454 |
| prev_sk_id_prev_max | 16454 |
| prev_sk_id_prev_min | 16454 |
| prev_sk_id_prev_count | 16454 |
| prev_amt_annuity_mean | 16871 |
| prev_amt_annuity_max | 16871 |
| prev_amt_annuity_min | 16871 |
| prev_amt_annuity_count | 16454 |
| prev_amt_application_mean | 16454 |
| prev_amt_application_max | 16454 |
| prev_amt_application_min | 16454 |
| prev_amt_application_count | 16454 |
| prev_amt_credit_mean | 16454 |
| prev_amt_credit_max | 16454 |
| prev_amt_credit_min | 16454 |
| prev_amt_credit_count | 16454 |
| prev_amt_down_payment_mean | 33906 |
| prev_amt_down_payment_max | 33906 |

| | |
|---|---|
| prev_amt_down_payment_min | 33906 |
| prev_amt_down_payment_count | 16454 |
| prev_amt_goods_price_mean | 17429 |
| prev_amt_goods_price_max | 17429 |
| prev_amt_goods_price_min | 17429 |
| prev_amt_goods_price_count | 16454 |
| prev_hour_appr_process_start_mean | 16454 |
| prev_hour_appr_process_start_max | 16454 |
| prev_hour_appr_process_start_min | 16454 |
| prev_hour_appr_process_start_count | 16454 |
| prev_nflag_last_appl_in_day_mean | 16454 |
| prev_nflag_last_appl_in_day_max | 16454 |
| prev_nflag_last_appl_in_day_min | 16454 |
| prev_nflag_last_appl_in_day_count | 16454 |
| prev_rate_down_payment_mean | 33906 |
| prev_rate_down_payment_max | 33906 |
| prev_rate_down_payment_min | 33906 |
| prev_rate_down_payment_count | 16454 |
| prev_rate_interest_primary_mean | 302902 |
| prev_rate_interest_primary_max | 302902 |
| prev_rate_interest_primary_min | 302902 |
| prev_rate_interest_primary_count | 16454 |
| prev_rate_interest_privileged_mean | 302902 |
| prev_rate_interest_privileged_max | 302902 |
| prev_rate_interest_privileged_min | 302902 |
| prev_rate_interest_privileged_count | 16454 |
| prev_days_decision_mean | 16454 |
| prev_days_decision_max | 16454 |
| prev_days_decision_min | 16454 |
| prev_days_decision_count | 16454 |
| prev_sellerplace_area_mean | 16454 |
| prev_sellerplace_area_max | 16454 |
| prev_sellerplace_area_min | 16454 |
| prev_sellerplace_area_count | 16454 |
| prev_cnt_payment_mean | 16869 |
| prev_cnt_payment_max | 16869 |
| prev_cnt_payment_min | 16869 |
| prev_cnt_payment_count | 16454 |
| prev_days_first_drawing_mean | 17751 |
| prev_days_first_drawing_max | 17751 |
| prev_days_first_drawing_min | 17751 |
| prev_days_first_drawing_count | 16454 |
| prev_days_first_due_mean | 17751 |
| prev_days_first_due_max | 17751 |
| prev_days_first_due_min | 17751 |
| prev_days_first_due_count | 16454 |
| prev_days_last_due_1st_version_mean | 17751 |
| prev_days_last_due_1st_version_max | 17751 |
| prev_days_last_due_1st_version_min | 17751 |
| prev_days_last_due_1st_version_count | 16454 |
| prev_days_last_due_mean | 17751 |
| prev_days_last_due_max | 17751 |
| prev_days_last_due_min | 17751 |
| prev_days_last_due_count | 16454 |
| prev_days_termination_mean | 17751 |
| prev_days_termination_max | 17751 |
| prev_days_termination_min | 17751 |
| prev_days_termination_count | 16454 |
| prev_nflag_insured_on_approval_mean | 17751 |
| prev_nflag_insured_on_approval_max | 17751 |
| prev_nflag_insured_on_approval_min | 17751 |
| prev_nflag_insured_on_approval_count | 16454 |
| posf_sk_id_prev_mean | 16454 |
| posf_sk_id_prev_max | 16454 |
| posf_sk_id_prev_min | 16454 |
| posf_sk_id_prev_count | 16454 |
| posf_pos_sk_id_curr_mean_mean | 20544 |
| posf_pos_sk_id_curr_mean_max | 20544 |
| posf_pos_sk_id_curr_mean_min | 20544 |

| | |
|---|---|
| posf_pos_sk_id_curr_mean_count | 16454 |
| posf_pos_sk_id_curr_max_mean | 20544 |
| posf_pos_sk_id_curr_max_max | 20544 |
| posf_pos_sk_id_curr_max_min | 20544 |
| posf_pos_sk_id_curr_max_count | 16454 |
| posf_pos_sk_id_curr_min_mean | 20544 |
| posf_pos_sk_id_curr_min_max | 20544 |
| posf_pos_sk_id_curr_min_min | 20544 |
| posf_pos_sk_id_curr_min_count | 16454 |
| posf_pos_sk_id_curr_count_mean | 20544 |
| posf_pos_sk_id_curr_count_max | 20544 |
| posf_pos_sk_id_curr_count_min | 20544 |
| posf_pos_sk_id_curr_count_count | 16454 |
| posf_pos_months_balance_mean_mean | 20544 |
| posf_pos_months_balance_mean_max | 20544 |
| posf_pos_months_balance_mean_min | 20544 |
| posf_pos_months_balance_mean_count | 16454 |
| posf_pos_months_balance_max_mean | 20544 |
| posf_pos_months_balance_max_max | 20544 |
| posf_pos_months_balance_max_min | 20544 |
| posf_pos_months_balance_max_count | 16454 |
| posf_pos_months_balance_min_mean | 20544 |
| posf_pos_months_balance_min_max | 20544 |
| posf_pos_months_balance_min_min | 20544 |
| posf_pos_months_balance_min_count | 16454 |
| posf_pos_months_balance_count_mean | 20544 |
| posf_pos_months_balance_count_max | 20544 |
| posf_pos_months_balance_count_min | 20544 |
| posf_pos_months_balance_count_count | 16454 |
| posf_pos_cnt_instalment_mean_mean | 20576 |
| posf_pos_cnt_instalment_mean_max | 20576 |
| posf_pos_cnt_instalment_mean_min | 20576 |
| posf_pos_cnt_instalment_mean_count | 16454 |
| posf_pos_cnt_instalment_max_mean | 20576 |
| posf_pos_cnt_instalment_max_max | 20576 |
| posf_pos_cnt_instalment_max_min | 20576 |
| posf_pos_cnt_instalment_max_count | 16454 |
| posf_pos_cnt_instalment_min_mean | 20576 |
| posf_pos_cnt_instalment_min_max | 20576 |
| posf_pos_cnt_instalment_min_min | 20576 |
| posf_pos_cnt_instalment_min_count | 16454 |
| posf_pos_cnt_instalment_count_mean | 20544 |
| posf_pos_cnt_instalment_count_max | 20544 |
| posf_pos_cnt_instalment_count_min | 20544 |
| posf_pos_cnt_instalment_count_count | 16454 |
| posf_pos_cnt_instalment_future_mean_mean | 20576 |
| posf_pos_cnt_instalment_future_mean_max | 20576 |
| posf_pos_cnt_instalment_future_mean_min | 20576 |
| posf_pos_cnt_instalment_future_mean_count | 16454 |
| posf_pos_cnt_instalment_future_max_mean | 20576 |
| posf_pos_cnt_instalment_future_max_max | 20576 |
| posf_pos_cnt_instalment_future_max_min | 20576 |
| posf_pos_cnt_instalment_future_max_count | 16454 |
| posf_pos_cnt_instalment_future_min_mean | 20576 |
| posf_pos_cnt_instalment_future_min_max | 20576 |
| posf_pos_cnt_instalment_future_min_min | 20576 |
| posf_pos_cnt_instalment_future_min_count | 16454 |
| posf_pos_cnt_instalment_future_count_mean | 20544 |
| posf_pos_cnt_instalment_future_count_max | 20544 |
| posf_pos_cnt_instalment_future_count_min | 20544 |
| posf_pos_cnt_instalment_future_count_count | 16454 |
| posf_pos_sk_dpd_mean_mean | 20544 |
| posf_pos_sk_dpd_mean_max | 20544 |
| posf_pos_sk_dpd_mean_min | 20544 |
| posf_pos_sk_dpd_mean_count | 16454 |
| posf_pos_sk_dpd_max_mean | 20544 |
| posf_pos_sk_dpd_max_max | 20544 |
| posf_pos_sk_dpd_max_min | 20544 |
| posf_pos_sk_dpd_max_count | 16454 |

| | |
|---|---|
| posf_pos_sk_dpd_min_mean | 20544 |
| posf_pos_sk_dpd_min_max | 20544 |
| posf_pos_sk_dpd_min_min | 20544 |
| posf_pos_sk_dpd_min_count | 16454 |
| posf_pos_sk_dpd_count_mean | 20544 |
| posf_pos_sk_dpd_count_max | 20544 |
| posf_pos_sk_dpd_count_min | 20544 |
| posf_pos_sk_dpd_count_count | 16454 |
| posf_pos_sk_dpd_def_mean_mean | 20544 |
| posf_pos_sk_dpd_def_mean_max | 20544 |
| posf_pos_sk_dpd_def_mean_min | 20544 |
| posf_pos_sk_dpd_def_mean_count | 16454 |
| posf_pos_sk_dpd_def_max_mean | 20544 |
| posf_pos_sk_dpd_def_max_max | 20544 |
| posf_pos_sk_dpd_def_max_min | 20544 |
| posf_pos_sk_dpd_def_max_count | 16454 |
| posf_pos_sk_dpd_def_min_mean | 20544 |
| posf_pos_sk_dpd_def_min_max | 20544 |
| posf_pos_sk_dpd_def_min_min | 20544 |
| posf_pos_sk_dpd_def_min_count | 16454 |
| posf_pos_sk_dpd_def_count_mean | 20544 |
| posf_pos_sk_dpd_def_count_max | 20544 |
| posf_pos_sk_dpd_def_count_min | 20544 |
| posf_pos_sk_dpd_def_count_count | 16454 |
| ccf_sk_id_prev_mean | 16454 |
| ccf_sk_id_prev_max | 16454 |
| ccf_sk_id_prev_min | 16454 |
| ccf_sk_id_prev_count | 16454 |
| ccf_cc_sk_id_curr_mean_mean | 229577 |
| ccf_cc_sk_id_curr_mean_max | 229577 |
| ccf_cc_sk_id_curr_mean_min | 229577 |
| ccf_cc_sk_id_curr_mean_count | 16454 |
| ccf_cc_sk_id_curr_max_mean | 229577 |
| ccf_cc_sk_id_curr_max_max | 229577 |
| ccf_cc_sk_id_curr_max_min | 229577 |
| ccf_cc_sk_id_curr_max_count | 16454 |
| ccf_cc_sk_id_curr_min_mean | 229577 |
| ccf_cc_sk_id_curr_min_max | 229577 |
| ccf_cc_sk_id_curr_min_min | 229577 |
| ccf_cc_sk_id_curr_min_count | 16454 |
| ccf_cc_sk_id_curr_count_mean | 229577 |
| ccf_cc_sk_id_curr_count_max | 229577 |
| ccf_cc_sk_id_curr_count_min | 229577 |
| ccf_cc_sk_id_curr_count_count | 16454 |
| ccf_cc_months_balance_mean_mean | 229577 |
| ccf_cc_months_balance_mean_max | 229577 |
| ccf_cc_months_balance_mean_min | 229577 |
| ccf_cc_months_balance_mean_count | 16454 |
| ccf_cc_months_balance_max_mean | 229577 |
| ccf_cc_months_balance_max_max | 229577 |
| ccf_cc_months_balance_max_min | 229577 |
| ccf_cc_months_balance_max_count | 16454 |
| ccf_cc_months_balance_min_mean | 229577 |
| ccf_cc_months_balance_min_max | 229577 |
| ccf_cc_months_balance_min_min | 229577 |
| ccf_cc_months_balance_min_count | 16454 |
| ccf_cc_months_balance_count_mean | 229577 |
| ccf_cc_months_balance_count_max | 229577 |
| ccf_cc_months_balance_count_min | 229577 |
| ccf_cc_months_balance_count_count | 16454 |
| ccf_cc_amt_balance_mean_mean | 229577 |
| ccf_cc_amt_balance_mean_max | 229577 |
| ccf_cc_amt_balance_mean_min | 229577 |
| ccf_cc_amt_balance_mean_count | 16454 |
| ccf_cc_amt_balance_max_mean | 229577 |
| ccf_cc_amt_balance_max_max | 229577 |
| ccf_cc_amt_balance_max_min | 229577 |
| ccf_cc_amt_balance_max_count | 16454 |
| ccf_cc_amt_balance_min_mean | 229577 |

| | |
|---|---|
| ccf_cc_amt_balance_min_max | 229577 |
| ccf_cc_amt_balance_min_min | 229577 |
| ccf_cc_amt_balance_min_count | 16454 |
| ccf_cc_amt_balance_count_mean | 229577 |
| ccf_cc_amt_balance_count_max | 229577 |
| ccf_cc_amt_balance_count_min | 229577 |
| ccf_cc_amt_balance_count_count | 16454 |
| ccf_cc_amt_credit_limit_actual_mean_mean | 229577 |
| ccf_cc_amt_credit_limit_actual_mean_max | 229577 |
| ccf_cc_amt_credit_limit_actual_mean_min | 229577 |
| ccf_cc_amt_credit_limit_actual_mean_count | 16454 |
| ccf_cc_amt_credit_limit_actual_max_mean | 229577 |
| ccf_cc_amt_credit_limit_actual_max_max | 229577 |
| ccf_cc_amt_credit_limit_actual_max_min | 229577 |
| ccf_cc_amt_credit_limit_actual_max_count | 16454 |
| ccf_cc_amt_credit_limit_actual_min_mean | 229577 |
| ccf_cc_amt_credit_limit_actual_min_max | 229577 |
| ccf_cc_amt_credit_limit_actual_min_min | 229577 |
| ccf_cc_amt_credit_limit_actual_min_count | 16454 |
| ccf_cc_amt_credit_limit_actual_count_mean | 229577 |
| ccf_cc_amt_credit_limit_actual_count_max | 229577 |
| ccf_cc_amt_credit_limit_actual_count_min | 229577 |
| ccf_cc_amt_credit_limit_actual_count_count | 16454 |
| ccf_cc_amt_drawings_atm_current_mean_mean | 254581 |
| ccf_cc_amt_drawings_atm_current_mean_max | 254581 |
| ccf_cc_amt_drawings_atm_current_mean_min | 254581 |
| ccf_cc_amt_drawings_atm_current_mean_count | 16454 |
| ccf_cc_amt_drawings_atm_current_max_mean | 254581 |
| ccf_cc_amt_drawings_atm_current_max_max | 254581 |
| ccf_cc_amt_drawings_atm_current_max_min | 254581 |
| ccf_cc_amt_drawings_atm_current_max_count | 16454 |
| ccf_cc_amt_drawings_atm_current_min_mean | 254581 |
| ccf_cc_amt_drawings_atm_current_min_max | 254581 |
| ccf_cc_amt_drawings_atm_current_min_min | 254581 |
| ccf_cc_amt_drawings_atm_current_min_count | 16454 |
| ccf_cc_amt_drawings_atm_current_count_mean | 229577 |
| ccf_cc_amt_drawings_atm_current_count_max | 229577 |
| ccf_cc_amt_drawings_atm_current_count_min | 229577 |
| ccf_cc_amt_drawings_atm_current_count_count | 16454 |
| ccf_cc_amt_drawings_current_mean_mean | 229577 |
| ccf_cc_amt_drawings_current_mean_max | 229577 |
| ccf_cc_amt_drawings_current_mean_min | 229577 |
| ccf_cc_amt_drawings_current_mean_count | 16454 |
| ccf_cc_amt_drawings_current_max_mean | 229577 |
| ccf_cc_amt_drawings_current_max_max | 229577 |
| ccf_cc_amt_drawings_current_max_min | 229577 |
| ccf_cc_amt_drawings_current_max_count | 16454 |
| ccf_cc_amt_drawings_current_min_mean | 229577 |
| ccf_cc_amt_drawings_current_min_max | 229577 |
| ccf_cc_amt_drawings_current_min_min | 229577 |
| ccf_cc_amt_drawings_current_min_count | 16454 |
| ccf_cc_amt_drawings_current_count_mean | 229577 |
| ccf_cc_amt_drawings_current_count_max | 229577 |
| ccf_cc_amt_drawings_current_count_min | 229577 |
| ccf_cc_amt_drawings_current_count_count | 16454 |
| ccf_cc_amt_drawings_other_current_mean_mean | 254581 |
| ccf_cc_amt_drawings_other_current_mean_max | 254581 |
| ccf_cc_amt_drawings_other_current_mean_min | 254581 |
| ccf_cc_amt_drawings_other_current_mean_count | 16454 |
| ccf_cc_amt_drawings_other_current_max_mean | 254581 |
| ccf_cc_amt_drawings_other_current_max_max | 254581 |
| ccf_cc_amt_drawings_other_current_max_min | 254581 |
| ccf_cc_amt_drawings_other_current_max_count | 16454 |
| ccf_cc_amt_drawings_other_current_min_mean | 254581 |
| ccf_cc_amt_drawings_other_current_min_max | 254581 |
| ccf_cc_amt_drawings_other_current_min_min | 254581 |
| ccf_cc_amt_drawings_other_current_min_count | 16454 |
| ccf_cc_amt_drawings_other_current_count_mean | 229577 |
| ccf_cc_amt_drawings_other_current_count_max | 229577 |

```
ccf_cc_amt_drawings_other_current_count_min       229577
ccf_cc_amt_drawings_other_current_count_count      16454
ccf_cc_amt_drawings_pos_current_mean_mean         254581
ccf_cc_amt_drawings_pos_current_mean_max          254581
ccf_cc_amt_drawings_pos_current_mean_min          254581
ccf_cc_amt_drawings_pos_current_mean_count         16454
ccf_cc_amt_drawings_pos_current_max_mean          254581
ccf_cc_amt_drawings_pos_current_max_max           254581
ccf_cc_amt_drawings_pos_current_max_min           254581
ccf_cc_amt_drawings_pos_current_max_count          16454
ccf_cc_amt_drawings_pos_current_min_mean          254581
ccf_cc_amt_drawings_pos_current_min_max           254581
ccf_cc_amt_drawings_pos_current_min_min           254581
ccf_cc_amt_drawings_pos_current_min_count          16454
ccf_cc_amt_drawings_pos_current_count_mean        229577
ccf_cc_amt_drawings_pos_current_count_max         229577
ccf_cc_amt_drawings_pos_current_count_min         229577
ccf_cc_amt_drawings_pos_current_count_count        16454
ccf_cc_amt_inst_min_regularity_mean_mean          229577
ccf_cc_amt_inst_min_regularity_mean_max           229577
ccf_cc_amt_inst_min_regularity_mean_min           229577
ccf_cc_amt_inst_min_regularity_mean_count          16454
ccf_cc_amt_inst_min_regularity_max_mean           229577
ccf_cc_amt_inst_min_regularity_max_max            229577
ccf_cc_amt_inst_min_regularity_max_min            229577
ccf_cc_amt_inst_min_regularity_max_count           16454
ccf_cc_amt_inst_min_regularity_min_mean           229577
ccf_cc_amt_inst_min_regularity_min_max            229577
ccf_cc_amt_inst_min_regularity_min_min            229577
ccf_cc_amt_inst_min_regularity_min_count           16454
ccf_cc_amt_inst_min_regularity_count_mean         229577
ccf_cc_amt_inst_min_regularity_count_max          229577
ccf_cc_amt_inst_min_regularity_count_min          229577
ccf_cc_amt_inst_min_regularity_count_count         16454
ccf_cc_amt_payment_current_mean_mean              254669
ccf_cc_amt_payment_current_mean_max               254669
ccf_cc_amt_payment_current_mean_min               254669
ccf_cc_amt_payment_current_mean_count              16454
ccf_cc_amt_payment_current_max_mean               254669
ccf_cc_amt_payment_current_max_max                254669
ccf_cc_amt_payment_current_max_min                254669
ccf_cc_amt_payment_current_max_count               16454
ccf_cc_amt_payment_current_min_mean               254669
ccf_cc_amt_payment_current_min_max                254669
ccf_cc_amt_payment_current_min_min                254669
ccf_cc_amt_payment_current_min_count               16454
ccf_cc_amt_payment_current_count_mean             229577
ccf_cc_amt_payment_current_count_max              229577
ccf_cc_amt_payment_current_count_min              229577
ccf_cc_amt_payment_current_count_count             16454
ccf_cc_amt_payment_total_current_mean_mean        229577
ccf_cc_amt_payment_total_current_mean_max         229577
ccf_cc_amt_payment_total_current_mean_min         229577
ccf_cc_amt_payment_total_current_mean_count        16454
ccf_cc_amt_payment_total_current_max_mean         229577
ccf_cc_amt_payment_total_current_max_max          229577
ccf_cc_amt_payment_total_current_max_min          229577
ccf_cc_amt_payment_total_current_max_count         16454
ccf_cc_amt_payment_total_current_min_mean         229577
ccf_cc_amt_payment_total_current_min_max          229577
ccf_cc_amt_payment_total_current_min_min          229577
ccf_cc_amt_payment_total_current_min_count         16454
ccf_cc_amt_payment_total_current_count_mean       229577
ccf_cc_amt_payment_total_current_count_max        229577
ccf_cc_amt_payment_total_current_count_min        229577
ccf_cc_amt_payment_total_current_count_count       16454
ccf_cc_amt_receivable_principal_mean_mean         229577
ccf_cc_amt_receivable_principal_mean_max          229577
ccf_cc_amt_receivable_principal_mean_min          229577
```

| | |
|---|---|
| ccf_cc_amt_receivable_principal_mean_count | 16454 |
| ccf_cc_amt_receivable_principal_max_mean | 229577 |
| ccf_cc_amt_receivable_principal_max_max | 229577 |
| ccf_cc_amt_receivable_principal_max_min | 229577 |
| ccf_cc_amt_receivable_principal_max_count | 16454 |
| ccf_cc_amt_receivable_principal_min_mean | 229577 |
| ccf_cc_amt_receivable_principal_min_max | 229577 |
| ccf_cc_amt_receivable_principal_min_min | 229577 |
| ccf_cc_amt_receivable_principal_min_count | 16454 |
| ccf_cc_amt_receivable_principal_count_mean | 229577 |
| ccf_cc_amt_receivable_principal_count_max | 229577 |
| ccf_cc_amt_receivable_principal_count_min | 229577 |
| ccf_cc_amt_receivable_principal_count_count | 16454 |
| ccf_cc_amt_recivable_mean_mean | 229577 |
| ccf_cc_amt_recivable_mean_max | 229577 |
| ccf_cc_amt_recivable_mean_min | 229577 |
| ccf_cc_amt_recivable_mean_count | 16454 |
| ccf_cc_amt_recivable_max_mean | 229577 |
| ccf_cc_amt_recivable_max_max | 229577 |
| ccf_cc_amt_recivable_max_min | 229577 |
| ccf_cc_amt_recivable_max_count | 16454 |
| ccf_cc_amt_recivable_min_mean | 229577 |
| ccf_cc_amt_recivable_min_max | 229577 |
| ccf_cc_amt_recivable_min_min | 229577 |
| ccf_cc_amt_recivable_min_count | 16454 |
| ccf_cc_amt_recivable_count_mean | 229577 |
| ccf_cc_amt_recivable_count_max | 229577 |
| ccf_cc_amt_recivable_count_min | 229577 |
| ccf_cc_amt_recivable_count_count | 16454 |
| ccf_cc_amt_total_receivable_mean_mean | 229577 |
| ccf_cc_amt_total_receivable_mean_max | 229577 |
| ccf_cc_amt_total_receivable_mean_min | 229577 |
| ccf_cc_amt_total_receivable_mean_count | 16454 |
| ccf_cc_amt_total_receivable_max_mean | 229577 |
| ccf_cc_amt_total_receivable_max_max | 229577 |
| ccf_cc_amt_total_receivable_max_min | 229577 |
| ccf_cc_amt_total_receivable_max_count | 16454 |
| ccf_cc_amt_total_receivable_min_mean | 229577 |
| ccf_cc_amt_total_receivable_min_max | 229577 |
| ccf_cc_amt_total_receivable_min_min | 229577 |
| ccf_cc_amt_total_receivable_min_count | 16454 |
| ccf_cc_amt_total_receivable_count_mean | 229577 |
| ccf_cc_amt_total_receivable_count_max | 229577 |
| ccf_cc_amt_total_receivable_count_min | 229577 |
| ccf_cc_amt_total_receivable_count_count | 16454 |
| ccf_cc_cnt_drawings_atm_current_mean_mean | 254581 |
| ccf_cc_cnt_drawings_atm_current_mean_max | 254581 |
| ccf_cc_cnt_drawings_atm_current_mean_min | 254581 |
| ccf_cc_cnt_drawings_atm_current_mean_count | 16454 |
| ccf_cc_cnt_drawings_atm_current_max_mean | 254581 |
| ccf_cc_cnt_drawings_atm_current_max_max | 254581 |
| ccf_cc_cnt_drawings_atm_current_max_min | 254581 |
| ccf_cc_cnt_drawings_atm_current_max_count | 16454 |
| ccf_cc_cnt_drawings_atm_current_min_mean | 254581 |
| ccf_cc_cnt_drawings_atm_current_min_max | 254581 |
| ccf_cc_cnt_drawings_atm_current_min_min | 254581 |
| ccf_cc_cnt_drawings_atm_current_min_count | 16454 |
| ccf_cc_cnt_drawings_atm_current_count_mean | 229577 |
| ccf_cc_cnt_drawings_atm_current_count_max | 229577 |
| ccf_cc_cnt_drawings_atm_current_count_min | 229577 |
| ccf_cc_cnt_drawings_atm_current_count_count | 16454 |
| ccf_cc_cnt_drawings_current_mean_mean | 229577 |
| ccf_cc_cnt_drawings_current_mean_max | 229577 |
| ccf_cc_cnt_drawings_current_mean_min | 229577 |
| ccf_cc_cnt_drawings_current_mean_count | 16454 |
| ccf_cc_cnt_drawings_current_max_mean | 229577 |
| ccf_cc_cnt_drawings_current_max_max | 229577 |
| ccf_cc_cnt_drawings_current_max_min | 229577 |
| ccf_cc_cnt_drawings_current_max_count | 16454 |

| | |
|---|---|
| ccf_cc_cnt_drawings_current_min_mean | 229577 |
| ccf_cc_cnt_drawings_current_min_max | 229577 |
| ccf_cc_cnt_drawings_current_min_min | 229577 |
| ccf_cc_cnt_drawings_current_min_count | 16454 |
| ccf_cc_cnt_drawings_current_count_mean | 229577 |
| ccf_cc_cnt_drawings_current_count_max | 229577 |
| ccf_cc_cnt_drawings_current_count_min | 229577 |
| ccf_cc_cnt_drawings_current_count_count | 16454 |
| ccf_cc_cnt_drawings_other_current_mean_mean | 254581 |
| ccf_cc_cnt_drawings_other_current_mean_max | 254581 |
| ccf_cc_cnt_drawings_other_current_mean_min | 254581 |
| ccf_cc_cnt_drawings_other_current_mean_count | 16454 |
| ccf_cc_cnt_drawings_other_current_max_mean | 254581 |
| ccf_cc_cnt_drawings_other_current_max_max | 254581 |
| ccf_cc_cnt_drawings_other_current_max_min | 254581 |
| ccf_cc_cnt_drawings_other_current_max_count | 16454 |
| ccf_cc_cnt_drawings_other_current_min_mean | 254581 |
| ccf_cc_cnt_drawings_other_current_min_max | 254581 |
| ccf_cc_cnt_drawings_other_current_min_min | 254581 |
| ccf_cc_cnt_drawings_other_current_min_count | 16454 |
| ccf_cc_cnt_drawings_other_current_count_mean | 229577 |
| ccf_cc_cnt_drawings_other_current_count_max | 229577 |
| ccf_cc_cnt_drawings_other_current_count_min | 229577 |
| ccf_cc_cnt_drawings_other_current_count_count | 16454 |
| ccf_cc_cnt_drawings_pos_current_mean_mean | 254581 |
| ccf_cc_cnt_drawings_pos_current_mean_max | 254581 |
| ccf_cc_cnt_drawings_pos_current_mean_min | 254581 |
| ccf_cc_cnt_drawings_pos_current_mean_count | 16454 |
| ccf_cc_cnt_drawings_pos_current_max_mean | 254581 |
| ccf_cc_cnt_drawings_pos_current_max_max | 254581 |
| ccf_cc_cnt_drawings_pos_current_max_min | 254581 |
| ccf_cc_cnt_drawings_pos_current_max_count | 16454 |
| ccf_cc_cnt_drawings_pos_current_min_mean | 254581 |
| ccf_cc_cnt_drawings_pos_current_min_max | 254581 |
| ccf_cc_cnt_drawings_pos_current_min_min | 254581 |
| ccf_cc_cnt_drawings_pos_current_min_count | 16454 |
| ccf_cc_cnt_drawings_pos_current_count_mean | 229577 |
| ccf_cc_cnt_drawings_pos_current_count_max | 229577 |
| ccf_cc_cnt_drawings_pos_current_count_min | 229577 |
| ccf_cc_cnt_drawings_pos_current_count_count | 16454 |
| ccf_cc_cnt_instalment_mature_cum_mean_mean | 229577 |
| ccf_cc_cnt_instalment_mature_cum_mean_max | 229577 |
| ccf_cc_cnt_instalment_mature_cum_mean_min | 229577 |
| ccf_cc_cnt_instalment_mature_cum_mean_count | 16454 |
| ccf_cc_cnt_instalment_mature_cum_max_mean | 229577 |
| ccf_cc_cnt_instalment_mature_cum_max_max | 229577 |
| ccf_cc_cnt_instalment_mature_cum_max_min | 229577 |
| ccf_cc_cnt_instalment_mature_cum_max_count | 16454 |
| ccf_cc_cnt_instalment_mature_cum_min_mean | 229577 |
| ccf_cc_cnt_instalment_mature_cum_min_max | 229577 |
| ccf_cc_cnt_instalment_mature_cum_min_min | 229577 |
| ccf_cc_cnt_instalment_mature_cum_min_count | 16454 |
| ccf_cc_cnt_instalment_mature_cum_count_mean | 229577 |
| ccf_cc_cnt_instalment_mature_cum_count_max | 229577 |
| ccf_cc_cnt_instalment_mature_cum_count_min | 229577 |
| ccf_cc_cnt_instalment_mature_cum_count_count | 16454 |
| ccf_cc_sk_dpd_mean_mean | 229577 |
| ccf_cc_sk_dpd_mean_max | 229577 |
| ccf_cc_sk_dpd_mean_min | 229577 |
| ccf_cc_sk_dpd_mean_count | 16454 |
| ccf_cc_sk_dpd_max_mean | 229577 |
| ccf_cc_sk_dpd_max_max | 229577 |
| ccf_cc_sk_dpd_max_min | 229577 |
| ccf_cc_sk_dpd_max_count | 16454 |
| ccf_cc_sk_dpd_min_mean | 229577 |
| ccf_cc_sk_dpd_min_max | 229577 |
| ccf_cc_sk_dpd_min_min | 229577 |
| ccf_cc_sk_dpd_min_count | 16454 |
| ccf_cc_sk_dpd_count_mean | 229577 |

```
ccf_cc_sk_dpd_count_max                     229577
ccf_cc_sk_dpd_count_min                     229577
ccf_cc_sk_dpd_count_count                    16454
ccf_cc_sk_dpd_def_mean_mean                 229577
ccf_cc_sk_dpd_def_mean_max                  229577
ccf_cc_sk_dpd_def_mean_min                  229577
ccf_cc_sk_dpd_def_mean_count                 16454
ccf_cc_sk_dpd_def_max_mean                  229577
ccf_cc_sk_dpd_def_max_max                   229577
ccf_cc_sk_dpd_def_max_min                   229577
ccf_cc_sk_dpd_def_max_count                  16454
ccf_cc_sk_dpd_def_min_mean                  229577
ccf_cc_sk_dpd_def_min_max                   229577
ccf_cc_sk_dpd_def_min_min                   229577
ccf_cc_sk_dpd_def_min_count                  16454
ccf_cc_sk_dpd_def_count_mean                229577
ccf_cc_sk_dpd_def_count_max                 229577
ccf_cc_sk_dpd_def_count_min                 229577
ccf_cc_sk_dpd_def_count_count                16454
instf_sk_id_prev_mean                        16454
instf_sk_id_prev_max                         16454
instf_sk_id_prev_min                         16454
instf_sk_id_prev_count                       16454
instf_inst_sk_id_curr_mean_mean              18105
instf_inst_sk_id_curr_mean_max               18105
instf_inst_sk_id_curr_mean_min               18105
instf_inst_sk_id_curr_mean_count             16454
instf_inst_sk_id_curr_max_mean               18105
instf_inst_sk_id_curr_max_max                18105
instf_inst_sk_id_curr_max_min                18105
instf_inst_sk_id_curr_max_count              16454
instf_inst_sk_id_curr_min_mean               18105
instf_inst_sk_id_curr_min_max                18105
instf_inst_sk_id_curr_min_min                18105
instf_inst_sk_id_curr_min_count              16454
instf_inst_sk_id_curr_count_mean             18105
instf_inst_sk_id_curr_count_max              18105
instf_inst_sk_id_curr_count_min              18105
instf_inst_sk_id_curr_count_count            16454
instf_inst_num_instalment_version_mean_mean       18105
instf_inst_num_instalment_version_mean_max        18105
instf_inst_num_instalment_version_mean_min        18105
instf_inst_num_instalment_version_mean_count      16454
instf_inst_num_instalment_version_max_mean        18105
instf_inst_num_instalment_version_max_max         18105
instf_inst_num_instalment_version_max_min         18105
instf_inst_num_instalment_version_max_count       16454
instf_inst_num_instalment_version_min_mean        18105
instf_inst_num_instalment_version_min_max         18105
instf_inst_num_instalment_version_min_min         18105
instf_inst_num_instalment_version_min_count       16454
instf_inst_num_instalment_version_count_mean      18105
instf_inst_num_instalment_version_count_max       18105
instf_inst_num_instalment_version_count_min       18105
instf_inst_num_instalment_version_count_count     16454
instf_inst_num_instalment_number_mean_mean        18105
instf_inst_num_instalment_number_mean_max         18105
instf_inst_num_instalment_number_mean_min         18105
instf_inst_num_instalment_number_mean_count       16454
instf_inst_num_instalment_number_max_mean         18105
instf_inst_num_instalment_number_max_max          18105
instf_inst_num_instalment_number_max_min          18105
instf_inst_num_instalment_number_max_count        16454
instf_inst_num_instalment_number_min_mean         18105
instf_inst_num_instalment_number_min_max          18105
instf_inst_num_instalment_number_min_min          18105
instf_inst_num_instalment_number_min_count        16454
instf_inst_num_instalment_number_count_mean       18105
instf_inst_num_instalment_number_count_max        18105
```

```
instf_inst_num_instalment_number_count_min        18105
instf_inst_num_instalment_number_count_count      16454
instf_inst_days_instalment_mean_mean              18105
instf_inst_days_instalment_mean_max               18105
instf_inst_days_instalment_mean_min               18105
instf_inst_days_instalment_mean_count             16454
instf_inst_days_instalment_max_mean               18105
instf_inst_days_instalment_max_max                18105
instf_inst_days_instalment_max_min                18105
instf_inst_days_instalment_max_count              16454
instf_inst_days_instalment_min_mean               18105
instf_inst_days_instalment_min_max                18105
instf_inst_days_instalment_min_min                18105
instf_inst_days_instalment_min_count              16454
instf_inst_days_instalment_count_mean             18105
instf_inst_days_instalment_count_max              18105
instf_inst_days_instalment_count_min              18105
instf_inst_days_instalment_count_count            16454
instf_inst_days_entry_payment_mean_mean           18113
instf_inst_days_entry_payment_mean_max            18113
instf_inst_days_entry_payment_mean_min            18113
instf_inst_days_entry_payment_mean_count          16454
instf_inst_days_entry_payment_max_mean            18113
instf_inst_days_entry_payment_max_max             18113
instf_inst_days_entry_payment_max_min             18113
instf_inst_days_entry_payment_max_count           16454
instf_inst_days_entry_payment_min_mean            18113
instf_inst_days_entry_payment_min_max             18113
instf_inst_days_entry_payment_min_min             18113
instf_inst_days_entry_payment_min_count           16454
instf_inst_days_entry_payment_count_mean          18105
instf_inst_days_entry_payment_count_max           18105
instf_inst_days_entry_payment_count_min           18105
instf_inst_days_entry_payment_count_count         16454
instf_inst_amt_instalment_mean_mean               18105
instf_inst_amt_instalment_mean_max                18105
instf_inst_amt_instalment_mean_min                18105
instf_inst_amt_instalment_mean_count              16454
instf_inst_amt_instalment_max_mean                18105
instf_inst_amt_instalment_max_max                 18105
instf_inst_amt_instalment_max_min                 18105
instf_inst_amt_instalment_max_count               16454
instf_inst_amt_instalment_min_mean                18105
instf_inst_amt_instalment_min_max                 18105
instf_inst_amt_instalment_min_min                 18105
instf_inst_amt_instalment_min_count               16454
instf_inst_amt_instalment_count_mean              18105
instf_inst_amt_instalment_count_max               18105
instf_inst_amt_instalment_count_min               18105
instf_inst_amt_instalment_count_count             16454
instf_inst_amt_payment_mean_mean                  18113
instf_inst_amt_payment_mean_max                   18113
instf_inst_amt_payment_mean_min                   18113
instf_inst_amt_payment_mean_count                 16454
instf_inst_amt_payment_max_mean                   18113
instf_inst_amt_payment_max_max                    18113
instf_inst_amt_payment_max_min                    18113
instf_inst_amt_payment_max_count                  16454
instf_inst_amt_payment_min_mean                   18113
instf_inst_amt_payment_min_max                    18113
instf_inst_amt_payment_min_min                    18113
instf_inst_amt_payment_min_count                  16454
instf_inst_amt_payment_count_mean                 18105
instf_inst_amt_payment_count_max                  18105
instf_inst_amt_payment_count_min                  18105
instf_inst_amt_payment_count_count                16454
```

### 5.4.1 Filling Missing Values

In [11]:
```
aux_missing_cols = {}


aux_missing_cols['is_building']          = df1.filter(like='commonarea_').notna().any(axis=1).a
aux_missing_cols['is_building_missing']  = (~df1.filter(like='commonarea_').notna().any(axis=1)
aux_missing_cols['has_basement']         = df1['basementarea_avg'].notna().astype(int)
aux_missing_cols['basementarea_missing'] = df1['basementarea_avg'].isna().astype(int)
aux_missing_cols['has_noliving']         = df1['nonlivingarea_avg'].notna().astype(int)
aux_missing_cols['nonlivingarea_missing']= df1['nonlivingarea_avg'].isna().astype(int)
aux_missing_cols['is_employed']          = (~df1['days_employed'].isna()).astype(int)

aux_missing_cols['livingarea_missing']    = df1['livingarea_avg'].isna().astype(int)
aux_missing_cols['apartments_missing']    = df1['apartments_avg'].isna().astype(int)
aux_missing_cols['floorsmax_missing']     = df1['floorsmax_avg'].isna().astype(int)
aux_missing_cols['years_build_missing']   = df1['years_build_avg'].isna().astype(int)
aux_missing_cols['commonarea_missing']    = df1['commonarea_avg'].isna().astype(int)

aux_missing_cols['emergencystate_missing']= df1['emergencystate_mode'].isna().astype(int)
df1['emergencystate_mode']               = df1['emergencystate_mode'].fillna(0)
for col in ['elevators_avg', 'elevators_mode', 'elevators_medi']:
    aux_missing_cols[col + "_missing"] = df1[col].isna().astype(int)
    df1[col] = df1[col].fillna(0)


cols_moda = [
    'housetype_mode', 'wallsmaterial_mode', 'occupation_type', 'organization_type'
]
for col in cols_moda:
    aux_missing_cols[col + '_missing'] = df1[col].isna().astype(int)

df1['housetype_mode']      = df1['housetype_mode'].fillna('Unknown')
df1['wallsmaterial_mode']  = df1['wallsmaterial_mode'].fillna('Unknown')
df1['occupation_type']     = df1['occupation_type'].fillna('Other')
df1['organization_type']   = df1['organization_type'].fillna('Unknown')

drop_columns = {
    'fondkapremont_mode', 'landarea_mode', 'landarea_medi',
    'livingarea_mode', 'livingarea_medi',
    'entrances_avg', 'entrances_mode', 'entrances_medi',
    'floorsmax_mode', 'floorsmax_medi',
    'apartments_mode', 'apartments_medi', 'years_build_mode','years_build_medi'
}

do_not_drop = {
    'livingarea_avg', 'apartments_avg', 'floorsmax_avg', 'years_build_avg',
    'basementarea_avg', 'nonlivingarea_avg', 'livingapartments_missing',
    'own_car_age', 'years_beginexpluatation_avg','commonarea_avg', 'nonlivingapartments_avg', '
}

prefixes = (
    'nonlivingapartments_','livingapartments_','floorsmin_','commonarea_','basementarea_',
    'nonlivingarea_','years_beginexpluatation_'
)

cols_to_drop = [
    col for col in df1.columns
    if ((col.startswith(prefixes) and col not in do_not_drop) or col in drop_columns)
]

df1 = df1.drop(columns=cols_to_drop)
```

In [12]:
```
aux_missing_cols['name_type_suite_missing'] = df1['name_type_suite'].isna().astype(int)
mode_suite = df1["name_type_suite"].mode()[0]
df1["name_type_suite"] = df1["name_type_suite"].fillna(mode_suite)

aux_missing_cols['code_gender_missing'] = df1['code_gender'].isna().astype(int)
mode_gender = df1["code_gender"].mode()[0]
df1["code_gender"] = df1["code_gender"].fillna(mode_gender)
```

```python
cols_nan_remanescentes = df1.columns[df1.isnull().any()]
df_mediana = pd.DataFrame(columns=['coluna', 'mediana'])
medianas = []
for col_nome in cols_nan_remanescentes:
    aux_missing_cols[col_nome + '_missing'] = df1[col_nome].isna().astype(int)
    mediana = df1[col_nome].median()
    medianas.append({'coluna': col_nome, 'mediana': mediana})
    df1[col_nome] = df1[col_nome].fillna(mediana)
df_mediana = pd.DataFrame(medianas)
```

In [13]:
```python
df1 = pd.concat([df1, pd.DataFrame(aux_missing_cols, index=df1.index)], axis=1)
df1 = df1.copy()
```

### 5.4.2 Checking Missing Values After Modifications

In [14]:
```python
print(df1.isna().sum().to_string())
```

```
target                              0
name_contract_type                  0
code_gender                         0
flag_own_car                        0
flag_own_realty                     0
cnt_children                        0
amt_income_total                    0
amt_credit                          0
amt_annuity                         0
amt_goods_price                     0
name_type_suite                     0
name_income_type                    0
name_education_type                 0
name_family_status                  0
name_housing_type                   0
region_population_relative          0
days_birth                          0
days_employed                       0
days_registration                   0
days_id_publish                     0
own_car_age                         0
flag_mobil                          0
flag_emp_phone                      0
flag_work_phone                     0
flag_cont_mobile                    0
flag_phone                          0
flag_email                          0
occupation_type                     0
cnt_fam_members                     0
region_rating_client                0
region_rating_client_w_city         0
weekday_appr_process_start          0
hour_appr_process_start             0
reg_region_not_live_region          0
reg_region_not_work_region          0
live_region_not_work_region         0
reg_city_not_live_city              0
reg_city_not_work_city              0
live_city_not_work_city             0
organization_type                   0
ext_source_1                        0
ext_source_2                        0
ext_source_3                        0
apartments_avg                      0
basementarea_avg                    0
years_beginexpluatation_avg         0
years_build_avg                     0
commonarea_avg                      0
elevators_avg                       0
floorsmax_avg                       0
landarea_avg                        0
livingapartments_avg                0
livingarea_avg                      0
nonlivingapartments_avg             0
nonlivingarea_avg                   0
elevators_mode                      0
elevators_medi                      0
housetype_mode                      0
totalarea_mode                      0
wallsmaterial_mode                  0
emergencystate_mode                 0
obs_30_cnt_social_circle            0
def_30_cnt_social_circle            0
obs_60_cnt_social_circle            0
def_60_cnt_social_circle            0
days_last_phone_change              0
flag_document_2                     0
flag_document_3                     0
flag_document_4                     0
```

```
flag_document_5                                        0
flag_document_6                                        0
flag_document_7                                        0
flag_document_8                                        0
flag_document_9                                        0
flag_document_10                                       0
flag_document_11                                       0
flag_document_12                                       0
flag_document_13                                       0
flag_document_14                                       0
flag_document_15                                       0
flag_document_16                                       0
flag_document_17                                       0
flag_document_18                                       0
flag_document_19                                       0
flag_document_20                                       0
flag_document_21                                       0
amt_req_credit_bureau_hour                             0
amt_req_credit_bureau_day                              0
amt_req_credit_bureau_week                             0
amt_req_credit_bureau_mon                              0
amt_req_credit_bureau_qrt                              0
amt_req_credit_bureau_year                             0
bur_sk_id_bureau_mean                                  0
bur_sk_id_bureau_max                                   0
bur_sk_id_bureau_min                                   0
bur_sk_id_bureau_count                                 0
bur_days_credit_mean                                   0
bur_days_credit_max                                    0
bur_days_credit_min                                    0
bur_days_credit_count                                  0
bur_credit_day_overdue_mean                            0
bur_credit_day_overdue_max                             0
bur_credit_day_overdue_min                             0
bur_credit_day_overdue_count                           0
bur_days_credit_enddate_mean                           0
bur_days_credit_enddate_max                            0
bur_days_credit_enddate_min                            0
bur_days_credit_enddate_count                          0
bur_days_enddate_fact_mean                             0
bur_days_enddate_fact_max                              0
bur_days_enddate_fact_min                              0
bur_days_enddate_fact_count                            0
bur_amt_credit_max_overdue_mean                        0
bur_amt_credit_max_overdue_max                         0
bur_amt_credit_max_overdue_min                         0
bur_amt_credit_max_overdue_count                       0
bur_cnt_credit_prolong_mean                            0
bur_cnt_credit_prolong_max                             0
bur_cnt_credit_prolong_min                             0
bur_cnt_credit_prolong_count                           0
bur_amt_credit_sum_mean                                0
bur_amt_credit_sum_max                                 0
bur_amt_credit_sum_min                                 0
bur_amt_credit_sum_count                               0
bur_amt_credit_sum_debt_mean                           0
bur_amt_credit_sum_debt_max                            0
bur_amt_credit_sum_debt_min                            0
bur_amt_credit_sum_debt_count                          0
bur_amt_credit_sum_limit_mean                          0
bur_amt_credit_sum_limit_max                           0
bur_amt_credit_sum_limit_min                           0
bur_amt_credit_sum_limit_count                         0
bur_amt_credit_sum_overdue_mean                        0
bur_amt_credit_sum_overdue_max                         0
bur_amt_credit_sum_overdue_min                         0
bur_amt_credit_sum_overdue_count                       0
bur_days_credit_update_mean                            0
bur_days_credit_update_max                             0
```

```
bur_days_credit_update_min                              0
bur_days_credit_update_count                            0
bur_amt_annuity_mean                                    0
bur_amt_annuity_max                                     0
bur_amt_annuity_min                                     0
bur_amt_annuity_count                                   0
bur_bb_months_balance_mean_mean                         0
bur_bb_months_balance_mean_max                          0
bur_bb_months_balance_mean_min                          0
bur_bb_months_balance_mean_count                        0
bur_bb_months_balance_max_mean                          0
bur_bb_months_balance_max_max                           0
bur_bb_months_balance_max_min                           0
bur_bb_months_balance_max_count                         0
bur_bb_months_balance_min_mean                          0
bur_bb_months_balance_min_max                           0
bur_bb_months_balance_min_min                           0
bur_bb_months_balance_min_count                         0
bur_bb_months_balance_count_mean                        0
bur_bb_months_balance_count_max                         0
bur_bb_months_balance_count_min                         0
bur_bb_months_balance_count_count                       0
prev_sk_id_prev_mean                                    0
prev_sk_id_prev_max                                     0
prev_sk_id_prev_min                                     0
prev_sk_id_prev_count                                   0
prev_amt_annuity_mean                                   0
prev_amt_annuity_max                                    0
prev_amt_annuity_min                                    0
prev_amt_annuity_count                                  0
prev_amt_application_mean                               0
prev_amt_application_max                                0
prev_amt_application_min                                0
prev_amt_application_count                              0
prev_amt_credit_mean                                    0
prev_amt_credit_max                                     0
prev_amt_credit_min                                     0
prev_amt_credit_count                                   0
prev_amt_down_payment_mean                              0
prev_amt_down_payment_max                               0
prev_amt_down_payment_min                               0
prev_amt_down_payment_count                             0
prev_amt_goods_price_mean                               0
prev_amt_goods_price_max                                0
prev_amt_goods_price_min                                0
prev_amt_goods_price_count                              0
prev_hour_appr_process_start_mean                       0
prev_hour_appr_process_start_max                        0
prev_hour_appr_process_start_min                        0
prev_hour_appr_process_start_count                      0
prev_nflag_last_appl_in_day_mean                        0
prev_nflag_last_appl_in_day_max                         0
prev_nflag_last_appl_in_day_min                         0
prev_nflag_last_appl_in_day_count                       0
prev_rate_down_payment_mean                             0
prev_rate_down_payment_max                              0
prev_rate_down_payment_min                              0
prev_rate_down_payment_count                            0
prev_rate_interest_primary_mean                         0
prev_rate_interest_primary_max                          0
prev_rate_interest_primary_min                          0
prev_rate_interest_primary_count                        0
prev_rate_interest_privileged_mean                      0
prev_rate_interest_privileged_max                       0
prev_rate_interest_privileged_min                       0
prev_rate_interest_privileged_count                     0
prev_days_decision_mean                                 0
prev_days_decision_max                                  0
prev_days_decision_min                                  0
```

```
prev_days_decision_count                                 0
prev_sellerplace_area_mean                               0
prev_sellerplace_area_max                                0
prev_sellerplace_area_min                                0
prev_sellerplace_area_count                              0
prev_cnt_payment_mean                                    0
prev_cnt_payment_max                                     0
prev_cnt_payment_min                                     0
prev_cnt_payment_count                                   0
prev_days_first_drawing_mean                             0
prev_days_first_drawing_max                              0
prev_days_first_drawing_min                              0
prev_days_first_drawing_count                            0
prev_days_first_due_mean                                 0
prev_days_first_due_max                                  0
prev_days_first_due_min                                  0
prev_days_first_due_count                                0
prev_days_last_due_1st_version_mean                      0
prev_days_last_due_1st_version_max                       0
prev_days_last_due_1st_version_min                       0
prev_days_last_due_1st_version_count                     0
prev_days_last_due_mean                                  0
prev_days_last_due_max                                   0
prev_days_last_due_min                                   0
prev_days_last_due_count                                 0
prev_days_termination_mean                               0
prev_days_termination_max                                0
prev_days_termination_min                                0
prev_days_termination_count                              0
prev_nflag_insured_on_approval_mean                      0
prev_nflag_insured_on_approval_max                       0
prev_nflag_insured_on_approval_min                       0
prev_nflag_insured_on_approval_count                     0
posf_sk_id_prev_mean                                     0
posf_sk_id_prev_max                                      0
posf_sk_id_prev_min                                      0
posf_sk_id_prev_count                                    0
posf_pos_sk_id_curr_mean_mean                            0
posf_pos_sk_id_curr_mean_max                             0
posf_pos_sk_id_curr_mean_min                             0
posf_pos_sk_id_curr_mean_count                           0
posf_pos_sk_id_curr_max_mean                             0
posf_pos_sk_id_curr_max_max                              0
posf_pos_sk_id_curr_max_min                              0
posf_pos_sk_id_curr_max_count                            0
posf_pos_sk_id_curr_min_mean                             0
posf_pos_sk_id_curr_min_max                              0
posf_pos_sk_id_curr_min_min                              0
posf_pos_sk_id_curr_min_count                            0
posf_pos_sk_id_curr_count_mean                           0
posf_pos_sk_id_curr_count_max                            0
posf_pos_sk_id_curr_count_min                            0
posf_pos_sk_id_curr_count_count                          0
posf_pos_months_balance_mean_mean                        0
posf_pos_months_balance_mean_max                         0
posf_pos_months_balance_mean_min                         0
posf_pos_months_balance_mean_count                       0
posf_pos_months_balance_max_mean                         0
posf_pos_months_balance_max_max                          0
posf_pos_months_balance_max_min                          0
posf_pos_months_balance_max_count                        0
posf_pos_months_balance_min_mean                         0
posf_pos_months_balance_min_max                          0
posf_pos_months_balance_min_min                          0
posf_pos_months_balance_min_count                        0
posf_pos_months_balance_count_mean                       0
posf_pos_months_balance_count_max                        0
posf_pos_months_balance_count_min                        0
posf_pos_months_balance_count_count                      0
```

```
posf_pos_cnt_instalment_mean_mean                         0
posf_pos_cnt_instalment_mean_max                          0
posf_pos_cnt_instalment_mean_min                          0
posf_pos_cnt_instalment_mean_count                        0
posf_pos_cnt_instalment_max_mean                          0
posf_pos_cnt_instalment_max_max                           0
posf_pos_cnt_instalment_max_min                           0
posf_pos_cnt_instalment_max_count                         0
posf_pos_cnt_instalment_min_mean                          0
posf_pos_cnt_instalment_min_max                           0
posf_pos_cnt_instalment_min_min                           0
posf_pos_cnt_instalment_min_count                         0
posf_pos_cnt_instalment_count_mean                        0
posf_pos_cnt_instalment_count_max                         0
posf_pos_cnt_instalment_count_min                         0
posf_pos_cnt_instalment_count_count                       0
posf_pos_cnt_instalment_future_mean_mean                  0
posf_pos_cnt_instalment_future_mean_max                   0
posf_pos_cnt_instalment_future_mean_min                   0
posf_pos_cnt_instalment_future_mean_count                 0
posf_pos_cnt_instalment_future_max_mean                   0
posf_pos_cnt_instalment_future_max_max                    0
posf_pos_cnt_instalment_future_max_min                    0
posf_pos_cnt_instalment_future_max_count                  0
posf_pos_cnt_instalment_future_min_mean                   0
posf_pos_cnt_instalment_future_min_max                    0
posf_pos_cnt_instalment_future_min_min                    0
posf_pos_cnt_instalment_future_min_count                  0
posf_pos_cnt_instalment_future_count_mean                 0
posf_pos_cnt_instalment_future_count_max                  0
posf_pos_cnt_instalment_future_count_min                  0
posf_pos_cnt_instalment_future_count_count                0
posf_pos_sk_dpd_mean_mean                                 0
posf_pos_sk_dpd_mean_max                                  0
posf_pos_sk_dpd_mean_min                                  0
posf_pos_sk_dpd_mean_count                                0
posf_pos_sk_dpd_max_mean                                  0
posf_pos_sk_dpd_max_max                                   0
posf_pos_sk_dpd_max_min                                   0
posf_pos_sk_dpd_max_count                                 0
posf_pos_sk_dpd_min_mean                                  0
posf_pos_sk_dpd_min_max                                   0
posf_pos_sk_dpd_min_min                                   0
posf_pos_sk_dpd_min_count                                 0
posf_pos_sk_dpd_count_mean                                0
posf_pos_sk_dpd_count_max                                 0
posf_pos_sk_dpd_count_min                                 0
posf_pos_sk_dpd_count_count                               0
posf_pos_sk_dpd_def_mean_mean                             0
posf_pos_sk_dpd_def_mean_max                              0
posf_pos_sk_dpd_def_mean_min                              0
posf_pos_sk_dpd_def_mean_count                            0
posf_pos_sk_dpd_def_max_mean                              0
posf_pos_sk_dpd_def_max_max                               0
posf_pos_sk_dpd_def_max_min                               0
posf_pos_sk_dpd_def_max_count                             0
posf_pos_sk_dpd_def_min_mean                              0
posf_pos_sk_dpd_def_min_max                               0
posf_pos_sk_dpd_def_min_min                               0
posf_pos_sk_dpd_def_min_count                             0
posf_pos_sk_dpd_def_count_mean                            0
posf_pos_sk_dpd_def_count_max                             0
posf_pos_sk_dpd_def_count_min                             0
posf_pos_sk_dpd_def_count_count                           0
ccf_sk_id_prev_mean                                       0
ccf_sk_id_prev_max                                        0
ccf_sk_id_prev_min                                        0
ccf_sk_id_prev_count                                      0
ccf_cc_sk_id_curr_mean_mean                               0
```

```
ccf_cc_sk_id_curr_mean_max                                0
ccf_cc_sk_id_curr_mean_min                                0
ccf_cc_sk_id_curr_mean_count                              0
ccf_cc_sk_id_curr_max_mean                                0
ccf_cc_sk_id_curr_max_max                                 0
ccf_cc_sk_id_curr_max_min                                 0
ccf_cc_sk_id_curr_max_count                               0
ccf_cc_sk_id_curr_min_mean                                0
ccf_cc_sk_id_curr_min_max                                 0
ccf_cc_sk_id_curr_min_min                                 0
ccf_cc_sk_id_curr_min_count                               0
ccf_cc_sk_id_curr_count_mean                              0
ccf_cc_sk_id_curr_count_max                               0
ccf_cc_sk_id_curr_count_min                               0
ccf_cc_sk_id_curr_count_count                             0
ccf_cc_months_balance_mean_mean                           0
ccf_cc_months_balance_mean_max                            0
ccf_cc_months_balance_mean_min                            0
ccf_cc_months_balance_mean_count                          0
ccf_cc_months_balance_max_mean                            0
ccf_cc_months_balance_max_max                             0
ccf_cc_months_balance_max_min                             0
ccf_cc_months_balance_max_count                           0
ccf_cc_months_balance_min_mean                            0
ccf_cc_months_balance_min_max                             0
ccf_cc_months_balance_min_min                             0
ccf_cc_months_balance_min_count                           0
ccf_cc_months_balance_count_mean                          0
ccf_cc_months_balance_count_max                           0
ccf_cc_months_balance_count_min                           0
ccf_cc_months_balance_count_count                         0
ccf_cc_amt_balance_mean_mean                              0
ccf_cc_amt_balance_mean_max                               0
ccf_cc_amt_balance_mean_min                               0
ccf_cc_amt_balance_mean_count                             0
ccf_cc_amt_balance_max_mean                               0
ccf_cc_amt_balance_max_max                                0
ccf_cc_amt_balance_max_min                                0
ccf_cc_amt_balance_max_count                              0
ccf_cc_amt_balance_min_mean                               0
ccf_cc_amt_balance_min_max                                0
ccf_cc_amt_balance_min_min                                0
ccf_cc_amt_balance_min_count                              0
ccf_cc_amt_balance_count_mean                             0
ccf_cc_amt_balance_count_max                              0
ccf_cc_amt_balance_count_min                              0
ccf_cc_amt_balance_count_count                            0
ccf_cc_amt_credit_limit_actual_mean_mean                  0
ccf_cc_amt_credit_limit_actual_mean_max                   0
ccf_cc_amt_credit_limit_actual_mean_min                   0
ccf_cc_amt_credit_limit_actual_mean_count                 0
ccf_cc_amt_credit_limit_actual_max_mean                   0
ccf_cc_amt_credit_limit_actual_max_max                    0
ccf_cc_amt_credit_limit_actual_max_min                    0
ccf_cc_amt_credit_limit_actual_max_count                  0
ccf_cc_amt_credit_limit_actual_min_mean                   0
ccf_cc_amt_credit_limit_actual_min_max                    0
ccf_cc_amt_credit_limit_actual_min_min                    0
ccf_cc_amt_credit_limit_actual_min_count                  0
ccf_cc_amt_credit_limit_actual_count_mean                 0
ccf_cc_amt_credit_limit_actual_count_max                  0
ccf_cc_amt_credit_limit_actual_count_min                  0
ccf_cc_amt_credit_limit_actual_count_count                0
ccf_cc_amt_drawings_atm_current_mean_mean                 0
ccf_cc_amt_drawings_atm_current_mean_max                  0
ccf_cc_amt_drawings_atm_current_mean_min                  0
ccf_cc_amt_drawings_atm_current_mean_count                0
ccf_cc_amt_drawings_atm_current_max_mean                  0
ccf_cc_amt_drawings_atm_current_max_max                   0
```

```
ccf_cc_amt_drawings_atm_current_max_min                 0
ccf_cc_amt_drawings_atm_current_max_count               0
ccf_cc_amt_drawings_atm_current_min_mean                0
ccf_cc_amt_drawings_atm_current_min_max                 0
ccf_cc_amt_drawings_atm_current_min_min                 0
ccf_cc_amt_drawings_atm_current_min_count               0
ccf_cc_amt_drawings_atm_current_count_mean              0
ccf_cc_amt_drawings_atm_current_count_max               0
ccf_cc_amt_drawings_atm_current_count_min               0
ccf_cc_amt_drawings_atm_current_count_count             0
ccf_cc_amt_drawings_current_mean_mean                   0
ccf_cc_amt_drawings_current_mean_max                    0
ccf_cc_amt_drawings_current_mean_min                    0
ccf_cc_amt_drawings_current_mean_count                  0
ccf_cc_amt_drawings_current_max_mean                    0
ccf_cc_amt_drawings_current_max_max                     0
ccf_cc_amt_drawings_current_max_min                     0
ccf_cc_amt_drawings_current_max_count                   0
ccf_cc_amt_drawings_current_min_mean                    0
ccf_cc_amt_drawings_current_min_max                     0
ccf_cc_amt_drawings_current_min_min                     0
ccf_cc_amt_drawings_current_min_count                   0
ccf_cc_amt_drawings_current_count_mean                  0
ccf_cc_amt_drawings_current_count_max                   0
ccf_cc_amt_drawings_current_count_min                   0
ccf_cc_amt_drawings_current_count_count                 0
ccf_cc_amt_drawings_other_current_mean_mean             0
ccf_cc_amt_drawings_other_current_mean_max              0
ccf_cc_amt_drawings_other_current_mean_min              0
ccf_cc_amt_drawings_other_current_mean_count            0
ccf_cc_amt_drawings_other_current_max_mean              0
ccf_cc_amt_drawings_other_current_max_max               0
ccf_cc_amt_drawings_other_current_max_min               0
ccf_cc_amt_drawings_other_current_max_count             0
ccf_cc_amt_drawings_other_current_min_mean              0
ccf_cc_amt_drawings_other_current_min_max               0
ccf_cc_amt_drawings_other_current_min_min               0
ccf_cc_amt_drawings_other_current_min_count             0
ccf_cc_amt_drawings_other_current_count_mean            0
ccf_cc_amt_drawings_other_current_count_max             0
ccf_cc_amt_drawings_other_current_count_min             0
ccf_cc_amt_drawings_other_current_count_count           0
ccf_cc_amt_drawings_pos_current_mean_mean               0
ccf_cc_amt_drawings_pos_current_mean_max                0
ccf_cc_amt_drawings_pos_current_mean_min                0
ccf_cc_amt_drawings_pos_current_mean_count              0
ccf_cc_amt_drawings_pos_current_max_mean                0
ccf_cc_amt_drawings_pos_current_max_max                 0
ccf_cc_amt_drawings_pos_current_max_min                 0
ccf_cc_amt_drawings_pos_current_max_count               0
ccf_cc_amt_drawings_pos_current_min_mean                0
ccf_cc_amt_drawings_pos_current_min_max                 0
ccf_cc_amt_drawings_pos_current_min_min                 0
ccf_cc_amt_drawings_pos_current_min_count               0
ccf_cc_amt_drawings_pos_current_count_mean              0
ccf_cc_amt_drawings_pos_current_count_max               0
ccf_cc_amt_drawings_pos_current_count_min               0
ccf_cc_amt_drawings_pos_current_count_count             0
ccf_cc_amt_inst_min_regularity_mean_mean                0
ccf_cc_amt_inst_min_regularity_mean_max                 0
ccf_cc_amt_inst_min_regularity_mean_min                 0
ccf_cc_amt_inst_min_regularity_mean_count               0
ccf_cc_amt_inst_min_regularity_max_mean                 0
ccf_cc_amt_inst_min_regularity_max_max                  0
ccf_cc_amt_inst_min_regularity_max_min                  0
ccf_cc_amt_inst_min_regularity_max_count                0
ccf_cc_amt_inst_min_regularity_min_mean                 0
ccf_cc_amt_inst_min_regularity_min_max                  0
ccf_cc_amt_inst_min_regularity_min_min                  0
```

| | |
|---|---|
| ccf_cc_amt_inst_min_regularity_min_count | 0 |
| ccf_cc_amt_inst_min_regularity_count_mean | 0 |
| ccf_cc_amt_inst_min_regularity_count_max | 0 |
| ccf_cc_amt_inst_min_regularity_count_min | 0 |
| ccf_cc_amt_inst_min_regularity_count_count | 0 |
| ccf_cc_amt_payment_current_mean_mean | 0 |
| ccf_cc_amt_payment_current_mean_max | 0 |
| ccf_cc_amt_payment_current_mean_min | 0 |
| ccf_cc_amt_payment_current_mean_count | 0 |
| ccf_cc_amt_payment_current_max_mean | 0 |
| ccf_cc_amt_payment_current_max_max | 0 |
| ccf_cc_amt_payment_current_max_min | 0 |
| ccf_cc_amt_payment_current_max_count | 0 |
| ccf_cc_amt_payment_current_min_mean | 0 |
| ccf_cc_amt_payment_current_min_max | 0 |
| ccf_cc_amt_payment_current_min_min | 0 |
| ccf_cc_amt_payment_current_min_count | 0 |
| ccf_cc_amt_payment_current_count_mean | 0 |
| ccf_cc_amt_payment_current_count_max | 0 |
| ccf_cc_amt_payment_current_count_min | 0 |
| ccf_cc_amt_payment_current_count_count | 0 |
| ccf_cc_amt_payment_total_current_mean_mean | 0 |
| ccf_cc_amt_payment_total_current_mean_max | 0 |
| ccf_cc_amt_payment_total_current_mean_min | 0 |
| ccf_cc_amt_payment_total_current_mean_count | 0 |
| ccf_cc_amt_payment_total_current_max_mean | 0 |
| ccf_cc_amt_payment_total_current_max_max | 0 |
| ccf_cc_amt_payment_total_current_max_min | 0 |
| ccf_cc_amt_payment_total_current_max_count | 0 |
| ccf_cc_amt_payment_total_current_min_mean | 0 |
| ccf_cc_amt_payment_total_current_min_max | 0 |
| ccf_cc_amt_payment_total_current_min_min | 0 |
| ccf_cc_amt_payment_total_current_min_count | 0 |
| ccf_cc_amt_payment_total_current_count_mean | 0 |
| ccf_cc_amt_payment_total_current_count_max | 0 |
| ccf_cc_amt_payment_total_current_count_min | 0 |
| ccf_cc_amt_payment_total_current_count_count | 0 |
| ccf_cc_amt_receivable_principal_mean_mean | 0 |
| ccf_cc_amt_receivable_principal_mean_max | 0 |
| ccf_cc_amt_receivable_principal_mean_min | 0 |
| ccf_cc_amt_receivable_principal_mean_count | 0 |
| ccf_cc_amt_receivable_principal_max_mean | 0 |
| ccf_cc_amt_receivable_principal_max_max | 0 |
| ccf_cc_amt_receivable_principal_max_min | 0 |
| ccf_cc_amt_receivable_principal_max_count | 0 |
| ccf_cc_amt_receivable_principal_min_mean | 0 |
| ccf_cc_amt_receivable_principal_min_max | 0 |
| ccf_cc_amt_receivable_principal_min_min | 0 |
| ccf_cc_amt_receivable_principal_min_count | 0 |
| ccf_cc_amt_receivable_principal_count_mean | 0 |
| ccf_cc_amt_receivable_principal_count_max | 0 |
| ccf_cc_amt_receivable_principal_count_min | 0 |
| ccf_cc_amt_receivable_principal_count_count | 0 |
| ccf_cc_amt_recivable_mean_mean | 0 |
| ccf_cc_amt_recivable_mean_max | 0 |
| ccf_cc_amt_recivable_mean_min | 0 |
| ccf_cc_amt_recivable_mean_count | 0 |
| ccf_cc_amt_recivable_max_mean | 0 |
| ccf_cc_amt_recivable_max_max | 0 |
| ccf_cc_amt_recivable_max_min | 0 |
| ccf_cc_amt_recivable_max_count | 0 |
| ccf_cc_amt_recivable_min_mean | 0 |
| ccf_cc_amt_recivable_min_max | 0 |
| ccf_cc_amt_recivable_min_min | 0 |
| ccf_cc_amt_recivable_min_count | 0 |
| ccf_cc_amt_recivable_count_mean | 0 |
| ccf_cc_amt_recivable_count_max | 0 |
| ccf_cc_amt_recivable_count_min | 0 |
| ccf_cc_amt_recivable_count_count | 0 |

```
ccf_cc_amt_total_receivable_mean_mean                   0
ccf_cc_amt_total_receivable_mean_max                    0
ccf_cc_amt_total_receivable_mean_min                    0
ccf_cc_amt_total_receivable_mean_count                  0
ccf_cc_amt_total_receivable_max_mean                    0
ccf_cc_amt_total_receivable_max_max                     0
ccf_cc_amt_total_receivable_max_min                     0
ccf_cc_amt_total_receivable_max_count                   0
ccf_cc_amt_total_receivable_min_mean                    0
ccf_cc_amt_total_receivable_min_max                     0
ccf_cc_amt_total_receivable_min_min                     0
ccf_cc_amt_total_receivable_min_count                   0
ccf_cc_amt_total_receivable_count_mean                  0
ccf_cc_amt_total_receivable_count_max                   0
ccf_cc_amt_total_receivable_count_min                   0
ccf_cc_amt_total_receivable_count_count                 0
ccf_cc_cnt_drawings_atm_current_mean_mean               0
ccf_cc_cnt_drawings_atm_current_mean_max                0
ccf_cc_cnt_drawings_atm_current_mean_min                0
ccf_cc_cnt_drawings_atm_current_mean_count              0
ccf_cc_cnt_drawings_atm_current_max_mean                0
ccf_cc_cnt_drawings_atm_current_max_max                 0
ccf_cc_cnt_drawings_atm_current_max_min                 0
ccf_cc_cnt_drawings_atm_current_max_count               0
ccf_cc_cnt_drawings_atm_current_min_mean                0
ccf_cc_cnt_drawings_atm_current_min_max                 0
ccf_cc_cnt_drawings_atm_current_min_min                 0
ccf_cc_cnt_drawings_atm_current_min_count               0
ccf_cc_cnt_drawings_atm_current_count_mean              0
ccf_cc_cnt_drawings_atm_current_count_max               0
ccf_cc_cnt_drawings_atm_current_count_min               0
ccf_cc_cnt_drawings_atm_current_count_count             0
ccf_cc_cnt_drawings_current_mean_mean                   0
ccf_cc_cnt_drawings_current_mean_max                    0
ccf_cc_cnt_drawings_current_mean_min                    0
ccf_cc_cnt_drawings_current_mean_count                  0
ccf_cc_cnt_drawings_current_max_mean                    0
ccf_cc_cnt_drawings_current_max_max                     0
ccf_cc_cnt_drawings_current_max_min                     0
ccf_cc_cnt_drawings_current_max_count                   0
ccf_cc_cnt_drawings_current_min_mean                    0
ccf_cc_cnt_drawings_current_min_max                     0
ccf_cc_cnt_drawings_current_min_min                     0
ccf_cc_cnt_drawings_current_min_count                   0
ccf_cc_cnt_drawings_current_count_mean                  0
ccf_cc_cnt_drawings_current_count_max                   0
ccf_cc_cnt_drawings_current_count_min                   0
ccf_cc_cnt_drawings_current_count_count                 0
ccf_cc_cnt_drawings_other_current_mean_mean             0
ccf_cc_cnt_drawings_other_current_mean_max              0
ccf_cc_cnt_drawings_other_current_mean_min              0
ccf_cc_cnt_drawings_other_current_mean_count            0
ccf_cc_cnt_drawings_other_current_max_mean              0
ccf_cc_cnt_drawings_other_current_max_max               0
ccf_cc_cnt_drawings_other_current_max_min               0
ccf_cc_cnt_drawings_other_current_max_count             0
ccf_cc_cnt_drawings_other_current_min_mean              0
ccf_cc_cnt_drawings_other_current_min_max               0
ccf_cc_cnt_drawings_other_current_min_min               0
ccf_cc_cnt_drawings_other_current_min_count             0
ccf_cc_cnt_drawings_other_current_count_mean            0
ccf_cc_cnt_drawings_other_current_count_max             0
ccf_cc_cnt_drawings_other_current_count_min             0
ccf_cc_cnt_drawings_other_current_count_count           0
ccf_cc_cnt_drawings_pos_current_mean_mean               0
ccf_cc_cnt_drawings_pos_current_mean_max                0
ccf_cc_cnt_drawings_pos_current_mean_min                0
ccf_cc_cnt_drawings_pos_current_mean_count              0
ccf_cc_cnt_drawings_pos_current_max_mean                0
```

```
ccf_cc_cnt_drawings_pos_current_max_max                     0
ccf_cc_cnt_drawings_pos_current_max_min                     0
ccf_cc_cnt_drawings_pos_current_max_count                   0
ccf_cc_cnt_drawings_pos_current_min_mean                    0
ccf_cc_cnt_drawings_pos_current_min_max                     0
ccf_cc_cnt_drawings_pos_current_min_min                     0
ccf_cc_cnt_drawings_pos_current_min_count                   0
ccf_cc_cnt_drawings_pos_current_count_mean                  0
ccf_cc_cnt_drawings_pos_current_count_max                   0
ccf_cc_cnt_drawings_pos_current_count_min                   0
ccf_cc_cnt_drawings_pos_current_count_count                 0
ccf_cc_cnt_instalment_mature_cum_mean_mean                  0
ccf_cc_cnt_instalment_mature_cum_mean_max                   0
ccf_cc_cnt_instalment_mature_cum_mean_min                   0
ccf_cc_cnt_instalment_mature_cum_mean_count                 0
ccf_cc_cnt_instalment_mature_cum_max_mean                   0
ccf_cc_cnt_instalment_mature_cum_max_max                    0
ccf_cc_cnt_instalment_mature_cum_max_min                    0
ccf_cc_cnt_instalment_mature_cum_max_count                  0
ccf_cc_cnt_instalment_mature_cum_min_mean                   0
ccf_cc_cnt_instalment_mature_cum_min_max                    0
ccf_cc_cnt_instalment_mature_cum_min_min                    0
ccf_cc_cnt_instalment_mature_cum_min_count                  0
ccf_cc_cnt_instalment_mature_cum_count_mean                 0
ccf_cc_cnt_instalment_mature_cum_count_max                  0
ccf_cc_cnt_instalment_mature_cum_count_min                  0
ccf_cc_cnt_instalment_mature_cum_count_count                0
ccf_cc_sk_dpd_mean_mean                                     0
ccf_cc_sk_dpd_mean_max                                      0
ccf_cc_sk_dpd_mean_min                                      0
ccf_cc_sk_dpd_mean_count                                    0
ccf_cc_sk_dpd_max_mean                                      0
ccf_cc_sk_dpd_max_max                                       0
ccf_cc_sk_dpd_max_min                                       0
ccf_cc_sk_dpd_max_count                                     0
ccf_cc_sk_dpd_min_mean                                      0
ccf_cc_sk_dpd_min_max                                       0
ccf_cc_sk_dpd_min_min                                       0
ccf_cc_sk_dpd_min_count                                     0
ccf_cc_sk_dpd_count_mean                                    0
ccf_cc_sk_dpd_count_max                                     0
ccf_cc_sk_dpd_count_min                                     0
ccf_cc_sk_dpd_count_count                                   0
ccf_cc_sk_dpd_def_mean_mean                                 0
ccf_cc_sk_dpd_def_mean_max                                  0
ccf_cc_sk_dpd_def_mean_min                                  0
ccf_cc_sk_dpd_def_mean_count                                0
ccf_cc_sk_dpd_def_max_mean                                  0
ccf_cc_sk_dpd_def_max_max                                   0
ccf_cc_sk_dpd_def_max_min                                   0
ccf_cc_sk_dpd_def_max_count                                 0
ccf_cc_sk_dpd_def_min_mean                                  0
ccf_cc_sk_dpd_def_min_max                                   0
ccf_cc_sk_dpd_def_min_min                                   0
ccf_cc_sk_dpd_def_min_count                                 0
ccf_cc_sk_dpd_def_count_mean                                0
ccf_cc_sk_dpd_def_count_max                                 0
ccf_cc_sk_dpd_def_count_min                                 0
ccf_cc_sk_dpd_def_count_count                               0
instf_sk_id_prev_mean                                       0
instf_sk_id_prev_max                                        0
instf_sk_id_prev_min                                        0
instf_sk_id_prev_count                                      0
instf_inst_sk_id_curr_mean_mean                             0
instf_inst_sk_id_curr_mean_max                              0
instf_inst_sk_id_curr_mean_min                              0
instf_inst_sk_id_curr_mean_count                            0
instf_inst_sk_id_curr_max_mean                              0
instf_inst_sk_id_curr_max_max                               0
```

```
instf_inst_sk_id_curr_max_min                        0
instf_inst_sk_id_curr_max_count                      0
instf_inst_sk_id_curr_min_mean                       0
instf_inst_sk_id_curr_min_max                        0
instf_inst_sk_id_curr_min_min                        0
instf_inst_sk_id_curr_min_count                      0
instf_inst_sk_id_curr_count_mean                     0
instf_inst_sk_id_curr_count_max                      0
instf_inst_sk_id_curr_count_min                      0
instf_inst_sk_id_curr_count_count                    0
instf_inst_num_instalment_version_mean_mean          0
instf_inst_num_instalment_version_mean_max           0
instf_inst_num_instalment_version_mean_min           0
instf_inst_num_instalment_version_mean_count         0
instf_inst_num_instalment_version_max_mean           0
instf_inst_num_instalment_version_max_max            0
instf_inst_num_instalment_version_max_min            0
instf_inst_num_instalment_version_max_count          0
instf_inst_num_instalment_version_min_mean           0
instf_inst_num_instalment_version_min_max            0
instf_inst_num_instalment_version_min_min            0
instf_inst_num_instalment_version_min_count          0
instf_inst_num_instalment_version_count_mean         0
instf_inst_num_instalment_version_count_max          0
instf_inst_num_instalment_version_count_min          0
instf_inst_num_instalment_version_count_count        0
instf_inst_num_instalment_number_mean_mean           0
instf_inst_num_instalment_number_mean_max            0
instf_inst_num_instalment_number_mean_min            0
instf_inst_num_instalment_number_mean_count          0
instf_inst_num_instalment_number_max_mean            0
instf_inst_num_instalment_number_max_max             0
instf_inst_num_instalment_number_max_min             0
instf_inst_num_instalment_number_max_count           0
instf_inst_num_instalment_number_min_mean            0
instf_inst_num_instalment_number_min_max             0
instf_inst_num_instalment_number_min_min             0
instf_inst_num_instalment_number_min_count           0
instf_inst_num_instalment_number_count_mean          0
instf_inst_num_instalment_number_count_max           0
instf_inst_num_instalment_number_count_min           0
instf_inst_num_instalment_number_count_count         0
instf_inst_days_instalment_mean_mean                 0
instf_inst_days_instalment_mean_max                  0
instf_inst_days_instalment_mean_min                  0
instf_inst_days_instalment_mean_count                0
instf_inst_days_instalment_max_mean                  0
instf_inst_days_instalment_max_max                   0
instf_inst_days_instalment_max_min                   0
instf_inst_days_instalment_max_count                 0
instf_inst_days_instalment_min_mean                  0
instf_inst_days_instalment_min_max                   0
instf_inst_days_instalment_min_min                   0
instf_inst_days_instalment_min_count                 0
instf_inst_days_instalment_count_mean                0
instf_inst_days_instalment_count_max                 0
instf_inst_days_instalment_count_min                 0
instf_inst_days_instalment_count_count               0
instf_inst_days_entry_payment_mean_mean              0
instf_inst_days_entry_payment_mean_max               0
instf_inst_days_entry_payment_mean_min               0
instf_inst_days_entry_payment_mean_count             0
instf_inst_days_entry_payment_max_mean               0
instf_inst_days_entry_payment_max_max                0
instf_inst_days_entry_payment_max_min                0
instf_inst_days_entry_payment_max_count              0
instf_inst_days_entry_payment_min_mean               0
instf_inst_days_entry_payment_min_max                0
instf_inst_days_entry_payment_min_min                0
```

```
instf_inst_days_entry_payment_min_count                  0
instf_inst_days_entry_payment_count_mean                 0
instf_inst_days_entry_payment_count_max                  0
instf_inst_days_entry_payment_count_min                  0
instf_inst_days_entry_payment_count_count                0
instf_inst_amt_instalment_mean_mean                      0
instf_inst_amt_instalment_mean_max                       0
instf_inst_amt_instalment_mean_min                       0
instf_inst_amt_instalment_mean_count                     0
instf_inst_amt_instalment_max_mean                       0
instf_inst_amt_instalment_max_max                        0
instf_inst_amt_instalment_max_min                        0
instf_inst_amt_instalment_max_count                      0
instf_inst_amt_instalment_min_mean                       0
instf_inst_amt_instalment_min_max                        0
instf_inst_amt_instalment_min_min                        0
instf_inst_amt_instalment_min_count                      0
instf_inst_amt_instalment_count_mean                     0
instf_inst_amt_instalment_count_max                      0
instf_inst_amt_instalment_count_min                      0
instf_inst_amt_instalment_count_count                    0
instf_inst_amt_payment_mean_mean                         0
instf_inst_amt_payment_mean_max                          0
instf_inst_amt_payment_mean_min                          0
instf_inst_amt_payment_mean_count                        0
instf_inst_amt_payment_max_mean                          0
instf_inst_amt_payment_max_max                           0
instf_inst_amt_payment_max_min                           0
instf_inst_amt_payment_max_count                         0
instf_inst_amt_payment_min_mean                          0
instf_inst_amt_payment_min_max                           0
instf_inst_amt_payment_min_min                           0
instf_inst_amt_payment_min_count                         0
instf_inst_amt_payment_count_mean                        0
instf_inst_amt_payment_count_max                         0
instf_inst_amt_payment_count_min                         0
instf_inst_amt_payment_count_count                       0
is_building                                              0
is_building_missing                                      0
has_basement                                             0
basementarea_missing                                     0
has_noliving                                             0
nonlivingarea_missing                                    0
is_employed                                              0
livingarea_missing                                       0
apartments_missing                                       0
floorsmax_missing                                        0
years_build_missing                                      0
commonarea_missing                                       0
emergencystate_missing                                   0
elevators_avg_missing                                    0
elevators_mode_missing                                   0
elevators_medi_missing                                   0
housetype_mode_missing                                   0
wallsmaterial_mode_missing                               0
occupation_type_missing                                  0
organization_type_missing                                0
name_type_suite_missing                                  0
code_gender_missing                                      0
amt_annuity_missing                                      0
amt_goods_price_missing                                  0
own_car_age_missing                                      0
cnt_fam_members_missing                                  0
ext_source_1_missing                                     0
ext_source_2_missing                                     0
ext_source_3_missing                                     0
apartments_avg_missing                                   0
basementarea_avg_missing                                 0
years_beginexpluatation_avg_missing                      0
```

```
years_build_avg_missing                                     0
commonarea_avg_missing                                      0
floorsmax_avg_missing                                       0
landarea_avg_missing                                        0
livingapartments_avg_missing                                0
livingarea_avg_missing                                      0
nonlivingapartments_avg_missing                             0
nonlivingarea_avg_missing                                   0
totalarea_mode_missing                                      0
obs_30_cnt_social_circle_missing                            0
def_30_cnt_social_circle_missing                            0
obs_60_cnt_social_circle_missing                            0
def_60_cnt_social_circle_missing                            0
days_last_phone_change_missing                              0
amt_req_credit_bureau_hour_missing                          0
amt_req_credit_bureau_day_missing                           0
amt_req_credit_bureau_week_missing                          0
amt_req_credit_bureau_mon_missing                           0
amt_req_credit_bureau_qrt_missing                           0
amt_req_credit_bureau_year_missing                          0
bur_sk_id_bureau_mean_missing                               0
bur_sk_id_bureau_max_missing                                0
bur_sk_id_bureau_min_missing                                0
bur_sk_id_bureau_count_missing                              0
bur_days_credit_mean_missing                                0
bur_days_credit_max_missing                                 0
bur_days_credit_min_missing                                 0
bur_days_credit_count_missing                               0
bur_credit_day_overdue_mean_missing                         0
bur_credit_day_overdue_max_missing                          0
bur_credit_day_overdue_min_missing                          0
bur_credit_day_overdue_count_missing                        0
bur_days_credit_enddate_mean_missing                        0
bur_days_credit_enddate_max_missing                         0
bur_days_credit_enddate_min_missing                         0
bur_days_credit_enddate_count_missing                       0
bur_days_enddate_fact_mean_missing                          0
bur_days_enddate_fact_max_missing                           0
bur_days_enddate_fact_min_missing                           0
bur_days_enddate_fact_count_missing                         0
bur_amt_credit_max_overdue_mean_missing                     0
bur_amt_credit_max_overdue_max_missing                      0
bur_amt_credit_max_overdue_min_missing                      0
bur_amt_credit_max_overdue_count_missing                    0
bur_cnt_credit_prolong_mean_missing                         0
bur_cnt_credit_prolong_max_missing                          0
bur_cnt_credit_prolong_min_missing                          0
bur_cnt_credit_prolong_count_missing                        0
bur_amt_credit_sum_mean_missing                             0
bur_amt_credit_sum_max_missing                              0
bur_amt_credit_sum_min_missing                              0
bur_amt_credit_sum_count_missing                            0
bur_amt_credit_sum_debt_mean_missing                        0
bur_amt_credit_sum_debt_max_missing                         0
bur_amt_credit_sum_debt_min_missing                         0
bur_amt_credit_sum_debt_count_missing                       0
bur_amt_credit_sum_limit_mean_missing                       0
bur_amt_credit_sum_limit_max_missing                        0
bur_amt_credit_sum_limit_min_missing                        0
bur_amt_credit_sum_limit_count_missing                      0
bur_amt_credit_sum_overdue_mean_missing                     0
bur_amt_credit_sum_overdue_max_missing                      0
bur_amt_credit_sum_overdue_min_missing                      0
bur_amt_credit_sum_overdue_count_missing                    0
bur_days_credit_update_mean_missing                         0
bur_days_credit_update_max_missing                          0
bur_days_credit_update_min_missing                          0
bur_days_credit_update_count_missing                        0
bur_amt_annuity_mean_missing                                0
```

```
bur_amt_annuity_max_missing                           0
bur_amt_annuity_min_missing                           0
bur_amt_annuity_count_missing                         0
bur_bb_months_balance_mean_mean_missing               0
bur_bb_months_balance_mean_max_missing                0
bur_bb_months_balance_mean_min_missing                0
bur_bb_months_balance_mean_count_missing              0
bur_bb_months_balance_max_mean_missing                0
bur_bb_months_balance_max_max_missing                 0
bur_bb_months_balance_max_min_missing                 0
bur_bb_months_balance_max_count_missing               0
bur_bb_months_balance_min_mean_missing                0
bur_bb_months_balance_min_max_missing                 0
bur_bb_months_balance_min_min_missing                 0
bur_bb_months_balance_min_count_missing               0
bur_bb_months_balance_count_mean_missing              0
bur_bb_months_balance_count_max_missing               0
bur_bb_months_balance_count_min_missing               0
bur_bb_months_balance_count_count_missing             0
prev_sk_id_prev_mean_missing                          0
prev_sk_id_prev_max_missing                           0
prev_sk_id_prev_min_missing                           0
prev_sk_id_prev_count_missing                         0
prev_amt_annuity_mean_missing                         0
prev_amt_annuity_max_missing                          0
prev_amt_annuity_min_missing                          0
prev_amt_annuity_count_missing                        0
prev_amt_application_mean_missing                     0
prev_amt_application_max_missing                      0
prev_amt_application_min_missing                      0
prev_amt_application_count_missing                    0
prev_amt_credit_mean_missing                          0
prev_amt_credit_max_missing                           0
prev_amt_credit_min_missing                           0
prev_amt_credit_count_missing                         0
prev_amt_down_payment_mean_missing                    0
prev_amt_down_payment_max_missing                     0
prev_amt_down_payment_min_missing                     0
prev_amt_down_payment_count_missing                   0
prev_amt_goods_price_mean_missing                     0
prev_amt_goods_price_max_missing                      0
prev_amt_goods_price_min_missing                      0
prev_amt_goods_price_count_missing                    0
prev_hour_appr_process_start_mean_missing             0
prev_hour_appr_process_start_max_missing              0
prev_hour_appr_process_start_min_missing              0
prev_hour_appr_process_start_count_missing            0
prev_nflag_last_appl_in_day_mean_missing              0
prev_nflag_last_appl_in_day_max_missing               0
prev_nflag_last_appl_in_day_min_missing               0
prev_nflag_last_appl_in_day_count_missing             0
prev_rate_down_payment_mean_missing                   0
prev_rate_down_payment_max_missing                    0
prev_rate_down_payment_min_missing                    0
prev_rate_down_payment_count_missing                  0
prev_rate_interest_primary_mean_missing               0
prev_rate_interest_primary_max_missing                0
prev_rate_interest_primary_min_missing                0
prev_rate_interest_primary_count_missing              0
prev_rate_interest_privileged_mean_missing            0
prev_rate_interest_privileged_max_missing             0
prev_rate_interest_privileged_min_missing             0
prev_rate_interest_privileged_count_missing           0
prev_days_decision_mean_missing                       0
prev_days_decision_max_missing                        0
prev_days_decision_min_missing                        0
prev_days_decision_count_missing                      0
prev_sellerplace_area_mean_missing                    0
prev_sellerplace_area_max_missing                     0
```

```
prev_sellerplace_area_min_missing                       0
prev_sellerplace_area_count_missing                     0
prev_cnt_payment_mean_missing                           0
prev_cnt_payment_max_missing                            0
prev_cnt_payment_min_missing                            0
prev_cnt_payment_count_missing                          0
prev_days_first_drawing_mean_missing                    0
prev_days_first_drawing_max_missing                     0
prev_days_first_drawing_min_missing                     0
prev_days_first_drawing_count_missing                   0
prev_days_first_due_mean_missing                        0
prev_days_first_due_max_missing                         0
prev_days_first_due_min_missing                         0
prev_days_first_due_count_missing                       0
prev_days_last_due_1st_version_mean_missing             0
prev_days_last_due_1st_version_max_missing              0
prev_days_last_due_1st_version_min_missing              0
prev_days_last_due_1st_version_count_missing            0
prev_days_last_due_mean_missing                         0
prev_days_last_due_max_missing                          0
prev_days_last_due_min_missing                          0
prev_days_last_due_count_missing                        0
prev_days_termination_mean_missing                      0
prev_days_termination_max_missing                       0
prev_days_termination_min_missing                       0
prev_days_termination_count_missing                     0
prev_nflag_insured_on_approval_mean_missing             0
prev_nflag_insured_on_approval_max_missing              0
prev_nflag_insured_on_approval_min_missing              0
prev_nflag_insured_on_approval_count_missing            0
posf_sk_id_prev_mean_missing                            0
posf_sk_id_prev_max_missing                             0
posf_sk_id_prev_min_missing                             0
posf_sk_id_prev_count_missing                           0
posf_pos_sk_id_curr_mean_mean_missing                   0
posf_pos_sk_id_curr_mean_max_missing                    0
posf_pos_sk_id_curr_mean_min_missing                    0
posf_pos_sk_id_curr_mean_count_missing                  0
posf_pos_sk_id_curr_max_mean_missing                    0
posf_pos_sk_id_curr_max_max_missing                     0
posf_pos_sk_id_curr_max_min_missing                     0
posf_pos_sk_id_curr_max_count_missing                   0
posf_pos_sk_id_curr_min_mean_missing                    0
posf_pos_sk_id_curr_min_max_missing                     0
posf_pos_sk_id_curr_min_min_missing                     0
posf_pos_sk_id_curr_min_count_missing                   0
posf_pos_sk_id_curr_count_mean_missing                  0
posf_pos_sk_id_curr_count_max_missing                   0
posf_pos_sk_id_curr_count_min_missing                   0
posf_pos_sk_id_curr_count_count_missing                 0
posf_pos_months_balance_mean_mean_missing               0
posf_pos_months_balance_mean_max_missing                0
posf_pos_months_balance_mean_min_missing                0
posf_pos_months_balance_mean_count_missing              0
posf_pos_months_balance_max_mean_missing                0
posf_pos_months_balance_max_max_missing                 0
posf_pos_months_balance_max_min_missing                 0
posf_pos_months_balance_max_count_missing               0
posf_pos_months_balance_min_mean_missing                0
posf_pos_months_balance_min_max_missing                 0
posf_pos_months_balance_min_min_missing                 0
posf_pos_months_balance_min_count_missing               0
posf_pos_months_balance_count_mean_missing              0
posf_pos_months_balance_count_max_missing               0
posf_pos_months_balance_count_min_missing               0
posf_pos_months_balance_count_count_missing             0
posf_pos_cnt_instalment_mean_mean_missing               0
posf_pos_cnt_instalment_mean_max_missing                0
posf_pos_cnt_instalment_mean_min_missing                0
```

| | |
|---|---|
| posf_pos_cnt_instalment_mean_count_missing | 0 |
| posf_pos_cnt_instalment_max_mean_missing | 0 |
| posf_pos_cnt_instalment_max_max_missing | 0 |
| posf_pos_cnt_instalment_max_min_missing | 0 |
| posf_pos_cnt_instalment_max_count_missing | 0 |
| posf_pos_cnt_instalment_min_mean_missing | 0 |
| posf_pos_cnt_instalment_min_max_missing | 0 |
| posf_pos_cnt_instalment_min_min_missing | 0 |
| posf_pos_cnt_instalment_min_count_missing | 0 |
| posf_pos_cnt_instalment_count_mean_missing | 0 |
| posf_pos_cnt_instalment_count_max_missing | 0 |
| posf_pos_cnt_instalment_count_min_missing | 0 |
| posf_pos_cnt_instalment_count_count_missing | 0 |
| posf_pos_cnt_instalment_future_mean_mean_missing | 0 |
| posf_pos_cnt_instalment_future_mean_max_missing | 0 |
| posf_pos_cnt_instalment_future_mean_min_missing | 0 |
| posf_pos_cnt_instalment_future_mean_count_missing | 0 |
| posf_pos_cnt_instalment_future_max_mean_missing | 0 |
| posf_pos_cnt_instalment_future_max_max_missing | 0 |
| posf_pos_cnt_instalment_future_max_min_missing | 0 |
| posf_pos_cnt_instalment_future_max_count_missing | 0 |
| posf_pos_cnt_instalment_future_min_mean_missing | 0 |
| posf_pos_cnt_instalment_future_min_max_missing | 0 |
| posf_pos_cnt_instalment_future_min_min_missing | 0 |
| posf_pos_cnt_instalment_future_min_count_missing | 0 |
| posf_pos_cnt_instalment_future_count_mean_missing | 0 |
| posf_pos_cnt_instalment_future_count_max_missing | 0 |
| posf_pos_cnt_instalment_future_count_min_missing | 0 |
| posf_pos_cnt_instalment_future_count_count_missing | 0 |
| posf_pos_sk_dpd_mean_mean_missing | 0 |
| posf_pos_sk_dpd_mean_max_missing | 0 |
| posf_pos_sk_dpd_mean_min_missing | 0 |
| posf_pos_sk_dpd_mean_count_missing | 0 |
| posf_pos_sk_dpd_max_mean_missing | 0 |
| posf_pos_sk_dpd_max_max_missing | 0 |
| posf_pos_sk_dpd_max_min_missing | 0 |
| posf_pos_sk_dpd_max_count_missing | 0 |
| posf_pos_sk_dpd_min_mean_missing | 0 |
| posf_pos_sk_dpd_min_max_missing | 0 |
| posf_pos_sk_dpd_min_min_missing | 0 |
| posf_pos_sk_dpd_min_count_missing | 0 |
| posf_pos_sk_dpd_count_mean_missing | 0 |
| posf_pos_sk_dpd_count_max_missing | 0 |
| posf_pos_sk_dpd_count_min_missing | 0 |
| posf_pos_sk_dpd_count_count_missing | 0 |
| posf_pos_sk_dpd_def_mean_mean_missing | 0 |
| posf_pos_sk_dpd_def_mean_max_missing | 0 |
| posf_pos_sk_dpd_def_mean_min_missing | 0 |
| posf_pos_sk_dpd_def_mean_count_missing | 0 |
| posf_pos_sk_dpd_def_max_mean_missing | 0 |
| posf_pos_sk_dpd_def_max_max_missing | 0 |
| posf_pos_sk_dpd_def_max_min_missing | 0 |
| posf_pos_sk_dpd_def_max_count_missing | 0 |
| posf_pos_sk_dpd_def_min_mean_missing | 0 |
| posf_pos_sk_dpd_def_min_max_missing | 0 |
| posf_pos_sk_dpd_def_min_min_missing | 0 |
| posf_pos_sk_dpd_def_min_count_missing | 0 |
| posf_pos_sk_dpd_def_count_mean_missing | 0 |
| posf_pos_sk_dpd_def_count_max_missing | 0 |
| posf_pos_sk_dpd_def_count_min_missing | 0 |
| posf_pos_sk_dpd_def_count_count_missing | 0 |
| ccf_sk_id_prev_mean_missing | 0 |
| ccf_sk_id_prev_max_missing | 0 |
| ccf_sk_id_prev_min_missing | 0 |
| ccf_sk_id_prev_count_missing | 0 |
| ccf_cc_sk_id_curr_mean_mean_missing | 0 |
| ccf_cc_sk_id_curr_mean_max_missing | 0 |
| ccf_cc_sk_id_curr_mean_min_missing | 0 |
| ccf_cc_sk_id_curr_mean_count_missing | 0 |

```
ccf_cc_sk_id_curr_max_mean_missing                      0
ccf_cc_sk_id_curr_max_max_missing                       0
ccf_cc_sk_id_curr_max_min_missing                       0
ccf_cc_sk_id_curr_max_count_missing                     0
ccf_cc_sk_id_curr_min_mean_missing                      0
ccf_cc_sk_id_curr_min_max_missing                       0
ccf_cc_sk_id_curr_min_min_missing                       0
ccf_cc_sk_id_curr_min_count_missing                     0
ccf_cc_sk_id_curr_count_mean_missing                    0
ccf_cc_sk_id_curr_count_max_missing                     0
ccf_cc_sk_id_curr_count_min_missing                     0
ccf_cc_sk_id_curr_count_count_missing                   0
ccf_cc_months_balance_mean_mean_missing                 0
ccf_cc_months_balance_mean_max_missing                  0
ccf_cc_months_balance_mean_min_missing                  0
ccf_cc_months_balance_mean_count_missing                0
ccf_cc_months_balance_max_mean_missing                  0
ccf_cc_months_balance_max_max_missing                   0
ccf_cc_months_balance_max_min_missing                   0
ccf_cc_months_balance_max_count_missing                 0
ccf_cc_months_balance_min_mean_missing                  0
ccf_cc_months_balance_min_max_missing                   0
ccf_cc_months_balance_min_min_missing                   0
ccf_cc_months_balance_min_count_missing                 0
ccf_cc_months_balance_count_mean_missing                0
ccf_cc_months_balance_count_max_missing                 0
ccf_cc_months_balance_count_min_missing                 0
ccf_cc_months_balance_count_count_missing               0
ccf_cc_amt_balance_mean_mean_missing                    0
ccf_cc_amt_balance_mean_max_missing                     0
ccf_cc_amt_balance_mean_min_missing                     0
ccf_cc_amt_balance_mean_count_missing                   0
ccf_cc_amt_balance_max_mean_missing                     0
ccf_cc_amt_balance_max_max_missing                      0
ccf_cc_amt_balance_max_min_missing                      0
ccf_cc_amt_balance_max_count_missing                    0
ccf_cc_amt_balance_min_mean_missing                     0
ccf_cc_amt_balance_min_max_missing                      0
ccf_cc_amt_balance_min_min_missing                      0
ccf_cc_amt_balance_min_count_missing                    0
ccf_cc_amt_balance_count_mean_missing                   0
ccf_cc_amt_balance_count_max_missing                    0
ccf_cc_amt_balance_count_min_missing                    0
ccf_cc_amt_balance_count_count_missing                  0
ccf_cc_amt_credit_limit_actual_mean_mean_missing        0
ccf_cc_amt_credit_limit_actual_mean_max_missing         0
ccf_cc_amt_credit_limit_actual_mean_min_missing         0
ccf_cc_amt_credit_limit_actual_mean_count_missing       0
ccf_cc_amt_credit_limit_actual_max_mean_missing         0
ccf_cc_amt_credit_limit_actual_max_max_missing          0
ccf_cc_amt_credit_limit_actual_max_min_missing          0
ccf_cc_amt_credit_limit_actual_max_count_missing        0
ccf_cc_amt_credit_limit_actual_min_mean_missing         0
ccf_cc_amt_credit_limit_actual_min_max_missing          0
ccf_cc_amt_credit_limit_actual_min_min_missing          0
ccf_cc_amt_credit_limit_actual_min_count_missing        0
ccf_cc_amt_credit_limit_actual_count_mean_missing       0
ccf_cc_amt_credit_limit_actual_count_max_missing        0
ccf_cc_amt_credit_limit_actual_count_min_missing        0
ccf_cc_amt_credit_limit_actual_count_count_missing      0
ccf_cc_amt_drawings_atm_current_mean_mean_missing       0
ccf_cc_amt_drawings_atm_current_mean_max_missing        0
ccf_cc_amt_drawings_atm_current_mean_min_missing        0
ccf_cc_amt_drawings_atm_current_mean_count_missing      0
ccf_cc_amt_drawings_atm_current_max_mean_missing        0
ccf_cc_amt_drawings_atm_current_max_max_missing         0
ccf_cc_amt_drawings_atm_current_max_min_missing         0
ccf_cc_amt_drawings_atm_current_max_count_missing       0
ccf_cc_amt_drawings_atm_current_min_mean_missing        0
```

| | |
|---|---|
| ccf_cc_amt_drawings_atm_current_min_max_missing | 0 |
| ccf_cc_amt_drawings_atm_current_min_min_missing | 0 |
| ccf_cc_amt_drawings_atm_current_min_count_missing | 0 |
| ccf_cc_amt_drawings_atm_current_count_mean_missing | 0 |
| ccf_cc_amt_drawings_atm_current_count_max_missing | 0 |
| ccf_cc_amt_drawings_atm_current_count_min_missing | 0 |
| ccf_cc_amt_drawings_atm_current_count_count_missing | 0 |
| ccf_cc_amt_drawings_current_mean_mean_missing | 0 |
| ccf_cc_amt_drawings_current_mean_max_missing | 0 |
| ccf_cc_amt_drawings_current_mean_min_missing | 0 |
| ccf_cc_amt_drawings_current_mean_count_missing | 0 |
| ccf_cc_amt_drawings_current_max_mean_missing | 0 |
| ccf_cc_amt_drawings_current_max_max_missing | 0 |
| ccf_cc_amt_drawings_current_max_min_missing | 0 |
| ccf_cc_amt_drawings_current_max_count_missing | 0 |
| ccf_cc_amt_drawings_current_min_mean_missing | 0 |
| ccf_cc_amt_drawings_current_min_max_missing | 0 |
| ccf_cc_amt_drawings_current_min_min_missing | 0 |
| ccf_cc_amt_drawings_current_min_count_missing | 0 |
| ccf_cc_amt_drawings_current_count_mean_missing | 0 |
| ccf_cc_amt_drawings_current_count_max_missing | 0 |
| ccf_cc_amt_drawings_current_count_min_missing | 0 |
| ccf_cc_amt_drawings_current_count_count_missing | 0 |
| ccf_cc_amt_drawings_other_current_mean_mean_missing | 0 |
| ccf_cc_amt_drawings_other_current_mean_max_missing | 0 |
| ccf_cc_amt_drawings_other_current_mean_min_missing | 0 |
| ccf_cc_amt_drawings_other_current_mean_count_missing | 0 |
| ccf_cc_amt_drawings_other_current_max_mean_missing | 0 |
| ccf_cc_amt_drawings_other_current_max_max_missing | 0 |
| ccf_cc_amt_drawings_other_current_max_min_missing | 0 |
| ccf_cc_amt_drawings_other_current_max_count_missing | 0 |
| ccf_cc_amt_drawings_other_current_min_mean_missing | 0 |
| ccf_cc_amt_drawings_other_current_min_max_missing | 0 |
| ccf_cc_amt_drawings_other_current_min_min_missing | 0 |
| ccf_cc_amt_drawings_other_current_min_count_missing | 0 |
| ccf_cc_amt_drawings_other_current_count_mean_missing | 0 |
| ccf_cc_amt_drawings_other_current_count_max_missing | 0 |
| ccf_cc_amt_drawings_other_current_count_min_missing | 0 |
| ccf_cc_amt_drawings_other_current_count_count_missing | 0 |
| ccf_cc_amt_drawings_pos_current_mean_mean_missing | 0 |
| ccf_cc_amt_drawings_pos_current_mean_max_missing | 0 |
| ccf_cc_amt_drawings_pos_current_mean_min_missing | 0 |
| ccf_cc_amt_drawings_pos_current_mean_count_missing | 0 |
| ccf_cc_amt_drawings_pos_current_max_mean_missing | 0 |
| ccf_cc_amt_drawings_pos_current_max_max_missing | 0 |
| ccf_cc_amt_drawings_pos_current_max_min_missing | 0 |
| ccf_cc_amt_drawings_pos_current_max_count_missing | 0 |
| ccf_cc_amt_drawings_pos_current_min_mean_missing | 0 |
| ccf_cc_amt_drawings_pos_current_min_max_missing | 0 |
| ccf_cc_amt_drawings_pos_current_min_min_missing | 0 |
| ccf_cc_amt_drawings_pos_current_min_count_missing | 0 |
| ccf_cc_amt_drawings_pos_current_count_mean_missing | 0 |
| ccf_cc_amt_drawings_pos_current_count_max_missing | 0 |
| ccf_cc_amt_drawings_pos_current_count_min_missing | 0 |
| ccf_cc_amt_drawings_pos_current_count_count_missing | 0 |
| ccf_cc_amt_inst_min_regularity_mean_mean_missing | 0 |
| ccf_cc_amt_inst_min_regularity_mean_max_missing | 0 |
| ccf_cc_amt_inst_min_regularity_mean_min_missing | 0 |
| ccf_cc_amt_inst_min_regularity_mean_count_missing | 0 |
| ccf_cc_amt_inst_min_regularity_max_mean_missing | 0 |
| ccf_cc_amt_inst_min_regularity_max_max_missing | 0 |
| ccf_cc_amt_inst_min_regularity_max_min_missing | 0 |
| ccf_cc_amt_inst_min_regularity_max_count_missing | 0 |
| ccf_cc_amt_inst_min_regularity_min_mean_missing | 0 |
| ccf_cc_amt_inst_min_regularity_min_max_missing | 0 |
| ccf_cc_amt_inst_min_regularity_min_min_missing | 0 |
| ccf_cc_amt_inst_min_regularity_min_count_missing | 0 |
| ccf_cc_amt_inst_min_regularity_count_mean_missing | 0 |
| ccf_cc_amt_inst_min_regularity_count_max_missing | 0 |

```
ccf_cc_amt_inst_min_regularity_count_min_missing          0
ccf_cc_amt_inst_min_regularity_count_count_missing        0
ccf_cc_amt_payment_current_mean_mean_missing              0
ccf_cc_amt_payment_current_mean_max_missing               0
ccf_cc_amt_payment_current_mean_min_missing               0
ccf_cc_amt_payment_current_mean_count_missing             0
ccf_cc_amt_payment_current_max_mean_missing               0
ccf_cc_amt_payment_current_max_max_missing                0
ccf_cc_amt_payment_current_max_min_missing                0
ccf_cc_amt_payment_current_max_count_missing              0
ccf_cc_amt_payment_current_min_mean_missing               0
ccf_cc_amt_payment_current_min_max_missing                0
ccf_cc_amt_payment_current_min_min_missing                0
ccf_cc_amt_payment_current_min_count_missing              0
ccf_cc_amt_payment_current_count_mean_missing             0
ccf_cc_amt_payment_current_count_max_missing              0
ccf_cc_amt_payment_current_count_min_missing              0
ccf_cc_amt_payment_current_count_count_missing            0
ccf_cc_amt_payment_total_current_mean_mean_missing        0
ccf_cc_amt_payment_total_current_mean_max_missing         0
ccf_cc_amt_payment_total_current_mean_min_missing         0
ccf_cc_amt_payment_total_current_mean_count_missing       0
ccf_cc_amt_payment_total_current_max_mean_missing         0
ccf_cc_amt_payment_total_current_max_max_missing          0
ccf_cc_amt_payment_total_current_max_min_missing          0
ccf_cc_amt_payment_total_current_max_count_missing        0
ccf_cc_amt_payment_total_current_min_mean_missing         0
ccf_cc_amt_payment_total_current_min_max_missing          0
ccf_cc_amt_payment_total_current_min_min_missing          0
ccf_cc_amt_payment_total_current_min_count_missing        0
ccf_cc_amt_payment_total_current_count_mean_missing       0
ccf_cc_amt_payment_total_current_count_max_missing        0
ccf_cc_amt_payment_total_current_count_min_missing        0
ccf_cc_amt_payment_total_current_count_count_missing      0
ccf_cc_amt_receivable_principal_mean_mean_missing         0
ccf_cc_amt_receivable_principal_mean_max_missing          0
ccf_cc_amt_receivable_principal_mean_min_missing          0
ccf_cc_amt_receivable_principal_mean_count_missing        0
ccf_cc_amt_receivable_principal_max_mean_missing          0
ccf_cc_amt_receivable_principal_max_max_missing           0
ccf_cc_amt_receivable_principal_max_min_missing           0
ccf_cc_amt_receivable_principal_max_count_missing         0
ccf_cc_amt_receivable_principal_min_mean_missing          0
ccf_cc_amt_receivable_principal_min_max_missing           0
ccf_cc_amt_receivable_principal_min_min_missing           0
ccf_cc_amt_receivable_principal_min_count_missing         0
ccf_cc_amt_receivable_principal_count_mean_missing        0
ccf_cc_amt_receivable_principal_count_max_missing         0
ccf_cc_amt_receivable_principal_count_min_missing         0
ccf_cc_amt_receivable_principal_count_count_missing       0
ccf_cc_amt_recivable_mean_mean_missing                    0
ccf_cc_amt_recivable_mean_max_missing                     0
ccf_cc_amt_recivable_mean_min_missing                     0
ccf_cc_amt_recivable_mean_count_missing                   0
ccf_cc_amt_recivable_max_mean_missing                     0
ccf_cc_amt_recivable_max_max_missing                      0
ccf_cc_amt_recivable_max_min_missing                      0
ccf_cc_amt_recivable_max_count_missing                    0
ccf_cc_amt_recivable_min_mean_missing                     0
ccf_cc_amt_recivable_min_max_missing                      0
ccf_cc_amt_recivable_min_min_missing                      0
ccf_cc_amt_recivable_min_count_missing                    0
ccf_cc_amt_recivable_count_mean_missing                   0
ccf_cc_amt_recivable_count_max_missing                    0
ccf_cc_amt_recivable_count_min_missing                    0
ccf_cc_amt_recivable_count_count_missing                  0
ccf_cc_amt_total_receivable_mean_mean_missing             0
ccf_cc_amt_total_receivable_mean_max_missing              0
ccf_cc_amt_total_receivable_mean_min_missing              0
```

```
ccf_cc_amt_total_receivable_mean_count_missing           0
ccf_cc_amt_total_receivable_max_mean_missing             0
ccf_cc_amt_total_receivable_max_max_missing              0
ccf_cc_amt_total_receivable_max_min_missing              0
ccf_cc_amt_total_receivable_max_count_missing            0
ccf_cc_amt_total_receivable_min_mean_missing             0
ccf_cc_amt_total_receivable_min_max_missing              0
ccf_cc_amt_total_receivable_min_min_missing              0
ccf_cc_amt_total_receivable_min_count_missing            0
ccf_cc_amt_total_receivable_count_mean_missing           0
ccf_cc_amt_total_receivable_count_max_missing            0
ccf_cc_amt_total_receivable_count_min_missing            0
ccf_cc_amt_total_receivable_count_count_missing          0
ccf_cc_cnt_drawings_atm_current_mean_mean_missing        0
ccf_cc_cnt_drawings_atm_current_mean_max_missing         0
ccf_cc_cnt_drawings_atm_current_mean_min_missing         0
ccf_cc_cnt_drawings_atm_current_mean_count_missing       0
ccf_cc_cnt_drawings_atm_current_max_mean_missing         0
ccf_cc_cnt_drawings_atm_current_max_max_missing          0
ccf_cc_cnt_drawings_atm_current_max_min_missing          0
ccf_cc_cnt_drawings_atm_current_max_count_missing        0
ccf_cc_cnt_drawings_atm_current_min_mean_missing         0
ccf_cc_cnt_drawings_atm_current_min_max_missing          0
ccf_cc_cnt_drawings_atm_current_min_min_missing          0
ccf_cc_cnt_drawings_atm_current_min_count_missing        0
ccf_cc_cnt_drawings_atm_current_count_mean_missing       0
ccf_cc_cnt_drawings_atm_current_count_max_missing        0
ccf_cc_cnt_drawings_atm_current_count_min_missing        0
ccf_cc_cnt_drawings_atm_current_count_count_missing      0
ccf_cc_cnt_drawings_current_mean_mean_missing            0
ccf_cc_cnt_drawings_current_mean_max_missing             0
ccf_cc_cnt_drawings_current_mean_min_missing             0
ccf_cc_cnt_drawings_current_mean_count_missing           0
ccf_cc_cnt_drawings_current_max_mean_missing             0
ccf_cc_cnt_drawings_current_max_max_missing              0
ccf_cc_cnt_drawings_current_max_min_missing              0
ccf_cc_cnt_drawings_current_max_count_missing            0
ccf_cc_cnt_drawings_current_min_mean_missing             0
ccf_cc_cnt_drawings_current_min_max_missing              0
ccf_cc_cnt_drawings_current_min_min_missing              0
ccf_cc_cnt_drawings_current_min_count_missing            0
ccf_cc_cnt_drawings_current_count_mean_missing           0
ccf_cc_cnt_drawings_current_count_max_missing            0
ccf_cc_cnt_drawings_current_count_min_missing            0
ccf_cc_cnt_drawings_current_count_count_missing          0
ccf_cc_cnt_drawings_other_current_mean_mean_missing      0
ccf_cc_cnt_drawings_other_current_mean_max_missing       0
ccf_cc_cnt_drawings_other_current_mean_min_missing       0
ccf_cc_cnt_drawings_other_current_mean_count_missing     0
ccf_cc_cnt_drawings_other_current_max_mean_missing       0
ccf_cc_cnt_drawings_other_current_max_max_missing        0
ccf_cc_cnt_drawings_other_current_max_min_missing        0
ccf_cc_cnt_drawings_other_current_max_count_missing      0
ccf_cc_cnt_drawings_other_current_min_mean_missing       0
ccf_cc_cnt_drawings_other_current_min_max_missing        0
ccf_cc_cnt_drawings_other_current_min_min_missing        0
ccf_cc_cnt_drawings_other_current_min_count_missing      0
ccf_cc_cnt_drawings_other_current_count_mean_missing     0
ccf_cc_cnt_drawings_other_current_count_max_missing      0
ccf_cc_cnt_drawings_other_current_count_min_missing      0
ccf_cc_cnt_drawings_other_current_count_count_missing    0
ccf_cc_cnt_drawings_pos_current_mean_mean_missing        0
ccf_cc_cnt_drawings_pos_current_mean_max_missing         0
ccf_cc_cnt_drawings_pos_current_mean_min_missing         0
ccf_cc_cnt_drawings_pos_current_mean_count_missing       0
ccf_cc_cnt_drawings_pos_current_max_mean_missing         0
ccf_cc_cnt_drawings_pos_current_max_max_missing          0
ccf_cc_cnt_drawings_pos_current_max_min_missing          0
ccf_cc_cnt_drawings_pos_current_max_count_missing        0
```

```
ccf_cc_cnt_drawings_pos_current_min_mean_missing          0
ccf_cc_cnt_drawings_pos_current_min_max_missing           0
ccf_cc_cnt_drawings_pos_current_min_min_missing           0
ccf_cc_cnt_drawings_pos_current_min_count_missing         0
ccf_cc_cnt_drawings_pos_current_count_mean_missing        0
ccf_cc_cnt_drawings_pos_current_count_max_missing         0
ccf_cc_cnt_drawings_pos_current_count_min_missing         0
ccf_cc_cnt_drawings_pos_current_count_count_missing       0
ccf_cc_cnt_instalment_mature_cum_mean_mean_missing        0
ccf_cc_cnt_instalment_mature_cum_mean_max_missing         0
ccf_cc_cnt_instalment_mature_cum_mean_min_missing         0
ccf_cc_cnt_instalment_mature_cum_mean_count_missing       0
ccf_cc_cnt_instalment_mature_cum_max_mean_missing         0
ccf_cc_cnt_instalment_mature_cum_max_max_missing          0
ccf_cc_cnt_instalment_mature_cum_max_min_missing          0
ccf_cc_cnt_instalment_mature_cum_max_count_missing        0
ccf_cc_cnt_instalment_mature_cum_min_mean_missing         0
ccf_cc_cnt_instalment_mature_cum_min_max_missing          0
ccf_cc_cnt_instalment_mature_cum_min_min_missing          0
ccf_cc_cnt_instalment_mature_cum_min_count_missing        0
ccf_cc_cnt_instalment_mature_cum_count_mean_missing       0
ccf_cc_cnt_instalment_mature_cum_count_max_missing        0
ccf_cc_cnt_instalment_mature_cum_count_min_missing        0
ccf_cc_cnt_instalment_mature_cum_count_count_missing      0
ccf_cc_sk_dpd_mean_mean_missing                           0
ccf_cc_sk_dpd_mean_max_missing                            0
ccf_cc_sk_dpd_mean_min_missing                            0
ccf_cc_sk_dpd_mean_count_missing                          0
ccf_cc_sk_dpd_max_mean_missing                            0
ccf_cc_sk_dpd_max_max_missing                             0
ccf_cc_sk_dpd_max_min_missing                             0
ccf_cc_sk_dpd_max_count_missing                           0
ccf_cc_sk_dpd_min_mean_missing                            0
ccf_cc_sk_dpd_min_max_missing                             0
ccf_cc_sk_dpd_min_min_missing                             0
ccf_cc_sk_dpd_min_count_missing                           0
ccf_cc_sk_dpd_count_mean_missing                          0
ccf_cc_sk_dpd_count_max_missing                           0
ccf_cc_sk_dpd_count_min_missing                           0
ccf_cc_sk_dpd_count_count_missing                         0
ccf_cc_sk_dpd_def_mean_mean_missing                       0
ccf_cc_sk_dpd_def_mean_max_missing                        0
ccf_cc_sk_dpd_def_mean_min_missing                        0
ccf_cc_sk_dpd_def_mean_count_missing                      0
ccf_cc_sk_dpd_def_max_mean_missing                        0
ccf_cc_sk_dpd_def_max_max_missing                         0
ccf_cc_sk_dpd_def_max_min_missing                         0
ccf_cc_sk_dpd_def_max_count_missing                       0
ccf_cc_sk_dpd_def_min_mean_missing                        0
ccf_cc_sk_dpd_def_min_max_missing                         0
ccf_cc_sk_dpd_def_min_min_missing                         0
ccf_cc_sk_dpd_def_min_count_missing                       0
ccf_cc_sk_dpd_def_count_mean_missing                      0
ccf_cc_sk_dpd_def_count_max_missing                       0
ccf_cc_sk_dpd_def_count_min_missing                       0
ccf_cc_sk_dpd_def_count_count_missing                     0
instf_sk_id_prev_mean_missing                             0
instf_sk_id_prev_max_missing                              0
instf_sk_id_prev_min_missing                              0
instf_sk_id_prev_count_missing                            0
instf_inst_sk_id_curr_mean_mean_missing                   0
instf_inst_sk_id_curr_mean_max_missing                    0
instf_inst_sk_id_curr_mean_min_missing                    0
instf_inst_sk_id_curr_mean_count_missing                  0
instf_inst_sk_id_curr_max_mean_missing                    0
instf_inst_sk_id_curr_max_max_missing                     0
instf_inst_sk_id_curr_max_min_missing                     0
instf_inst_sk_id_curr_max_count_missing                   0
instf_inst_sk_id_curr_min_mean_missing                    0
```

```
instf_inst_sk_id_curr_min_max_missing                   0
instf_inst_sk_id_curr_min_min_missing                   0
instf_inst_sk_id_curr_min_count_missing                 0
instf_inst_sk_id_curr_count_mean_missing                0
instf_inst_sk_id_curr_count_max_missing                 0
instf_inst_sk_id_curr_count_min_missing                 0
instf_inst_sk_id_curr_count_count_missing               0
instf_inst_num_instalment_version_mean_mean_missing     0
instf_inst_num_instalment_version_mean_max_missing      0
instf_inst_num_instalment_version_mean_min_missing      0
instf_inst_num_instalment_version_mean_count_missing    0
instf_inst_num_instalment_version_max_mean_missing      0
instf_inst_num_instalment_version_max_max_missing       0
instf_inst_num_instalment_version_max_min_missing       0
instf_inst_num_instalment_version_max_count_missing     0
instf_inst_num_instalment_version_min_mean_missing      0
instf_inst_num_instalment_version_min_max_missing       0
instf_inst_num_instalment_version_min_min_missing       0
instf_inst_num_instalment_version_min_count_missing     0
instf_inst_num_instalment_version_count_mean_missing    0
instf_inst_num_instalment_version_count_max_missing     0
instf_inst_num_instalment_version_count_min_missing     0
instf_inst_num_instalment_version_count_count_missing   0
instf_inst_num_instalment_number_mean_mean_missing      0
instf_inst_num_instalment_number_mean_max_missing       0
instf_inst_num_instalment_number_mean_min_missing       0
instf_inst_num_instalment_number_mean_count_missing     0
instf_inst_num_instalment_number_max_mean_missing       0
instf_inst_num_instalment_number_max_max_missing        0
instf_inst_num_instalment_number_max_min_missing        0
instf_inst_num_instalment_number_max_count_missing      0
instf_inst_num_instalment_number_min_mean_missing       0
instf_inst_num_instalment_number_min_max_missing        0
instf_inst_num_instalment_number_min_min_missing        0
instf_inst_num_instalment_number_min_count_missing      0
instf_inst_num_instalment_number_count_mean_missing     0
instf_inst_num_instalment_number_count_max_missing      0
instf_inst_num_instalment_number_count_min_missing      0
instf_inst_num_instalment_number_count_count_missing    0
instf_inst_days_instalment_mean_mean_missing            0
instf_inst_days_instalment_mean_max_missing             0
instf_inst_days_instalment_mean_min_missing             0
instf_inst_days_instalment_mean_count_missing           0
instf_inst_days_instalment_max_mean_missing             0
instf_inst_days_instalment_max_max_missing              0
instf_inst_days_instalment_max_min_missing              0
instf_inst_days_instalment_max_count_missing            0
instf_inst_days_instalment_min_mean_missing             0
instf_inst_days_instalment_min_max_missing              0
instf_inst_days_instalment_min_min_missing              0
instf_inst_days_instalment_min_count_missing            0
instf_inst_days_instalment_count_mean_missing           0
instf_inst_days_instalment_count_max_missing            0
instf_inst_days_instalment_count_min_missing            0
instf_inst_days_instalment_count_count_missing          0
instf_inst_days_entry_payment_mean_mean_missing         0
instf_inst_days_entry_payment_mean_max_missing          0
instf_inst_days_entry_payment_mean_min_missing          0
instf_inst_days_entry_payment_mean_count_missing        0
instf_inst_days_entry_payment_max_mean_missing          0
instf_inst_days_entry_payment_max_max_missing           0
instf_inst_days_entry_payment_max_min_missing           0
instf_inst_days_entry_payment_max_count_missing         0
instf_inst_days_entry_payment_min_mean_missing          0
instf_inst_days_entry_payment_min_max_missing           0
instf_inst_days_entry_payment_min_min_missing           0
instf_inst_days_entry_payment_min_count_missing         0
instf_inst_days_entry_payment_count_mean_missing        0
instf_inst_days_entry_payment_count_max_missing         0
```

```
instf_inst_days_entry_payment_count_min_missing          0
instf_inst_days_entry_payment_count_count_missing        0
instf_inst_amt_instalment_mean_mean_missing              0
instf_inst_amt_instalment_mean_max_missing               0
instf_inst_amt_instalment_mean_min_missing               0
instf_inst_amt_instalment_mean_count_missing             0
instf_inst_amt_instalment_max_mean_missing               0
instf_inst_amt_instalment_max_max_missing                0
instf_inst_amt_instalment_max_min_missing                0
instf_inst_amt_instalment_max_count_missing              0
instf_inst_amt_instalment_min_mean_missing               0
instf_inst_amt_instalment_min_max_missing                0
instf_inst_amt_instalment_min_min_missing                0
instf_inst_amt_instalment_min_count_missing              0
instf_inst_amt_instalment_count_mean_missing             0
instf_inst_amt_instalment_count_max_missing              0
instf_inst_amt_instalment_count_min_missing              0
instf_inst_amt_instalment_count_count_missing            0
instf_inst_amt_payment_mean_mean_missing                 0
instf_inst_amt_payment_mean_max_missing                  0
instf_inst_amt_payment_mean_min_missing                  0
instf_inst_amt_payment_mean_count_missing                0
instf_inst_amt_payment_max_mean_missing                  0
instf_inst_amt_payment_max_max_missing                   0
instf_inst_amt_payment_max_min_missing                   0
instf_inst_amt_payment_max_count_missing                 0
instf_inst_amt_payment_min_mean_missing                  0
instf_inst_amt_payment_min_max_missing                   0
instf_inst_amt_payment_min_min_missing                   0
instf_inst_amt_payment_min_count_missing                 0
instf_inst_amt_payment_count_mean_missing                0
instf_inst_amt_payment_count_max_missing                 0
instf_inst_amt_payment_count_min_missing                 0
instf_inst_amt_payment_count_count_missing               0
```

# 6. Feature Engineering

In [ ]:
```
df2 = df1.copy()
```

## 6.1 List of Hypotheses

### Block 1 - (1 a 20)

**H1** — Contract type influences the probability of default.

It is expected that customers with Revolving loans present higher risk, as these are short-term credits with higher interest rates.

**H2** — Gender is associated with default risk.

Differences in financial behavior between men and women may be reflected in payment rates.

**H3** — Customers who own a car have a lower probability of default.

Vehicle ownership may indicate greater financial stability.

**H4** — Owning a home reduces the chance of default.

Ownership of a fixed asset may reflect financial security and a stronger credit history.

**H5** — The number of children influences default risk.

Larger families tend to have higher fixed expenses, which may increase the probability of late payments.

**H6** — Higher total income is associated with lower default risk.

Customers with greater financial capacity have more margin to honor their debts.

**H7** — Higher credit amounts are related to higher default risk.

Larger loans may overload the budget, especially for lower-income customers.

**H8** — Higher monthly installments increase the chance of default.

High payments may compromise the customer's cash flow.

**H9** — The value of goods purchased influences default risk.

High-value purchases may indicate higher indebtedness and greater financial risk.

**H10** — The type of accompaniment when applying for credit is associated with default risk.

Customers who apply alone (Unaccompanied) may have different financial behavior than couples or families.

### Block 2 - (21 a 40)

**H21** — Having a work phone registered reduces the risk of default.

A validated employment link may indicate professional stability and more reliable income.

**H22** — Customers with a work phone provided are less likely to default.

This information tends to be provided by formally employed workers, reflecting better economic stability.

**H23** — Having a registered mobile phone is associated with lower default risk.

It indicates greater ease of communication and follow-up by the lender.

**H24** — Having a landline phone registered reduces default risk.

It may be associated with fixed residences and greater social stability.

**H25** — Customers with a registered email tend to present lower default risk.

It indicates a higher level of formalization, digital access, and ease of communication for collections or notifications.

**H26** — Occupation type influences default risk.

Self-employed and temporary workers tend to have more unstable income, increasing risk compared to formally employed or public servants.

**H27** — The number of family members is positively related to default risk.

Larger families imply higher fixed expenses and lower financial margin for payments.

**H28** — Customers from regions with lower ratings have a higher probability of default.

Regional ratings may reflect socioeconomic conditions and access to credit in the area.

**H29** — The customer's city rating influences default risk.

Urban regions with worse economic indicators may concentrate customers with higher financial risk.

**H30** — The day of the week when the credit application is made influences the probability of default.

Applications made on weekdays (especially early in the week) may come from more organized profiles than those made on weekends.

**H31** — The time of credit application is associated with default.

Requests made at atypical hours (late night, early morning) may be linked to impulsive behavior or higher risk.

**H32** — Living in a region different from the registered one increases default risk.

It indicates recent mobility or registration inconsistencies, factors linked to lower reliability.

**H33** — Working in a region different from the registered one is associated with higher risk.

It may represent long commutes or job instability.

**H34** — Living and working in different regions may increase the probability of default.

Commuting may indicate additional costs and less available time, affecting financial stability.

**H35** — Living in a city different from the registered one increases the chance of default.

Differences between official and actual addresses may signal registration inconsistencies or residential instability.

**H36** — Working in a city different from the registered one increases default risk.

It indicates possible long commutes or informal employment.

**H37** — Living in a different city than the workplace influences default risk.

Long commutes can represent higher costs and lower professional stability.

**H38** — The type of employing organization is associated with default risk.

Public employees and workers in large companies tend to present lower risk compared to self-employed or small company workers.

**H39** — External score 2 is inversely related to default.

The higher the ext_source_2 value, the lower the default risk, as it indicates a better external credit assessment.

**H40** — External score 3 is inversely related to default.

High values reflect greater trustworthiness and lower credit risk according to external sources.

### Block 3 - (41 a 72)

**H41** — The average number of elevators in a building is inversely related to the probability of default.

Properties with more elevators usually belong to higher-standard buildings, indicating better socioeconomic conditions and lower credit risk.

**H42** — Housing type influences default risk.

Customers living in owned houses or apartments tend to have lower default rates than those living in rented or third-party housing, reflecting greater asset stability.

**H43** — The main wall material of the property is associated with default risk.

More durable or higher-quality materials (such as stone or brick) tend to indicate higher-standard properties and better financial conditions.

**H44** — A higher number of observations or defaulters in the 30-day social circle increases the customer's probability of default.

Individuals inserted in social groups with higher default incidence may share similar risk profiles or economic vulnerability.

**H45** — Default in the 60-day social circle is positively associated with individual default risk.

The financial behavior of close contacts over longer periods tends to reflect social influence and similar economic conditions.

**H46** — The time since the last phone change is related to default probability.

Customers who frequently change their phone number may present greater instability or contact difficulties, increasing credit risk.

**H47** — The number of submitted documents is inversely associated with default.

Submitting more documents indicates greater transparency and compliance, while fewer documents may signal fraud risk or lower reliability.

### Block 4 - (73 a 90)

**H48** — Credit inquiry history and credit amounts influence the probability of default.

These variables represent both the frequency of credit bureau inquiries and the average and total amounts of contracted credit. Customers who perform many bureau checks or hold large amounts of active credit tend to show higher financial exposure and, consequently, higher default risk.

**H49** — Property characteristics and employment status influence repayment capacity.

Variables related to property structure and employment situation help estimate the customer's economic and social stability.

## 6.2 Feature Derivation

In [6]:
```
df2['days_employed_anom'] = df2["days_employed"] == 365243
df2['days_birth'] = df2['days_birth'].abs()
df2['days_employed'] = df2['days_employed'].abs()
df2['days_id_publish'] = df2['days_id_publish'].abs()
df2['days_registration'] = df2['days_registration'].abs()
df2['age_years'] = df2['days_birth'] / 365
df2['employment_years'] = df2['days_employed'] / 365
df2['id_publish_years'] = df2['days_id_publish'] / 365

df2['annuity_burden_ratio'] = df2['amt_annuity'] / (df2['bur_amt_credit_sum_mean'] + 1e-6)
df2['phone_change_rate'] = df2['days_last_phone_change'] / (df2['days_birth'] + 1e-6)
df2['id_change_rate'] = df2['days_id_publish'] / (df2['days_birth'] + 1e-6)
df2['ext_source_weighted_mean'] = (
    0.5 * df2['ext_source_2'] + 0.3 * df2['ext_source_3'] + 0.2 * df2['ext_source_1']
)
df2['ext_source_max'] = df2[['ext_source_1', 'ext_source_2', 'ext_source_3']].max(axis=1)
df2['amt_application_credit_diff'] = df2['prev_amt_application_mean'] - df2['bur_amt_credit_sum
df2['amt_application_goods_diff'] = df2['prev_amt_application_mean'] - df2['amt_goods_price']


flag_document_cols = [col for col in df2.columns if col.startswith('flag_document_')]
df2['num_flag_document'] = df2[flag_document_cols].sum(axis=1)
df2['credit_to_income_ratio'] = df2['bur_amt_credit_sum_mean'] / (df2['amt_income_total'] + 1e-
df2['annuity_to_income_ratio'] = df2['amt_annuity'] / (df2['amt_income_total'] + 1e-5)
```

```
df2['payment_rate'] = df2['amt_annuity'] / (df2['bur_amt_credit_sum_mean'] + 1e-5)
df2['goods_to_credit_ratio'] = df2['bur_amt_credit_sum_mean'] / (df2['amt_goods_price'] + 1e-5)
df2['credit_efficiency'] = df2['bur_amt_credit_sum_mean'] / (df2['prev_amt_application_mean'] +
df2['employment_life_ratio'] = df2['days_employed'] / (df2['days_birth'])
df2['bureau_request_intensity'] = (
    df2['amt_req_credit_bureau_day'] +
    df2['amt_req_credit_bureau_week'] +
    df2['amt_req_credit_bureau_mon'] +
    df2['amt_req_credit_bureau_qrt']
)

ext_sources = ['ext_source_1', 'ext_source_2', 'ext_source_3']
df2['ext_source_mean'] = df2[ext_sources].mean(axis=1)
df2['ext_source_range'] = df2[ext_sources].max(axis=1) - df2[ext_sources].min(axis=1)
df2['ext_source_std'] = df2[ext_sources].std(axis=1)
df2['ext_source_agreement'] = 1 / (df2['ext_source_std'] + 1e-5)


df2['decision_credit_diff'] = df2['prev_days_decision_mean'] / (df2['bur_amt_credit_sum_mean']
df2['bureau_to_credit_ratio'] = df2['bureau_request_intensity'] / (df2['bur_amt_credit_sum_mear

df2['credit_per_employment_year'] = df2['bur_amt_credit_sum_mean'] / (df2['employment_years'] +
df2['annuity_per_employment_year'] = df2['amt_annuity'] / (df2['employment_years'] + 1e-6)

df2['income_per_employed'] = df2['amt_income_total'] / ((df2['days_employed']+ 1e-5))
df2['income_per_birth'] = df2['amt_income_total'] / (df2['days_birth'])
df2['own_car_age_birth_ratio'] = df2['own_car_age'] / (df2['days_birth'])
df2['own_car_age_employed_ratio'] = df2['own_car_age'] / ((df2['days_employed']+ 1e-5))
df2['days_since_last_employment_until_application'] = df2['days_employed'] - df2['days_birth']

poly_vars = [
    'days_birth',
    'payment_rate',
    'ext_source_mean',
]
X_poly = df2[poly_vars].fillna(0).copy()
poly = PolynomialFeatures(degree=3, include_bias=False)
X_poly_trans = poly.fit_transform(X_poly)
poly_feature_names = poly.get_feature_names_out(poly_vars)
df_poly = pd.DataFrame(X_poly_trans, columns=poly_feature_names, index=df2.index)
df_poly = df_poly.drop(columns=poly_vars, errors='ignore')
df2 = pd.concat([df2, df_poly], axis=1)


df2['employment_stability'] = df2['employment_years'] / (df2['age_years'] + 1e-6)
df2['id_document_age_ratio'] = df2['id_publish_years'] / (df2['age_years'] + 1e-6)
df2['phone_change_frequency'] = 1 / (df2['days_last_phone_change'] + 1e-6)


df2['recent_instability'] = df2['phone_change_rate'] + df2['id_change_rate']
df2['bureau_overdue_ratio'] = df2['bur_amt_credit_max_overdue_max'] / (df2['bur_amt_credit_sum_
df2['credit_risk_signal'] = df2['credit_to_income_ratio'] * ((df2['ext_source_1'] + df2['ext_sc
df2['annuity_per_age'] = df2['amt_annuity'] / (df2['own_car_age'] + 1e-6)
df2["overdue_flag"] = (df2["bur_amt_credit_max_overdue_max"] > 0).astype(int)
df2["entry_vs_due_ratio"] = df2["instf_inst_days_entry_payment_mean_mean"] / (df2["prev_days_fi
df2["ext_source_interaction"] = df2["ext_source_1"] * df2["ext_source_3"]
df2["pos_balance_range"] = df2["posf_pos_months_balance_max_max"] - df2["bur_bb_months_balance_
df2["area_quality"] = df2["totalarea_mode"] / (df2["region_population_relative"] + 1e-6)
```

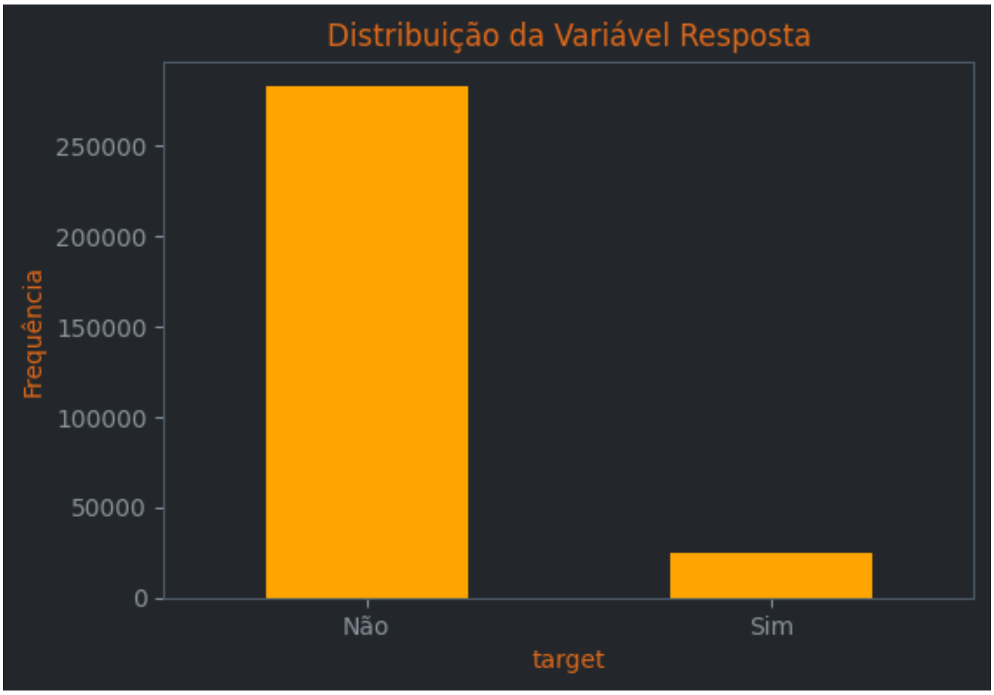
# 7. Exploratory Data Analysis

In [ ]:
```
df3 = df2.copy()
```

## 7.1 Univariate Analysis

### 7.1.1 Target Variable

In [57]:
```
plt.figure(figsize=(6,4))
df3['target'].value_counts().plot(kind='bar', color='orange')
plt.title('Distribuição da Variável Resposta')
plt.xlabel('target')
plt.ylabel('Frequência')
plt.xticks([0,1], ['Não', 'Sim'], rotation=0)
plt.show()
```

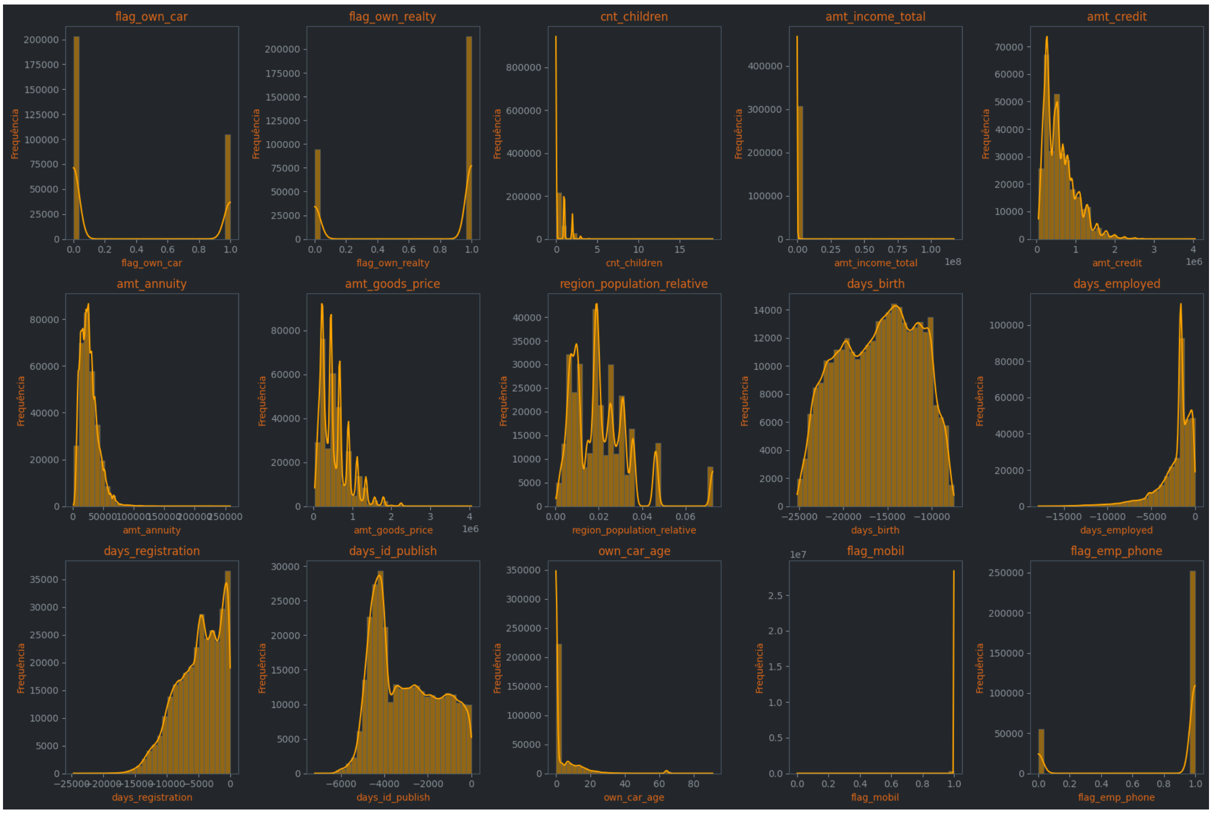



### 7.1.2 Numerical Variables

In [ ]:
```
df_numeric = df3.select_dtypes(include=['number']).drop(columns=['target'])

df_numeric_1 = df_numeric.iloc[:, 0:15]    # colunas 0 a 14  (15 colunas)
df_numeric_2 = df_numeric.iloc[:, 15:30]   # colunas 15 a 29 (15 colunas)
df_numeric_3 = df_numeric.iloc[:, 30:45]   # colunas 30 a 44 (15 colunas)
df_numeric_4 = df_numeric.iloc[:, 45:60]   # colunas 45 a 59 (15 colunas)
df_numeric_5 = df_numeric.iloc[:, 60:75]   # colunas 60 a 74 (15 colunas)
```

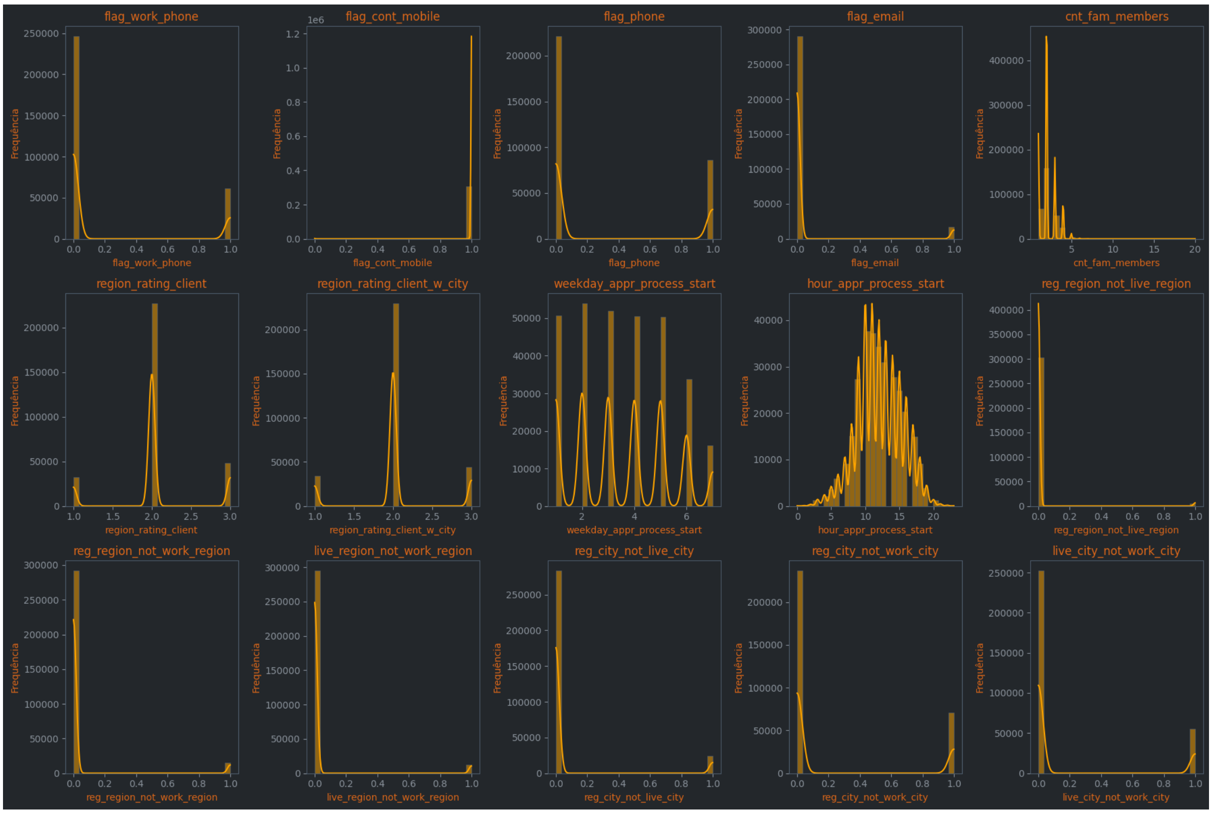
Block 1 - (1 a 15)

In [59]:
```
plot_numeric_block(df_numeric_1)
```



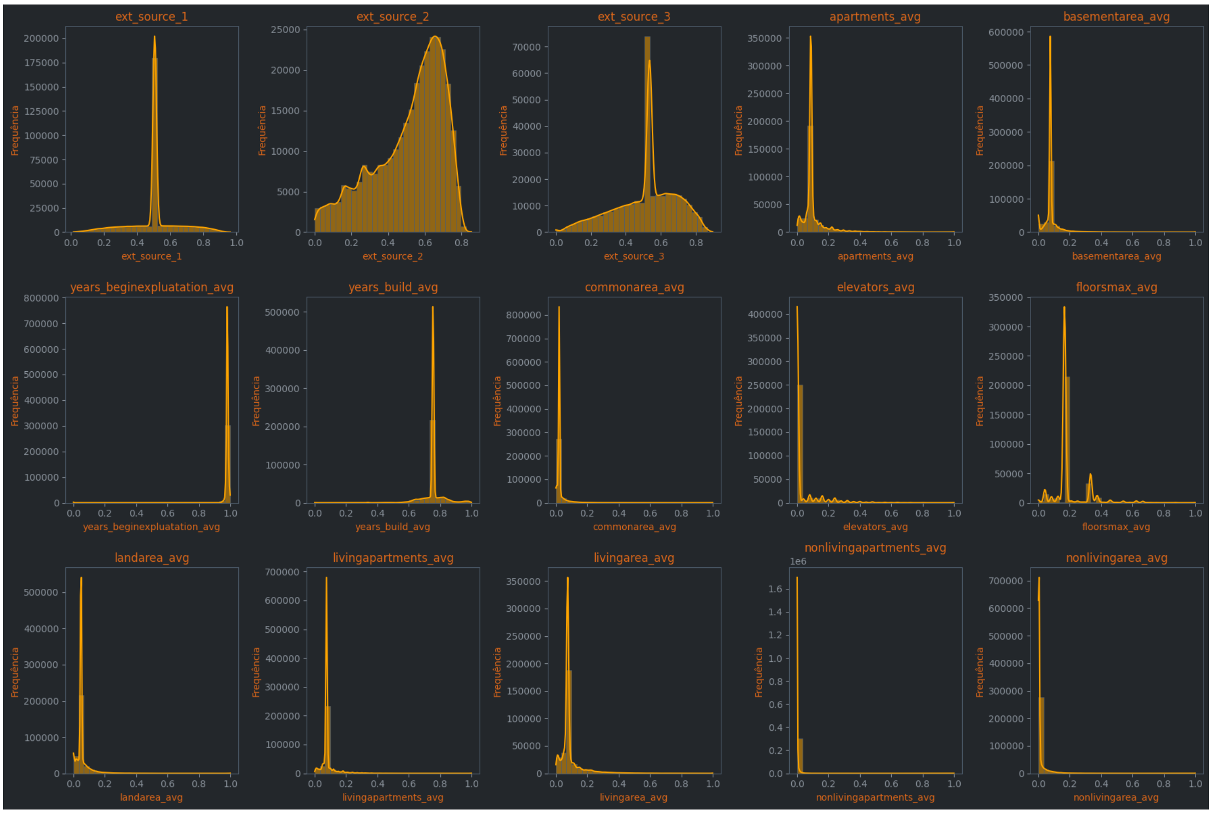
Block 2 - (16 a 30)

```
In [60]: plot_numeric_block(df_numeric_2)
```



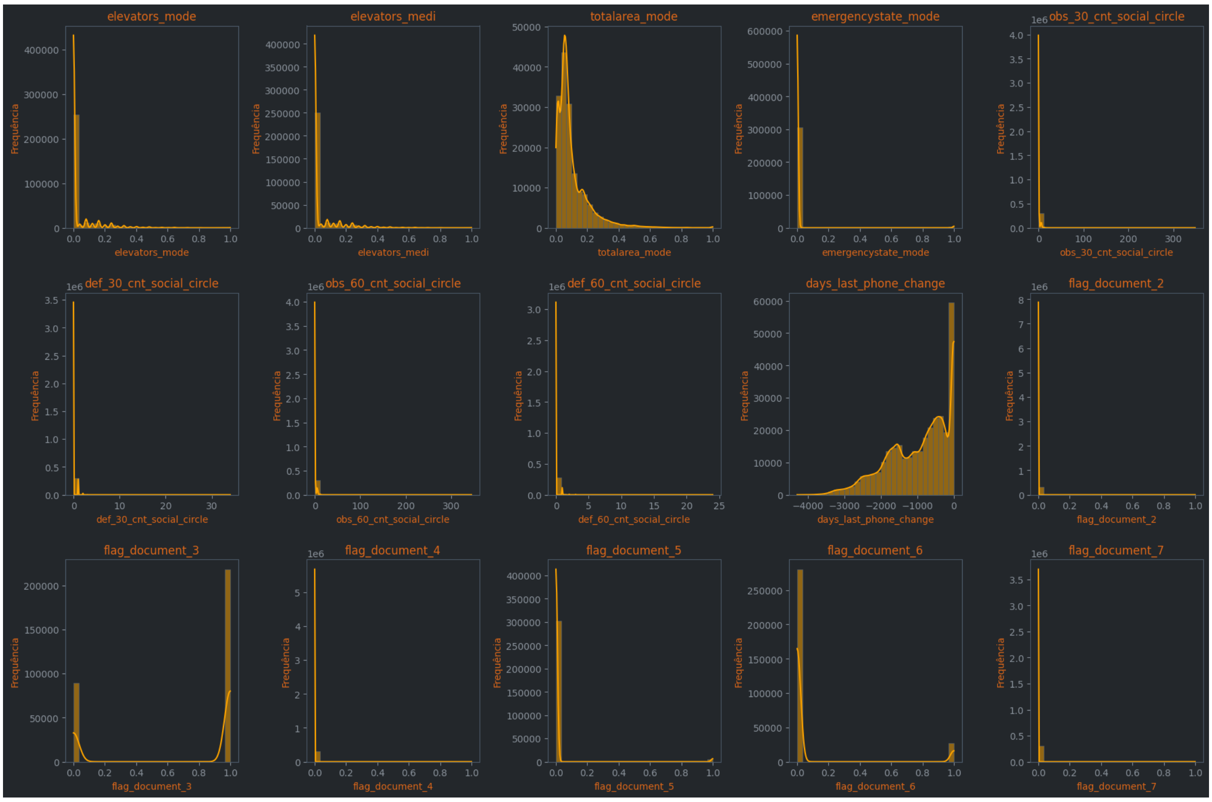
Block 3 - (31 a 45)

```
In [61]: plot_numeric_block(df_numeric_3)
```



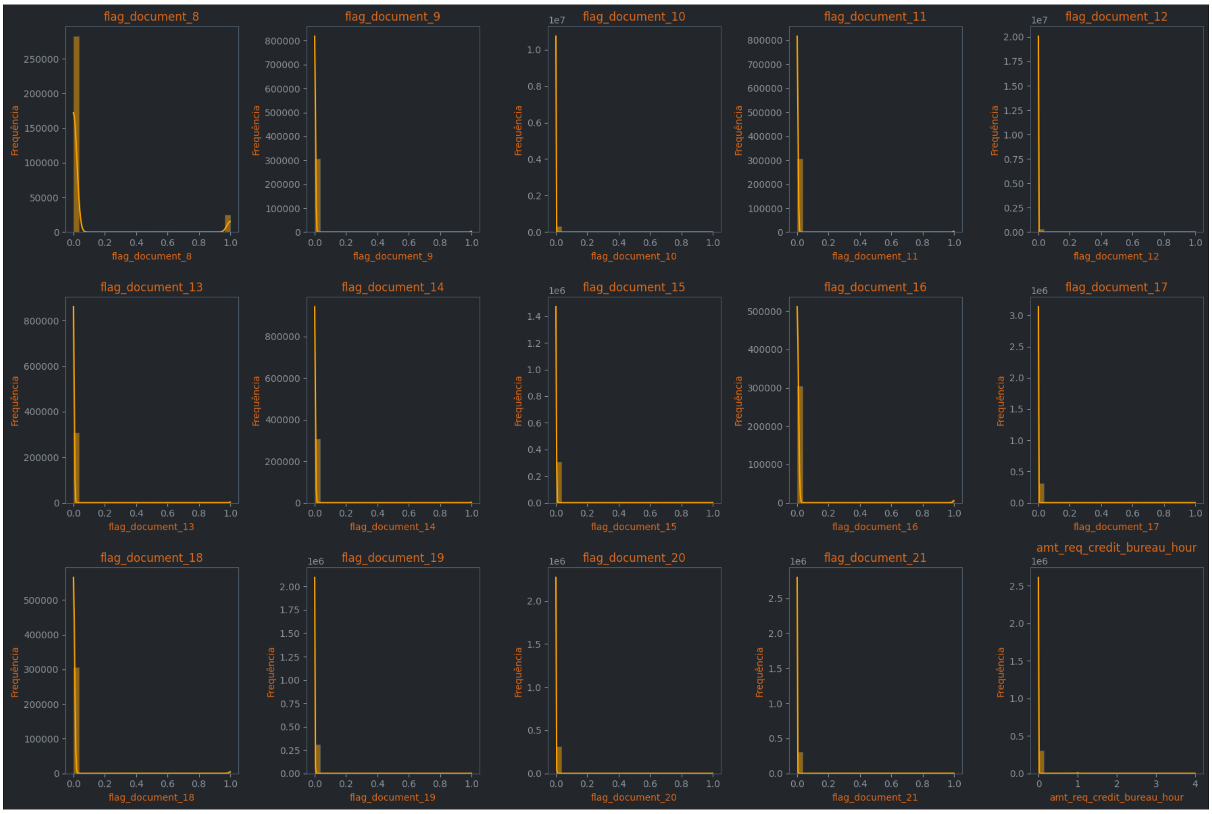

Block 4 - (46 a 60)

In [62]:
```
plot_numeric_block(df_numeric_4)
```




Block 5 - (61 a 75)

In [63]:
```
plot_numeric_block(df_numeric_5)
```




### 7.1.3 Categorical Variables

In [66]:
```
df_categorical = df3.select_dtypes(include=['object', 'category'])

cat_cols = df_categorical.columns.tolist()

df_categorical_1 = df_categorical[cat_cols[:4]]
df_categorical_2 = df_categorical[cat_cols[4:8]]
df_categorical_3 = df_categorical[cat_cols[8:13]]
```

Block 1 - (1 a 4)

In [67]:
```
fig, axs = plt.subplots(2, 2, figsize=(16, 12))

categorical_columns = df_categorical_1.columns.tolist()
colors_list = [
    ['royalblue', 'orange', 'seagreen', 'crimson'],
    ['red', 'mediumseagreen', 'steelblue', 'gold'],
    ['firebrick', 'rebeccapurple', 'teal', 'magenta'],
    ['slateblue', 'orange', 'forestgreen', 'orchid']
]

for idx, col in enumerate(categorical_columns):
    row = idx // 2
    col_pos = idx % 2


    count_vals = df_categorical_1[col].value_counts()
    ordered_categories = count_vals.index.tolist()


    sns.countplot(
        x=col,
        data=df_categorical_1,
        ax=axs[row, col_pos],
        order=ordered_categories,
        color=None
    )
    colors = colors_list[idx] if idx < len(colors_list) else None
    for i, bar in enumerate(axs[row, col_pos].patches):
```

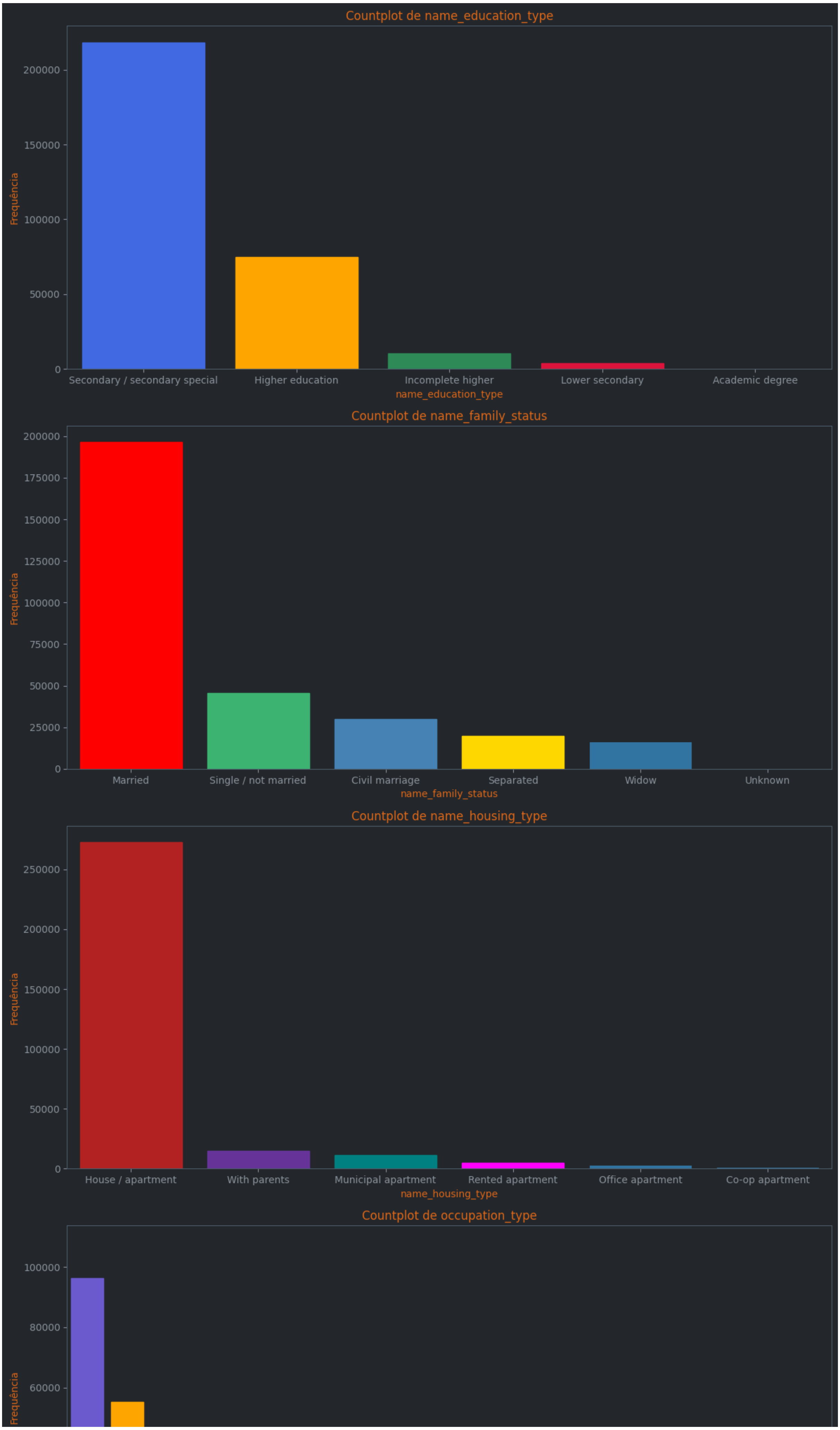
```python
        if colors and i < len(colors):
            bar.set_color(colors[i])

    axs[row, col_pos].set_title(f'Countplot de {col}')
    axs[row, col_pos].set_xlabel(col)
    axs[row, col_pos].set_ylabel('Frequência')

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

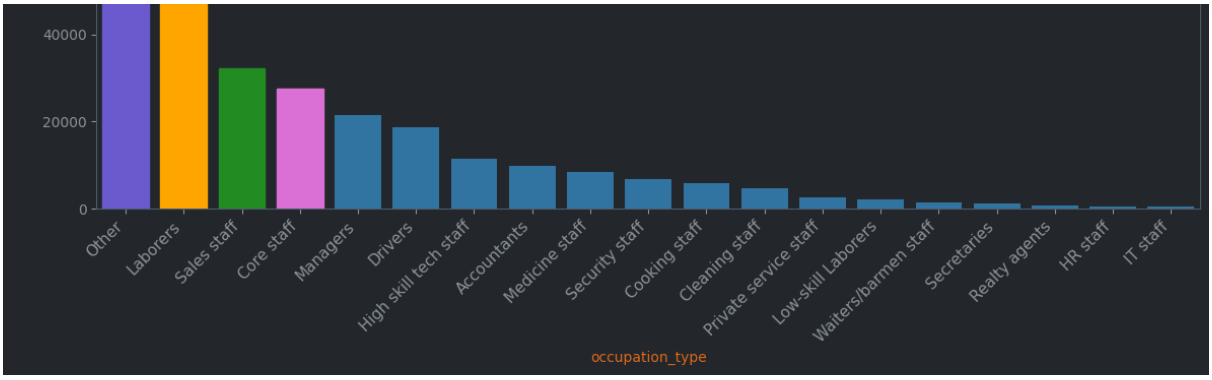

Block 2 - (5 a 8)

In [68]:
```python
categorical_columns = df_categorical_2.columns.tolist()

fig, axs = plt.subplots(len(categorical_columns), 1, figsize=(12, 24))
colors_list = [
    ['royalblue', 'orange', 'seagreen', 'crimson'],
    ['red', 'mediumseagreen', 'steelblue', 'gold'],
    ['firebrick', 'rebeccapurple', 'teal', 'magenta'],
    ['slateblue', 'orange', 'forestgreen', 'orchid'],
]

if len(categorical_columns) == 1:
    axs = [axs]

for idx, col in enumerate(categorical_columns):
    ax = axs[idx]

    freq_order = df_categorical_2[col].value_counts().index.tolist()

    sns.countplot(
        x=col,
        data=df_categorical_2,
        ax=ax,
        order=freq_order,
        color=None
    )
```

```python
    colors = colors_list[idx] if idx < len(colors_list) else None
    for i, bar in enumerate(ax.patches):
        if colors and i < len(colors):
            bar.set_color(colors[i])

    ax.set_title(f'Countplot de {col}')
    ax.set_xlabel(col)
    ax.set_ylabel('Frequência')


    if col.upper() == "OCCUPATION_TYPE":
        ax.set_xticklabels(ax.get_xticklabels(), rotation=45, ha='right', fontsize=11)
        ax.margins(y=0.18)

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

```
C:\Users\Patryck\AppData\Local\Temp\ipykernel_12620\382229923.py:37: UserWarning: set_ticklabel
s() should only be used with a fixed number of ticks, i.e. after set_ticks() or using a FixedLo
cator.
  ax.set_xticklabels(ax.get_xticklabels(), rotation=45, ha='right', fontsize=11)
```

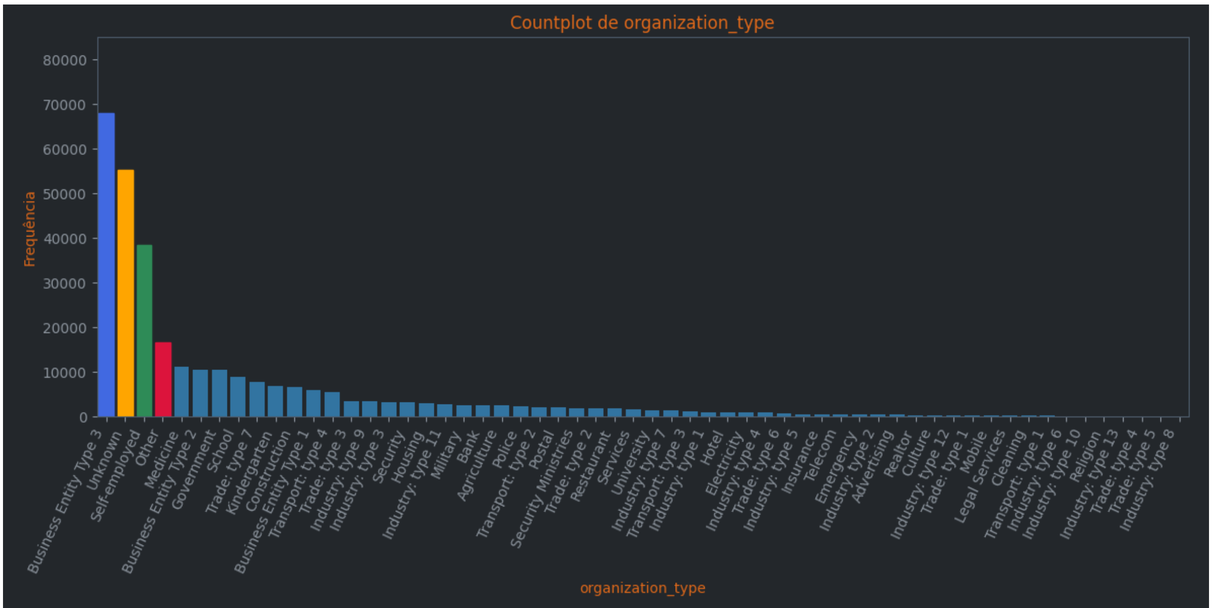

Countplot de name_education_type
Frequência
200000
150000
100000
50000
0
Secondary / secondary special
Higher education
Incomplete higher
Lower secondary
Academic degree
name_education_type
Countplot de name_family_status
Frequência
200000
175000
150000
125000
100000
75000
50000
25000
0
Married
Single / not married
Civil marriage
Separated
Widow
Unknown
name_family_status
Countplot de name_housing_type
Frequência
250000
200000
150000
100000
50000
0
House / apartment
With parents
Municipal apartment
Rented apartment
Office apartment
Co-op apartment
name_housing_type
Countplot de occupation_type
Frequência
100000
80000
60000



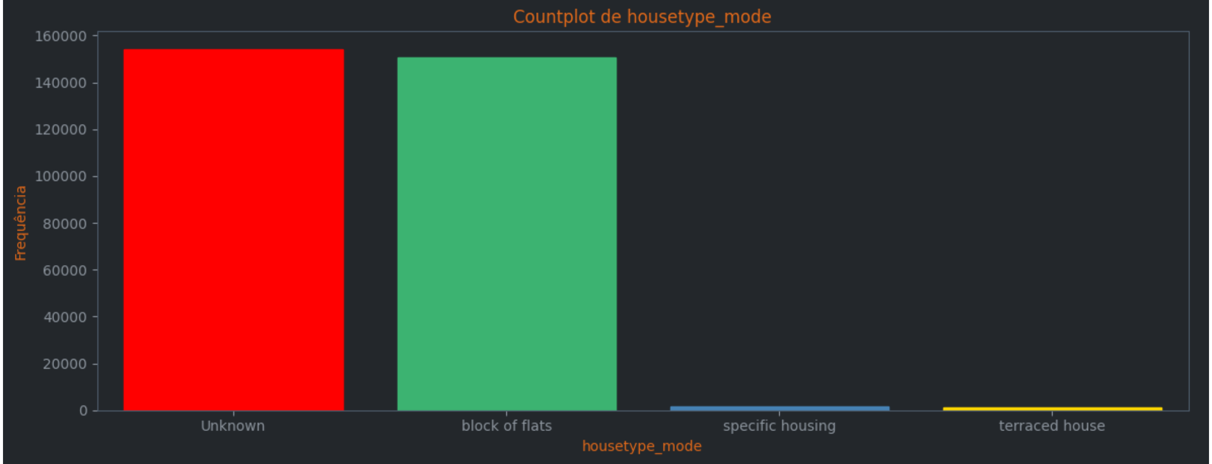

Block 3 - (8 a 13)

In [69]:
```python
categorical_columns = df_categorical_3.columns.tolist()

fig, axs = plt.subplots(5, 1, figsize=(12, 28))

colors_list = [
    ['royalblue', 'orange', 'seagreen', 'crimson'],
    ['red', 'mediumseagreen', 'steelblue', 'gold'],
    ['firebrick', 'rebeccapurple', 'teal', 'magenta'],
    ['slateblue', 'orange', 'forestgreen', 'orchid'],
    ['goldenrod', 'orchid', 'dodgerblue', 'firebrick'],
]

for idx, col in enumerate(categorical_columns):
    ax = axs[idx]

    order = df_categorical_3[col].value_counts().index.tolist()

    sns.countplot(
        x=col,
        data=df_categorical_3,
        ax=ax,
        order=order,
        color=None
    )
    colors = colors_list[idx] if idx < len(colors_list) else None
    for i, bar in enumerate(ax.patches):
        if colors and i < len(colors):
            bar.set_color(colors[i])

    ax.set_title(f'Countplot de {col}')
    ax.set_xlabel(col)
    ax.set_ylabel('Frequência')

    if col.upper() == "ORGANIZATION_TYPE":
        ax.set_xticklabels(
            ax.get_xticklabels(),
            rotation=65,
            ha='right',
            fontsize=10
        )
        ax.margins(y=0.25)
        plt.subplots_adjust(bottom=0.38, top=0.96)

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

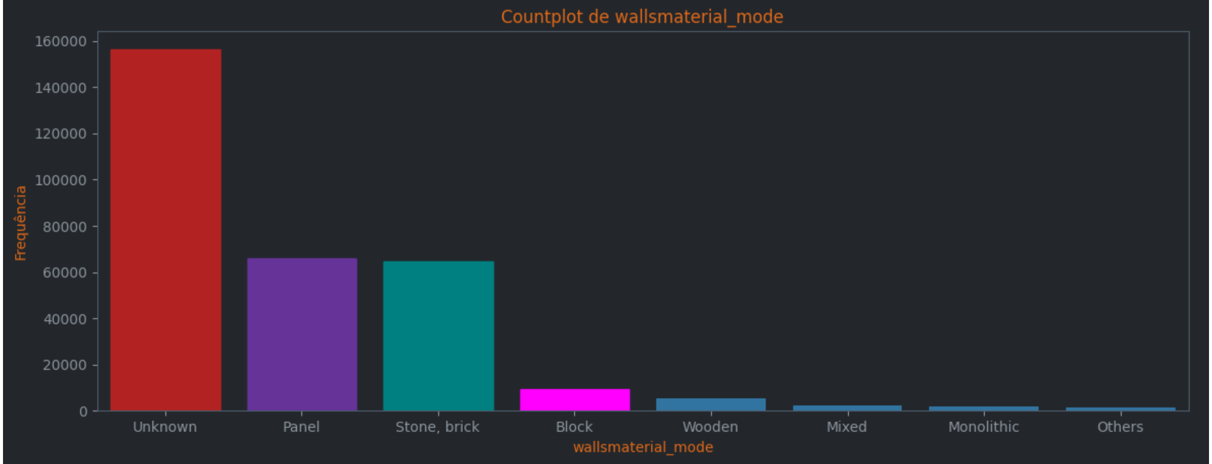
```
C:\Users\Patryck\AppData\Local\Temp\ipykernel_12620\372829898.py:35: UserWarning: set_ticklabel
s() should only be used with a fixed number of ticks, i.e. after set_ticks() or using a FixedLo
cator.
  ax.set_xticklabels(
```



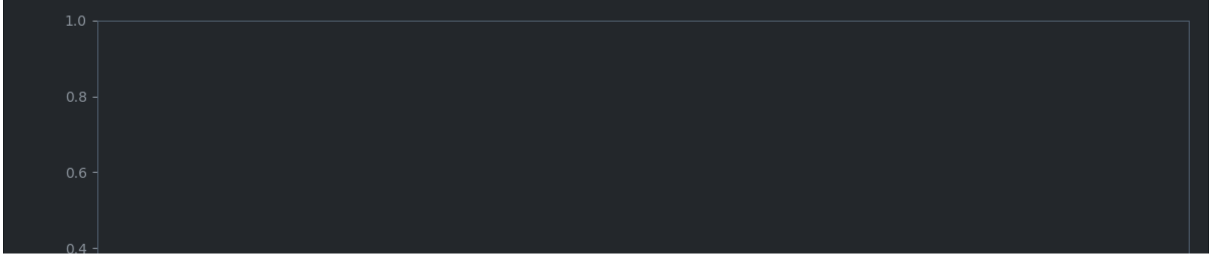
Countplot de organization_type
Frequência
80000
70000
60000
50000
40000
30000
20000
10000
0
Business Entity Type 3
Unknown
Self-employed
Other
Medicine
Business Entity Type 2
Government
School
Trade: type 7
Kindergarten
Construction
Business Entity Type 1
Transport: type 4
Trade: type 3
Industry: type 9
Industry: type 3
Security
Housing
Industry: type 11
Military
Bank
Agriculture
Police
Transport: type 2
Postal
Security Ministries
Trade: type 2
Restaurant
Services
University
Industry: type 7
Transport: type 3
Industry: type 1
Hotel
Electricity
Industry: type 4
Trade: type 6
Industry: type 5
Insurance
Telecom
Emergency
Industry: type 2
Advertising
Realtor
Culture
Industry: type 12
Trade: type 1
Mobile
Legal Services
Cleaning
Transport: type 1
Industry: type 6
Industry: type 10
Religion
Industry: type 13
Trade: type 4
Trade: type 5
Industry: type 8
organization_type

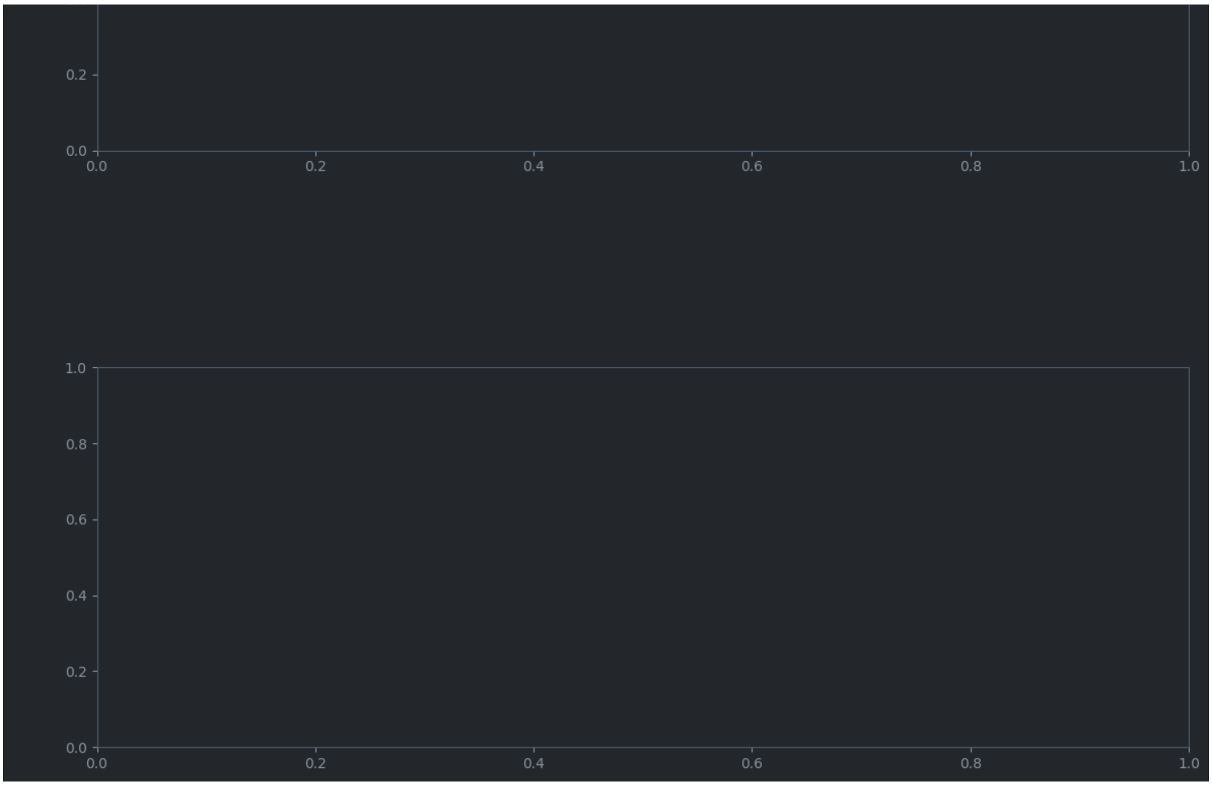
Countplot de housetype_mode
Frequência
160000
140000
120000
100000
80000
60000
40000
20000
0
Unknown
block of flats
specific housing
terraced house
housetype_mode

Countplot de wallsmaterial_mode
Frequência
160000
140000
120000
100000
80000
60000
40000
20000
0
Unknown
Panel
Stone, brick
Block
Wooden
Mixed
Monolithic
Others
wallsmaterial_mode

1.0
0.8
0.6
0.4

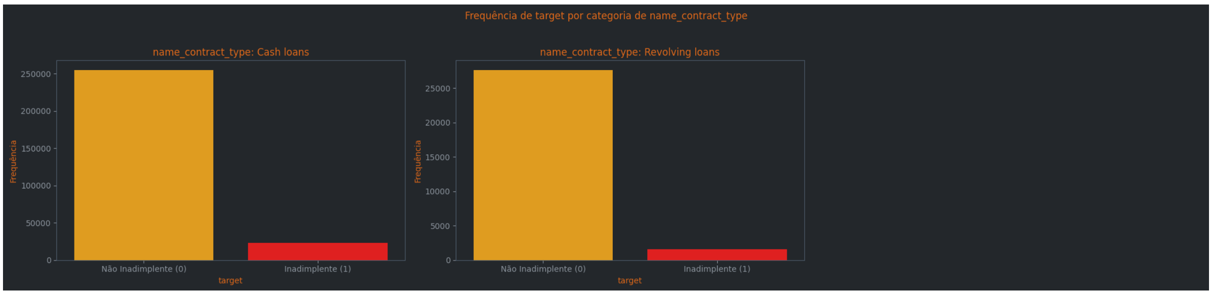



## 7.2 Bivariate Analysis

### Block 1 Hypotesis

H1 — Contract type influences the probability of default. FALSE

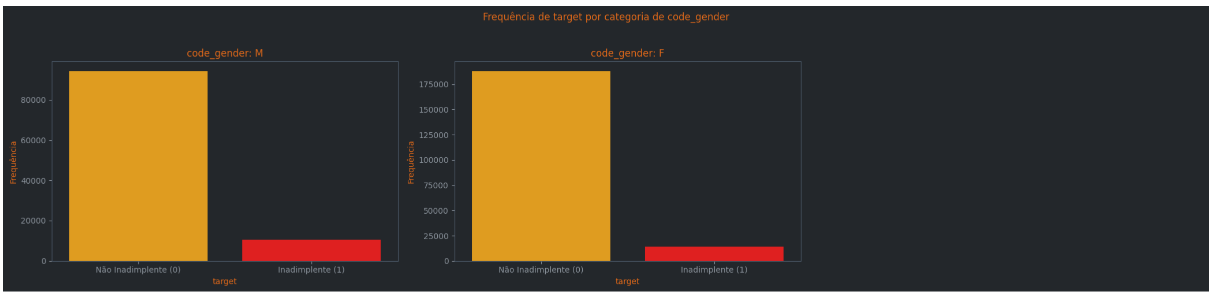
In [70]:
```
plot_target_by_categorical(df3, cat_col='name_contract_type', target_col='target')
calcular_cramers_v(df3, 'name_contract_type', 'target')
```




```
V de Cramer entre name_contract_type e target: 0.0309
```

H2 — Gender is associated with default risk. FALSE

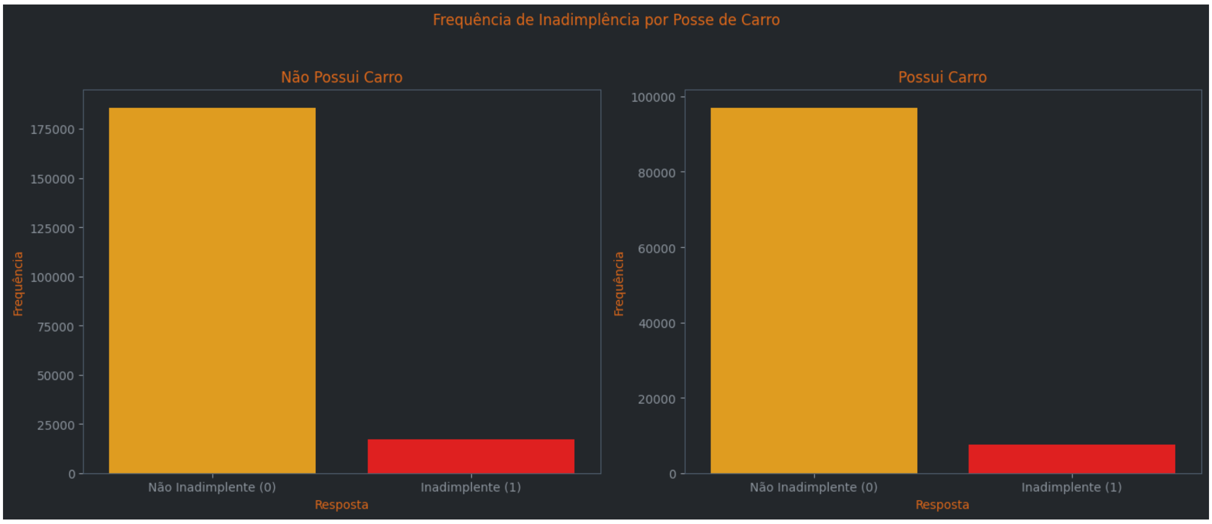
In [71]:
```
plot_target_by_categorical(df3, cat_col='code_gender', target_col='target')

calcular_cramers_v(df3, 'code_gender', 'target')
```




```
V de Cramer entre code_gender e target: 0.0547
```

H3 — Customers who own a car have a lower probability of default. FALSE

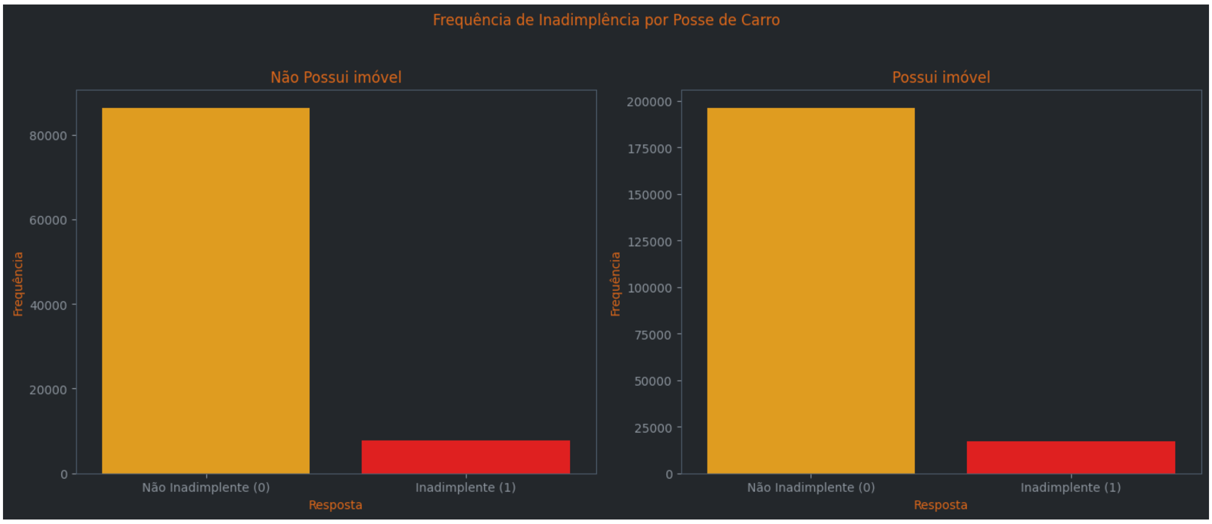
In [72]:
```python
plot_binaria_target(
    df3,
    var_binaria='flag_own_car',
    label_0='Não Possui Carro',
    label_1='Possui Carro',
    suptitle='Frequência de Inadimplência por Posse de Carro'
)

calcular_cramers_v(df3, 'flag_own_car', 'target')
```




```
V de Cramer entre flag_own_car e target: 0.0218
```

H4 — Owning a home reduces the chance of default. FALSE

In [73]:
```python
plot_binaria_target(
    df3,
    var_binaria='flag_own_realty',
    label_0='Não Possui imóvel',
    label_1='Possui imóvel',
    suptitle='Frequência de Inadimplência por Posse de Carro'
)

calcular_cramers_v(df3, 'flag_own_realty', 'target')
```

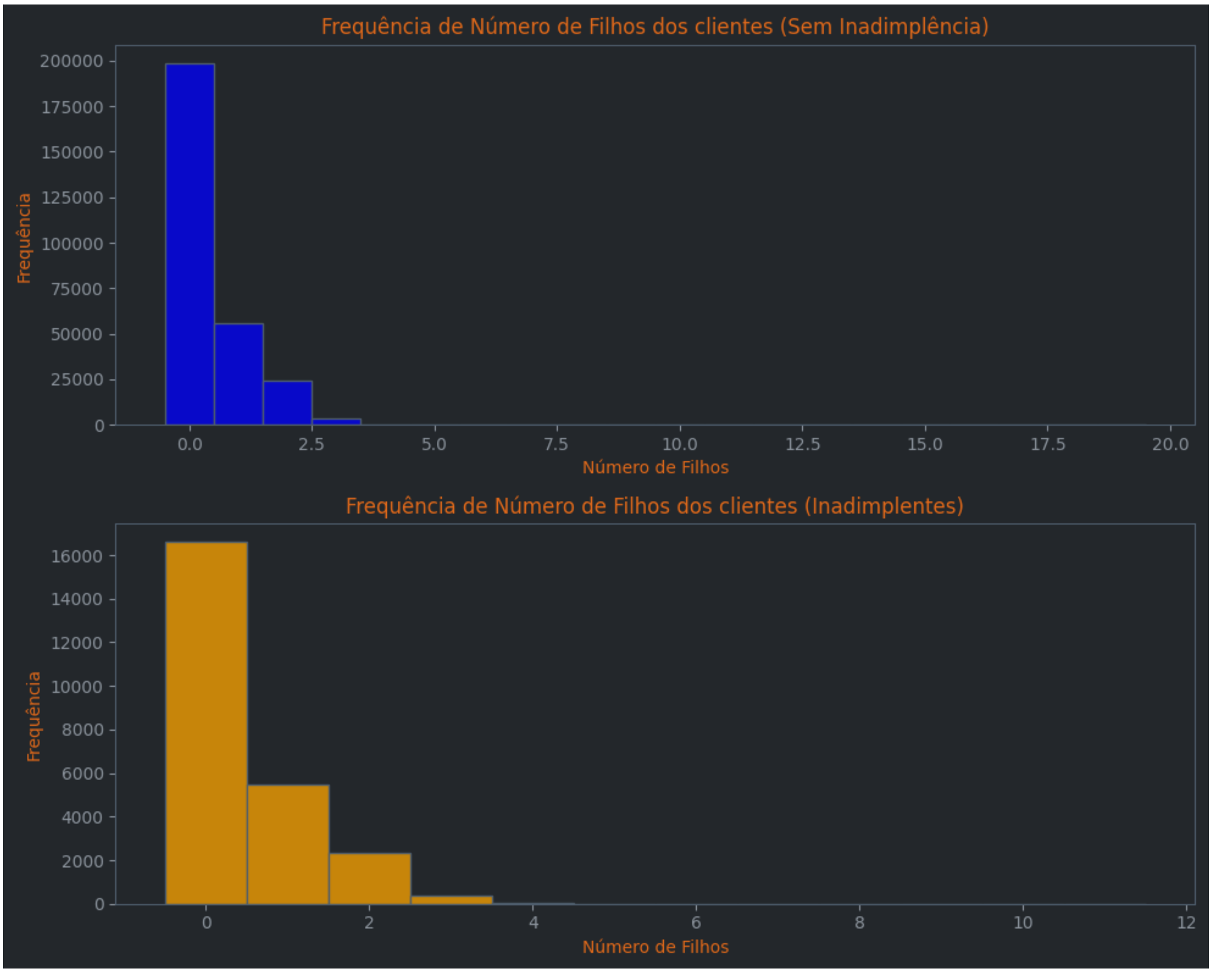



```
V de Cramer entre flag_own_realty e target: 0.0061
```

H5 — The number of children influences default risk. FALSE

In [74]:
```python
plot_num_var_by_target(
    df3,
    num_var='cnt_children',
    title_0='Frequência de Número de Filhos dos clientes (Sem Inadimplência)',
    title_1='Frequência de Número de Filhos dos clientes (Inadimplentes)',
    label_x='Número de Filhos',
```

```
    discrete=True
)

pearson_corr = df3['cnt_children'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre cnt_children e target: {pearson_corr:.4f}")
```



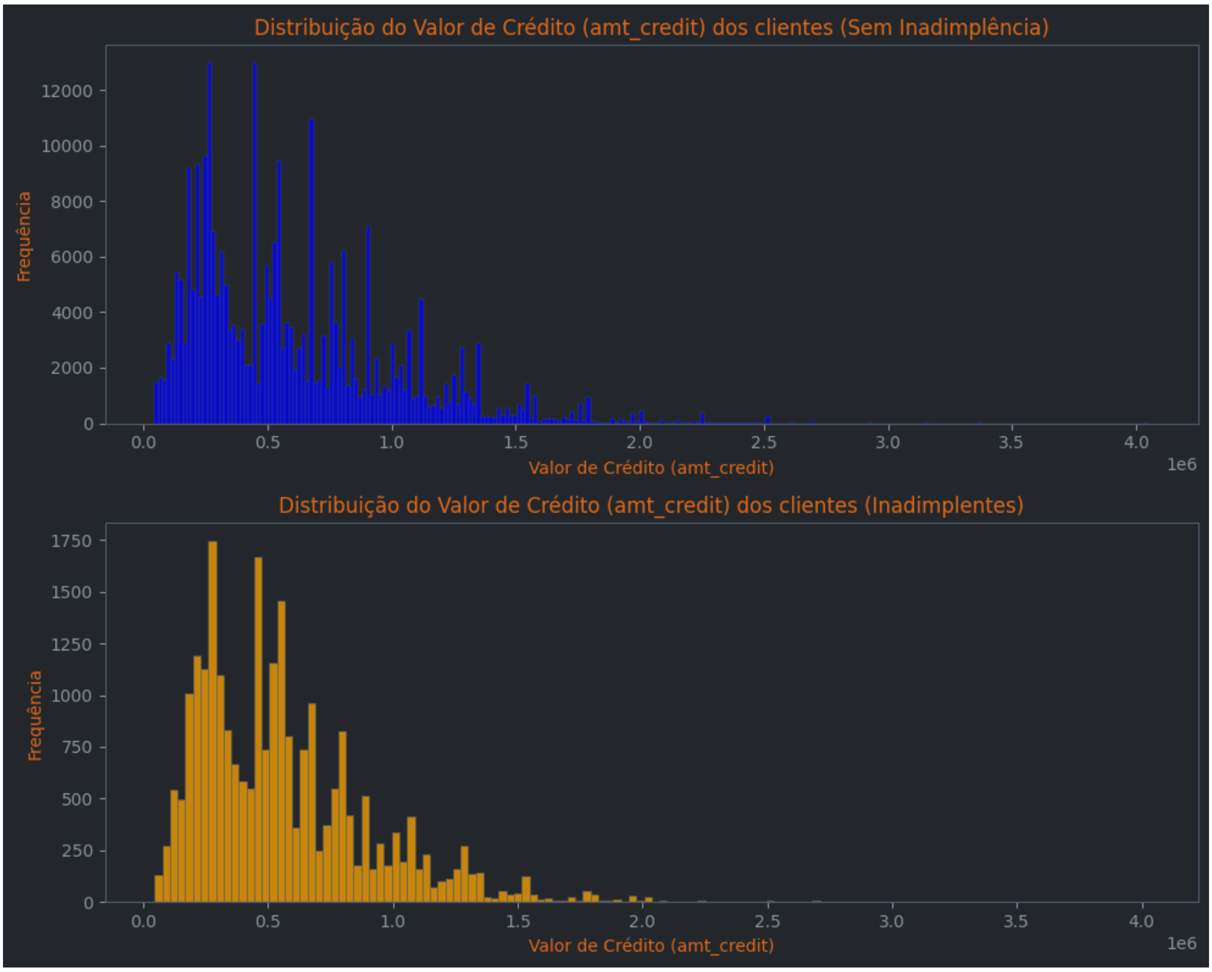

```
Correlação de Pearson entre cnt_children e target: 0.0192
```

H6 — Higher total income is associated with lower default risk. TRUE

```
In [ ]: plot_num_var_by_target(
    df3,
    num_var='amt_income_total',
    title_0='Distribuição da Renda Total (amt_income_total) dos clientes (Sem Inadimplência)',
    title_1='Distribuição da Renda Total (amt_income_total) dos clientes (Inadimplentes)',
    label_x='Renda Total',
    discrete=True
)

pearson_corr = df3['amt_income_total'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre amt_income_total e target: {pearson_corr:.4f}")
```

H7 — Higher credit amounts are related to higher default risk. FALSE

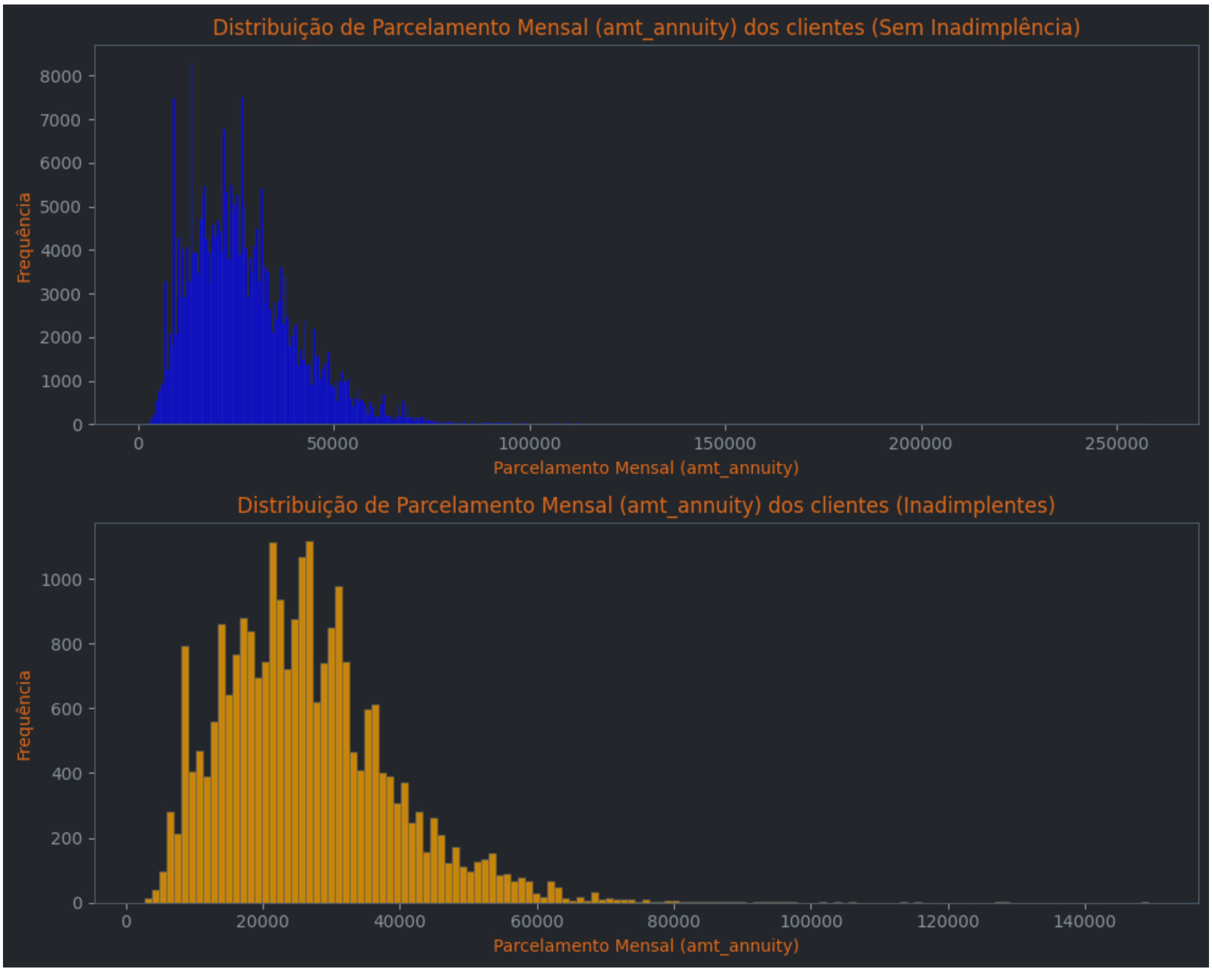
```
In [ ]: plot_num_var_by_target(
    df3,
    num_var='amt_credit',
    title_0='Distribuição do Valor de Crédito (amt_credit) dos clientes (Sem Inadimplência)',
    title_1='Distribuição do Valor de Crédito (amt_credit) dos clientes (Inadimplentes)',
    label_x='Valor de Crédito',
    discrete=True
)

pearson_corr = df3['amt_credit'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre amt_credit e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre amt_credit e target: -0.0304
```

H8 — Higher monthly installments increase the chance of default. FALSE

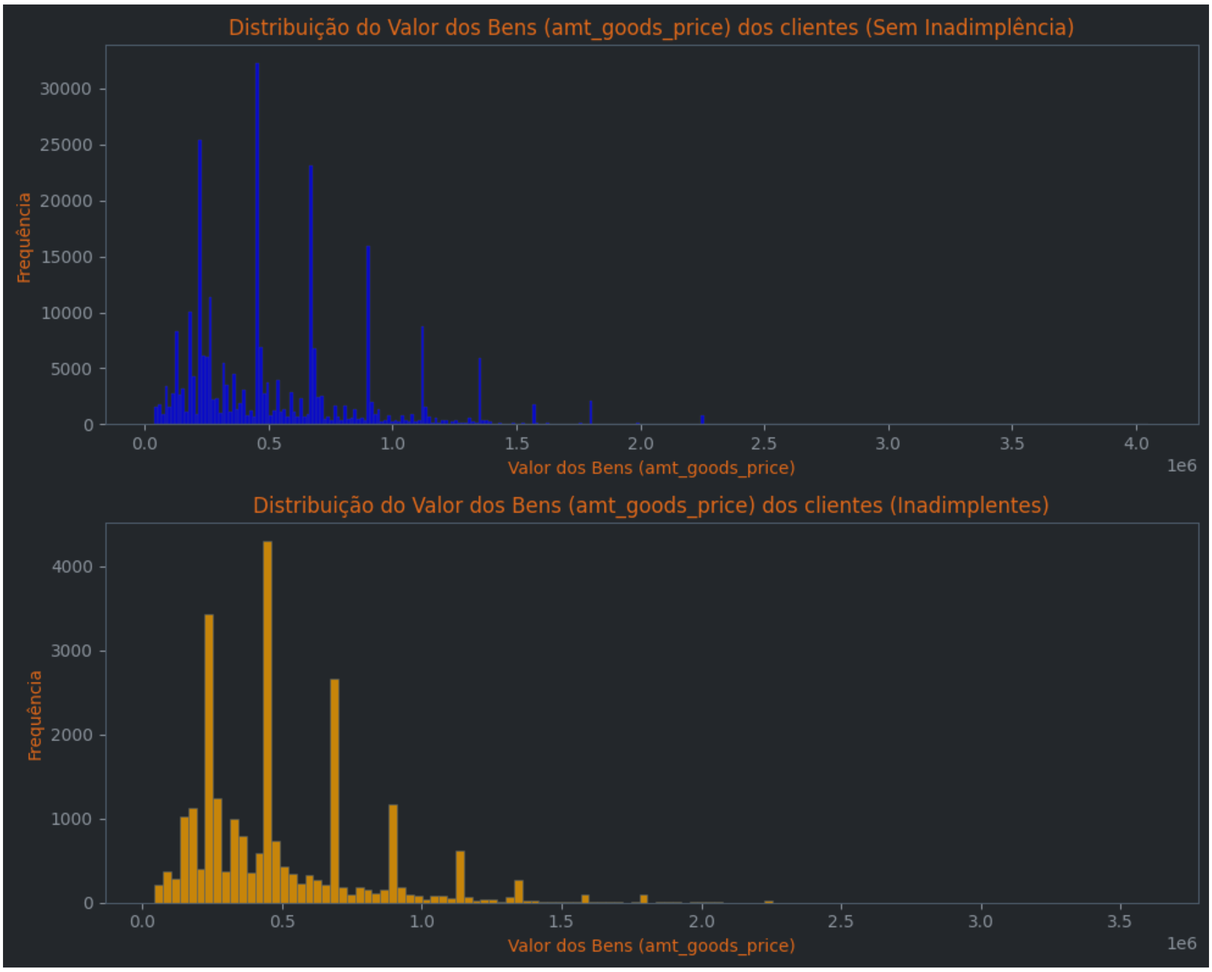
In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='amt_annuity',
    title_0='Distribuição de Parcelamento Mensal (amt_annuity) dos clientes (Sem Inadimplência)
    title_1='Distribuição de Parcelamento Mensal (amt_annuity) dos clientes (Inadimplentes)',
    label_x='Parcelamento Mensal',
    discrete=True
)
pearson_corr = df3['amt_annuity'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre amt_annuity e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre amt_annuity e target: -0.0128
```

H9 — The value of goods purchased influences default risk. FALSE

In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='amt_goods_price',
    title_0='Distribuição do Valor dos Bens (amt_goods_price) dos clientes (Sem Inadimplência)'
    title_1='Distribuição do Valor dos Bens (amt_goods_price) dos clientes (Inadimplentes)',
    label_x='Valor dos Bens',
    discrete=True
)

pearson_corr = df3['amt_goods_price'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre amt_goods_price e target: {pearson_corr:.4f}")
```

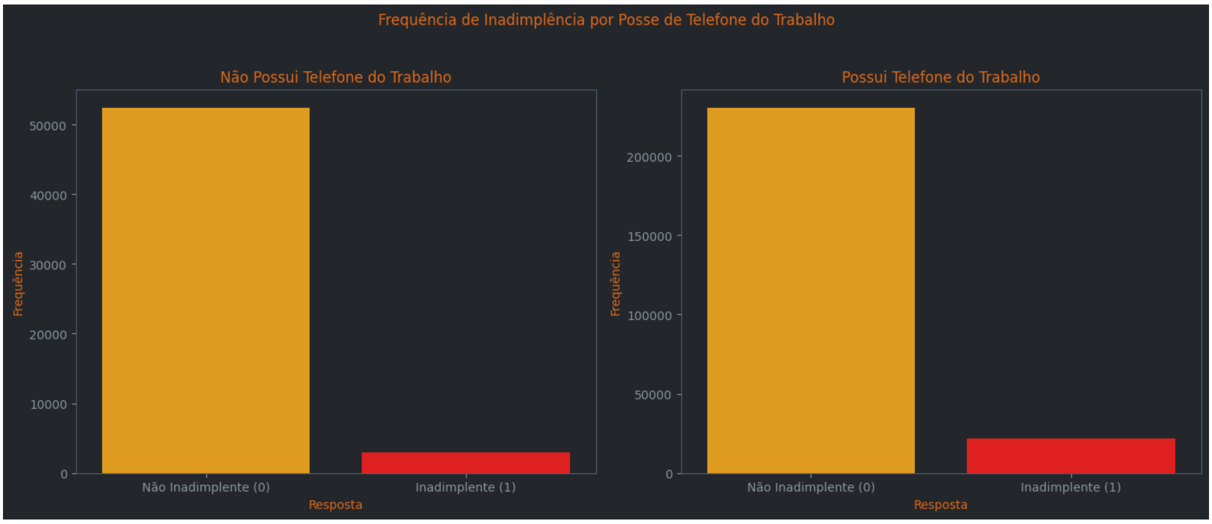



```
Correlação de Pearson entre amt_goods_price e target: -0.0396
```

## Block 2 Hypotesis

H21 — Having a work phone registered reduces the risk of default. TRUE

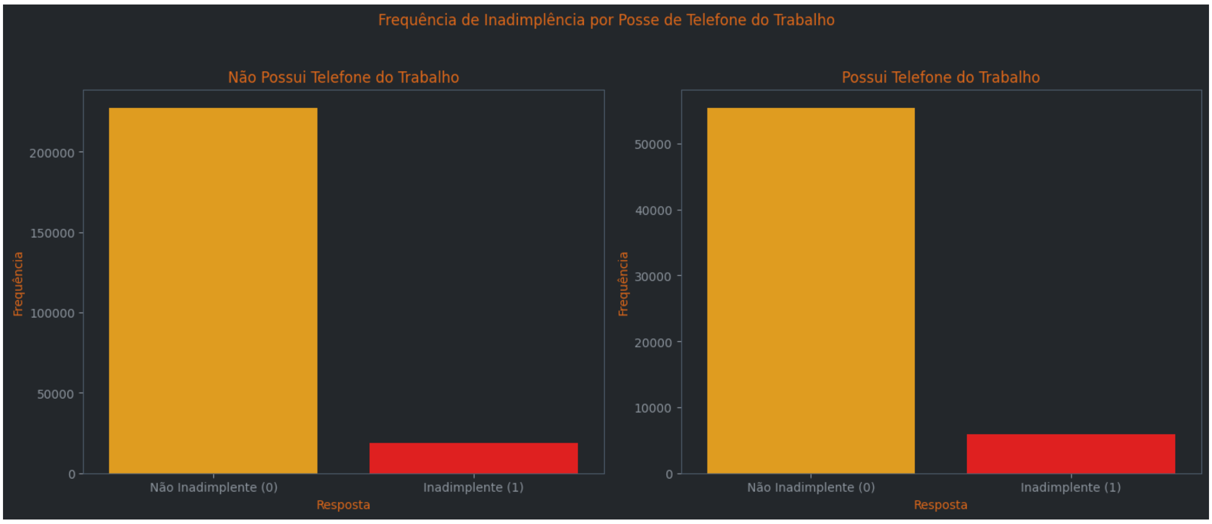
In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='flag_emp_phone',
    label_0='Não Possui Telefone do Trabalho',
    label_1='Possui Telefone do Trabalho',
    suptitle='Frequência de Inadimplência por Posse de Telefone do Trabalho'
)

calcular_cramers_v(df3, 'flag_emp_phone', 'target')
```




```
V de Cramer entre flag_emp_phone e target: 0.0460
```

H22 — Customers with a work phone provided are less likely to default. TRUE

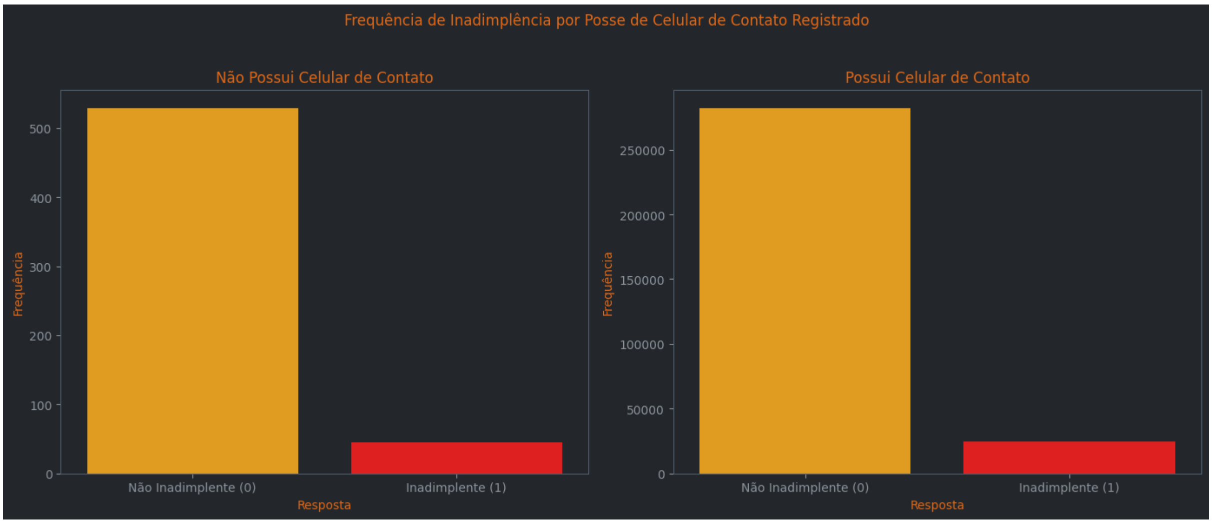
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_work_phone',
            label_0='Não Possui Telefone do Trabalho',
            label_1='Possui Telefone do Trabalho',
            suptitle='Frequência de Inadimplência por Posse de Telefone do Trabalho'
        )

        calcular_cramers_v(df3, 'flag_work_phone', 'target')
```




```
V de Cramer entre flag_work_phone e target: 0.0285
```

H23 — Having a registered mobile phone is associated with lower default risk. FALSE

```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_cont_mobile',
            label_0='Não Possui Celular de Contato',
            label_1='Possui Celular de Contato',
            suptitle='Frequência de Inadimplência por Posse de Celular de Contato Registrado'
        )

        calcular_cramers_v(df3, 'flag_cont_mobile', 'target')
```

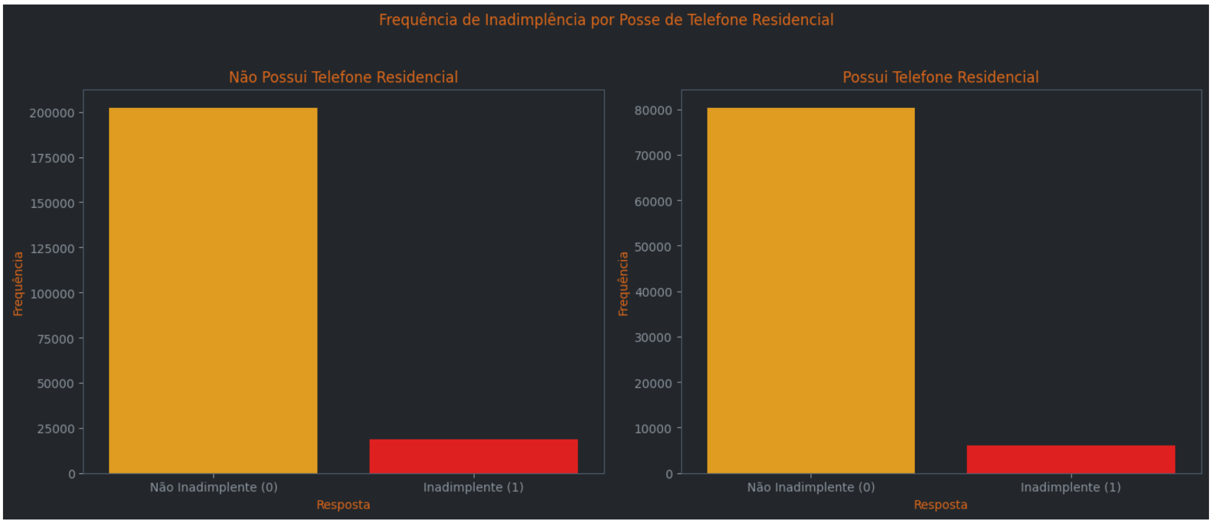



```
V de Cramer entre flag_cont_mobile e target: 0.0002
```

H24 — Having a landline phone registered reduces default risk. TRUE

```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_phone',
            label_0='Não Possui Telefone Residencial',
```

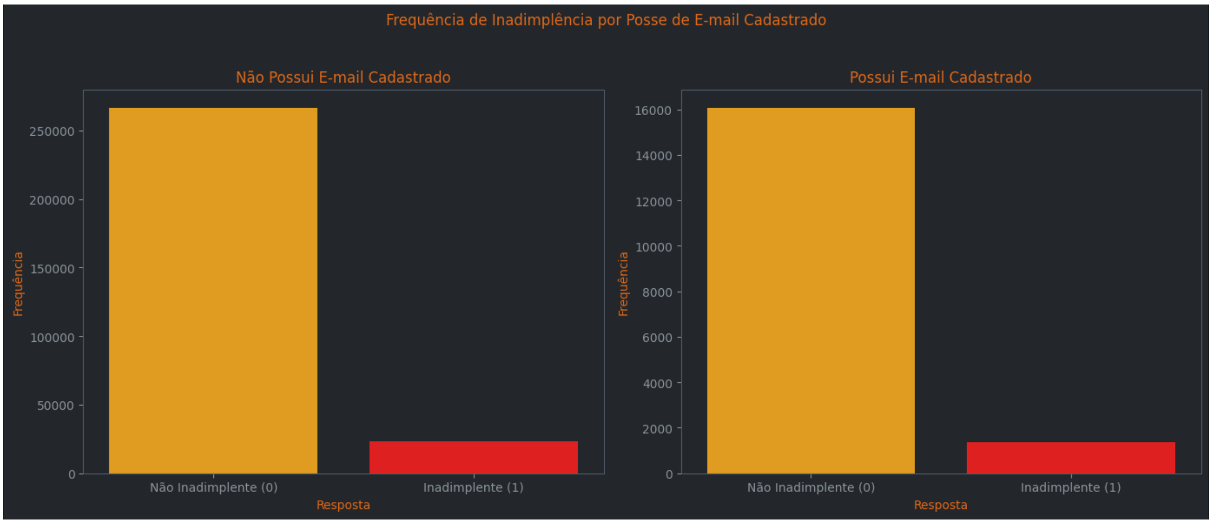
```
    label_1='Possui Telefone Residencial',
    suptitle='Frequência de Inadimplência por Posse de Telefone Residencial'
)


calcular_cramers_v(df3, 'flag_phone', 'target')
```




```
V de Cramer entre flag_phone e target: 0.0238
```

H25 — Customers with a registered email tend to present lower default risk. FALSE

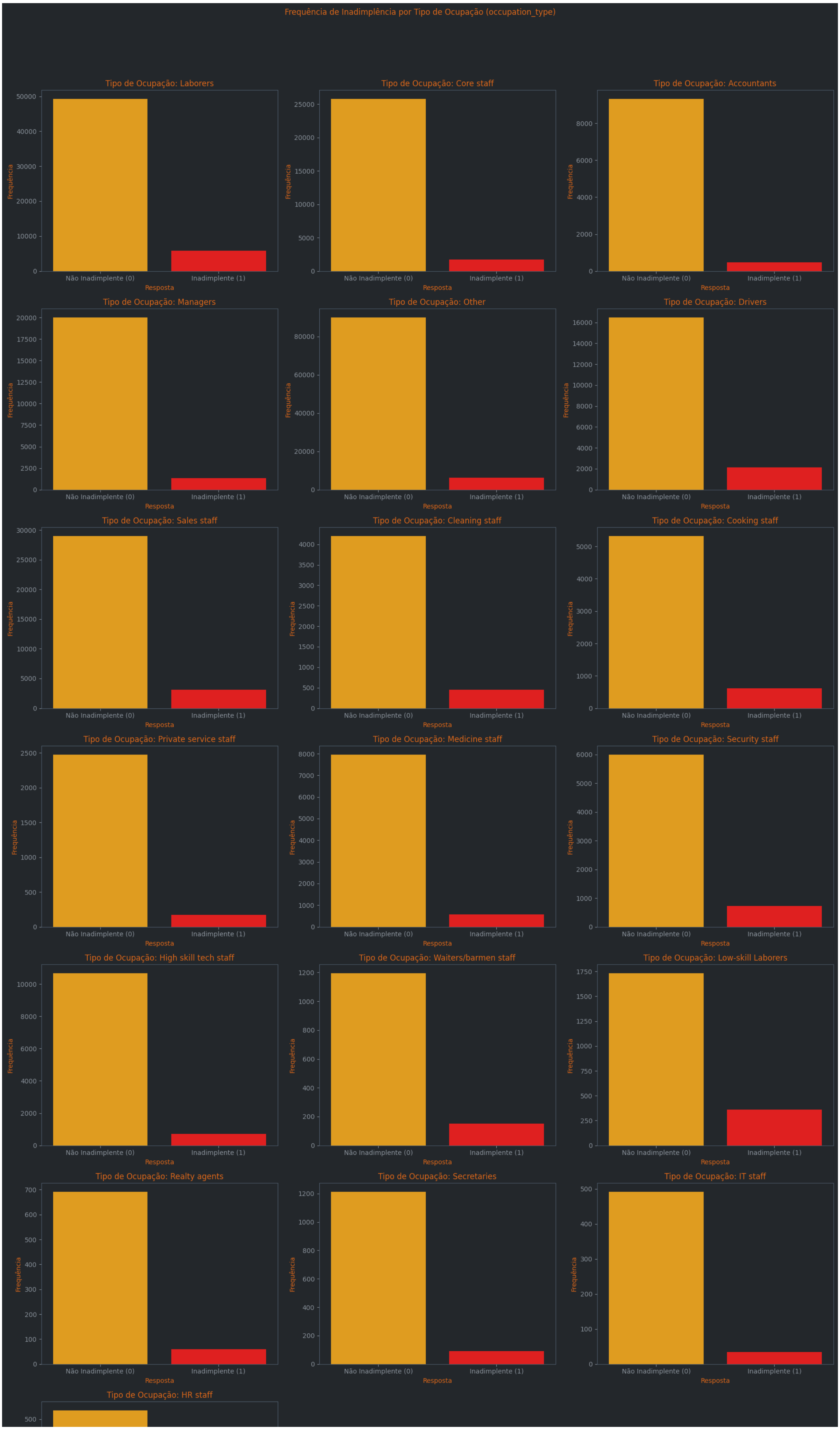
In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='flag_email',
    label_0='Não Possui E-mail Cadastrado',
    label_1='Possui E-mail Cadastrado',
    suptitle='Frequência de Inadimplência por Posse de E-mail Cadastrado'
)


calcular_cramers_v(df3, 'flag_email', 'target')
```




```
V de Cramer entre flag_email e target: 0.0017
```

H26 — Occupation type influences default risk. TRUE

In [ ]:
```
plot_target_by_categorical(df3, cat_col='occupation_type', target_col='target')
calcular_cramers_v(df3, 'occupation_type', 'target')
```


Frequência de Inadimplência por Tipo de Ocupação (occupation_type)
Tipo de Ocupação: Laborers
Tipo de Ocupação: Core staff
Tipo de Ocupação: Accountants
Tipo de Ocupação: Managers
Tipo de Ocupação: Other
Tipo de Ocupação: Drivers
Tipo de Ocupação: Sales staff
Tipo de Ocupação: Cleaning staff
Tipo de Ocupação: Cooking staff
Tipo de Ocupação: Private service staff
Tipo de Ocupação: Medicine staff
Tipo de Ocupação: Security staff
Tipo de Ocupação: High skill tech staff
Tipo de Ocupação: Waiters/barmen staff
Tipo de Ocupação: Low-skill Laborers
Tipo de Ocupação: Realty agents
Tipo de Ocupação: Secretaries
Tipo de Ocupação: IT staff
Tipo de Ocupação: HR staff
Frequência
Resposta
Não Inadimplente (0)
Inadimplente (1)

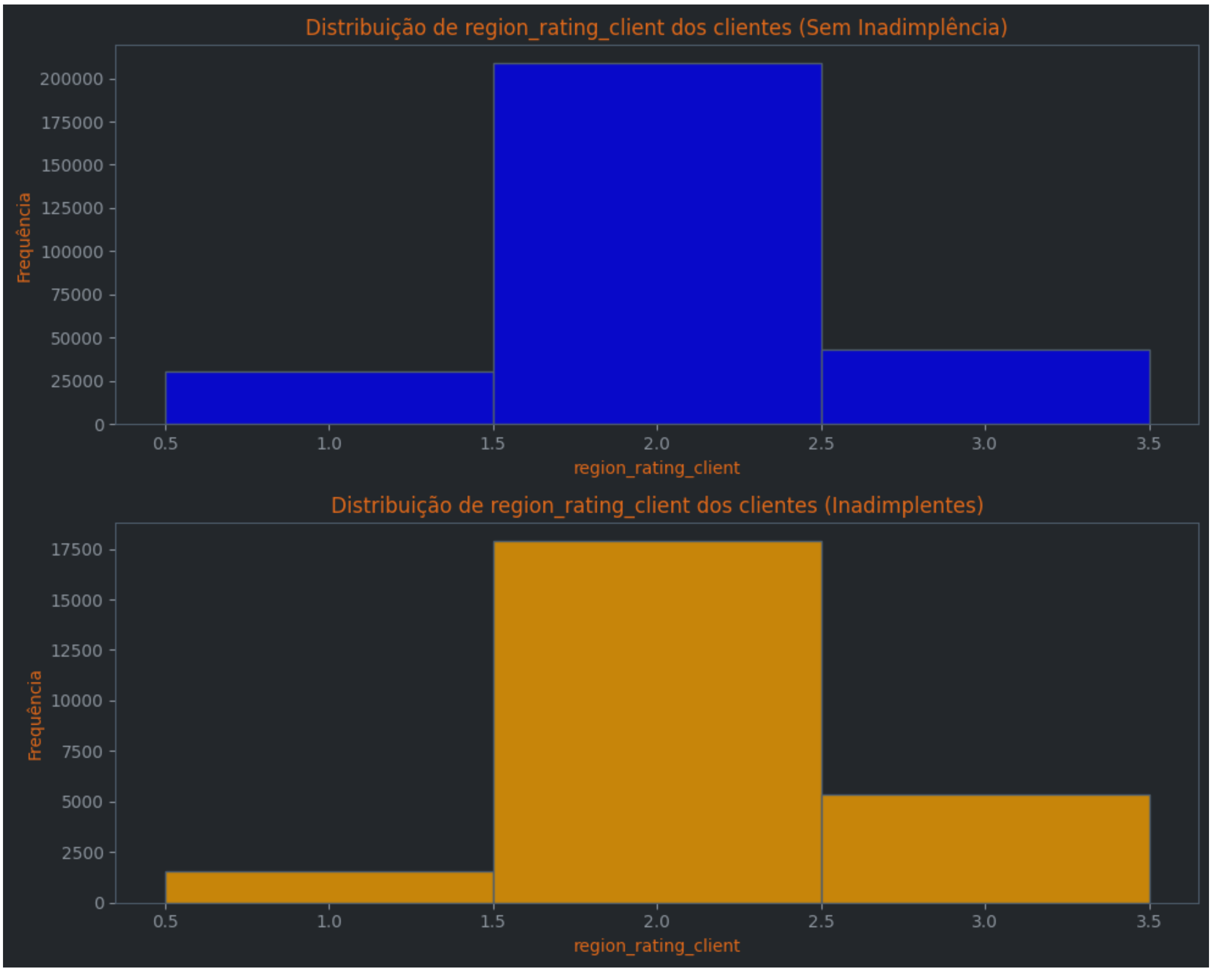

```
V de Cramer entre occupation_type e target: 0.0801
```

H27 — The number of family members is positively related to default risk. FALSE

```
In [ ]: plot_num_var_by_target(
    df3,
    num_var='cnt_fam_members',
    title_0='Distribuição de cnt_fam_members dos clientes (Sem Inadimplência)',
    title_1='Distribuição de cnt_fam_members dos clientes (Inadimplentes)',
    label_x='cnt_fam_members',
    discrete=True
)
pearson_corr = df3['cnt_fam_members'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre cnt_fam_members e target: {pearson_corr:.4f}")
```

H28 — Customers from regions with lower ratings have a higher probability of default. TRUE

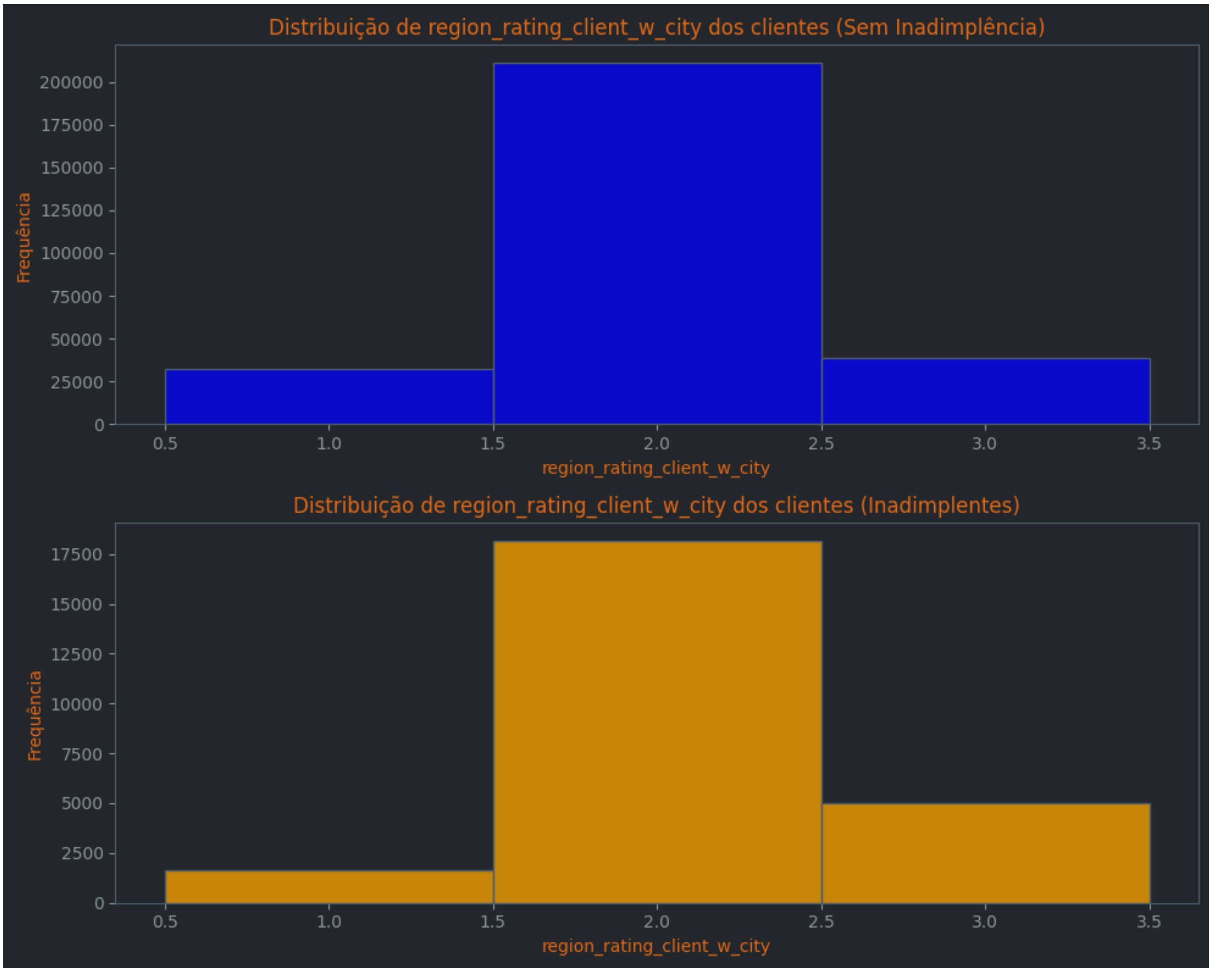
```
In [ ]: plot_num_var_by_target(
    df3,
    num_var='region_rating_client',
    title_0='Distribuição de region_rating_client dos clientes (Sem Inadimplência)',
    title_1='istribuição de region_rating_client dos clientes (Inadimplentes)',
    label_x='region_rating_client',
    discrete=True
)
# Correlação de region_rating_client com a target
pearson_corr = df3['region_rating_client'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre region_rating_client e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre region_rating_client e target: 0.0589
```

H29 — The customer's city rating influences default risk. TRUE

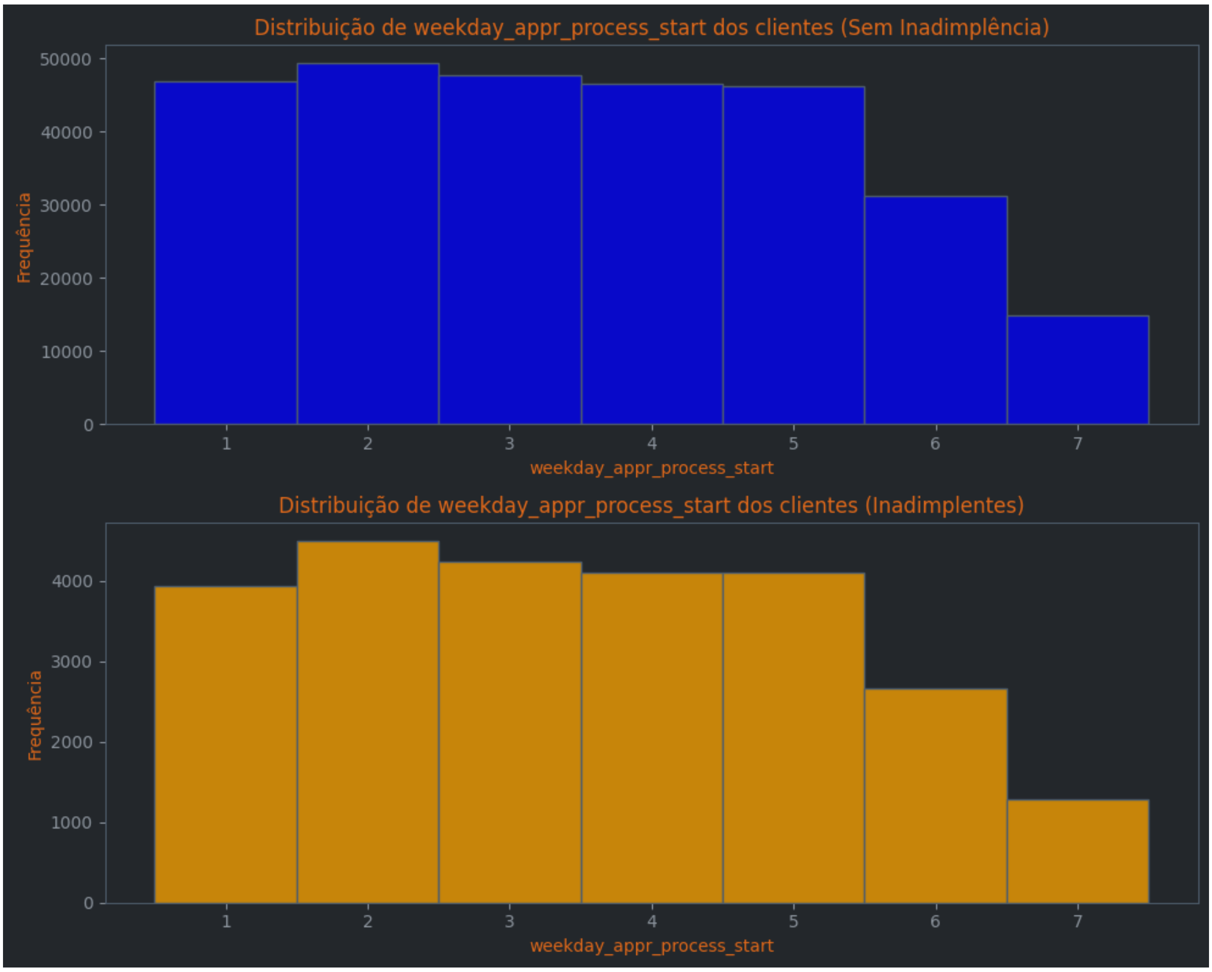
In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='region_rating_client_w_city',
    title_0='Distribuição de region_rating_client_w_city dos clientes (Sem Inadimplência)',
    title_1='Distribuição de region_rating_client_w_city dos clientes (Inadimplentes)',
    label_x='region_rating_client_w_city',
    discrete=True
)
# Correlação de region_rating_client_w_city com a target
pearson_corr = df3['region_rating_client_w_city'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre region_rating_client_w_city e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre region_rating_client_w_city e target: 0.0609
```

H30 — The day of the week when the credit application is made influences the probability of default.
FALSE

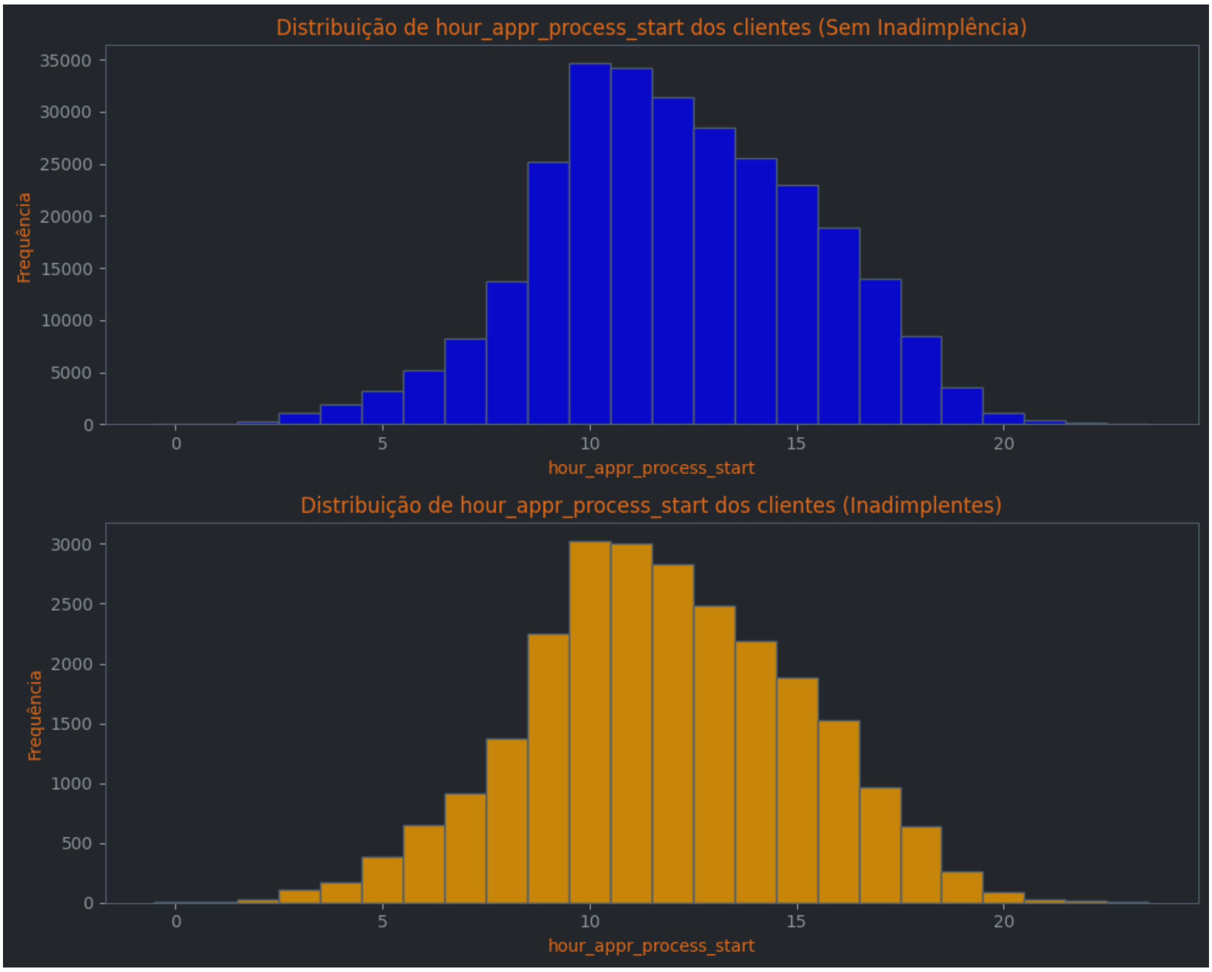
In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='weekday_appr_process_start',
    title_0='Distribuição de weekday_appr_process_start dos clientes (Sem Inadimplência)',
    title_1='Distribuição de weekday_appr_process_start dos clientes (Inadimplentes)',
    label_x='weekday_appr_process_start',
    discrete=True
)

pearson_corr = df3['weekday_appr_process_start'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre weekday_appr_process_start e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre weekday_appr_process_start e target: -0.0002
```

H31 — The time of credit application is associated with default. FALSE

In [ ]:
```python
plot_num_var_by_target(
    df3,
    num_var='hour_appr_process_start',
    title_0='Distribuição de hour_appr_process_start dos clientes (Sem Inadimplência)',
    title_1='Distribuição de hour_appr_process_start dos clientes (Inadimplentes)',
    label_x='hour_appr_process_start',
    discrete=True
)
pearson_corr = df3['hour_appr_process_start'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre hour_appr_process_start e target: {pearson_corr:.4f}")
```

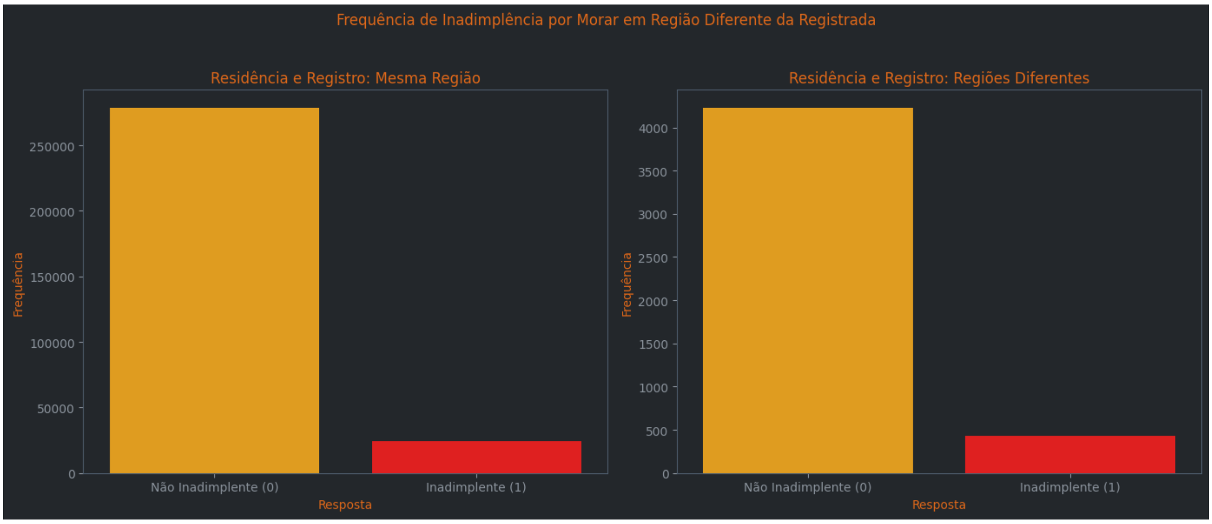



```
Correlação de Pearson entre hour_appr_process_start e target: -0.0242
```

H32 — Living in a region different from the registered one increases default risk. FALSE

In [ ]:
```
reg_region_flags = [0, 1]

palette_target = {'0': "orange", '1': "red"}

fig, axes = plt.subplots(1, 2, figsize=(14, 6), sharey=False)

for i, flag in enumerate(reg_region_flags):
    data_plot = df3[df3['reg_region_not_live_region'] == flag].copy()
    data_plot['target_str'] = data_plot['target'].astype(str)
    sns.countplot(
        data=data_plot,
        x='target_str',
        hue='target_str',
        palette=palette_target,
        order=['0', '1'],
        ax=axes[i],
        legend=False
    )
    reg_region_label = "Mesma Região" if flag == 0 else "Regiões Diferentes"
    axes[i].set_title(f"Residência e Registro: {reg_region_label}")
    axes[i].set_xlabel('Resposta')
    axes[i].set_ylabel('Frequência')
    axes[i].set_xticks([0, 1])
    axes[i].set_xticklabels(['Não Inadimplente (0)', 'Inadimplente (1)'])

plt.suptitle('Frequência de Inadimplência por Morar em Região Diferente da Registrada')
plt.tight_layout(rect=[0, 0, 1, 0.95])
plt.show()

plot_num_var_by_target(
    df3,
    num_var='reg_region_not_live_region',
```

```python
    title_0='Distribuição do Valor de Crédito (amt_credit) dos clientes (Sem Inadimplência)',
    title_1='Distribuição do Valor de Crédito (amt_credit) dos clientes (Inadimplentes)',
    label_x='reg_region_not_live_region',
    discrete=True
)
calcular_cramers_v(df3, 'reg_region_not_live_region', 'target')
```




V de Cramer entre reg_region_not_live_region e target: 0.0055

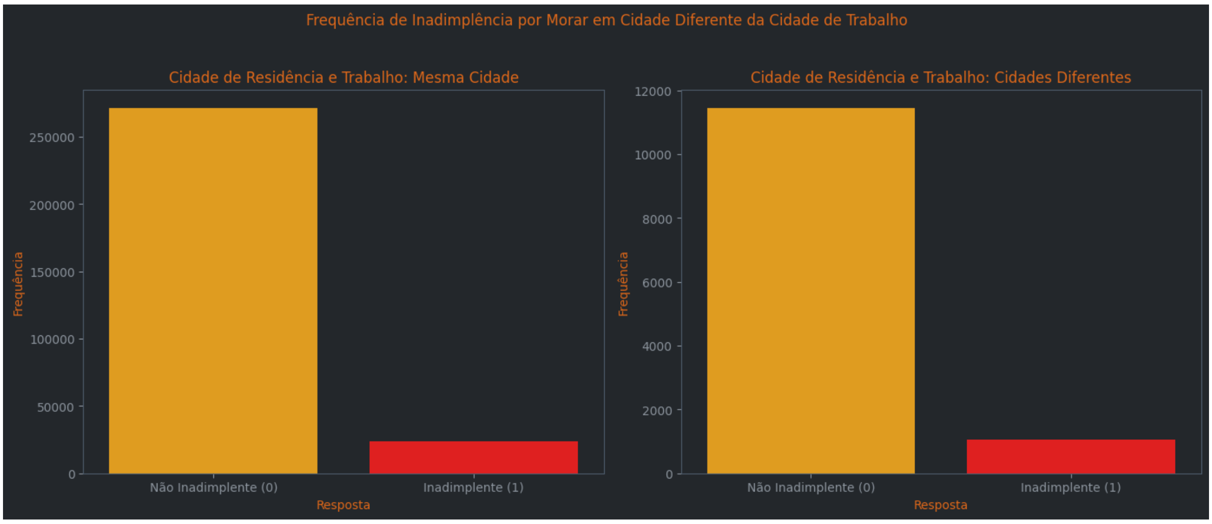
H33 — Working in a region different from the registered one is associated with higher risk. FALSE

In [ ]:
```python
plot_binaria_target(
    df3,
    var_binaria='reg_region_not_work_region',
    label_0='Mesma Região',
    label_1='Regiões Diferentes',
    suptitle='Frequência de Inadimplência por Morar em Região Diferente da Região de Trabalho'
)

calcular_cramers_v(df3, 'reg_region_not_work_region', 'target')
```

H34 — Living and working in different regions may increase the probability of default. FALSE

In [ ]:
```python
live_region_not_work_flags = [0, 1]

palette_target = {'0': "orange", '1': "red"}

fig, axes = plt.subplots(1, 2, figsize=(14, 6), sharey=False)

for i, flag in enumerate(live_region_not_work_flags):

    data_plot = df3[df3['live_region_not_work_region'] == flag].copy()
    data_plot['target_str'] = data_plot['target'].astype(str)
    sns.countplot(
        data=data_plot,
        x='target_str',
        hue='target_str',
        palette=palette_target,
        order=['0', '1'],
        ax=axes[i],
        legend=False
    )

    live_region_work_str = "Mesma Cidade" if flag == 0 else "Cidades Diferentes"
    axes[i].set_title(f"Cidade de Residência e Trabalho: {live_region_work_str}")
    axes[i].set_xlabel('Resposta')
    axes[i].set_ylabel('Frequência')
    axes[i].set_xticks([0, 1])
    axes[i].set_xticklabels(['Não Inadimplente (0)', 'Inadimplente (1)'])

plt.suptitle('Frequência de Inadimplência por Morar em Cidade Diferente da Cidade de Trabalho')
```

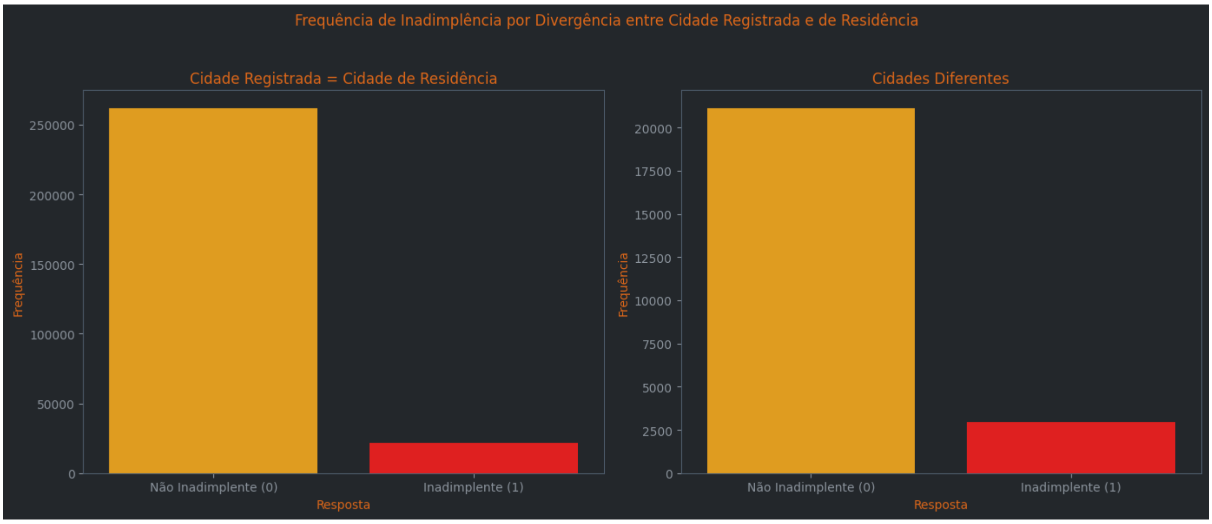
```
plt.tight_layout(rect=[0, 0, 1, 0.95])
plt.show()

plot_binaria_target(
    df3,
    var_binaria='live_region_not_work_region',
    label_0='Mesma Cidade',
    label_1='Cidades Diferentes',
    suptitle='Frequência de Inadimplência por Morar em Cidade Diferente da Cidade de Trabalho'
)
calcular_cramers_v(df3, 'live_region_not_work_region', 'target')
```




```
V de Cramer entre live_region_not_work_region e target: 0.0028
```

H35 — Living in a city different from the registered one increases the chance of default. TRUE

```
In [ ]: plot_binaria_target(
    df3,
    var_binaria='reg_city_not_live_city',
    label_0='Cidade Registrada = Cidade de Residência',
    label_1='Cidades Diferentes',
    suptitle='Frequência de Inadimplência por Divergência entre Cidade Registrada e de Residênc
)
calcular_cramers_v(df3, 'reg_city_not_live_city', 'target')
```

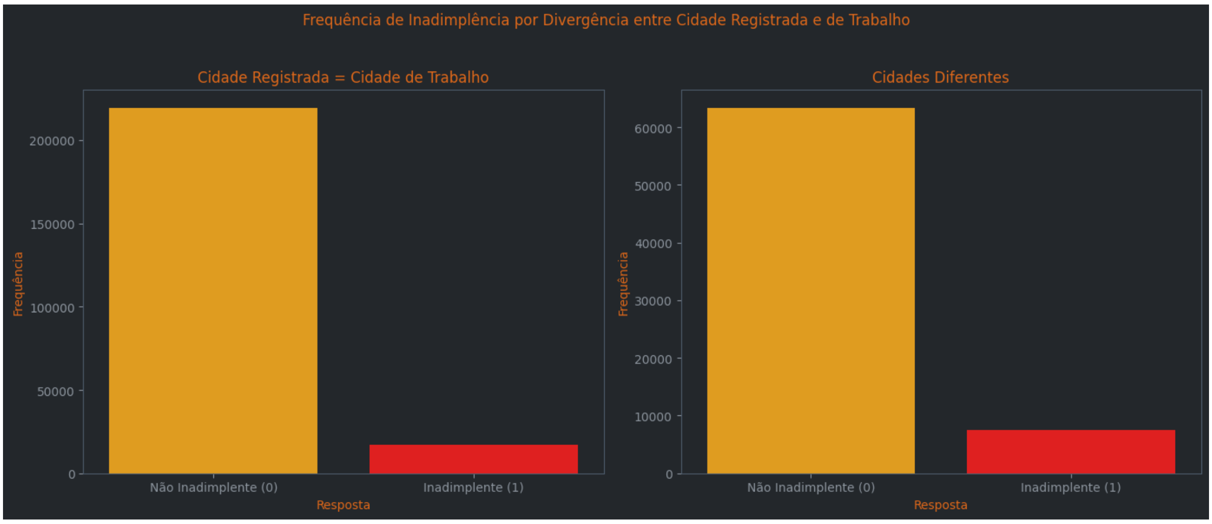



```
V de Cramer entre reg_city_not_live_city e target: 0.0444
```

H36 — Working in a city different from the registered one increases default risk. TRUE

```
In [ ]: plot_binaria_target(
    df3,
    var_binaria='reg_city_not_work_city',
    label_0='Cidade Registrada = Cidade de Trabalho',
    label_1='Cidades Diferentes',
```

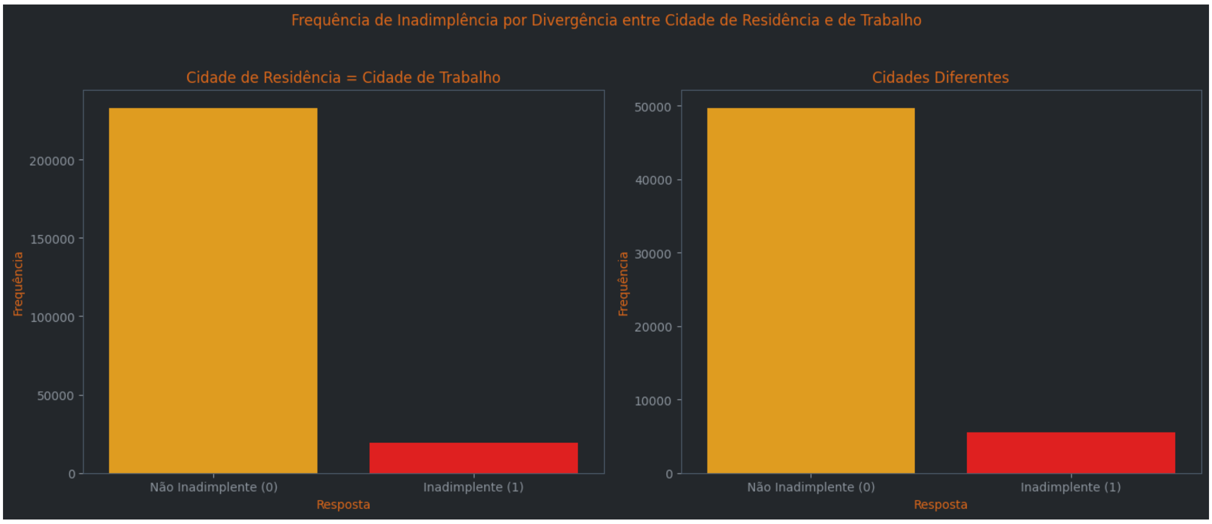
```
    suptitle='Frequência de Inadimplência por Divergência entre Cidade Registrada e de Trabalho
)
calcular_cramers_v(df3, 'reg_city_not_work_city', 'target')
```




```
V de Cramer entre reg_city_not_work_city e target: 0.0510
```

H37 — Living in a different city than the workplace influences default risk. TRUE

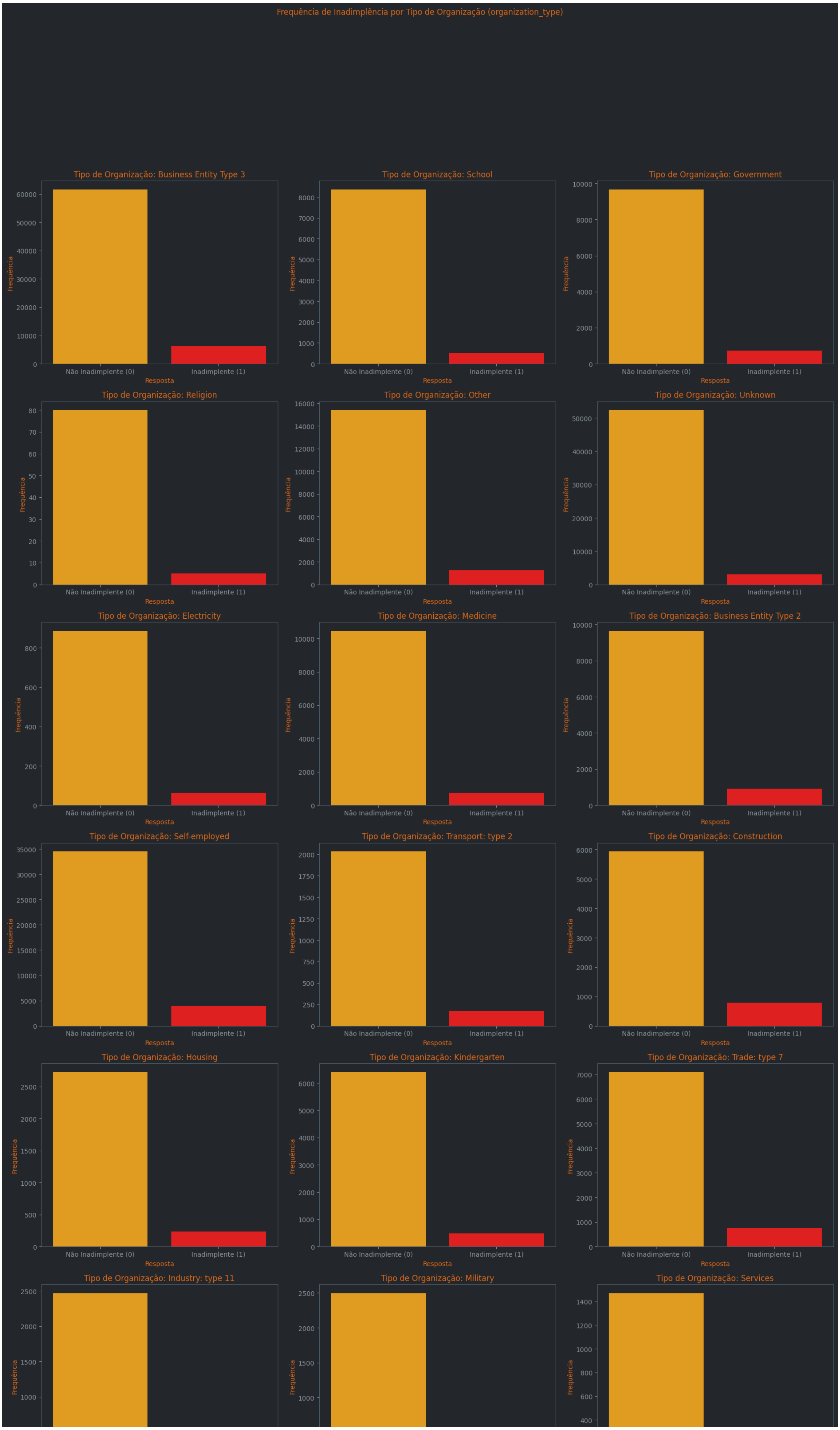
In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='live_city_not_work_city',
    label_0='Cidade de Residência = Cidade de Trabalho',
    label_1='Cidades Diferentes',
    suptitle='Frequência de Inadimplência por Divergência entre Cidade de Residência e de Traba
)
calcular_cramers_v(df3, 'live_city_not_work_city', 'target')
```

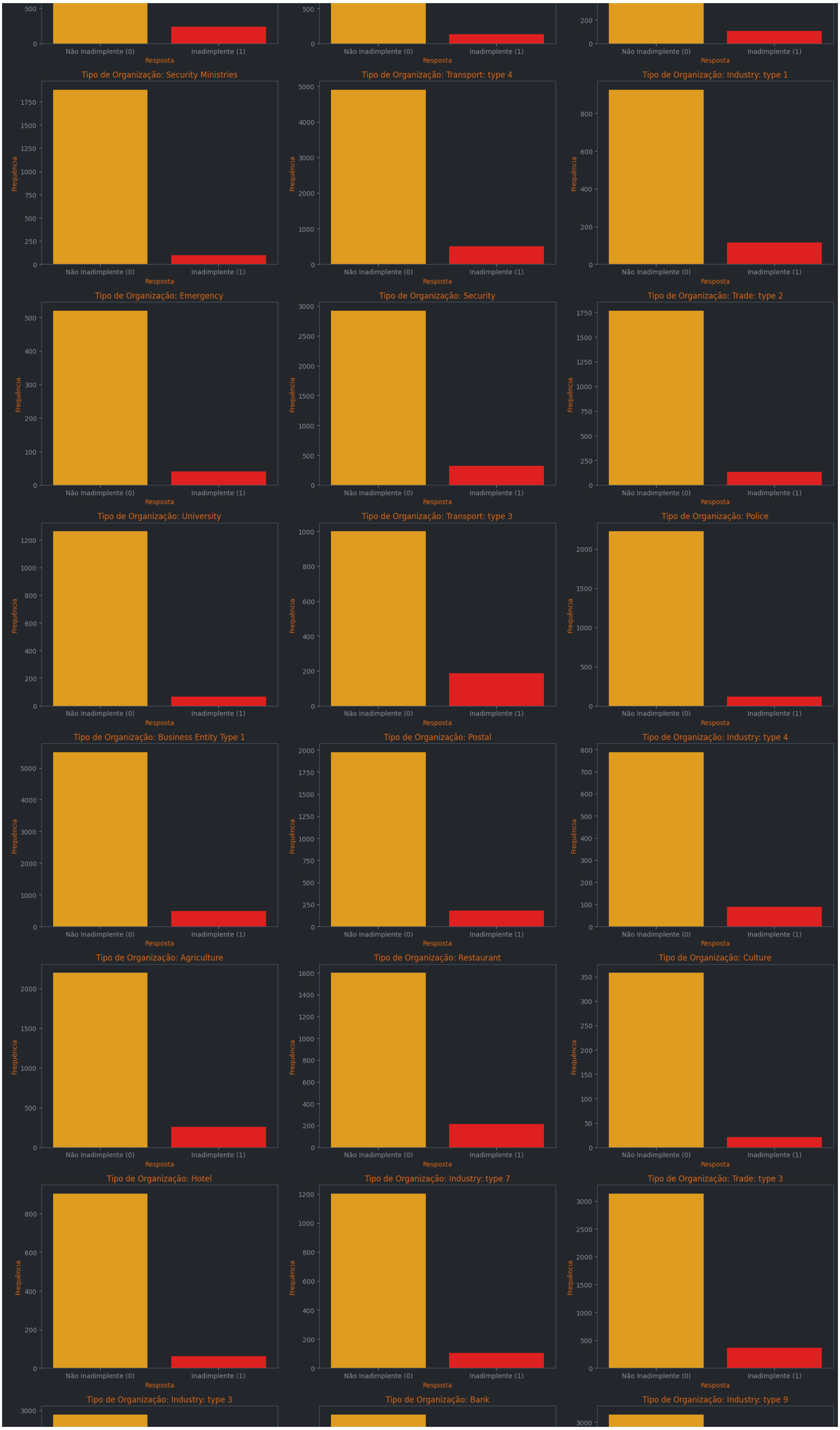


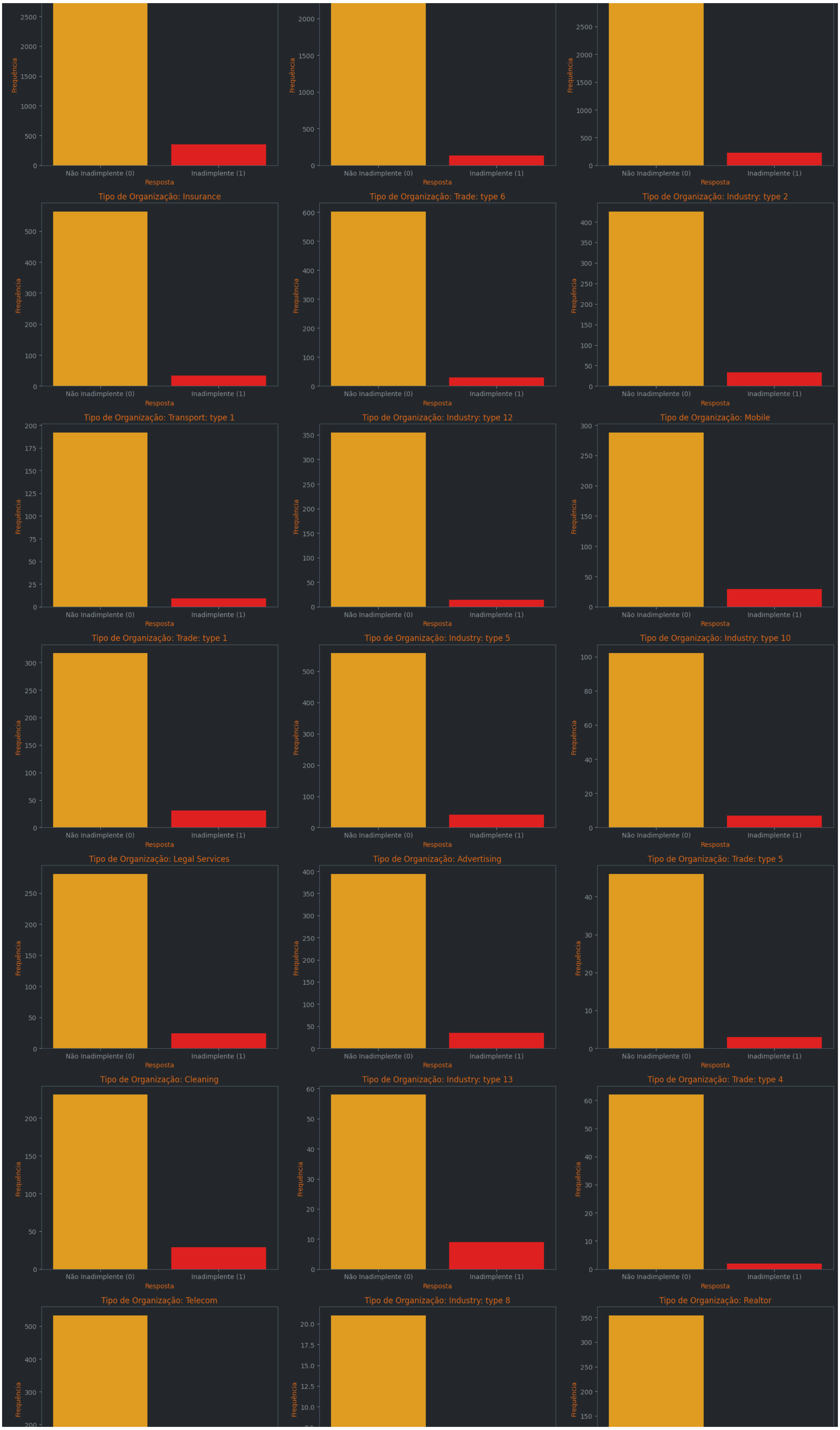

```
V de Cramer entre live_city_not_work_city e target: 0.0325
```

H38 — The type of employing organization is associated with default risk. TRUE

In [ ]:
```
plot_target_by_categorical(df3, cat_col='organization_type', target_col='target')
calcular_cramers_v(df3, 'organization_type', 'target')
```


Frequência de Inadimplência por Tipo de Organização (organization_type)
Tipo de Organização: Business Entity Type 3
Tipo de Organização: School
Tipo de Organização: Government
Tipo de Organização: Religion
Tipo de Organização: Other
Tipo de Organização: Unknown
Tipo de Organização: Electricity
Tipo de Organização: Medicine
Tipo de Organização: Business Entity Type 2
Tipo de Organização: Self-employed
Tipo de Organização: Transport: type 2
Tipo de Organização: Construction
Tipo de Organização: Housing
Tipo de Organização: Kindergarten
Tipo de Organização: Trade: type 7
Tipo de Organização: Industry: type 11
Tipo de Organização: Military
Tipo de Organização: Services
Frequência
Resposta
Não Inadimplente (0)
Inadimplente (1)

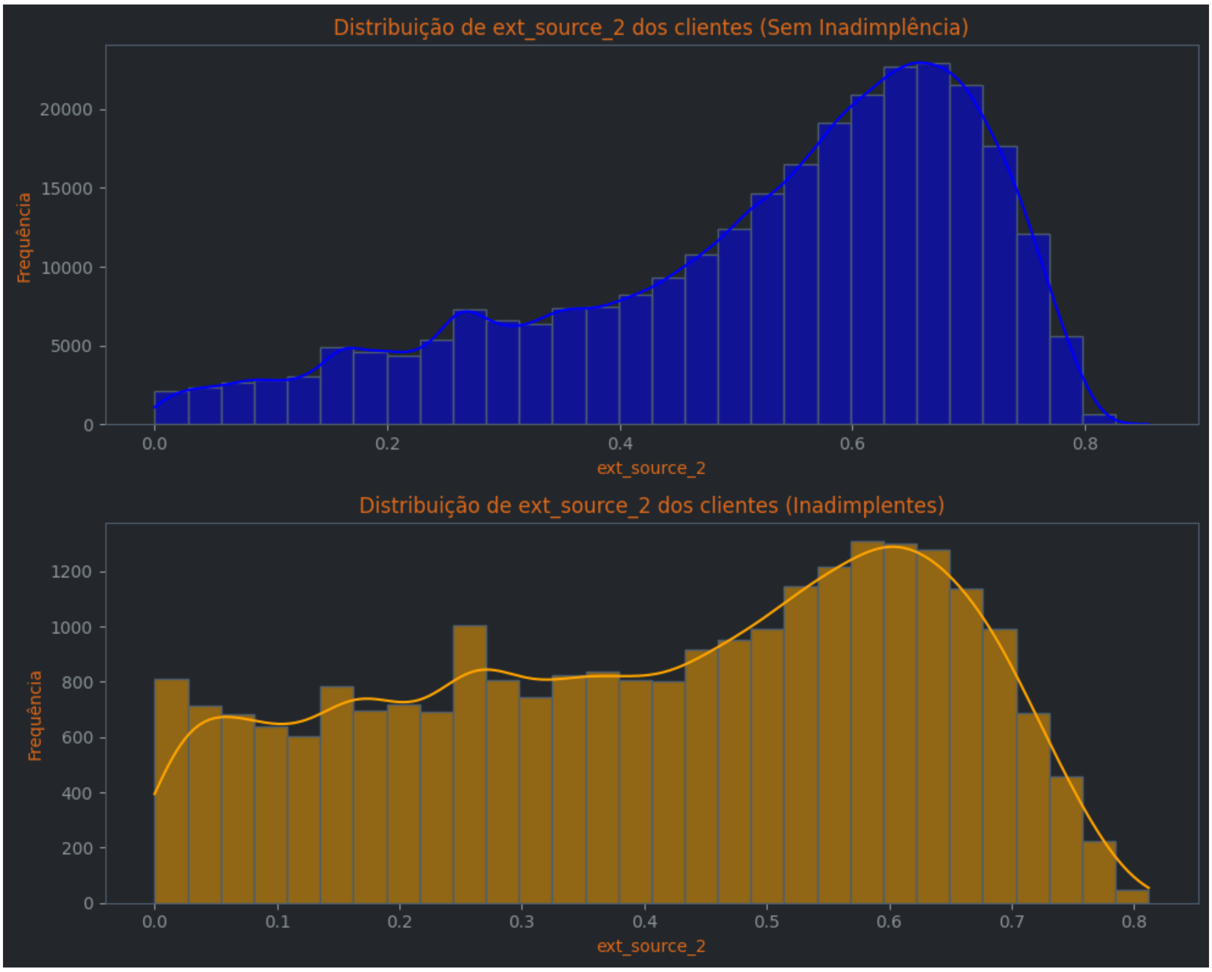

Tipo de Organização: Security Ministries
Tipo de Organização: Transport: type 4
Tipo de Organização: Industry: type 1
Tipo de Organização: Emergency
Tipo de Organização: Security
Tipo de Organização: Trade: type 2
Tipo de Organização: University
Tipo de Organização: Transport: type 3
Tipo de Organização: Police
Tipo de Organização: Business Entity Type 1
Tipo de Organização: Postal
Tipo de Organização: Industry: type 4
Tipo de Organização: Agriculture
Tipo de Organização: Restaurant
Tipo de Organização: Culture
Tipo de Organização: Hotel
Tipo de Organização: Industry: type 7
Tipo de Organização: Trade: type 3
Tipo de Organização: Industry: type 3
Tipo de Organização: Bank
Tipo de Organização: Industry: type 9
Frequência
Resposta
Não Inadimplente (0)
Inadimplente (1)


Frequência
Não Inadimplente (0)
Inadimplente (1)
Resposta
Tipo de Organização: Insurance
Tipo de Organização: Trade: type 6
Tipo de Organização: Industry: type 2
Tipo de Organização: Transport: type 1
Tipo de Organização: Industry: type 12
Tipo de Organização: Mobile
Tipo de Organização: Trade: type 1
Tipo de Organização: Industry: type 5
Tipo de Organização: Industry: type 10
Tipo de Organização: Legal Services
Tipo de Organização: Advertising
Tipo de Organização: Trade: type 5
Tipo de Organização: Cleaning
Tipo de Organização: Industry: type 13
Tipo de Organização: Trade: type 4
Tipo de Organização: Telecom
Tipo de Organização: Industry: type 8
Tipo de Organização: Realtor


```
V de Cramer entre organization_type e target: 0.0723
```

H39 — External score 2 is inversely related to default. TRUE

In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='ext_source_2',
    title_0='Distribuição de ext_source_2 dos clientes (Sem Inadimplência)',
    title_1='Distribuição de ext_source_2 dos clientes (Inadimplentes)',
    label_x='Distribuição de ext_source_2 dos clientes (Inadimplentes)',
    discrete=True
)
pearson_corr = df3['ext_source_2'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre ext_source_2 e target: {pearson_corr:.4f}")
```

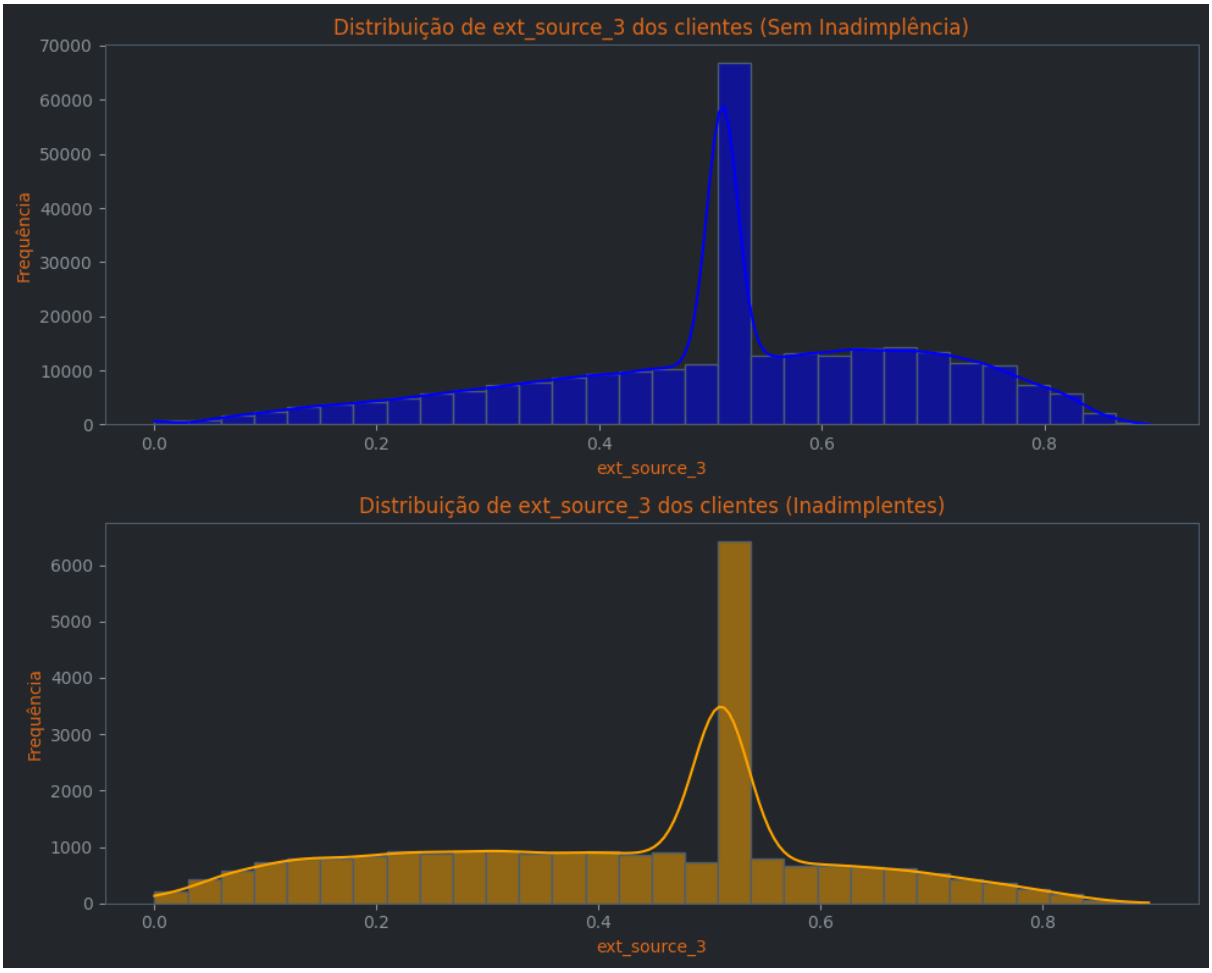



```
Correlação de Pearson entre ext_source_2 e target: -0.1603
```

H40 — External score 3 is inversely related to default. TRUE

In [ ]:
```
plot_num_var_by_target(
    df3,
```

```
    num_var='ext_source_2',
    title_0='Distribuição de ext_source_3 dos clientes (Sem Inadimplência)',
    title_1='Distribuição de ext_source_3 dos clientes (Inadimplentes)',
    label_x='Distribuição de ext_source_3 dos clientes (Inadimplentes)',
    discrete=True
)


pearson_corr = df3['ext_source_3'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre ext_source_3 e target: {pearson_corr:.4f}")
```

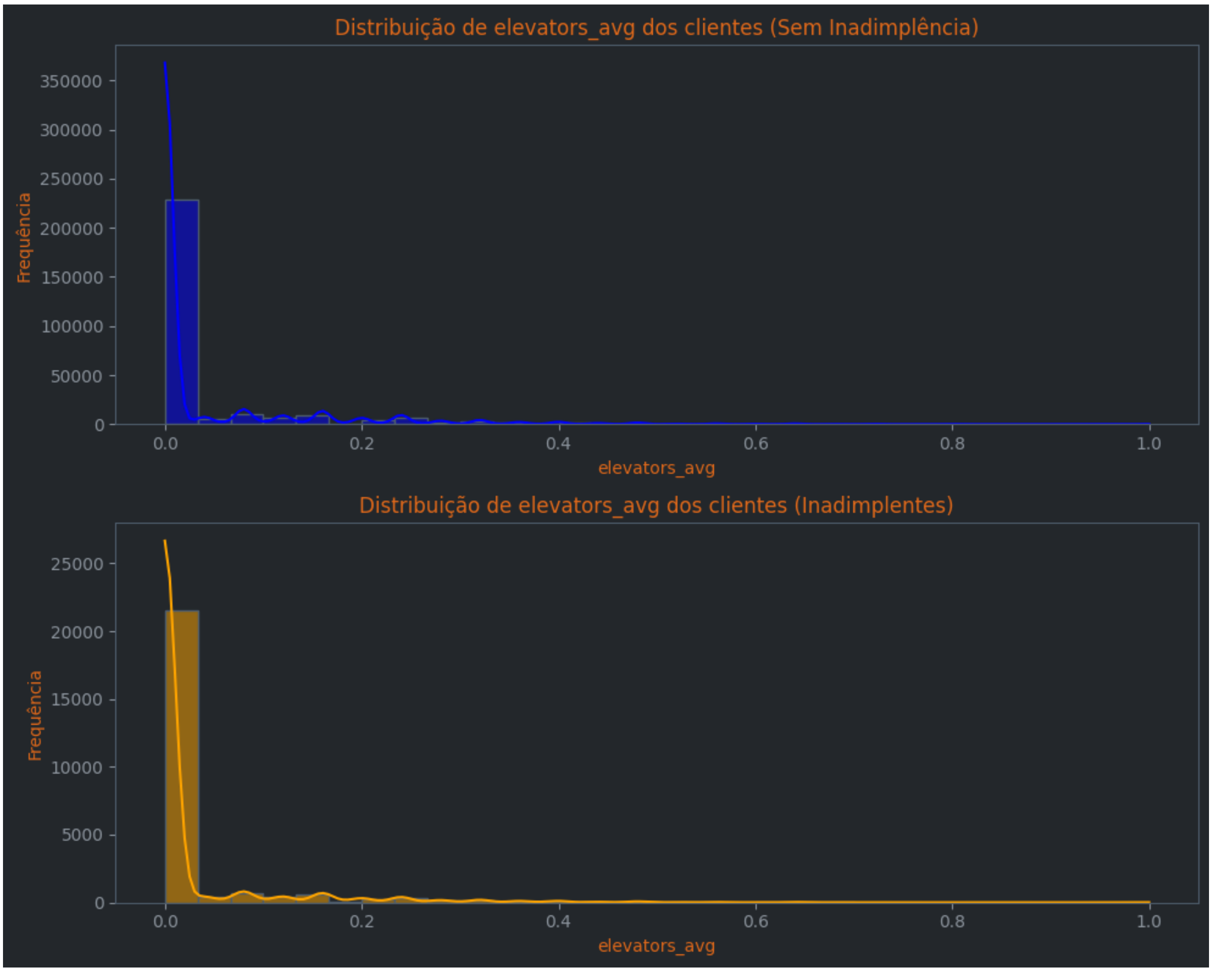



```
Correlação de Pearson entre ext_source_3 e target: -0.1574
```

## Block 3 Hypotesis

H41 — The average number of elevators in a building is inversely related to the probability of default. TRUE

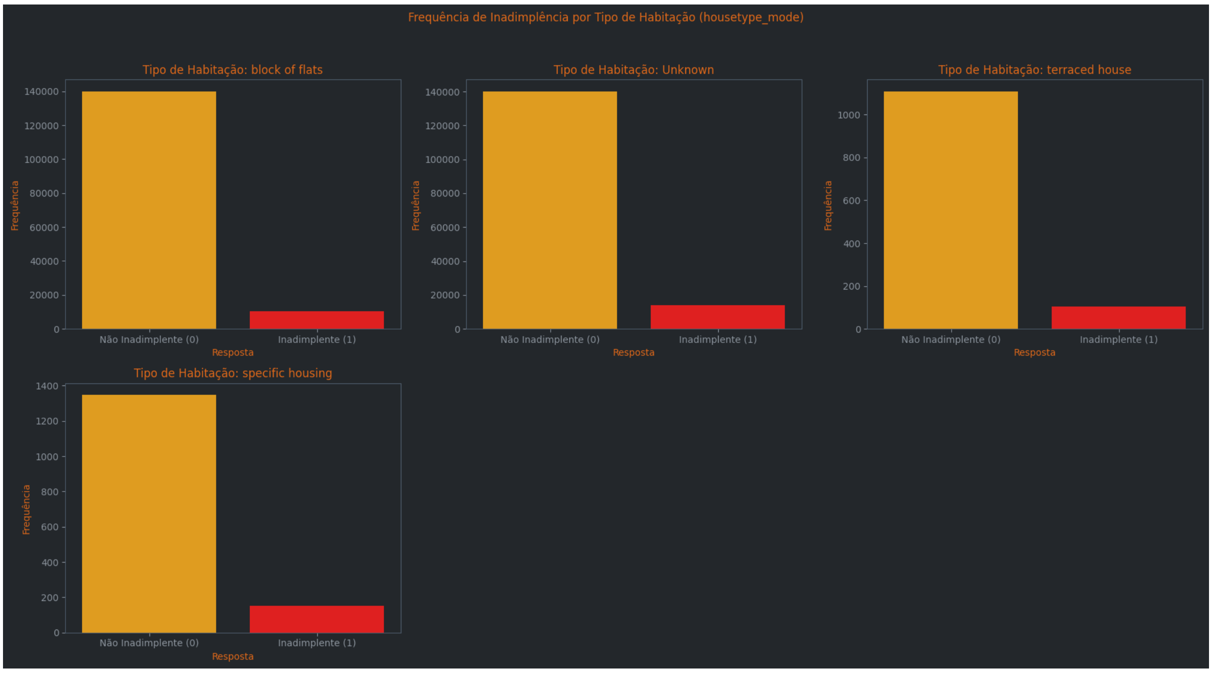
In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='elevators_avg',
    title_0='Distribuição de elevators_avg dos clientes (Sem Inadimplência)',
    title_1='Distribuição de elevators_avg dos clientes (Inadimplentes)',
    label_x='elevators_avg',
    discrete=True
)
# Correlação de elevators_avg com a target
pearson_corr = df3['elevators_avg'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre elevators_avg e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre elevators_avg e target: -0.0359
```

H42 — Housing type influences default risk. TRUE

In [ ]:
```
plot_target_by_categorical(df3, cat_col='housetype_mode', target_col='target')

calcular_cramers_v(df3, 'housetype_mode', 'target')
```




```
V de Cramer entre housetype_mode e target: 0.0407
```

H43 — The main wall material of the property is associated with default risk. TRUE

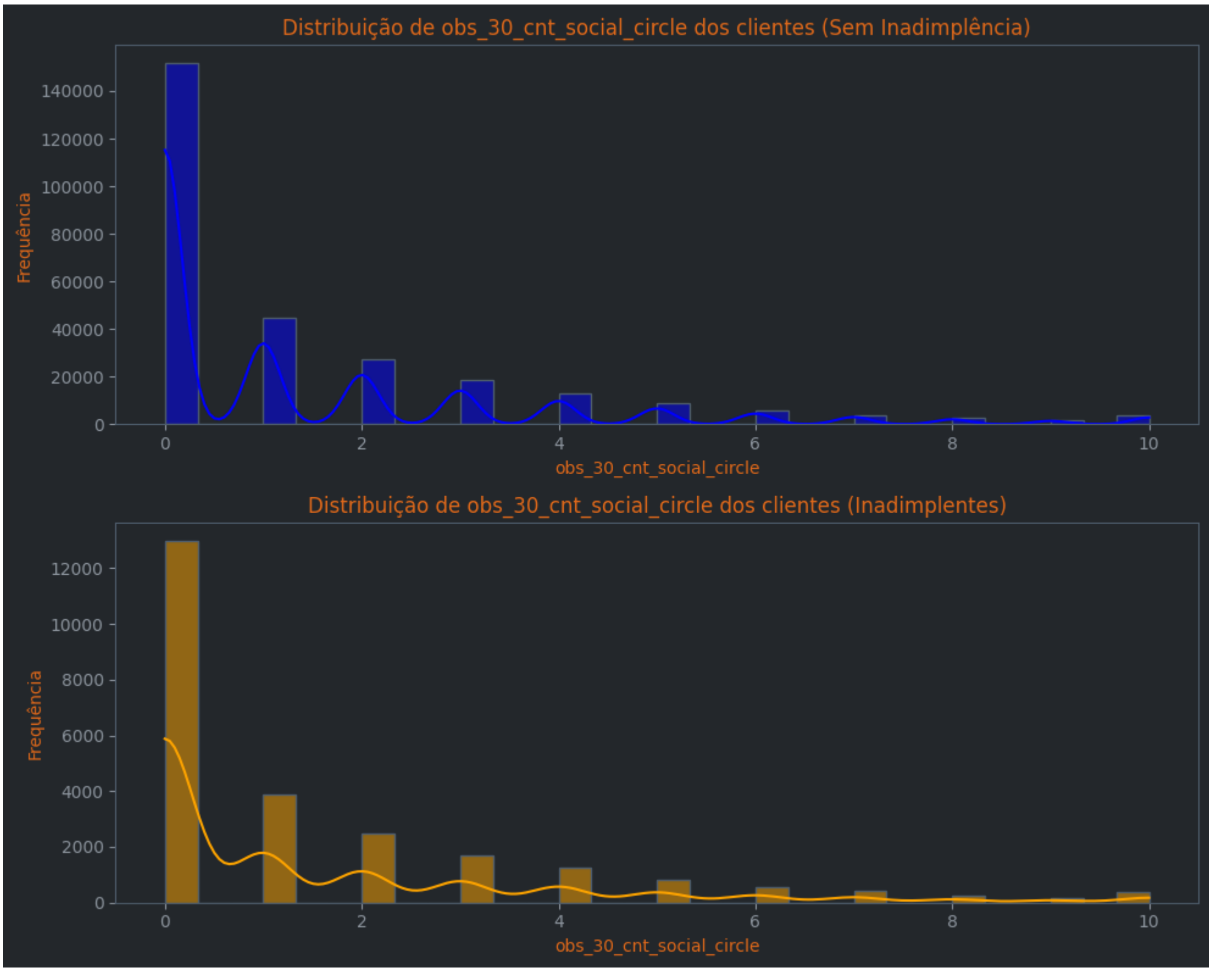
In [ ]:
```
plot_target_by_categorical(df3, cat_col='wallsmaterial_mode', target_col='target')
```

```
calcular_cramers_v(df3, 'wallsmaterial_mode', 'target')
```


```
V de Cramer entre wallsmaterial_mode e target: 0.0441
```

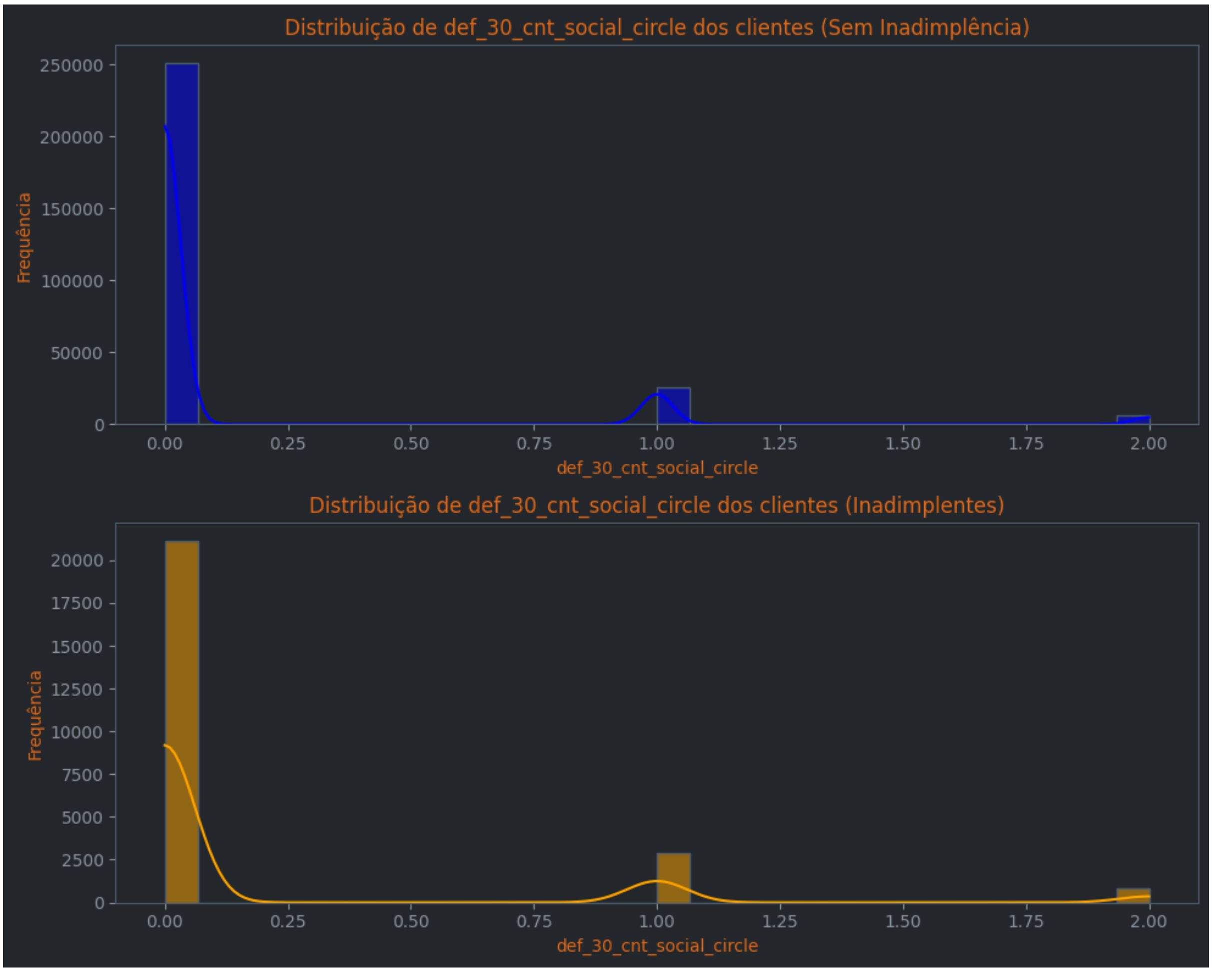
H44 — A higher number of observations or defaulters in the 30-day social circle increases the customer's probability of default. TRUE

```
In [ ]: plot_num_var_by_target(
    df3,
    num_var='obs_30_cnt_social_circle',
    title_0='Distribuição de obs_30_cnt_social_circle dos clientes (Sem Inadimplência)',
    title_1='Distribuição de obs_30_cnt_social_circle dos clientes (Inadimplentes)',
    label_x='obs_30_cnt_social_circle',
    discrete=True
)
# Correlação de obs_30_cnt_social_circle com a target
pearson_corr = df3['obs_30_cnt_social_circle'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre obs_30_cnt_social_circle e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre obs_30_cnt_social_circle e target: 0.0104
```

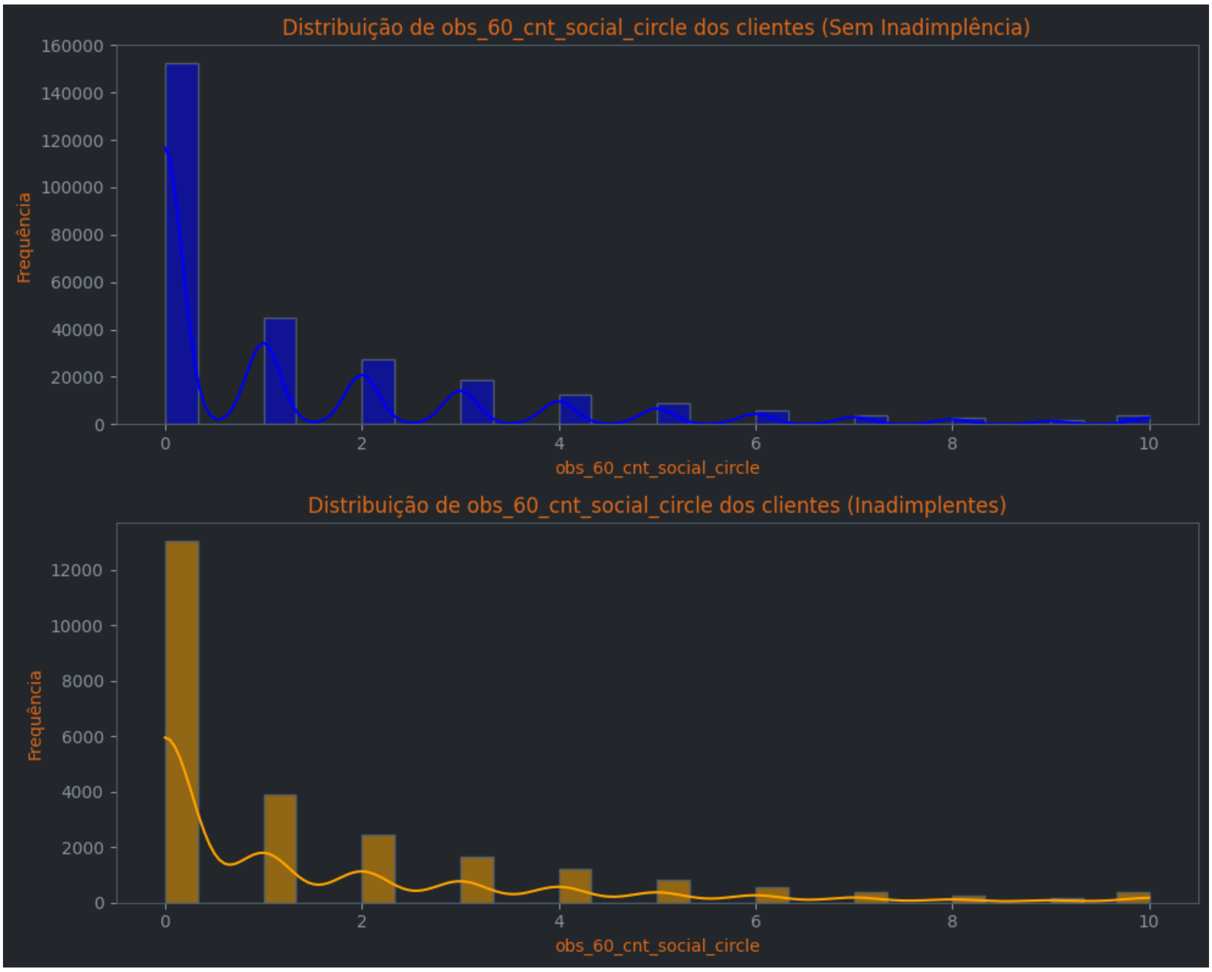
In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='def_30_cnt_social_circle',
    title_0='Distribuição de def_30_cnt_social_circle dos clientes (Sem Inadimplência)',
    title_1='Distribuição de def_30_cnt_social_circle dos clientes (Inadimplentes)',
    label_x='def_30_cnt_social_circle',
    discrete=True
)
# Correlação de def_30_cnt_social_circle com a target
pearson_corr = df3['def_30_cnt_social_circle'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre def_30_cnt_social_circle e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre def_30_cnt_social_circle e target: 0.0331
```

H45 — Default in the 60-day social circle is positively associated with individual default risk. TRUE

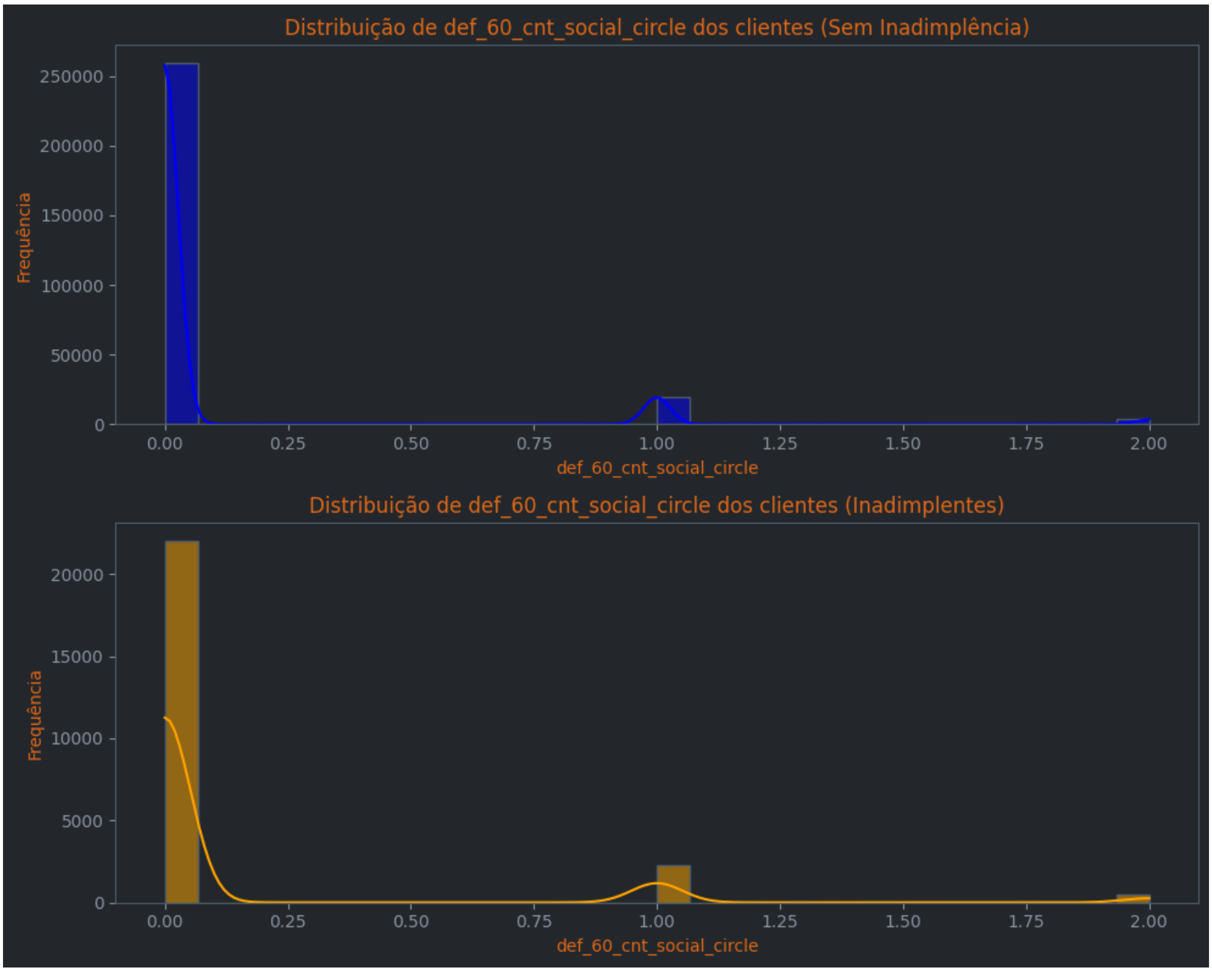
In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='obs_60_cnt_social_circle',
    title_0='Distribuição de obs_60_cnt_social_circle dos clientes (Sem Inadimplência)',
    title_1='Distribuição de obs_60_cnt_social_circle dos clientes (Inadimplentes)',
    label_x='obs_60_cnt_social_circle',
    discrete=True
)

# Correlação de obs_60_cnt_social_circle com a target
pearson_corr = df3['obs_60_cnt_social_circle'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre obs_60_cnt_social_circle e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre obs_60_cnt_social_circle e target: 0.0103
```

In [ ]:

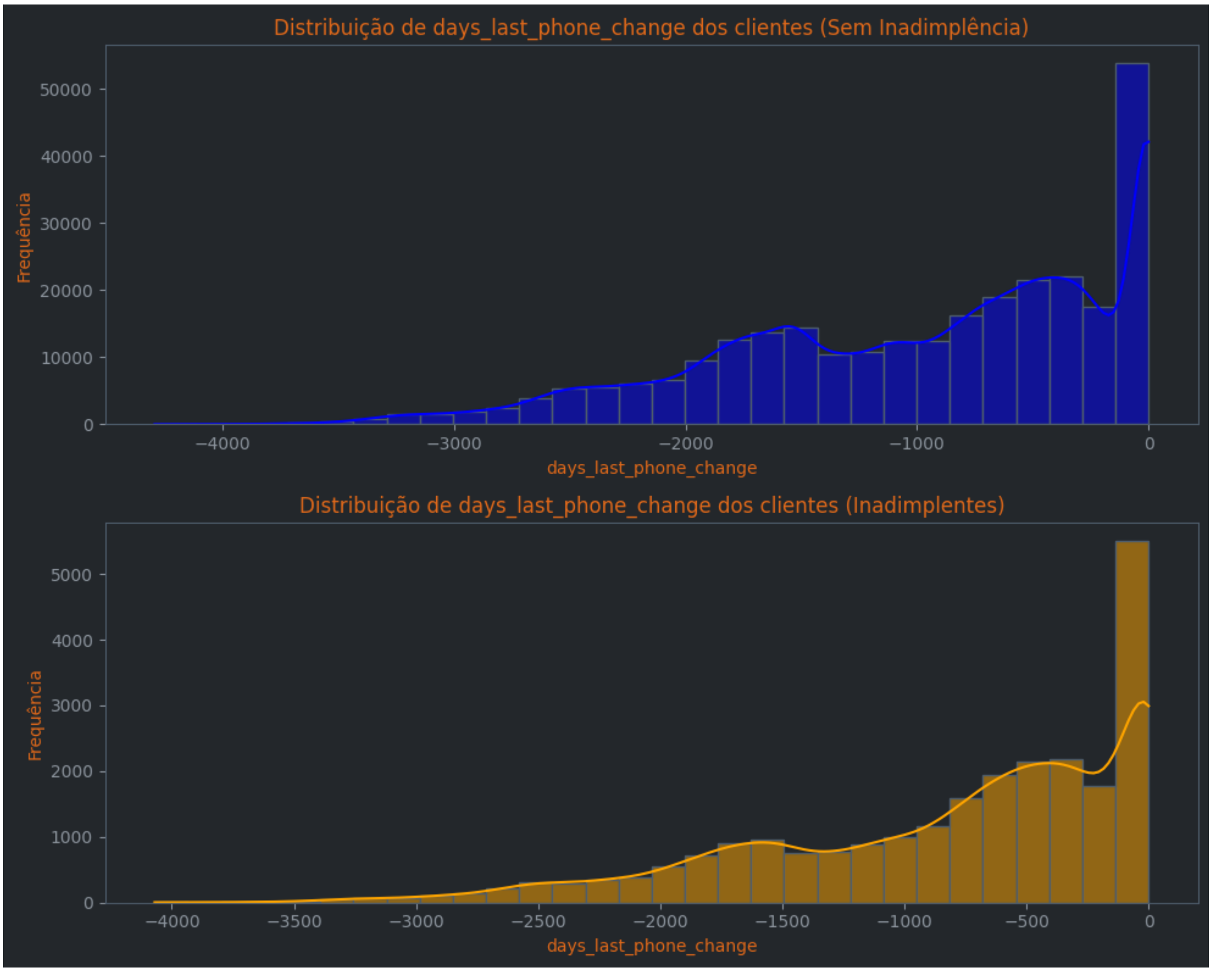
```python
plot_num_var_by_target(
    df3,
    num_var='def_60_cnt_social_circle',
    title_0='Distribuição de def_60_cnt_social_circle dos clientes (Sem Inadimplência)',
    title_1='Distribuição de def_60_cnt_social_circle dos clientes (Inadimplentes)',
    label_x='def_60_cnt_social_circle',
    discrete=True
)
# Correlação de def_60_cnt_social_circle com a target
pearson_corr = df3['def_60_cnt_social_circle'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre def_60_cnt_social_circle e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre def_60_cnt_social_circle e target: 0.0318
```

H46 — The time since the last phone change is related to default probability. FALSE

In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='days_last_phone_change',
    title_0='Distribuição de days_last_phone_change dos clientes (Sem Inadimplência)',
    title_1='Distribuição de days_last_phone_change dos clientes (Inadimplentes)',
    label_x='days_last_phone_change',
    discrete=True
)
# Correlação de days_last_phone_change com a target
pearson_corr = df3['days_last_phone_change'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre days_last_phone_change e target: {pearson_corr:.4f}")
```

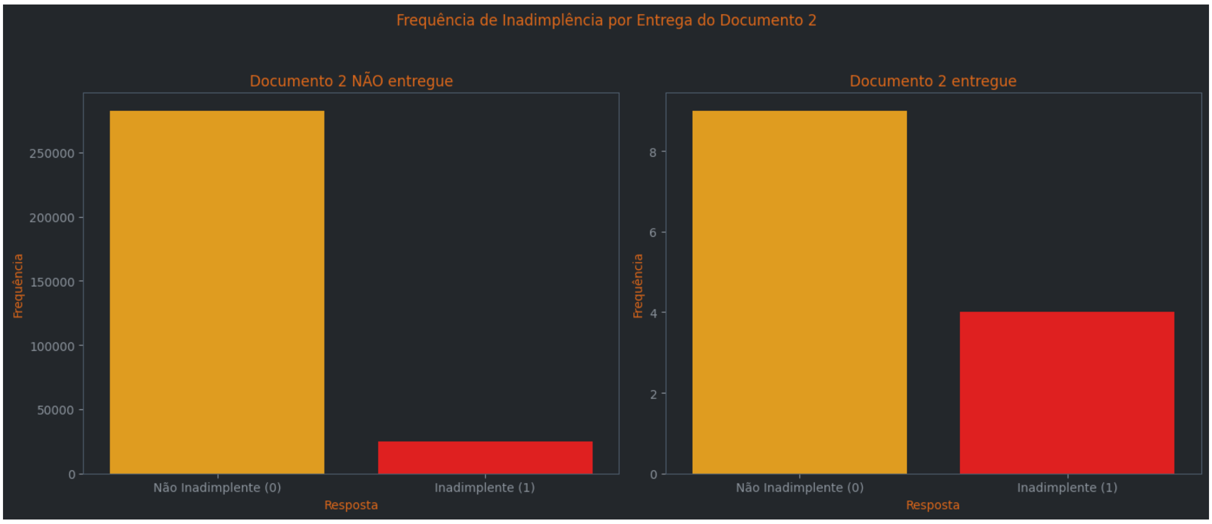



```
Correlação de Pearson entre days_last_phone_change e target: 0.0552
```

H47 — The number of submitted documents is inversely associated with default. FALSE

flag_document_2

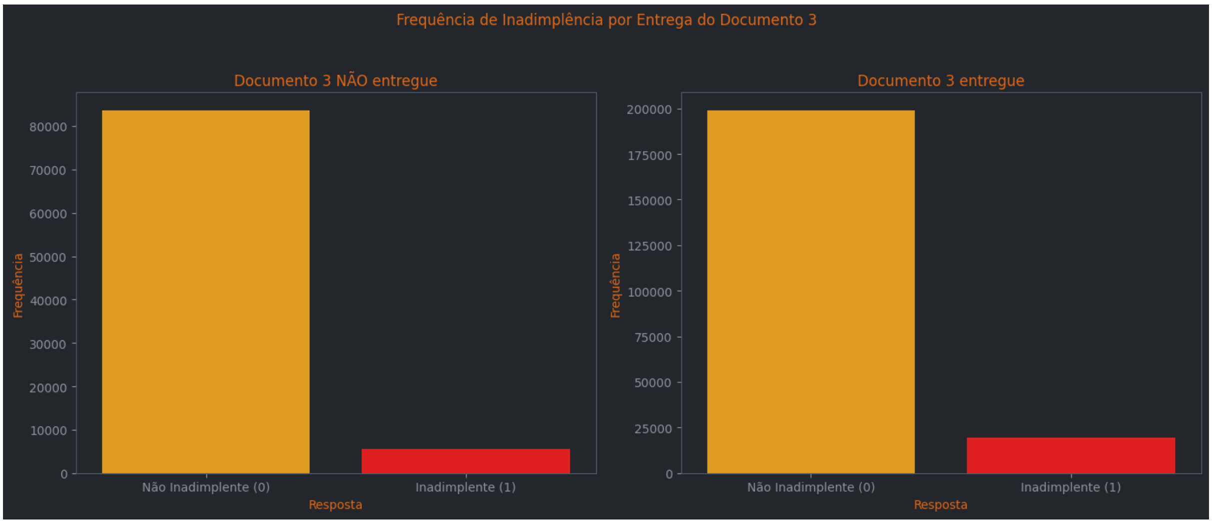
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_2',
            label_0='Documento 2 NÃO entregue',
            label_1='Documento 2 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 2'
        )
        calcular_cramers_v(df3, 'flag_document_2', 'target')
```




```
V de Cramer entre flag_document_2 e target: 0.0045
```

flag_document_3

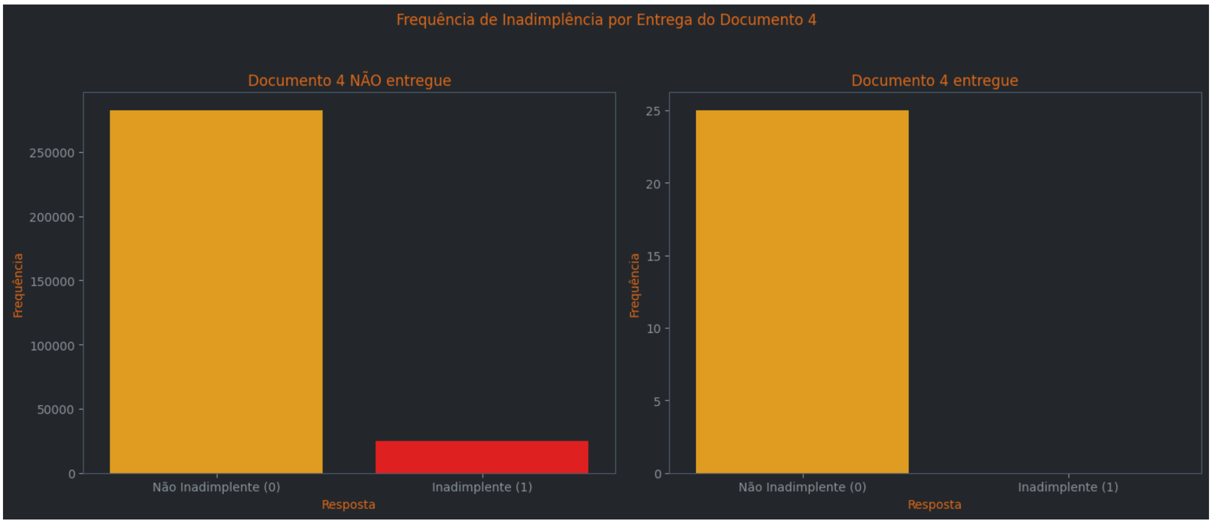
In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='flag_document_3',
    label_0='Documento 3 NÃO entregue',
    label_1='Documento 3 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 3'
)

calcular_cramers_v(df3, 'flag_document_3', 'target')
```




```
V de Cramer entre flag_document_3 e target: 0.0443
```

flag_document_4

In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='flag_document_4',
    label_0='Documento 4 NÃO entregue',
    label_1='Documento 4 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 4'
)
calcular_cramers_v(df3, 'flag_document_4', 'target')
```

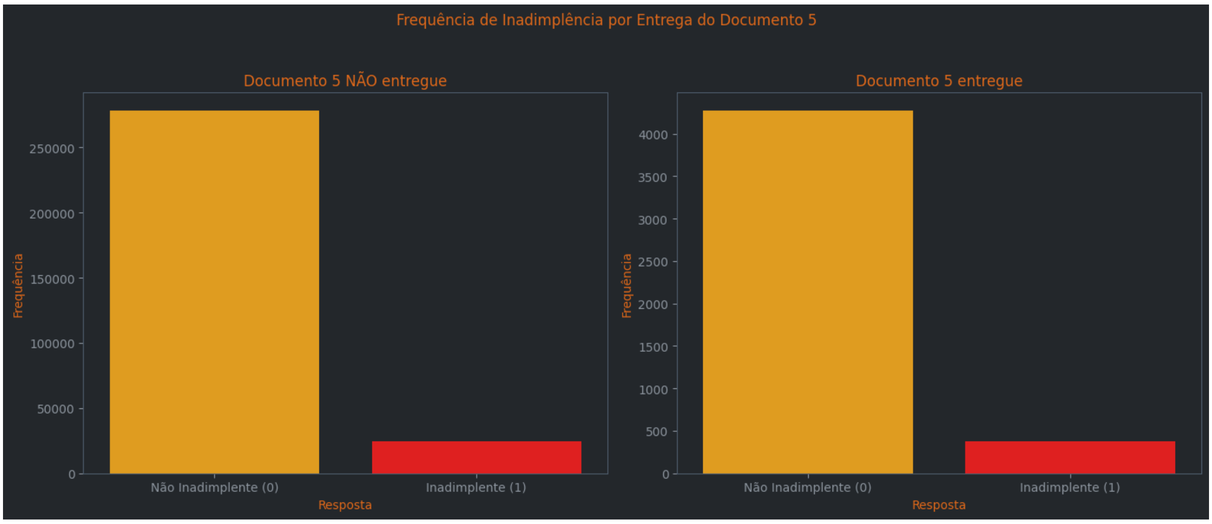



```
V de Cramer entre flag_document_4 e target: 0.0020
```

flag_document_5

In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='flag_document_5',
    label_0='Documento 5 NÃO entregue',
    label_1='Documento 5 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 5'
)
```

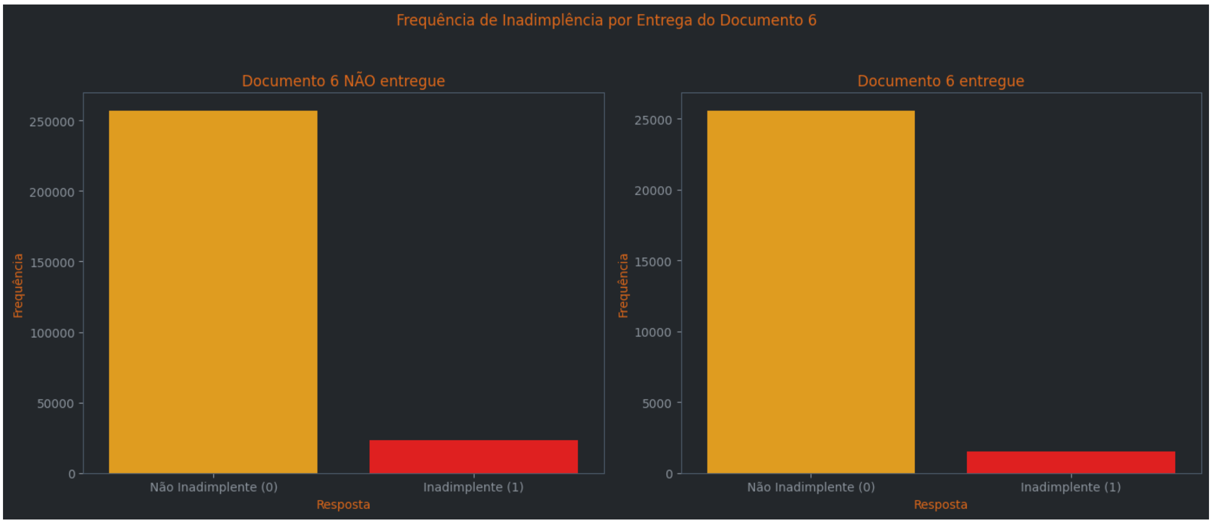
```
calcular_cramers_v(df3, 'flag_document_5', 'target')
```




```
V de Cramer entre flag_document_5 e target: 0.0003
```

flag_document_6

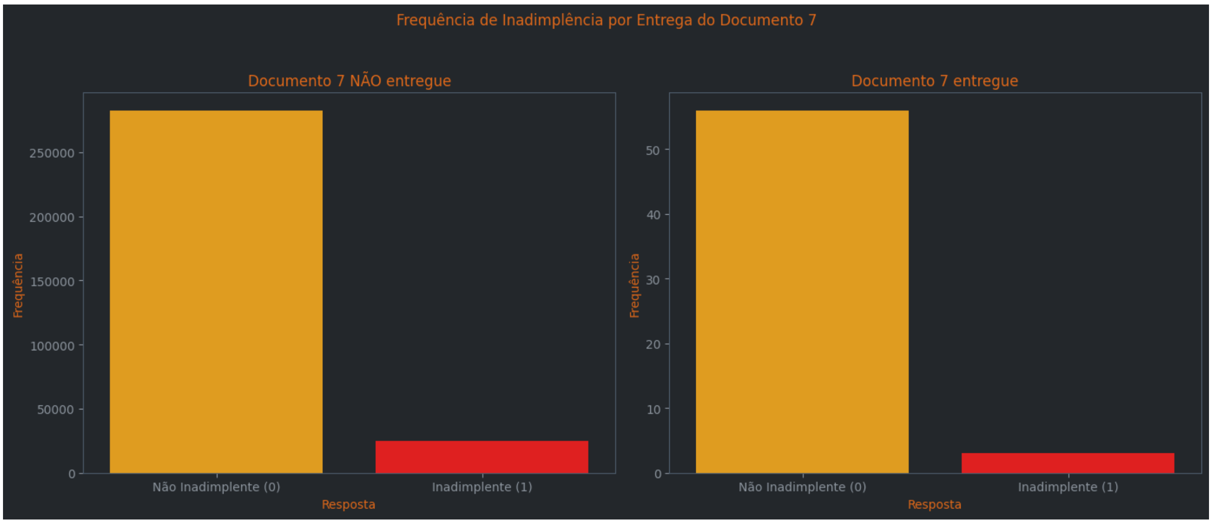
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_6',
            label_0='Documento 6 NÃO entregue',
            label_1='Documento 6 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 6'
        )


        calcular_cramers_v(df3, 'flag_document_6', 'target')
```




```
V de Cramer entre flag_document_6 e target: 0.0286
```

flag_document_7

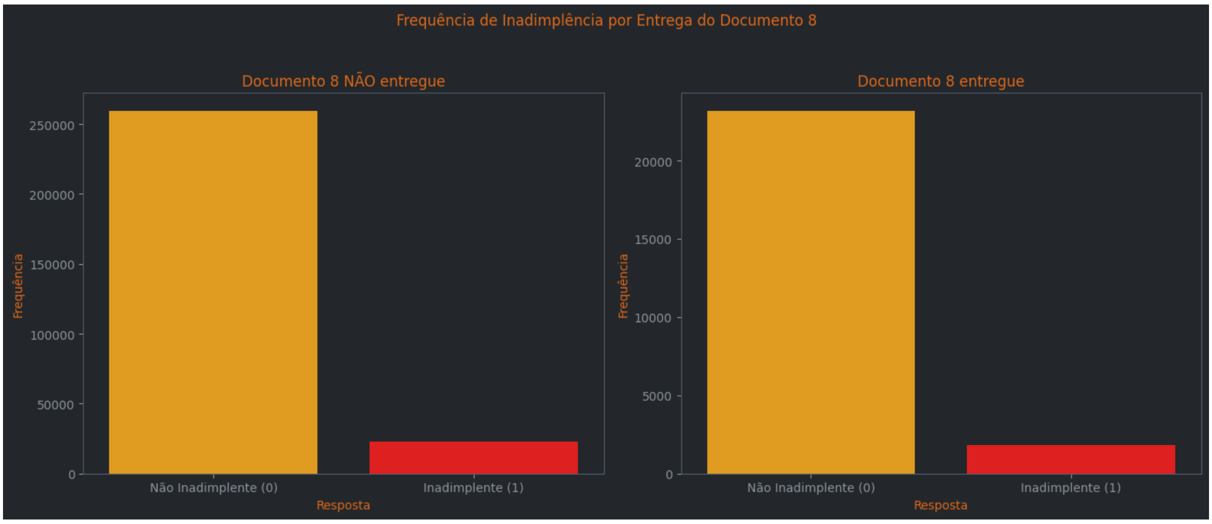
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_7',
            label_0='Documento 7 NÃO entregue',
            label_1='Documento 7 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 7'
        )


        calcular_cramers_v(df3, 'flag_document_7', 'target')
```




```
V de Cramer entre flag_document_7 e target: 0.0011
```

flag_document_8

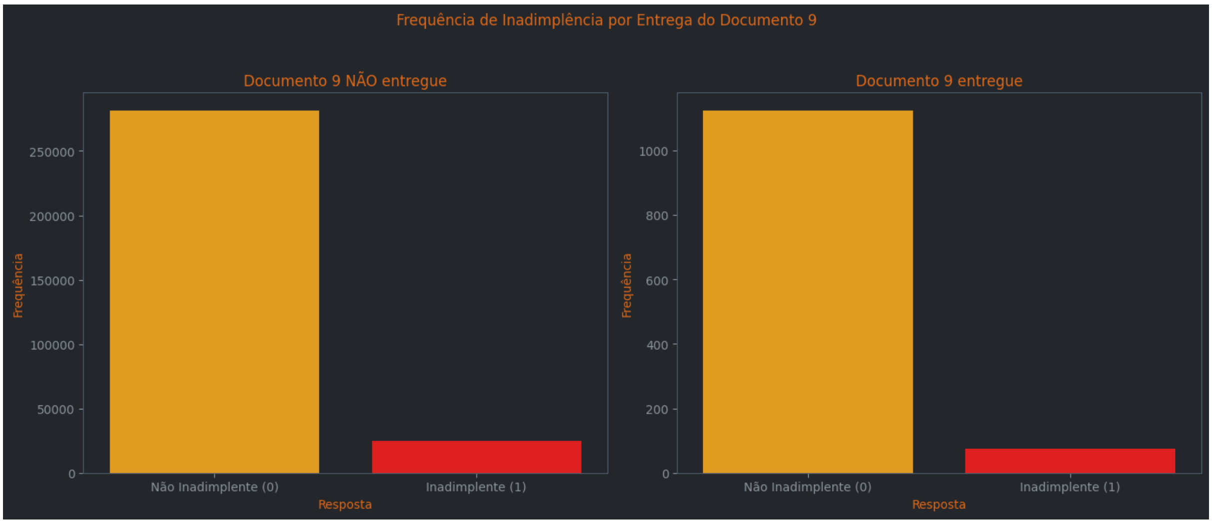
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_8',
            label_0='Documento 8 NÃO entregue',
            label_1='Documento 8 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 8'
        )

        calcular_cramers_v(df3, 'flag_document_8', 'target')
```




```
V de Cramer entre flag_document_8 e target: 0.0080
```

flag_document_9

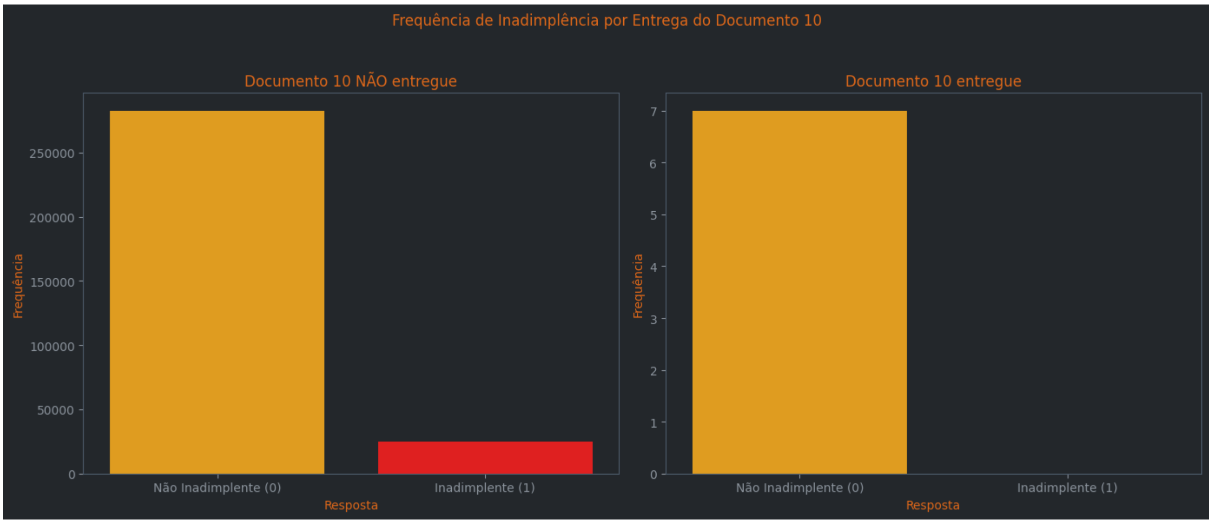
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_9',
            label_0='Documento 9 NÃO entregue',
            label_1='Documento 9 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 9'
        )

        calcular_cramers_v(df3, 'flag_document_9', 'target')
```




```
V de Cramer entre flag_document_9 e target: 0.0043
```

flag_document_10

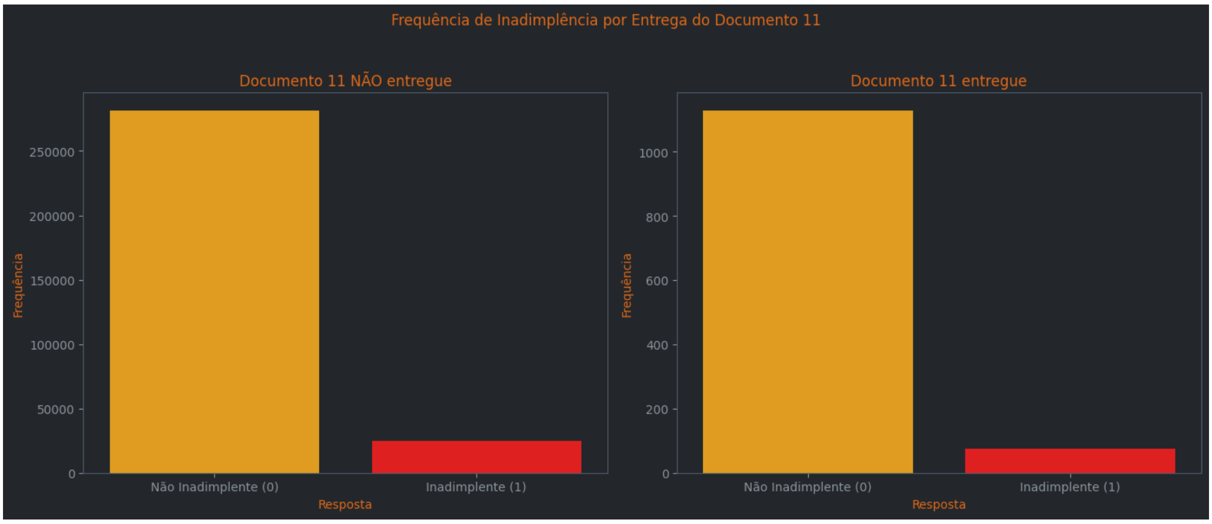
```python
plot_binaria_target(
    df3,
    var_binaria='flag_document_10',
    label_0='Documento 10 NÃO entregue',
    label_1='Documento 10 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 10'
)

calcular_cramers_v(df3, 'flag_document_10', 'target')
```




```
V de Cramer entre flag_document_10 e target: 0.0002
```

flag_document_11

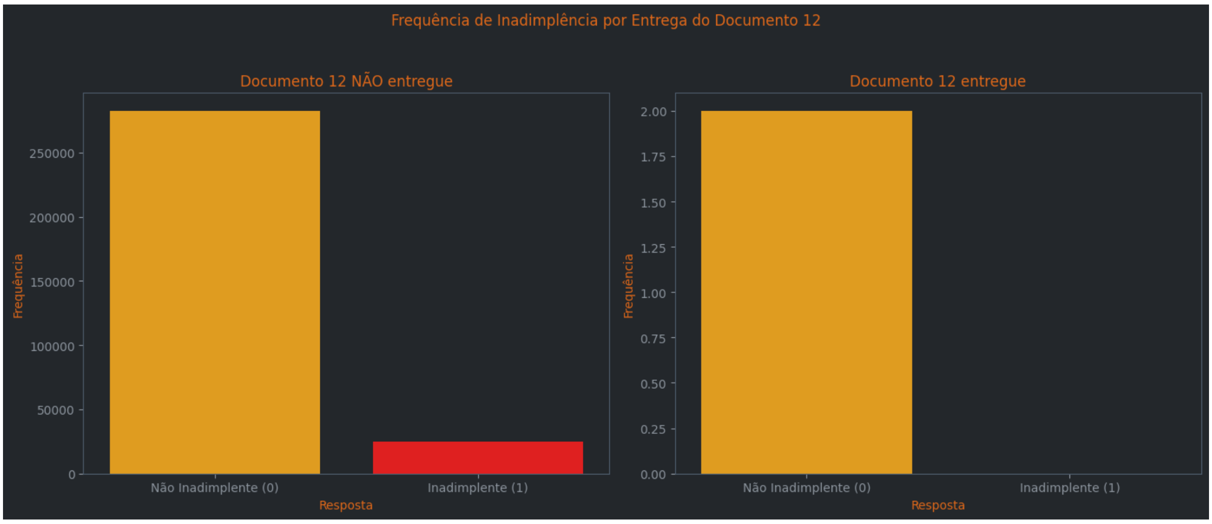
```python
plot_binaria_target(
    df3,
    var_binaria='flag_document_11',
    label_0='Documento 11 NÃO entregue',
    label_1='Documento 11 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 11'
)


calcular_cramers_v(df3, 'flag_document_11', 'target')
```




```
V de Cramer entre flag_document_11 e target: 0.0041
```

flag_document_12

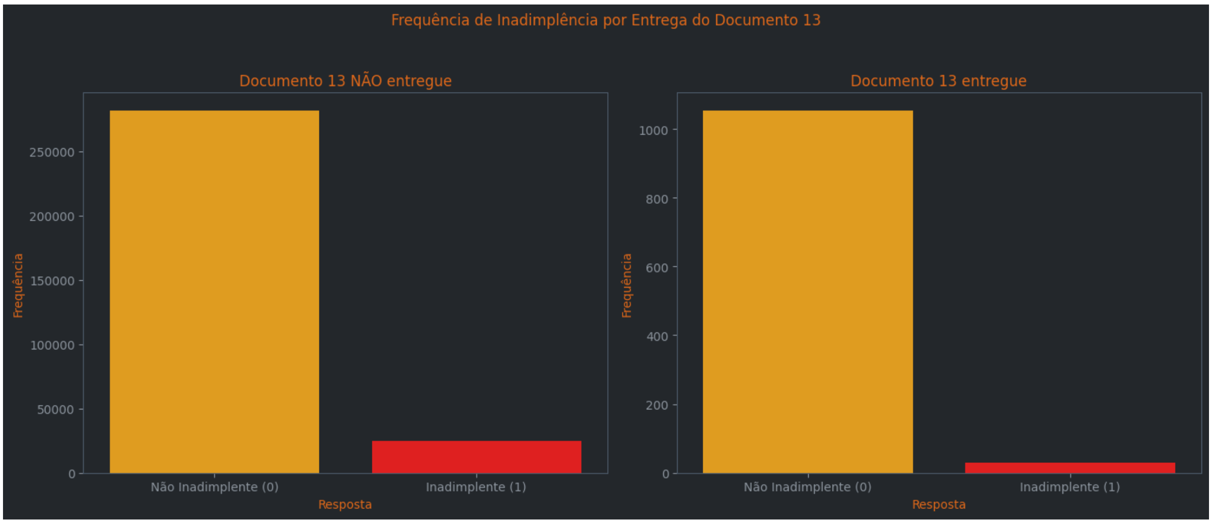
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_12',
            label_0='Documento 12 NÃO entregue',
            label_1='Documento 12 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 12'
        )

        calcular_cramers_v(df3, 'flag_document_12', 'target')
```




```
V de Cramer entre flag_document_12 e target: 0.0000
```

flag_document_13

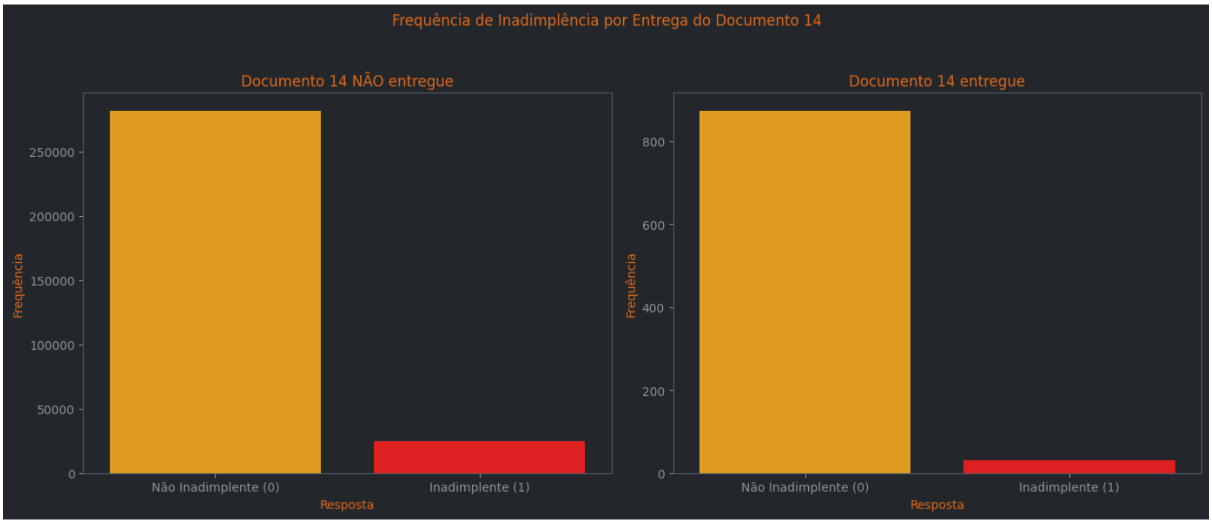
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_13',
            label_0='Documento 13 NÃO entregue',
            label_1='Documento 13 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 13'
        )
        calcular_cramers_v(df3, 'flag_document_13', 'target')
```




```
V de Cramer entre flag_document_13 e target: 0.0115
```

flag_document_14

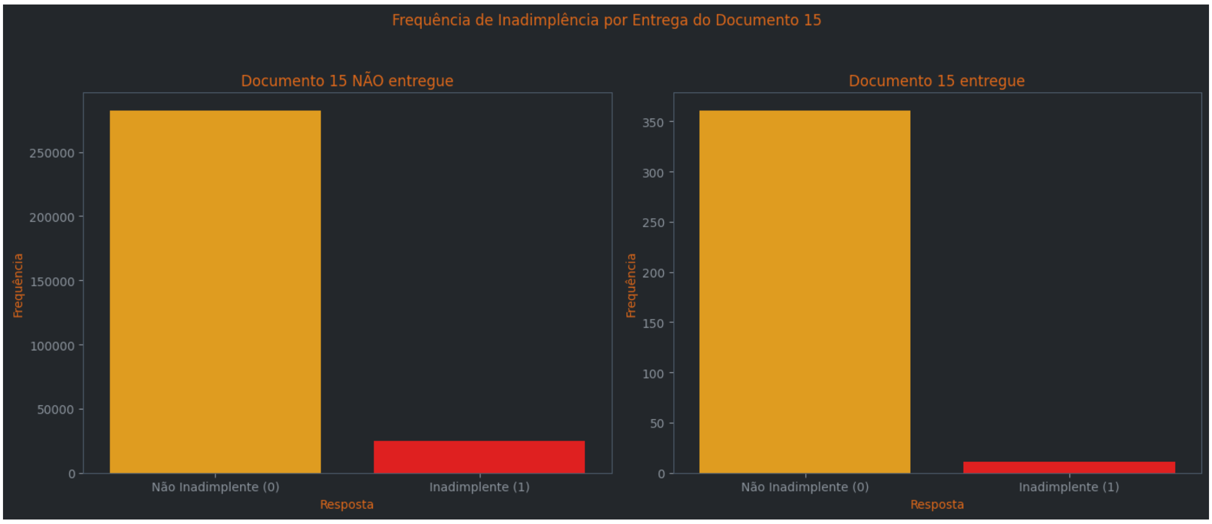
```
In [ ]: plot_binaria_target(
    df3,
    var_binaria='flag_document_14',
    label_0='Documento 14 NÃO entregue',
    label_1='Documento 14 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 14'
)
calcular_cramers_v(df3, 'flag_document_14', 'target')
```




```
V de Cramer entre flag_document_14 e target: 0.0094
```

flag_document_15

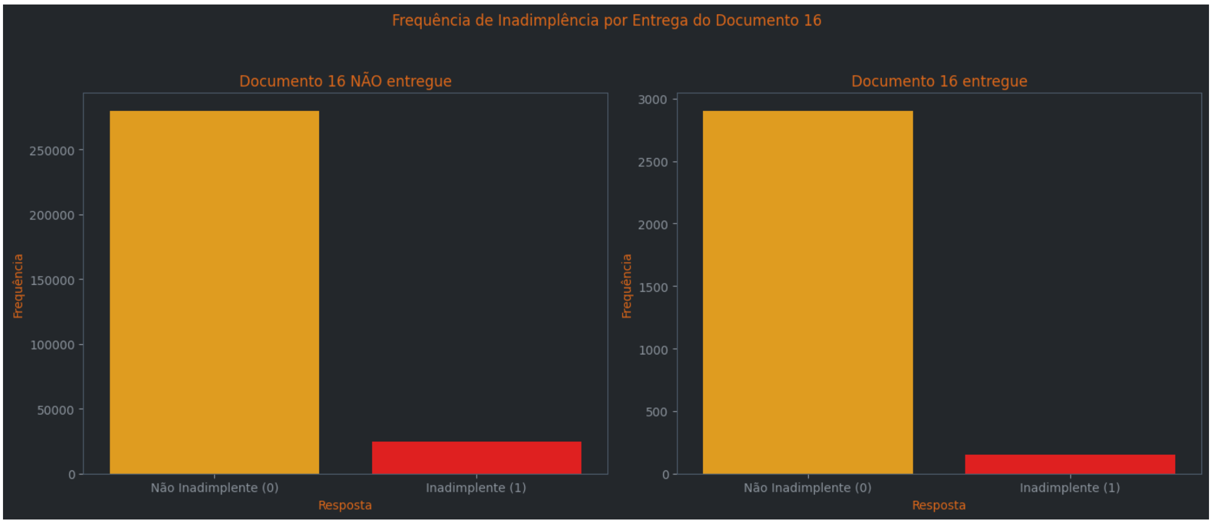
```
In [ ]: plot_binaria_target(
    df3,
    var_binaria='flag_document_15',
    label_0='Documento 15 NÃO entregue',
    label_1='Documento 15 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 15'
)
calcular_cramers_v(df3, 'flag_document_15', 'target')
```




```
V de Cramer entre flag_document_15 e target: 0.0064
```

flag_document_16

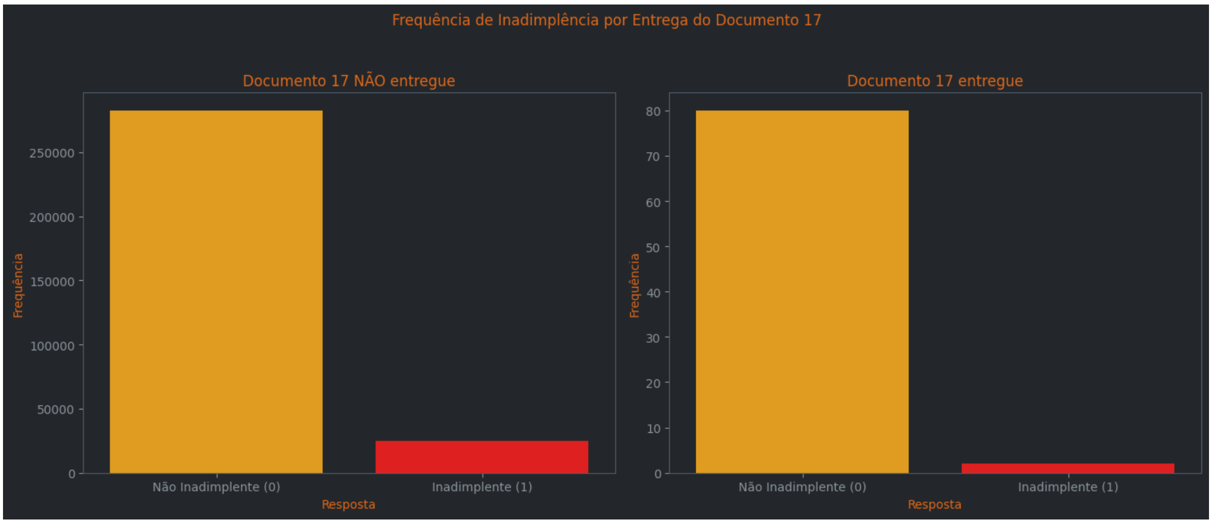
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_16',
            label_0='Documento 16 NÃO entregue',
            label_1='Documento 16 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 16'
        )

        calcular_cramers_v(df3, 'flag_document_16', 'target')
```




```
V de Cramer entre flag_document_16 e target: 0.0116
```

flag_document_17

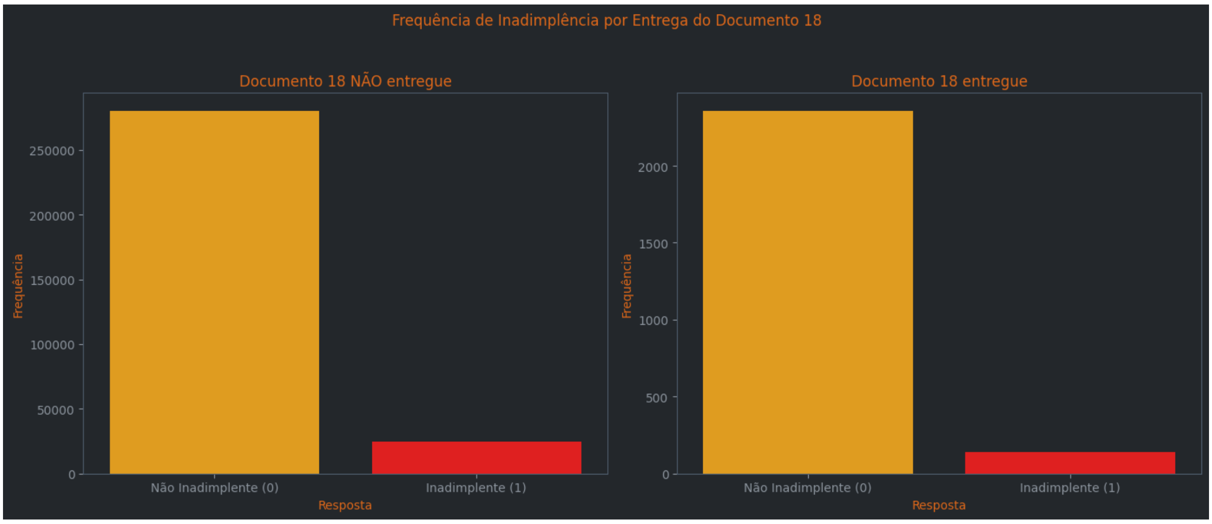
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_17',
            label_0='Documento 17 NÃO entregue',
            label_1='Documento 17 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 17'
        )
        calcular_cramers_v(df3, 'flag_document_17', 'target')
```




V de Cramer entre flag_document_17 e target: 0.0030

flag_document_18

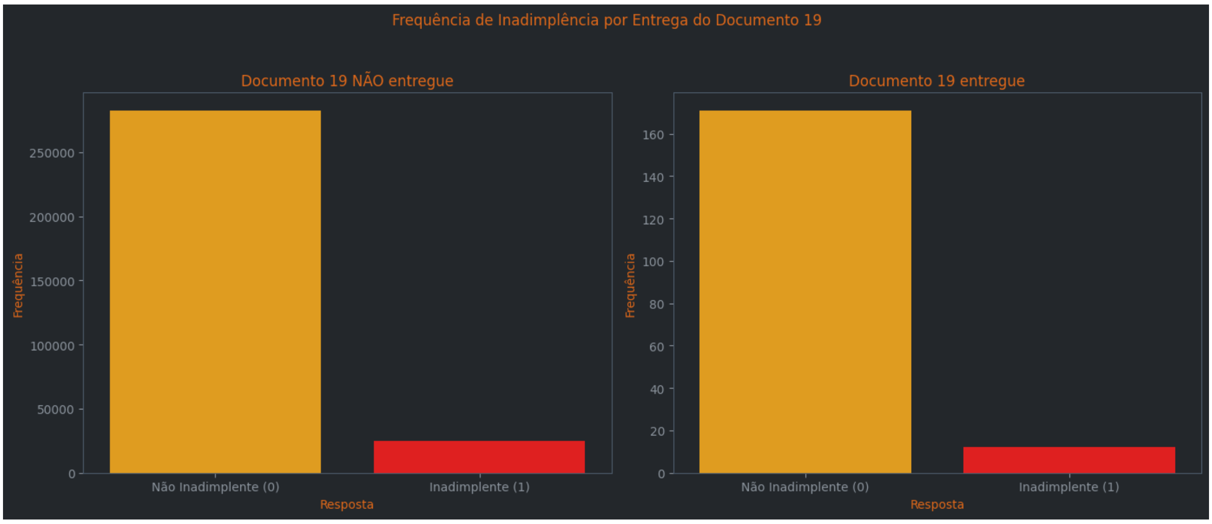
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_18',
            label_0='Documento 18 NÃO entregue',
            label_1='Documento 18 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 18'
        )

        calcular_cramers_v(df3, 'flag_document_18', 'target')
```




V de Cramer entre flag_document_18 e target: 0.0079

flag_document_19

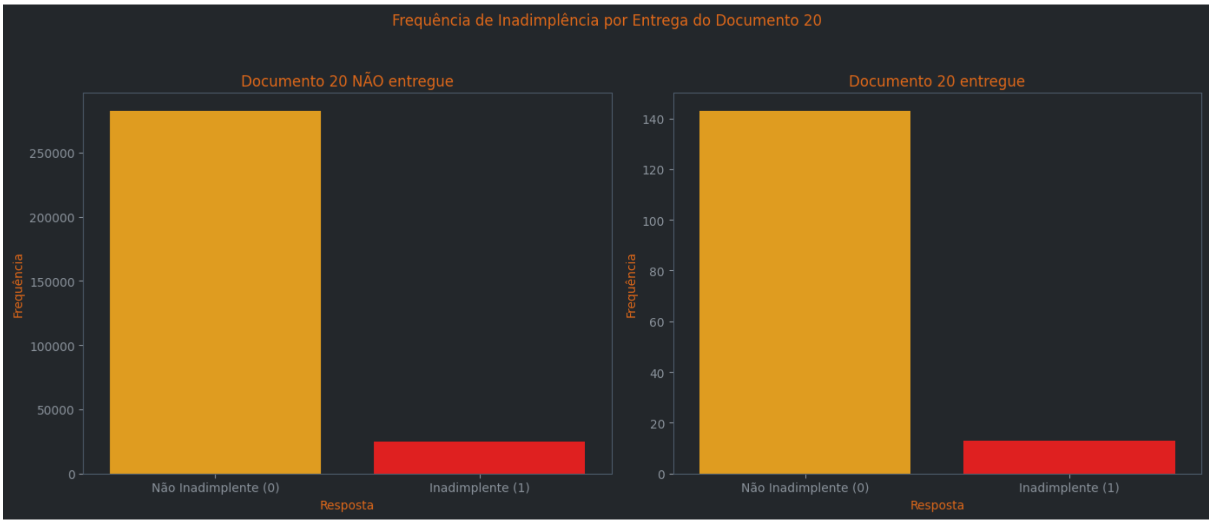
```
In [ ]: plot_binaria_target(
            df3,
            var_binaria='flag_document_19',
            label_0='Documento 19 NÃO entregue',
            label_1='Documento 19 entregue',
            suptitle='Frequência de Inadimplência por Entrega do Documento 19'
        )

        calcular_cramers_v(df3, 'flag_document_19', 'target')
```




```
V de Cramer entre flag_document_19 e target: 0.0011
```

flag_document_20

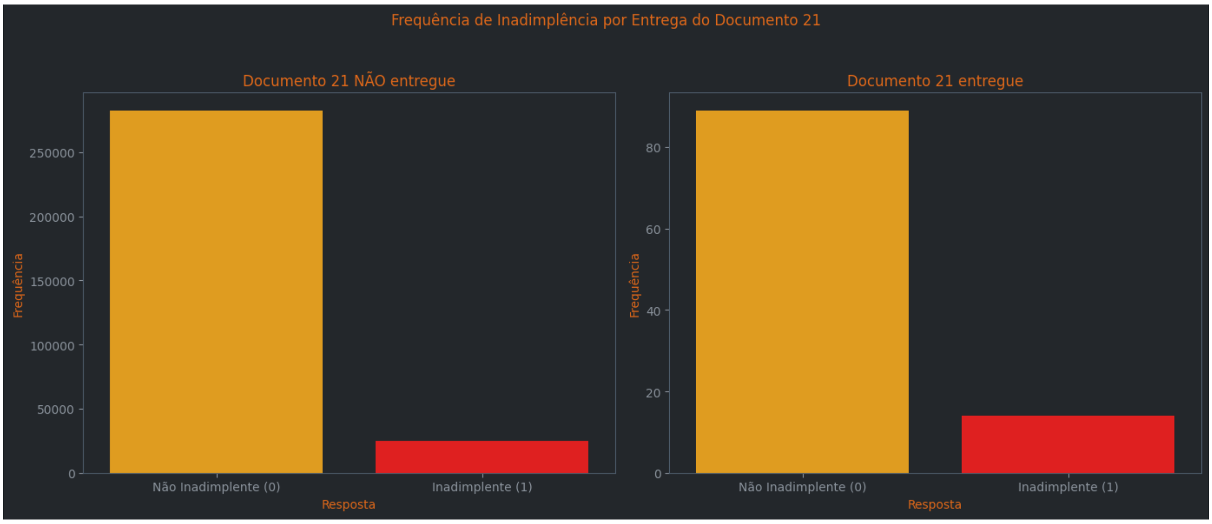
In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='flag_document_20',
    label_0='Documento 20 NÃO entregue',
    label_1='Documento 20 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 20'
)

calcular_cramers_v(df3, 'flag_document_20', 'target')
```




```
V de Cramer entre flag_document_20 e target: 0.0000
```

flag_document_21

In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='flag_document_21',
    label_0='Documento 21 NÃO entregue',
    label_1='Documento 21 entregue',
    suptitle='Frequência de Inadimplência por Entrega do Documento 21'
)
calcular_cramers_v(df3, 'flag_document_21', 'target')
```



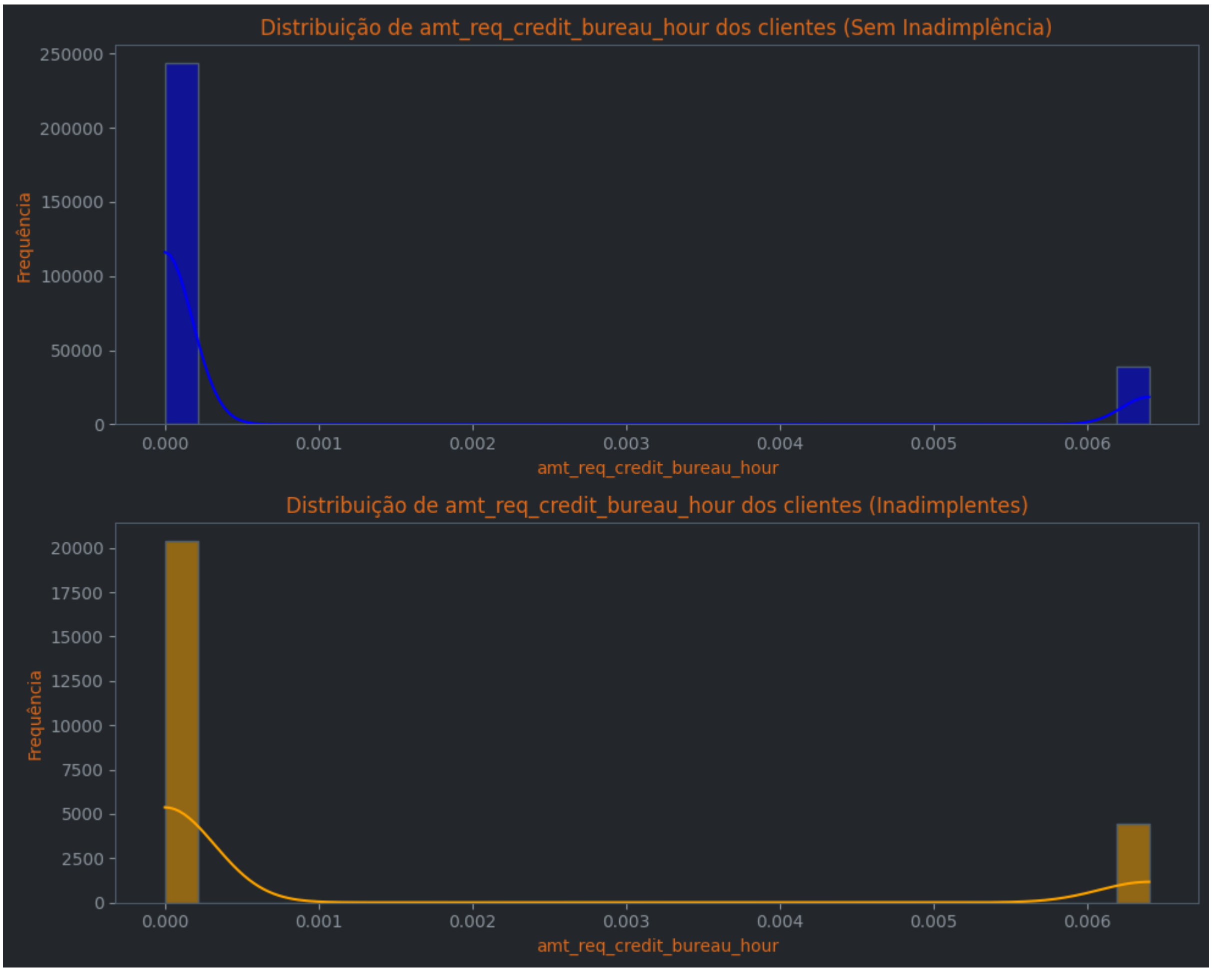

```
V de Cramer entre flag_document_21 e target: 0.0034
```

## Block 4 Hypotesis

H48 — Credit inquiry history and credit amounts influence the probability of default. TRUE

amt_req_credit_bureau_hour

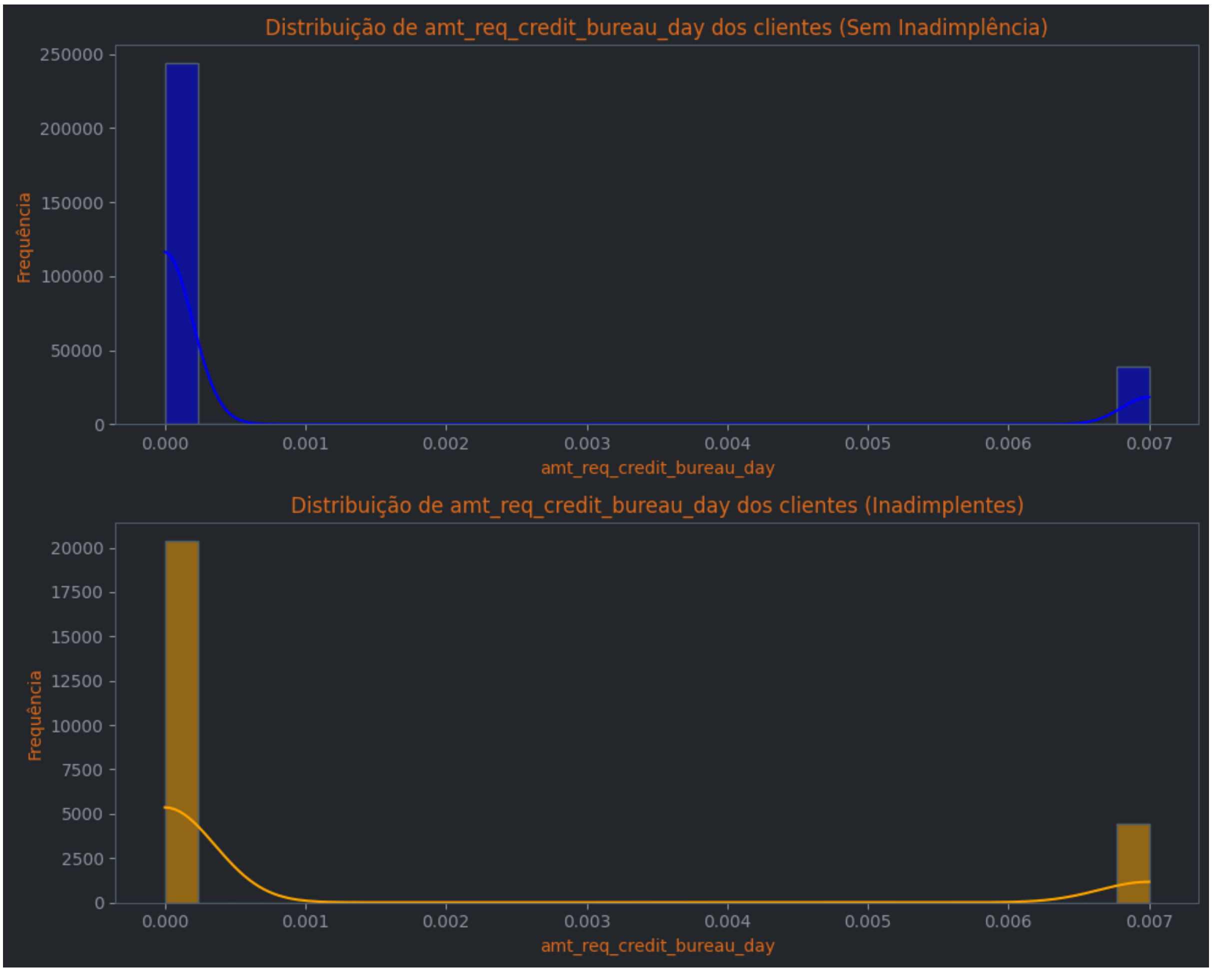
In [ ]:
```
plot_num_var_by_target(
    df3,
    num_var='amt_req_credit_bureau_hour',
    title_0='Distribuição de amt_req_credit_bureau_hour dos clientes (Sem Inadimplência)',
    title_1='Distribuição de amt_req_credit_bureau_hour dos clientes (Inadimplentes)',
    label_x='amt_req_credit_bureau_hour',
    discrete=True
)

# Correlação de amt_req_credit_bureau_hour com a target
pearson_corr = df3['amt_req_credit_bureau_hour'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre amt_req_credit_bureau_hour e target: {pearson_corr:.4f}")
```




```
Correlação de Pearson entre amt_req_credit_bureau_hour e target: 0.0323
```

amt_req_credit_bureau_day

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_req_credit_bureau_day',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_req_credit_bureau_day dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_req_credit_bureau_day')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_req_credit_bureau_day',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_req_credit_bureau_day dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_req_credit_bureau_day')

plt.tight_layout()
plt.show()


pearson_corr = df3['amt_req_credit_bureau_day'].corr(df3['target'], method='pearson')
print(f"Correlação de Pearson entre amt_req_credit_bureau_day e target: {pearson_corr:.4f}")
```

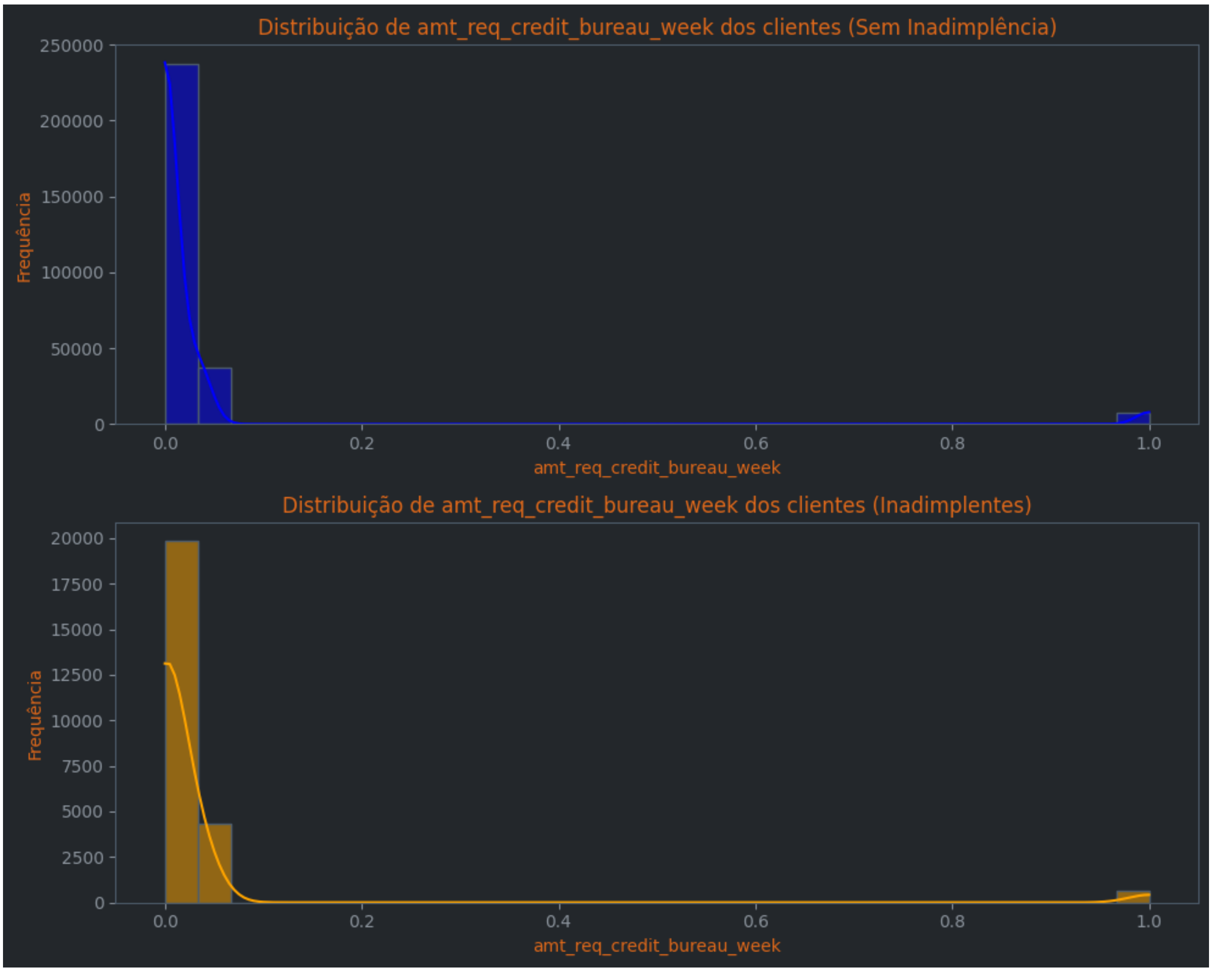



```
Correlação de Pearson entre amt_req_credit_bureau_day e target: 0.0331
```

amt_req_credit_bureau_week

```
In [ ]: fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_req_credit_bureau_week',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_req_credit_bureau_week dos clientes (Sem Inadimplência)'
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_req_credit_bureau_week')


sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_req_credit_bureau_week',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_req_credit_bureau_week dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_req_credit_bureau_week')

plt.tight_layout()
plt.show()


pearson_corr = df3['amt_req_credit_bureau_week'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_req_credit_bureau_week e target: {pearson_corr:.4f}")
```

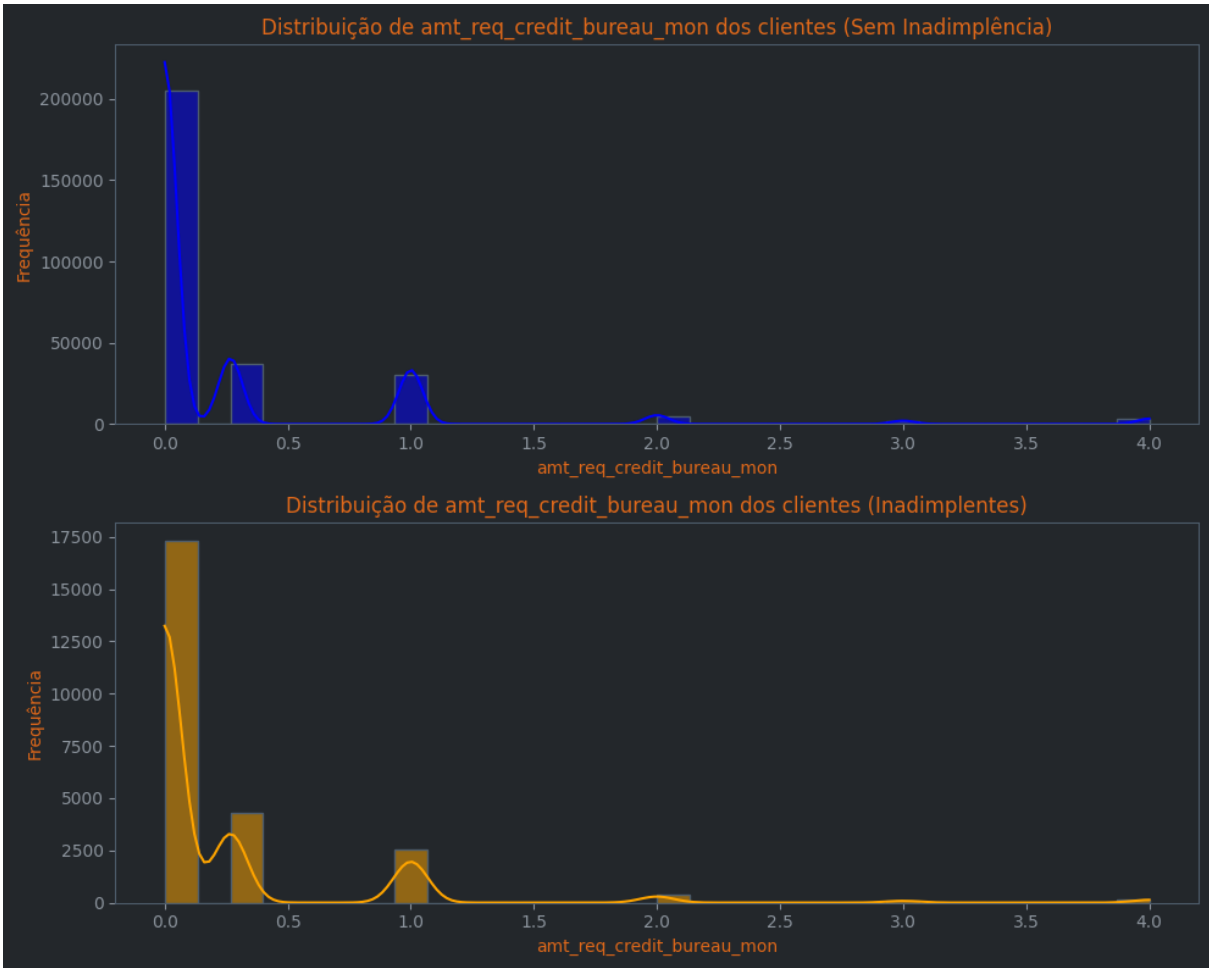



```
Correlação de Pearson entre amt_req_credit_bureau_week e target: 0.0008
```

amt_req_credit_bureau_mon

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_req_credit_bureau_mon',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_req_credit_bureau_mon dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_req_credit_bureau_mon')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_req_credit_bureau_mon',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_req_credit_bureau_mon dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_req_credit_bureau_mon')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_req_credit_bureau_mon'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_req_credit_bureau_mon e target: {pearson_corr:.4f}")
```

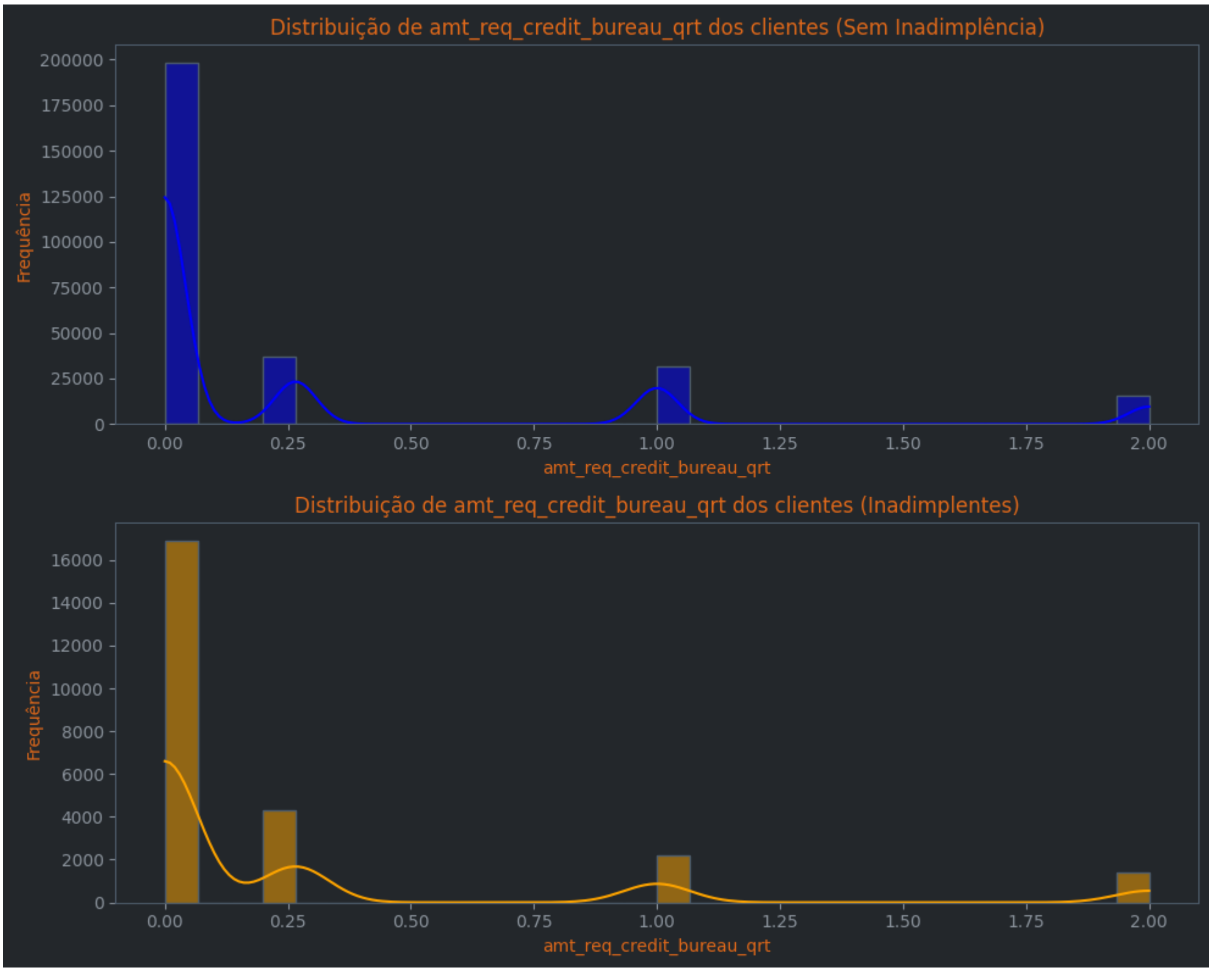



```
Correlação de Pearson entre amt_req_credit_bureau_mon e target: -0.0099
```

amt_req_credit_bureau_qrt

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_req_credit_bureau_qrt',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_req_credit_bureau_qrt dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_req_credit_bureau_qrt')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_req_credit_bureau_qrt',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_req_credit_bureau_qrt dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_req_credit_bureau_qrt')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_req_credit_bureau_qrt'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_req_credit_bureau_qrt e target: {pearson_corr:.4f}")
```

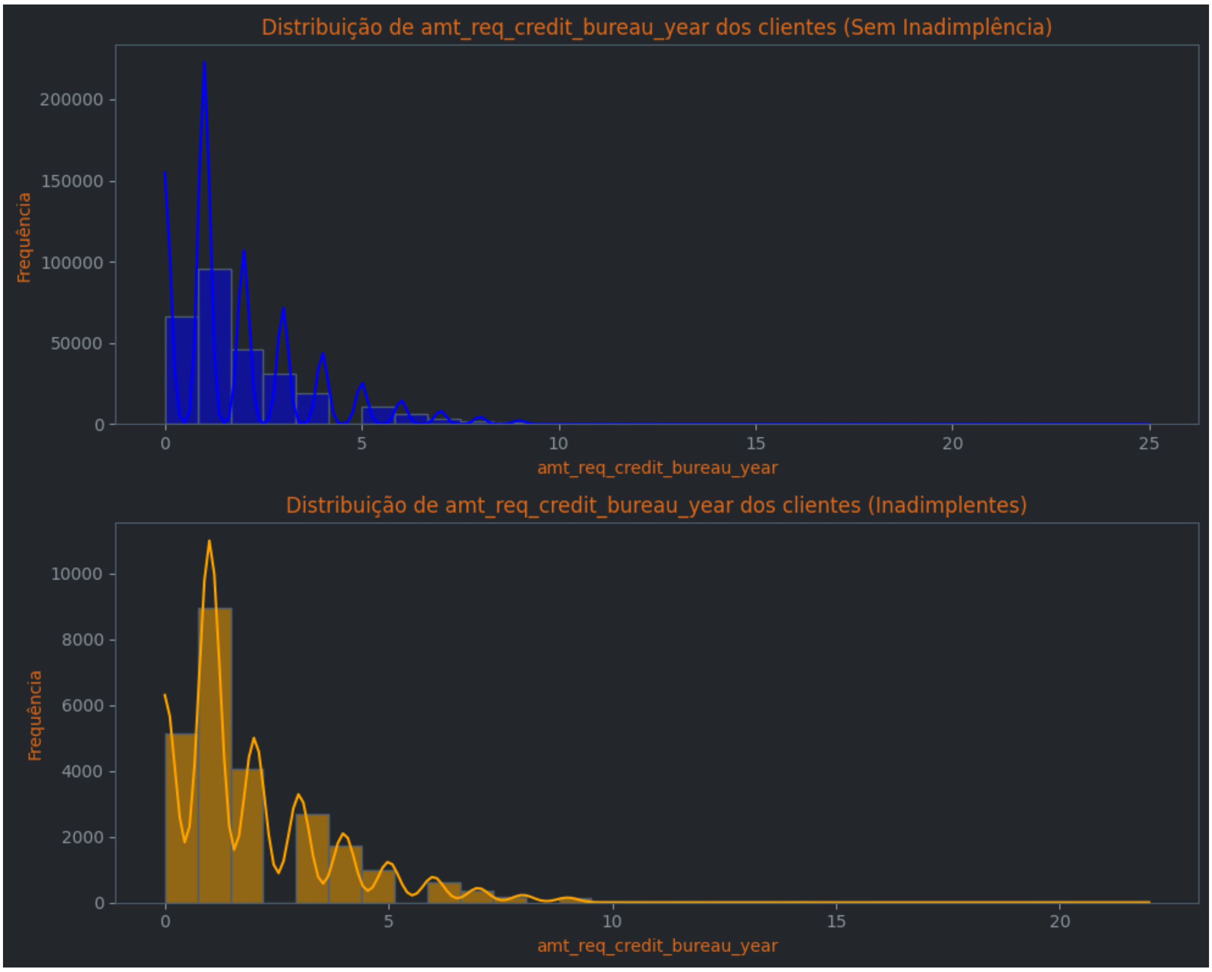



```
Correlação de Pearson entre amt_req_credit_bureau_qrt e target: -0.0035
```

amt_req_credit_bureau_year

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_req_credit_bureau_year',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_req_credit_bureau_year dos clientes (Sem Inadimplência)'
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_req_credit_bureau_year')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_req_credit_bureau_year',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_req_credit_bureau_year dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_req_credit_bureau_year')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_req_credit_bureau_year'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_req_credit_bureau_year e target: {pearson_corr:.4f}")
```

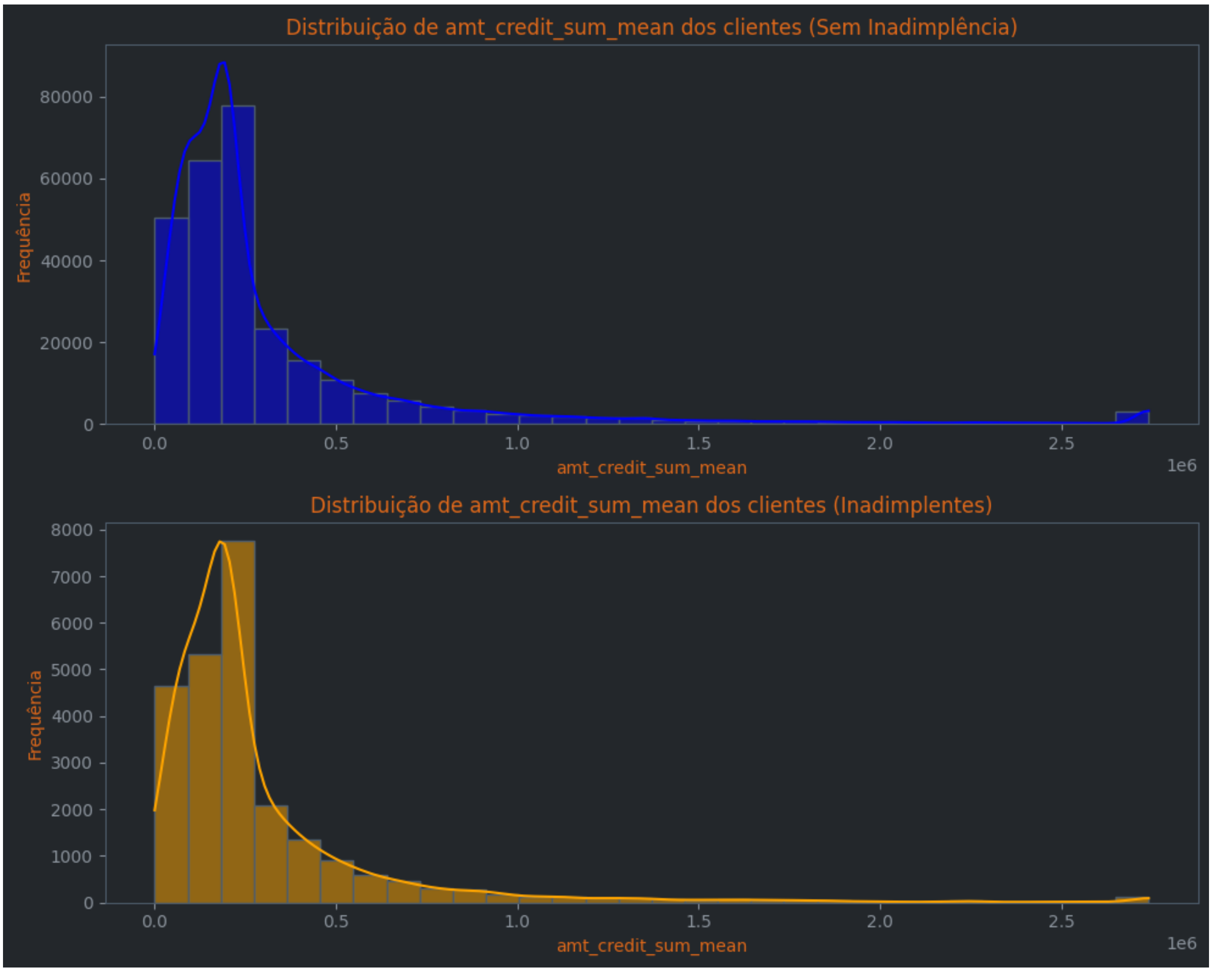



```
Correlação de Pearson entre amt_req_credit_bureau_year e target: 0.0122
```

amt_credit_sum_mean

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_credit_sum_mean',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_credit_sum_mean dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_credit_sum_mean')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_credit_sum_mean',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_credit_sum_mean dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_credit_sum_mean')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_credit_sum_mean'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_credit_sum_mean e target: {pearson_corr:.4f}")
```

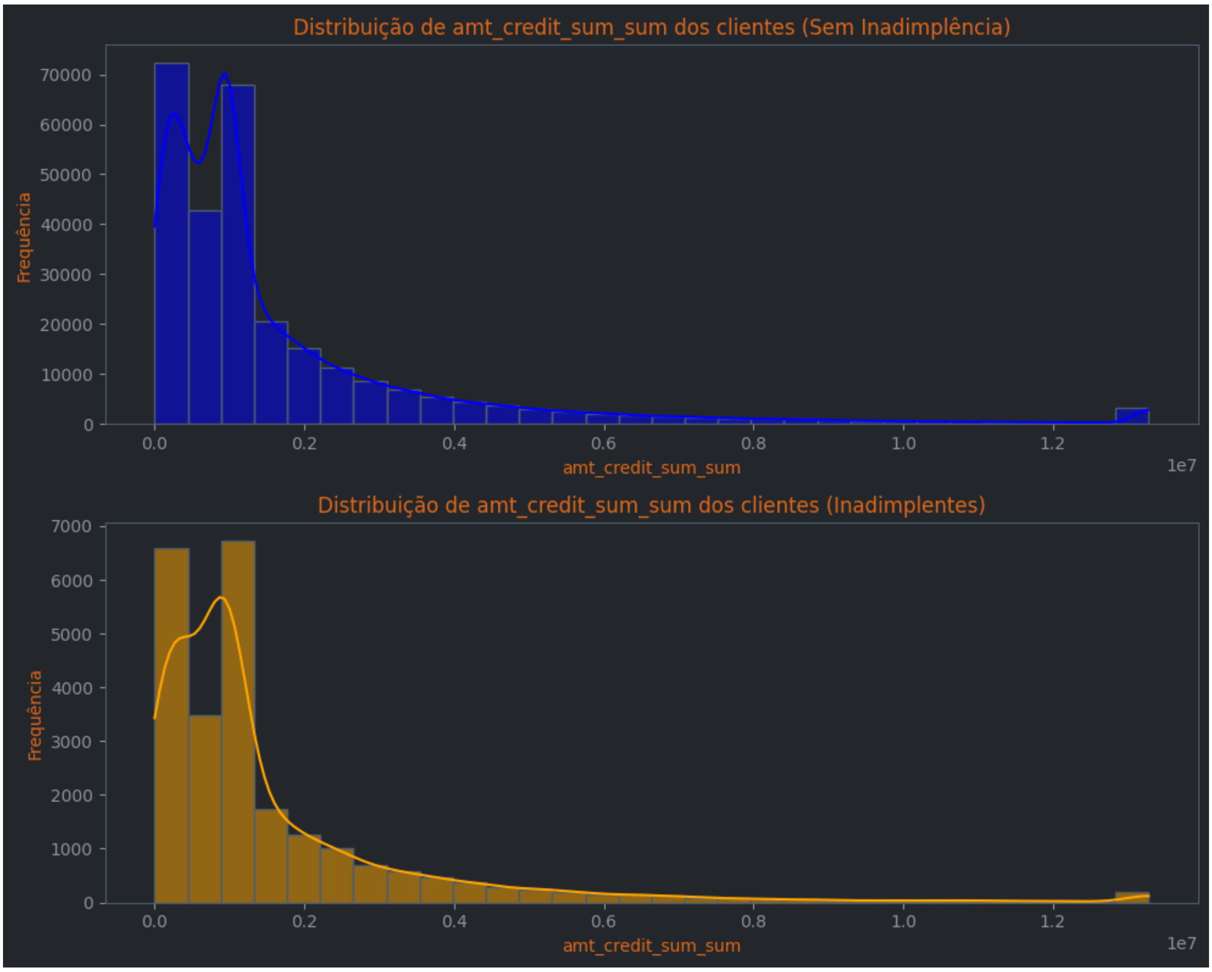



```
Correlação de Pearson entre amt_credit_sum_mean e target: -0.0289
```

amt_credit_sum_sum

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_credit_sum_sum',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_credit_sum_sum dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_credit_sum_sum')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_credit_sum_sum',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_credit_sum_sum dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_credit_sum_sum')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_credit_sum_sum'].corr(df3['target'], method='pearson')
```

```python
print(f"Correlação de Pearson entre amt_credit_sum_sum e target: {pearson_corr:.4f}")
```

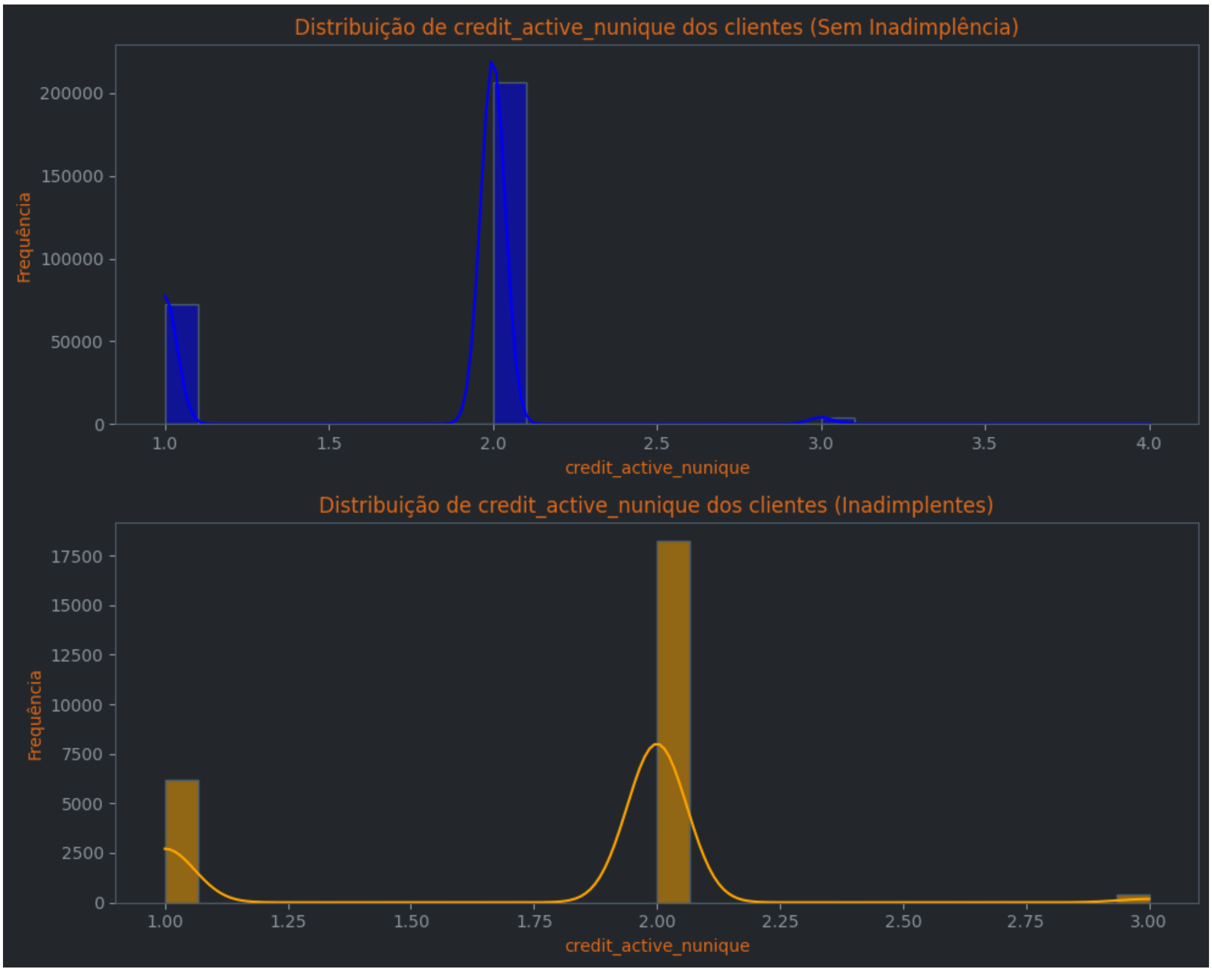



```
Correlação de Pearson entre amt_credit_sum_sum e target: -0.0198
```

credit_active_nunique

In [ ]:
```python
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='credit_active_nunique',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de credit_active_nunique dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('credit_active_nunique')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='credit_active_nunique',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de credit_active_nunique dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('credit_active_nunique')

plt.tight_layout()
plt.show()

pearson_corr = df3['credit_active_nunique'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre credit_active_nunique e target: {pearson_corr:.4f}")
```

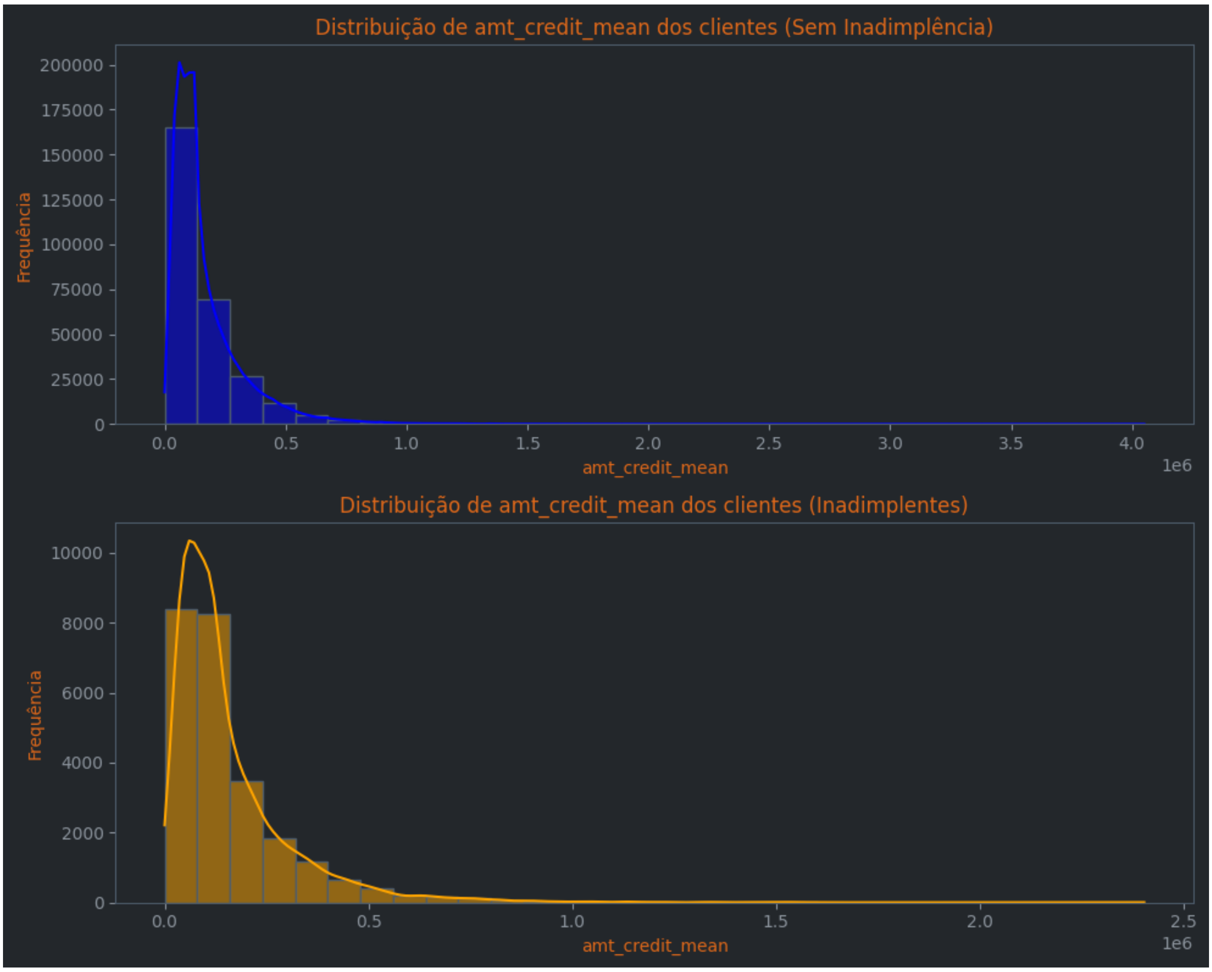



```
Correlação de Pearson entre credit_active_nunique e target: 0.0060
```

amt_credit_mean

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_credit_mean',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_credit_mean dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_credit_mean')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_credit_mean',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_credit_mean dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_credit_mean')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_credit_mean'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_credit_mean e target: {pearson_corr:.4f}")
```

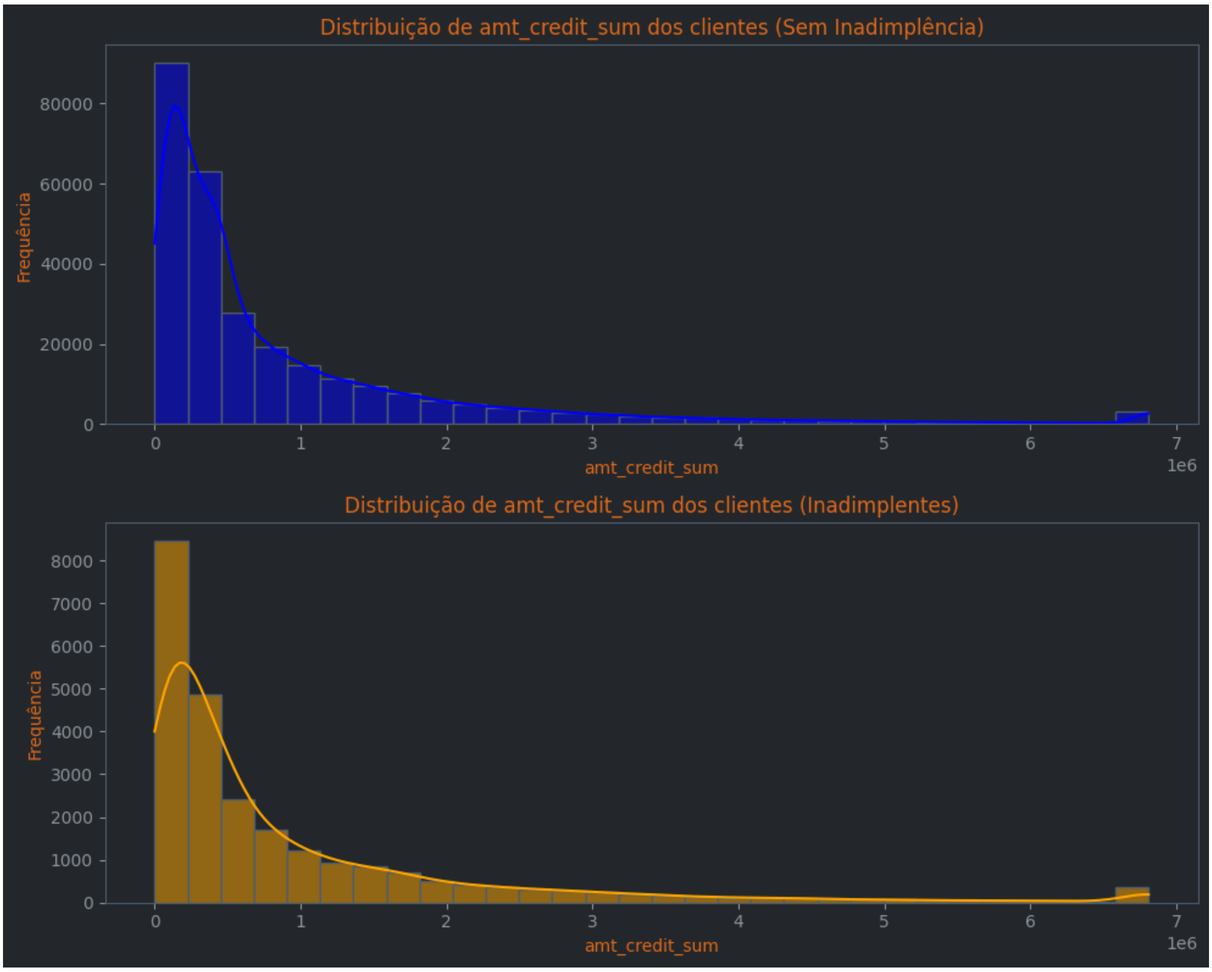



```
Correlação de Pearson entre amt_credit_mean e target: -0.0144
```

amt_credit_sum

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_credit_sum',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_credit_sum dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_credit_sum')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_credit_sum',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_credit_sum dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_credit_sum')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_credit_sum'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_credit_sum e target: {pearson_corr:.4f}")
```

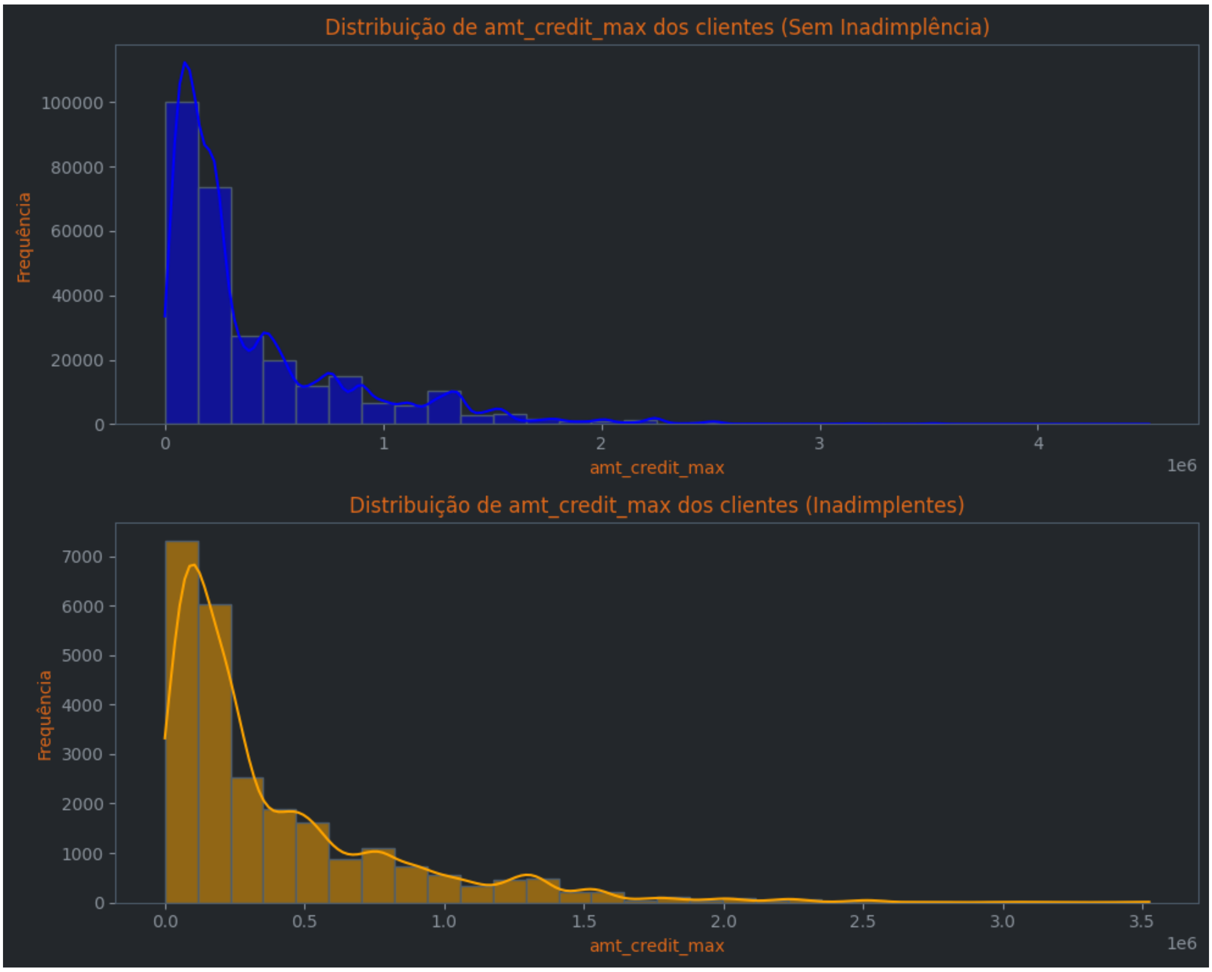



```
Correlação de Pearson entre amt_credit_sum e target: 0.0076
```

amt_credit_max

```
In [ ]: fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_credit_max',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_credit_max dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_credit_max')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_credit_max',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_credit_max dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_credit_max')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_credit_max'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_credit_max e target: {pearson_corr:.4f}")
```

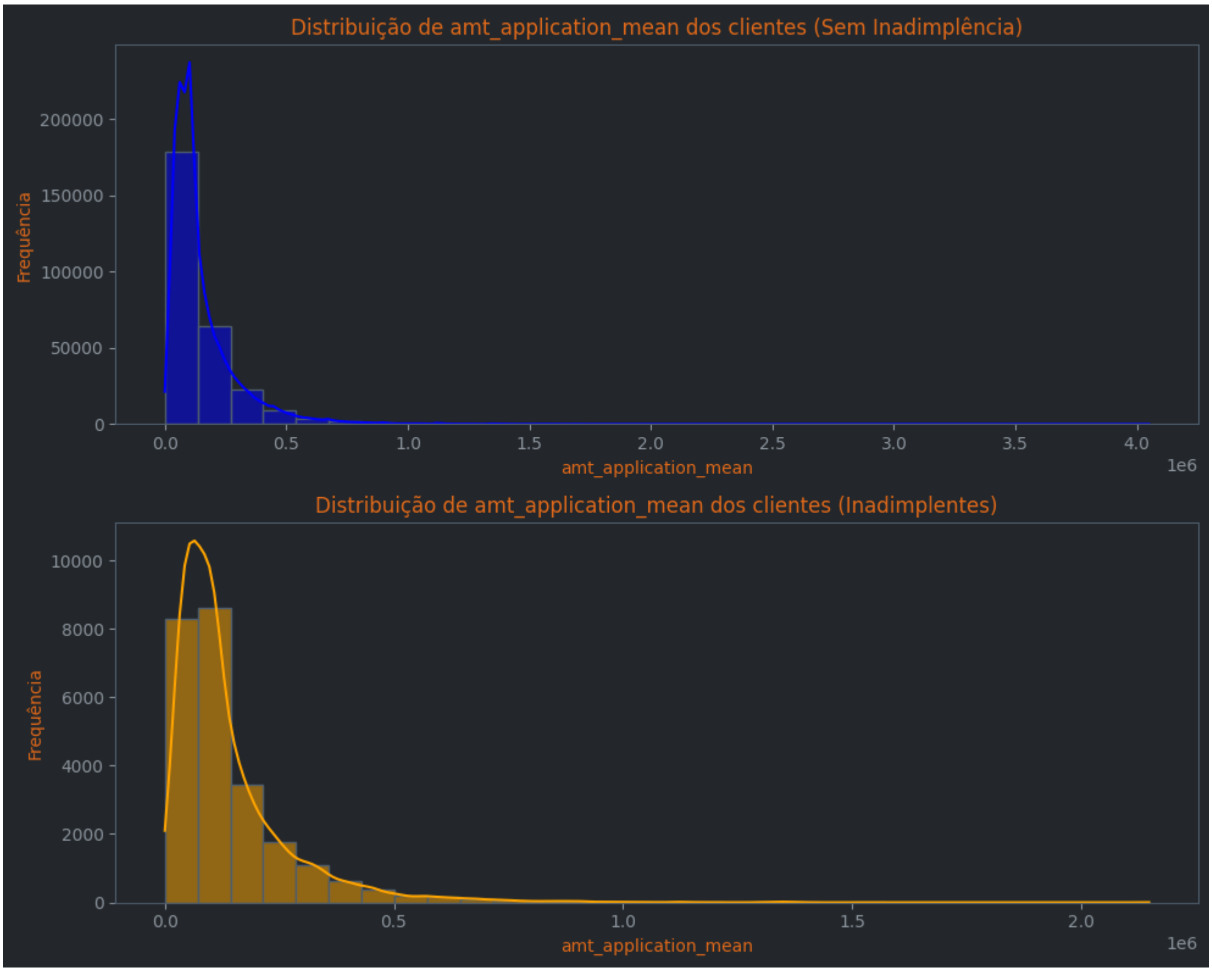



```
Correlação de Pearson entre amt_credit_max e target: -0.0065
```

amt_application_mean

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='amt_application_mean',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de amt_application_mean dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('amt_application_mean')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='amt_application_mean',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de amt_application_mean dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('amt_application_mean')

plt.tight_layout()
plt.show()

pearson_corr = df3['amt_application_mean'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre amt_application_mean e target: {pearson_corr:.4f}")
```

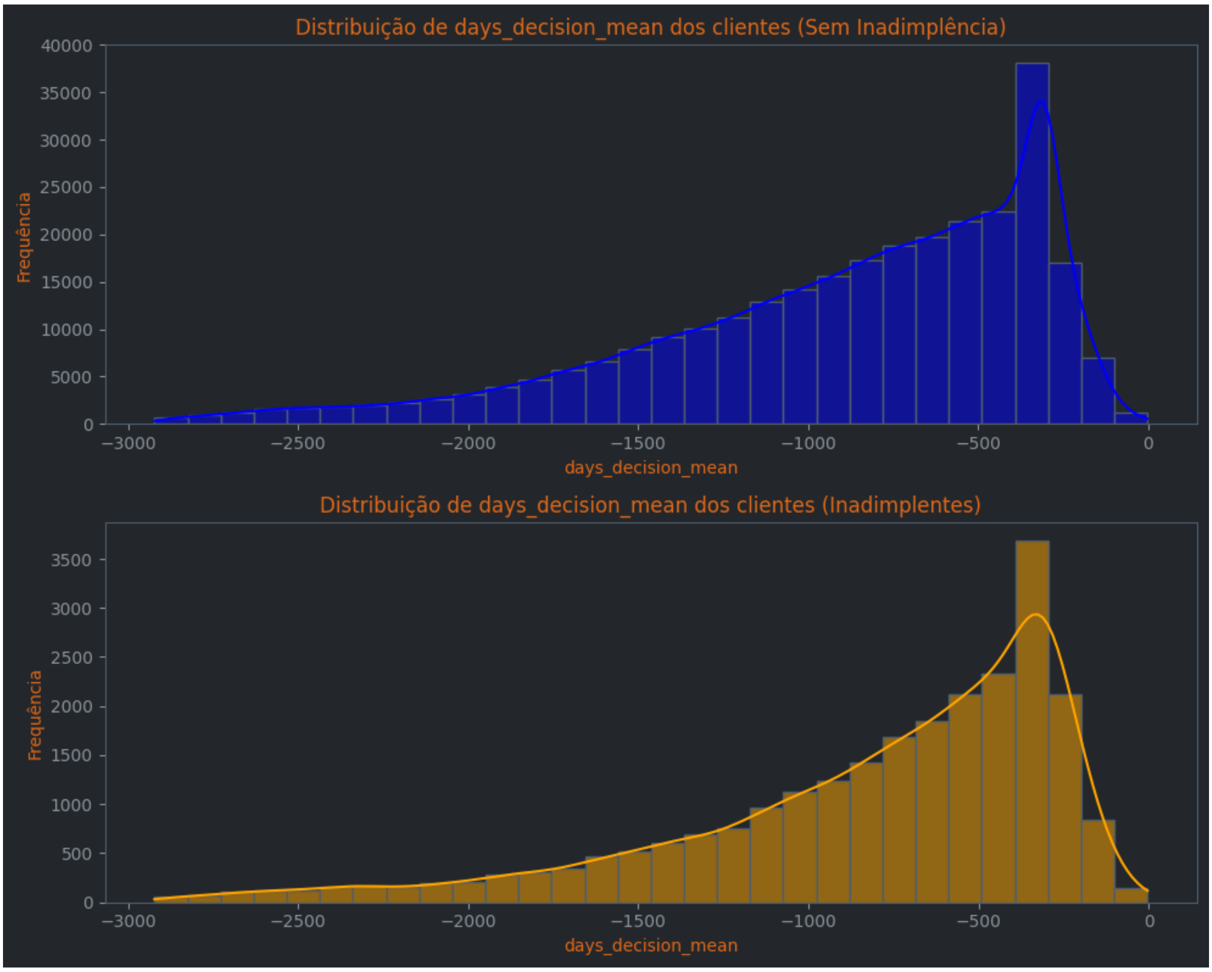



```
Correlação de Pearson entre amt_application_mean e target: -0.0200
```

days_decision_mean

In [ ]:
```
fig, axes = plt.subplots(2, 1, figsize=(10, 8), sharey=False)

sns.histplot(
    data=df3[df3['target'] == 0],
    x='days_decision_mean',
    color='blue',
    ax=axes[0],
    kde=True,
    bins=30
)
axes[0].set_title('Distribuição de days_decision_mean dos clientes (Sem Inadimplência)')
axes[0].set_ylabel('Frequência')
axes[0].set_xlabel('days_decision_mean')

sns.histplot(
    data=df3[df3['target'] == 1],
    x='days_decision_mean',
    color='orange',
    ax=axes[1],
    kde=True,
    bins=30
)
axes[1].set_title('Distribuição de days_decision_mean dos clientes (Inadimplentes)')
axes[1].set_ylabel('Frequência')
axes[1].set_xlabel('days_decision_mean')

plt.tight_layout()
plt.show()

pearson_corr = df3['days_decision_mean'].corr(df3['target'], method='pearson')
```

```
print(f"Correlação de Pearson entre days_decision_mean e target: {pearson_corr:.4f}")
```

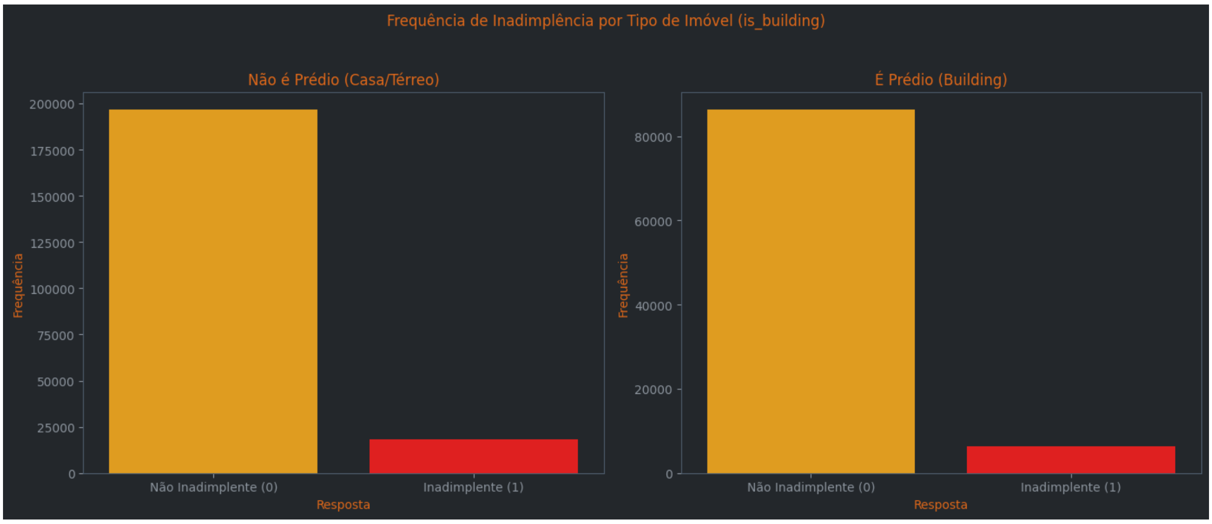



```
Correlação de Pearson entre days_decision_mean e target: 0.0402
```

H49 — Property characteristics and employment status influence repayment capacity. TRUE

is_building

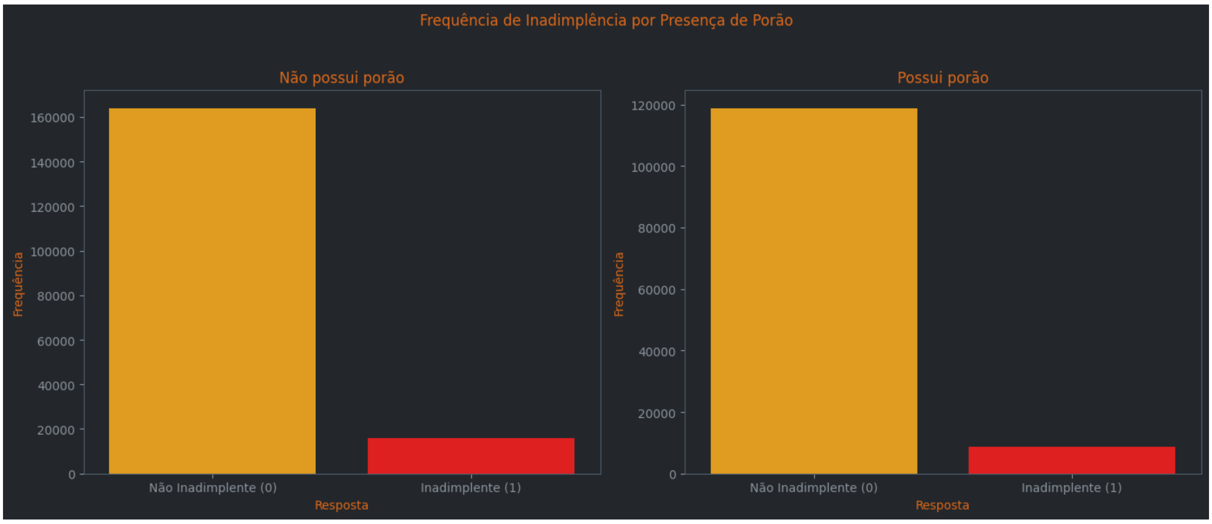
In [ ]:
```
plot_binaria_target(
    df3,
    var_binaria='is_building',
    label_0='Não é Prédio',
    label_1='É Prédio',
    suptitle='Frequência de Inadimplência por tipo do Imóvel'
)

calcular_cramers_v(df3, 'is_building', 'target')
```




```
V de Cramer entre is_building e target: 0.0280
```

has_basement

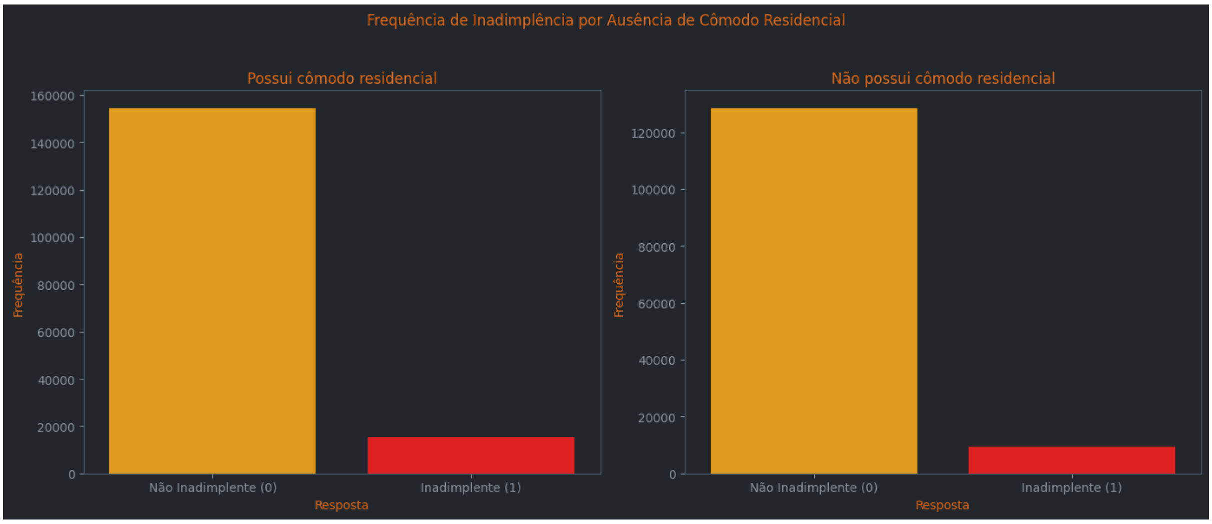
In [ ]:
```python
plot_binaria_target(
    df3,
    var_binaria='has_basement',
    label_0='Não possui porão',
    label_1='Possui porão',
    suptitle='Frequência de Inadimplência por Presença de Porão'
)

calcular_cramers_v(df3, 'has_basement', 'target')
```




```
V de Cramer entre has_basement e target: 0.0366
```

has_noliving

In [ ]:
```python
plot_binaria_target(
    df3,
    var_binaria='has_noliving',
    label_0='Possui cômodo residencial',
    label_1='Possui cômodo residencial',
    suptitle='Frequência de Inadimplência por Ausência de Cômodo Residencial'
)
calcular_cramers_v(df3, 'has_noliving', 'target')
```

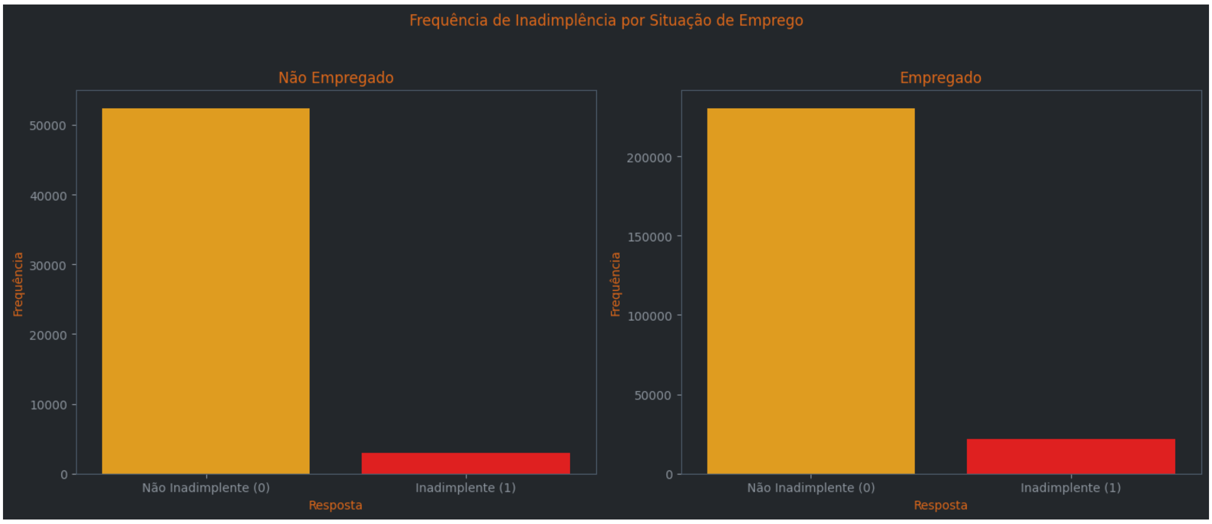



```
V de Cramer entre has_noliving e target: 0.0392
```

is_employed

In [ ]:
```python
plot_binaria_target(
    df3,
    var_binaria='is_building',
    label_0='Não Empregado',
```

```
    label_1='Empregado',
    suptitle='Frequência de Inadimplência por Situação de Emprego'
)
calcular_cramers_v(df3, 'is_employed', 'target')
```




```
V de Cramer entre is_employed e target: 0.0460
```

# 8. Data Preparation

In [ ]:
```
df4 = df3.copy()
```

## 8.1 Scaling

### 8.1.1 Log Transform

In [8]:
```
log_transform_cols = [
    'decision_credit_diff',
    'annuity_burden_ratio',
    'credit_efficiency',
]

for col in log_transform_cols:
    df4[col + '_log'] = np.log1p(df4[col])
    df4.drop(columns=col, inplace=True)
```

```
c:\Users\Patryck\AppData\Local\Programs\Python\Python311\Lib\site-packages\pandas\core\arraylik
e.py:399: RuntimeWarning: invalid value encountered in log1p
  result = getattr(ufunc, method)(*inputs, **kwargs)
```

### 8.1.2 Robust Scaler

In [9]:
```
cols_to_scale = [
    'phone_change_frequency',
    'amt_income_total',
    'amt_credit',
    'num_flag_document',
    'amt_annuity',
    'amt_goods_price',
    'apartments_avg',
    'floorsmax_avg',
    'livingarea_avg',
    'years_build_avg',
    'phone_change_rate',
    'elevators_avg',
    'elevators_mode',
    'elevators_medi',
    'own_car_age',
    'obs_30_cnt_social_circle',
```

```
    'def_30_cnt_social_circle',
    'obs_60_cnt_social_circle',
    'def_60_cnt_social_circle',
    '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',
    'goods_to_credit_ratio',
    'basementarea_avg',
    'livingapartments_avg',
    'landarea_avg',
    'nonlivingapartments_avg',
    'commonarea_avg',
    'years_beginexpluatation_avg',
    'nonlivingarea_avg',
    'days_employed',
    'payment_rate',
    'payment_rate^2',
    'payment_rate ext_source_mean',
    'days_birth^2 payment_rate',
    'days_birth payment_rate^2',
    'payment_rate^3',
    'payment_rate^2 ext_source_mean',
    'payment_rate ext_source_mean^2',
]

robust_scaler = RobustScaler()
df4[cols_to_scale] = robust_scaler.fit_transform(df4[cols_to_scale])
```

### 8.1.3 Standard Scaler

In [10]:
```
cols_to_standard_scale = [
    'days_registration',
    'days_since_last_employment_until_application',
    'income_per_employed',
    'days_id_publish',
    'days_last_phone_change',
    'recent_instability',
    'employment_stability',
    'employment_life_ratio',
    'cnt_fam_members',
    'goods_to_credit_ratio',
    'days_birth',
    'days_birth^2',
    'days_birth payment_rate',
    'days_birth ext_source_mean',
    'ext_source_mean^2',
    'days_birth^3',
    'days_birth^2 ext_source_mean',
    'days_birth payment_rate ext_source_mean',
    'days_birth ext_source_mean^2',
    'ext_source_mean^3'
]


standard_scaler = StandardScaler()
df4[cols_to_standard_scale] = standard_scaler.fit_transform(df4[cols_to_standard_scale])
```

### 8.1.4 MinMaxScaler

In [11]:
```
cols_to_minmax_scale = [
    'cnt_children',
    'region_population_relative',
    'bureau_to_credit_ratio',
    'bureau_request_intensity',
```

```
    'annuity_to_income_ratio',
    'id_document_age_ratio',
]
minmax_scaler = MinMaxScaler()

df4[cols_to_minmax_scale] = minmax_scaler.fit_transform(df4[cols_to_minmax_scale])
```

### 8.1.5 Scaling Final

In [12]:
```
binary_cols = [col for col in df4.columns if sorted(df4[col].dropna().unique()) in [[0, 1], [1]

lists_to_exclude = set(
    cols_to_standard_scale +
    cols_to_scale +
    cols_to_minmax_scale +
    binary_cols +
    [col for col in df4.columns if df4[col].dtype == 'object'] +
    ['target']
)

other_columns = [col for col in df4.columns if (col not in lists_to_exclude) and (col not in bi

scaler = StandardScaler()
df4[other_columns] = scaler.fit_transform(df4[other_columns])
```

## 8.2 Encoding

### 8.2.1 BinaryEncoding

In [4]:
```
df4['name_contract_type'] = (df4['name_contract_type'] != 'Cash loans').astype(int)
df4['code_gender'] = df4['code_gender'].map({'F': 0, 'M': 1})
```

### 8.2.2 OneHotEncoding

In [5]:
```
encoder_suite = OneHotEncoder(drop='first', sparse_output=False)
encoded_suite = encoder_suite.fit_transform(df4[['name_type_suite']])
col_names_suite = [f"nts_{cat}" for cat in encoder_suite.categories_[0][1:]]
encoded_df_suite = pd.DataFrame(encoded_suite, columns=col_names_suite, index=df4.index)
df4 = pd.concat([df4.drop(columns=['name_type_suite']), encoded_df_suite], axis=1)

encoder_fam = OneHotEncoder(drop='first', sparse_output=False)
encoded_fam = encoder_fam.fit_transform(df4[['name_family_status']])
col_names_fam = [f"nfs_{cat}" for cat in encoder_fam.categories_[0][1:]]
encoded_df_fam = pd.DataFrame(encoded_fam, columns=col_names_fam, index=df4.index)
df4 = pd.concat([df4.drop(columns=['name_family_status']), encoded_df_fam], axis=1)

encoder_housing = OneHotEncoder(drop='first', sparse_output=False)
encoded_housing = encoder_housing.fit_transform(df4[['name_housing_type']])
col_names_housing = [f"nht_{cat}" for cat in encoder_housing.categories_[0][1:]]
encoded_df_housing = pd.DataFrame(encoded_housing, columns=col_names_housing, index=df4.index)
df4 = pd.concat([df4.drop(columns=['name_housing_type']), encoded_df_housing], axis=1)

encoder_housetype_mode = OneHotEncoder(drop='first', sparse_output=False)
encoded_housetype_mode = encoder_housetype_mode.fit_transform(df4[['housetype_mode']])
col_names_housetype_mode = [f"htm_{cat}" for cat in encoder_housetype_mode.categories_[0][1:]]
encoded_df_housetype_mode = pd.DataFrame(encoded_housetype_mode, columns=col_names_housetype_mc
df4 = pd.concat([df4.drop(columns=['housetype_mode']), encoded_df_housetype_mode], axis=1)

encoder_walls = OneHotEncoder(drop='first', sparse_output=False)
encoded_walls = encoder_walls.fit_transform(df4[['wallsmaterial_mode']])
col_names_walls = [f"wm_{cat}" for cat in encoder_walls.categories_[0][1:]]
encoded_df_walls = pd.DataFrame(encoded_walls, columns=col_names_walls, index=df4.index)
df4 = pd.concat([df4.drop(columns=['wallsmaterial_mode']), encoded_df_walls], axis=1)
```

### 8.2.3 TargetEncoding

In [6]:
```
target_mean_income = df4.groupby('name_income_type')['target'].mean()
df4['name_income_type_te'] = df4['name_income_type'].map(target_mean_income)
df4.drop('name_income_type', axis=1, inplace=True)

target_mean_occupation = df4.groupby('occupation_type')['target'].mean()
df4['occupation_type_te'] = df4['occupation_type'].map(target_mean_occupation)
df4.drop('occupation_type', axis=1, inplace=True)

target_mean_organization = df4.groupby('organization_type')['target'].mean()
df4['organization_type_te'] = df4['organization_type'].map(target_mean_organization)
df4.drop('organization_type', axis=1, inplace=True)

target_mean_region_rating_client = df4.groupby('region_rating_client')['target'].mean()
df4['region_rating_client_te'] = df4['region_rating_client'].map(target_mean_region_rating_clie
df4.drop('region_rating_client', axis=1, inplace=True)

target_mean_region_rating_client_w_city = df4.groupby('region_rating_client_w_city')['target'].
df4['region_rating_client_w_city_te'] = df4['region_rating_client_w_city'].map(target_mean_regi
df4.drop('region_rating_client_w_city', axis=1, inplace=True)
```

### 8.2.4 OrdinalEncoding

In [7]:
```
education_order = [
    'Lower secondary',
    'Secondary / secondary special',
    'Incomplete higher',
    'Higher education',
    'Academic degree'
]
df4['name_education_type'] = pd.Categorical(
    df4['name_education_type'],
    categories=education_order,
    ordered=True
).codes
```

# 9. Feature Selection

In [ ]:
```
df5 = df3.copy()
```

In [4]:
```
df5.columns = [col.replace('/', '_').replace(',', '_').replace(' ', '') for col in df5.columns]
```

## 9.1 Features Importance

In [5]:
```
X = df5.drop(['target'], axis=1)
y =  df5['target']


target = df5['target']
num_neg = (target == 0).sum()
num_pos = (target == 1).sum()
scale_pos_weight = num_neg / num_pos

xgbm_model = xgb.XGBClassifier(
    n_estimators=300,
    random_state=42,
    n_jobs=-1,
    scale_pos_weight=scale_pos_weight,
    eval_metric='logloss'
)
xgbm_model.fit(X, y)

lgbm_model = lgb.LGBMClassifier(
```

```python
    n_estimators=300,
    random_state=42,
    n_jobs=-1,
    scale_pos_weight=scale_pos_weight
)
lgbm_model.fit(X, y)

cat_model = CatBoostClassifier(
    iterations=300,
    random_state=42,
    verbose=0,
    scale_pos_weight=scale_pos_weight
)
cat_model.fit(X, y)
shap_sample = X.sample(n=min(1000, len(X)), random_state=42)

explainer_xgb = shap.TreeExplainer(xgbm_model)
shap_values_xgb = explainer_xgb.shap_values(shap_sample)
mean_abs_shap_xgb = np.abs(shap_values_xgb).mean(axis=0)

feat_importance_xgb = pd.DataFrame({
    'Feature': X.columns,
    'SHAP_XGB': mean_abs_shap_xgb
})

explainer_lgb = shap.TreeExplainer(lgbm_model)
shap_values_lgb = explainer_lgb.shap_values(shap_sample)
if isinstance(shap_values_lgb, list):
    shap_values_lgb = shap_values_lgb[1]

mean_abs_shap_lgb = np.abs(shap_values_lgb).mean(axis=0)
feat_importance_lgb = pd.DataFrame({
    'Feature': X.columns,
    'SHAP_LGBM': mean_abs_shap_lgb
})

explainer_cat = shap.TreeExplainer(cat_model)
shap_values_cat = explainer_cat.shap_values(shap_sample)
if isinstance(shap_values_cat, (list, tuple)):
    shap_values_cat = shap_values_cat[1]

mean_abs_shap_cat = np.abs(shap_values_cat).mean(axis=0)
feat_importance_cat = pd.DataFrame({
    'Feature': X.columns,
    'SHAP_CAT': mean_abs_shap_cat
})

feat_importance_df = (
    feat_importance_xgb
        .merge(feat_importance_lgb, on='Feature')
        .merge(feat_importance_cat, on='Feature')
)

feat_importance_df['SHAP_XGB_NORM'] = feat_importance_df['SHAP_XGB'] / feat_importance_df['SHAP
feat_importance_df['SHAP_LGBM_NORM'] = feat_importance_df['SHAP_LGBM'] / feat_importance_df['SH
feat_importance_df['SHAP_CAT_NORM'] = feat_importance_df['SHAP_CAT'] / feat_importance_df['SHAP

feat_importance_df['SHAP_MEAN_NORM'] = feat_importance_df[
    ['SHAP_XGB_NORM', 'SHAP_LGBM_NORM', 'SHAP_CAT_NORM']
].mean(axis=1)

feat_importance_df = feat_importance_df.sort_values(by='SHAP_MEAN_NORM', ascending=False).reset
```

```
[LightGBM] [Info] Number of positive: 24825, number of negative: 282686
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of testing was 5.431486 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 119911
[LightGBM] [Info] Number of data points in the train set: 307511, number of used features: 1603
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.080729 -> initscore=-2.432486
[LightGBM] [Info] Start training from score -2.432486
```

```
c:\Users\Patryck\AppData\Local\Programs\Python\Python311\Lib\site-packages\shap\explainers\_tree.py:587: UserWarning: LightGBM binary classifier with TreeExplainer shap values output has changed to a list of ndarray
  warnings.warn(
```

In [6]:
```
feat_importance_df.head(50)
```

Out[6]:

| | Feature | SHAP_XGB | SHAP_LGBM | SHAP_CAT | SHAP_XGB_NORM | SI |
|---|---|---|---|---|---|---|
| 0 | ext_source_mean | 0.479819 | 0.136462 | 0.098005 | 0.053773 | |
| 1 | ext_source_mean^3 | 0.000000 | 0.234489 | 0.196949 | 0.000000 | |
| 2 | amt_goods_price | 0.180001 | 0.119373 | 0.168450 | 0.020172 | |
| 3 | amt_credit | 0.188181 | 0.099917 | 0.149596 | 0.021089 | |
| 4 | ext_source_mean^2 | 0.000000 | 0.128990 | 0.256225 | 0.000000 | |
| 5 | code_gender | 0.131131 | 0.120886 | 0.131836 | 0.014696 | |
| 6 | name_education_type | 0.093606 | 0.084137 | 0.100661 | 0.010490 | |
| 7 | instf_inst_amt_payment_min_mean | 0.112430 | 0.082894 | 0.070336 | 0.012600 | |
| 8 | amt_annuity | 0.100947 | 0.068007 | 0.084914 | 0.011313 | |
| 9 | nfs_Married | 0.080827 | 0.077176 | 0.077103 | 0.009058 | |
| 10 | organization_type_te | 0.082617 | 0.071622 | 0.078300 | 0.009259 | |
| 11 | bur_amt_credit_sum_debt_mean | 0.078518 | 0.064338 | 0.091906 | 0.008799 | |
| 12 | ext_source_1_missing | 0.085076 | 0.064582 | 0.085060 | 0.009534 | |
| 13 | ext_source_weighted_mean | 0.069700 | 0.057586 | 0.080541 | 0.007811 | |
| 14 | instf_inst_amt_payment_min_min | 0.071058 | 0.061853 | 0.058185 | 0.007963 | |
| 15 | occupation_type_te | 0.058921 | 0.054293 | 0.069931 | 0.006603 | |
| 16 | bur_days_credit_enddate_max | 0.072368 | 0.052928 | 0.056696 | 0.008110 | |
| 17 | posf_pos_cnt_instalment_future_mean_mean | 0.061260 | 0.042279 | 0.080664 | 0.006865 | |
| 18 | employment_life_ratio | 0.032763 | 0.033041 | 0.115123 | 0.003672 | |
| 19 | prev_cnt_payment_max | 0.038009 | 0.047791 | 0.069048 | 0.004260 | |
| 20 | bur_days_enddate_fact_max | 0.061550 | 0.043459 | 0.054840 | 0.006898 | |
| 21 | flag_own_car | 0.072230 | 0.059843 | 0.018257 | 0.008095 | |
| 22 | posf_pos_months_balance_max_max | 0.061593 | 0.043903 | 0.047087 | 0.006903 | |
| 23 | num_flag_document | 0.056485 | 0.046360 | 0.039938 | 0.006330 | |
| 24 | bur_days_credit_max | 0.056292 | 0.039222 | 0.049257 | 0.006309 | |
| 25 | annuity_per_employment_year | 0.041860 | 0.040980 | 0.057281 | 0.004691 | |
| 26 | annuity_to_income_ratio | 0.055552 | 0.032860 | 0.047513 | 0.006226 | |
| 27 | instf_inst_days_entry_payment_max_max | 0.064776 | 0.025673 | 0.046376 | 0.007259 | |
| 28 | ext_source_3 | 0.041073 | 0.029021 | 0.058268 | 0.004603 | |
| 29 | instf_inst_amt_payment_min_max | 0.032871 | 0.028211 | 0.066105 | 0.003684 | |
| 30 | own_car_age_employed_ratio | 0.048990 | 0.038457 | 0.030191 | 0.005490 | |
| 31 | days_birthext_source_mean^2 | 0.068693 | 0.034609 | 0.017099 | 0.007698 | |
| 32 | prev_cnt_payment_mean | 0.064248 | 0.032823 | 0.017195 | 0.007200 | |
| 33 | region_population_relative | 0.045858 | 0.024654 | 0.043919 | 0.005139 | |
| 34 | bur_amt_credit_sum_min | 0.046560 | 0.024092 | 0.044253 | 0.005218 | |
| 35 | amt_application_goods_diff | 0.048215 | 0.025340 | 0.039803 | 0.005403 | |
| 36 | days_id_publish | 0.047277 | 0.039052 | 0.014773 | 0.005298 | |

| | Feature | SHAP_XGB | SHAP_LGBM | SHAP_CAT | SHAP_XGB_NORM | SI |
|---|---|---|---|---|---|---|
| **37** | prev_amt_down_payment_max | 0.042961 | 0.034000 | 0.024261 | 0.004815 | |
| **38** | ext_source_2 | 0.046125 | 0.021802 | 0.040196 | 0.005169 | |
| **39** | days_birth | 0.049212 | 0.021245 | 0.037912 | 0.005515 | |
| **40** | instf_inst_days_instalment_max_max | 0.050373 | 0.019795 | 0.039331 | 0.005645 | |
| **41** | flag_document_3 | 0.035472 | 0.021595 | 0.047636 | 0.003975 | |
| **42** | posf_pos_cnt_instalment_future_min_mean | 0.039702 | 0.033119 | 0.024424 | 0.004449 | |
| **43** | bur_amt_credit_max_overdue_max | 0.053756 | 0.027124 | 0.020737 | 0.006024 | |
| **44** | phone_change_rate | 0.076217 | 0.014552 | 0.022423 | 0.008542 | |
| **45** | income_per_employed | 0.041240 | 0.009397 | 0.057745 | 0.004622 | |
| **46** | posf_pos_cnt_instalment_future_min_max | 0.024989 | 0.025092 | 0.044489 | 0.002800 | |
| **47** | region_rating_client_w_city_te | 0.033190 | 0.025745 | 0.035299 | 0.003720 | |
| **48** | days_birth^2ext_source_mean | 0.038953 | 0.016967 | 0.044518 | 0.004365 | |
| **49** | days_registration | 0.043024 | 0.019410 | 0.033100 | 0.004822 | |

In [7]:
```
print(f"Número de colunas iniciais em X: {df5.shape[1]}")

feat_importance_df_ordenado = feat_importance_df.sort_values(by='SHAP_LGBM_NORM', ascending=Fal


cumsum = feat_importance_df_ordenado['SHAP_LGBM_NORM'].cumsum()
n_feat_95 = (cumsum <= 0.95).sum() + 1

selected_features_95 = feat_importance_df_ordenado.loc[:n_feat_95-1, 'Feature'].tolist()

print(f"Quantidade de features para explicar 95% do fenômeno: {len(selected_features_95)}")
print(selected_features_95)

X = df5[selected_features_95]
```

```
Número de colunas iniciais em X: 1628
Quantidade de features para explicar 95% do fenômeno: 256
['ext_source_mean^3', 'ext_source_mean', 'ext_source_mean^2', 'code_gender', 'amt_goods_price',
'amt_credit', 'name_education_type', 'instf_inst_amt_payment_min_mean', 'nfs_Married', 'organiz
ation_type_te', 'amt_annuity', 'ext_source_1_missing', 'bur_amt_credit_sum_debt_mean', 'instf_i
nst_amt_payment_min_min', 'flag_own_car', 'ext_source_weighted_mean', 'occupation_type_te', 'bu
r_days_credit_enddate_max', 'prev_cnt_payment_max', 'num_flag_document', 'posf_pos_months_balan
ce_max_max', 'bur_days_enddate_fact_max', 'posf_pos_cnt_instalment_future_mean_mean', 'annuity_
per_employment_year', 'bur_days_credit_max', 'days_id_publish', 'own_car_age_employed_ratio', '
days_birthext_source_mean^2', 'prev_amt_down_payment_max', 'posf_pos_cnt_instalment_future_min_
mean', 'employment_life_ratio', 'annuity_to_income_ratio', 'prev_cnt_payment_mean', 'ext_source
_3', 'instf_inst_amt_payment_min_max', 'posf_pos_cnt_instalment_future_mean_max', 'bur_amt_cred
it_max_overdue_max', 'region_rating_client_w_city_te', 'instf_inst_days_entry_payment_max_max',
'amt_application_goods_diff', 'posf_pos_cnt_instalment_future_min_max', 'region_population_rela
tive', 'bur_amt_credit_sum_min', 'own_car_age', 'ccf_cc_cnt_drawings_atm_current_mean_max', 'ex
t_source_2', 'flag_document_3', 'def_30_cnt_social_circle', 'amt_req_credit_bureau_qrt', 'days_
birth', 'posf_pos_sk_id_curr_mean_count', 'weekday_appr_process_start', 'bur_days_enddate_fact_
count', 'instf_inst_days_instalment_max_max', 'bur_days_credit_mean', 'days_registration', 'pos
f_pos_sk_dpd_def_max_mean', 'prev_rate_down_payment_max', 'ext_source_interaction', 'prev_selle
rplace_area_mean', 'bur_amt_credit_sum_limit_count', 'days_last_phone_change', 'ext_source_1',
'days_birth^2ext_source_mean', 'prev_cnt_payment_min', 'bur_amt_credit_sum_max', 'instf_inst_da
ys_entry_payment_count_mean', 'instf_inst_num_instalment_version_mean_mean', 'bur_amt_credit_su
m_limit_mean', 'posf_pos_months_balance_mean_max', 'own_car_age_birth_ratio', 'flag_work_phone'
, 'days_since_last_employment_until_application', 'days_birth^2', 'phone_change_rate', 'days_bi
rthpayment_rate', 'bureau_overdue_ratio', 'posf_pos_cnt_instalment_count_max', 'instf_inst_num_
instalment_version_mean_max', 'days_birthext_source_mean', 'ext_source_max', 'reg_city_not_live
_city', 'bur_amt_credit_max_overdue_mean', 'posf_pos_sk_dpd_def_mean_max', 'bur_sk_id_bureau_me
an_missing', 'def_60_cnt_social_circle', 'instf_inst_num_instalment_number_max_max', 'bur_days_
credit_update_max', 'instf_inst_amt_payment_mean_max', 'prev_days_first_drawing_count', 'prev_a
mt_annuity_mean', 'bur_days_credit_update_mean', 'prev_nflag_insured_on_approval_mean', 'prev_a
mt_annuity_min', 'name_contract_type', 'decision_credit_diff_log', 'pos_balance_range', 'bur_am
t_credit_sum_limit_mean_missing', 'years_beginexpluatation_avg', 'area_quality', 'id_document_a
ge_ratio', 'goods_to_credit_ratio', 'prev_sellerplace_area_max', 'instf_inst_amt_instalment_min
_min', 'ccf_cc_cnt_drawings_atm_current_mean_mean', 'wm_Panel', 'prev_amt_goods_price_mean', 'p
hone_change_frequency', 'prev_days_last_due_1st_version_max', 'prev_sk_id_prev_max', 'ccf_cc_am
t_credit_limit_actual_mean_mean', 'name_income_type_te', 'hour_appr_process_start', 'posf_pos_c
nt_instalment_mean_count', 'income_per_employed', 'prev_days_decision_mean', 'income_per_birth'
, 'posf_pos_cnt_instalment_count_mean', 'bur_amt_credit_sum_debt_max', 'ccf_cc_amt_balance_max_
max', 'bur_days_credit_min', 'prev_amt_down_payment_mean', 'id_change_rate', 'instf_inst_num_in
stalment_version_max_max', 'credit_per_employment_year', 'posf_pos_sk_id_curr_count_max', 'inst
f_inst_amt_payment_mean_min', 'prev_days_last_due_mean', 'prev_sk_id_prev_count', 'prev_days_de
cision_max', 'prev_days_decision_min', 'entry_vs_due_ratio', 'bur_days_credit_enddate_mean', 'd
ays_employed', 'ccf_cc_amt_payment_current_mean_mean', 'bur_sk_id_bureau_mean', 'prev_hour_appr
_process_start_mean', 'prev_rate_down_payment_mean', 'prev_rate_down_payment_min', 'prev_days_f
irst_due_min', 'flag_phone', 'credit_risk_signal', 'ccf_cc_cnt_drawings_atm_current_mean_min',
'posf_pos_sk_id_curr_count_mean', 'instf_inst_amt_instalment_max_max', 'annuity_per_age', 'bur_
days_credit_update_min', 'instf_inst_amt_payment_max_mean', 'credit_efficiency_log', 'posf_pos_
sk_id_curr_mean_mean', 'ccf_cc_cnt_drawings_current_max_max', 'prev_sk_id_prev_mean', 'apartmen
ts_avg', 'ccf_cc_cnt_drawings_current_mean_max', 'employment_years', 'bur_sk_id_bureau_min', 'p
rev_hour_appr_process_start_min', 'bur_bb_months_balance_mean_count', 'bureau_to_credit_ratio',
'days_birth^3', 'payment_rate', 'posf_pos_cnt_instalment_count_min', 'instf_inst_amt_instalment
_min_max', 'landarea_avg', 'bur_days_credit_enddate_min', 'posf_pos_cnt_instalment_future_max_m
ean', 'posf_pos_sk_id_curr_count_min', 'bur_amt_credit_sum_limit_max', 'prev_hour_appr_process_
start_max', 'bur_days_enddate_fact_min', 'days_birth^2payment_rate', 'posf_pos_cnt_instalment_m
ax_mean', 'instf_inst_days_instalment_max_min', 'bur_amt_credit_sum_mean', 'posf_pos_cnt_instal
ment_future_count_mean', 'livingarea_avg', 'bur_amt_credit_max_overdue_mean_missing', 'instf_in
st_amt_payment_max_max', 'recent_instability', 'floorsmax_avg', 'amt_income_total', 'instf_inst
_num_instalment_number_max_mean', 'instf_inst_days_entry_payment_min_mean', 'credit_to_income_r
atio', 'bur_sk_id_bureau_max', 'posf_pos_cnt_instalment_min_mean', 'instf_inst_days_instalment_
min_min', 'ccf_cc_months_balance_mean_min', 'instf_inst_sk_id_curr_mean_mean', 'prev_amt_goods_
price_min', 'posf_pos_months_balance_min_min', 'posf_pos_cnt_instalment_mean_mean', 'posf_pos_c
nt_instalment_mean_min', 'years_build_avg', 'posf_pos_months_balance_min_mean', 'instf_inst_sk_
id_curr_mean_count', 'ccf_cc_amt_balance_mean_mean', 'instf_inst_days_instalment_min_max', 'pre
v_days_last_due_1st_version_mean', 'days_birthpayment_rateext_source_mean', 'ccf_cc_amt_receiva
ble_principal_mean_min', 'instf_inst_num_instalment_version_max_mean', 'ext_source_agreement',
'prev_sellerplace_area_min', 'bur_days_enddate_fact_mean', 'payment_rateext_source_mean^2', 'in
stf_inst_sk_id_curr_count_mean', 'prev_amt_application_mean', 'instf_inst_amt_instalment_min_me
an', 'bur_bb_months_balance_count_mean', 'ccf_cc_amt_receivable_principal_mean_mean', 'prev_amt
_application_max', 'instf_inst_days_entry_payment_mean_max', 'prev_amt_credit_min', 'prev_amt_a
```

```
nnuity_max', 'prev_amt_annuity_count', 'ext_source_range', 'commonarea_avg', 'bur_bb_months_bal
ance_count_max', 'prev_amt_goods_price_max', 'prev_amt_credit_max', 'amt_application_credit_dif
f', 'posf_pos_cnt_instalment_min_min', 'annuity_burden_ratio_log', 'ccf_cc_amt_payment_total_cu
rrent_mean_max', 'ext_source_std', 'bur_bb_months_balance_max_mean', 'prev_days_last_due_1st_ve
rsion_min', 'ext_source_3_missing', 'ccf_cc_amt_receivable_principal_mean_max', 'bur_amt_credit
_sum_debt_min', 'instf_inst_num_instalment_number_mean_min', 'instf_inst_amt_payment_mean_mean'
, 'prev_amt_application_min', 'ccf_cc_amt_balance_min_mean', 'ccf_cc_amt_balance_mean_max', 'in
stf_inst_days_instalment_mean_max', 'instf_inst_amt_instalment_max_min', 'days_birthpayment_rat
e^2', 'totalarea_mode', 'nonlivingarea_avg', 'ccf_cc_amt_credit_limit_actual_min_min', 'prev_sk
_id_prev_min', 'bur_amt_credit_sum_debt_count', 'ccf_cc_amt_balance_mean_min', 'prev_days_termi
nation_min', 'nht_Municipalapartment', 'posf_pos_sk_dpd_def_mean_mean', 'bur_sk_id_bureau_count
', 'ccf_cc_cnt_drawings_current_mean_min', 'bureau_request_intensity', 'payment_rate^2ext_sourc
e_mean', 'ccf_cc_cnt_drawings_current_max_mean', 'prev_days_termination_mean', 'instf_inst_amt_
instalment_max_mean', 'livingapartments_avg']
```

# 10. Machine Learning

In [9]:
```python
X_train, X_temp, y_train, y_temp = train_test_split(
    X, y, test_size=0.3, random_state=0, stratify=y
)

X_val, X_test, y_val, y_test = train_test_split(
    X_temp, y_temp, test_size=0.5, random_state=0, stratify=y_temp
)
```

## 10.1 Logistic Regression

In [9]:
```python
neg, pos = np.bincount(y_train)
scale_pos_weight = neg / pos

logreg = LogisticRegression(
    max_iter=2000,
    class_weight='balanced'
)
```

In [10]:
```python
logreg.fit(X_train, y_train)

df_metricas = avaliar_metricas(logreg, X_val, y_val, X_test, y_test)
display(df_metricas)
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.997315 | 0.998120 |
| **precision** | 0.080792 | 0.080845 |
| **f1_score** | 0.149475 | 0.149574 |
| **auc_roc** | 0.500389 | 0.500746 |
| **auc_pr** | 0.080792 | 0.080845 |

## 10.2 Random Forest

In [ ]:
```python
rf_clf = BalancedRandomForestClassifier(
    n_estimators=1000,
    random_state=42,
    n_jobs=-1
)
```

In [ ]:
```python
rf_clf.fit(X_train, y_train)

df_metricas = avaliar_metricas(rf_clf, X_val, y_val, X_test, y_test)
display(df_metricas)
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.504834 | 0.516917 |
| **precision** | 0.215893 | 0.219950 |
| **f1_score** | 0.302445 | 0.308592 |
| **auc_roc** | 0.757899 | 0.768832 |
| **auc_pr** | 0.230295 | 0.240063 |

## 10.3 XGBoost

In [10]:
```
num_neg = (y_train == 0).sum()
num_pos = (y_train == 1).sum()
scale_pos_weight = num_neg / num_pos

xgb_clf = xgb.XGBClassifier(
    n_estimators=1000,
    random_state=42,
    scale_pos_weight=scale_pos_weight,
)
```

In [11]:
```
xgb_clf.fit(X_train, y_train)

df_metricas = avaliar_metricas(xgb_clf, X_val, y_val, X_test, y_test)
display(df_metricas)
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.209184 | 0.204082 |
| **precision** | 0.304654 | 0.292871 |
| **f1_score** | 0.248050 | 0.240544 |
| **auc_roc** | 0.729740 | 0.723740 |
| **auc_pr** | 0.217711 | 0.214192 |

## 10.4 LightGBM

In [12]:
```
num_neg = (y_train == 0).sum()
num_pos = (y_train == 1).sum()
scale_pos_weight = num_neg / num_pos

lgbm_clf = lgb.LGBMClassifier(
    n_estimators=1000,
    random_state=42,
    scale_pos_weight=scale_pos_weight,
    verbose=-1
)
```

In [13]:
```
lgbm_clf.fit(X_train, y_train)

df_metricas = avaliar_metricas(lgbm_clf, X_val, y_val, X_test, y_test)
display(df_metricas)
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.488722 | 0.485768 |
| **precision** | 0.232024 | 0.230387 |
| **f1_score** | 0.314661 | 0.312543 |
| **auc_roc** | 0.764907 | 0.763319 |
| **auc_pr** | 0.252291 | 0.250929 |

## 10.5 CatBoost

In [14]:
```
num_neg = (y_train == 0).sum()
num_pos = (y_train == 1).sum()
scale_pos_weight = num_neg / num_pos

cat_clf = CatBoostClassifier(
    iterations=1000,
    random_state=42,
    verbose=0,
    scale_pos_weight=scale_pos_weight,
)
```

In [15]:
```
cat_clf.fit(X_train, y_train)


df_metricas = avaliar_metricas(cat_clf, X_val, y_val, X_test, y_test)
display(df_metricas)
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.601504 | 0.594522 |
| **precision** | 0.208391 | 0.207265 |
| **f1_score** | 0.309542 | 0.307372 |
| **auc_roc** | 0.774728 | 0.776648 |
| **auc_pr** | 0.271922 | 0.267967 |

## 10.6 ADABoosting

In [ ]:
```
adaboost_clf = AdaBoostClassifier(
    estimator=DecisionTreeClassifier(
        max_depth=1,
        class_weight={0: 1.0, 1: scale_pos_weight}
    ),
    n_estimators=1000,
    random_state=42
)
```

In [ ]:
```
adaboost_clf.fit(X_train, y_train)

df_metricas = avaliar_metricas(adaboost_clf, X_val, y_val, X_test, y_test)
display(df_metricas)
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.656284 | 0.675081 |
| **precision** | 0.143900 | 0.147026 |
| **f1_score** | 0.236044 | 0.241464 |
| **auc_roc** | 0.656692 | 0.665560 |
| **auc_pr** | 0.122189 | 0.125486 |

## 10.7 HistBoosting

In [ ]:
```
histboost_clf = HistGradientBoostingClassifier(
    max_iter=200,
    learning_rate=0.1,
    max_depth=None,
    random_state=42,
    class_weight='balanced'
)
```

In [ ]:
```
histboost_clf.fit(X_train, y_train)

df_metricas = avaliar_metricas(histboost_clf, X_val, y_val, X_test, y_test)
display(df_metricas)
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.665951 | 0.693609 |
| **precision** | 0.182299 | 0.188595 |
| **f1_score** | 0.286242 | 0.296556 |
| **auc_roc** | 0.774241 | 0.783426 |
| **auc_pr** | 0.254090 | 0.272599 |

## 10.8 Nayves Bayes

In [ ]:
```python
nb_clf = GaussianNB()

nb_clf.fit(X_train, y_train)

df_metricas = avaliar_metricas(nb_clf, X_val, y_val, X_test, y_test)
display(df_metricas)
```

```
c:\Users\Patryck\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\metrics\_cla
ssification.py:1731: UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 due
to no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", result.shape[0])
c:\Users\Patryck\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\metrics\_cla
ssification.py:1731: UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 due
to no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", result.shape[0])
```

| | validacao | teste |
|---|---|---|
| **recall** | 0.000000 | 0.000000 |
| **precision** | 0.000000 | 0.000000 |
| **f1_score** | 0.000000 | 0.000000 |
| **auc_roc** | 0.500378 | 0.500664 |
| **auc_pr** | 0.080792 | 0.080839 |

# 11. HyperTuning

## 11.1 BayesSearch

In [ ]:
```python
X_full = pd.concat([X_train, X_val]).reset_index(drop=True)
y_full = pd.concat([y_train, y_val]).reset_index(drop=True)

search_spaces = {
    'n_estimators': Integer(2000, 6000),
    'learning_rate': Real(0.0005, 0.1, prior='log-uniform'),
    'max_depth': Integer(3, 12),
    'min_child_weight': Integer(1, 30),
    'gamma': Real(0, 5.0),
    'reg_alpha': Real(1e-8, 50, prior='log-uniform'),
    'reg_lambda': Real(1e-6, 300, prior='log-uniform'),
    'subsample': Real(0.5, 1.0),
    'colsample_bytree': Real(0.4, 1.0),
    'colsample_bylevel': Real(0.3, 1.0),
    'colsample_bynode': Real(0.3, 1.0),
    'booster': Categorical(['gbtree']),
    'tree_method': Categorical(['hist', 'exact']),
    'grow_policy': Categorical(['depthwise', 'lossguide']),
    'scale_pos_weight': Integer(1, 40),
    'max_delta_step': Integer(0, 10),
}

model = xgb.XGBClassifier(
    random_state=42,
    eval_metric='auc',
    tree_method='hist'
)

bayes = BayesSearchCV(
    estimator=model,
    search_spaces=search_spaces,
    scoring='roc_auc',
    n_iter=120,
    cv=3,
    n_jobs=-1,
```

```
    verbose=3,
    random_state=42,
    refit=True,
    optimizer_kwargs={'acq_func': 'EI'}
)

bayes.fit(
    X_full,
    y_full,
    callback=None,
    **{
        "eval_set": [(X_val, y_val)],
        "early_stopping_rounds": 50,
        "verbose": False
    }
)

print("\n🔝 Melhor score (roc_auc):", bayes.best_score_)
print("🔧 Melhores parâmetros encontrados:\n")
for p, v in bayes.best_params_.items():
    print(f"  {p}: {v}")
```

# 12. Training the Final Model

In [10]:
```
xgb_params = {
    'booster': 'gbtree',
    'n_estimators': 5116,
    'learning_rate': 0.006466,
    'max_depth': 6,
    'subsample': 0.83743,
    'colsample_bytree': 0.921139,
    'colsample_bylevel': 0.674959,
    'gamma': 2.165815,
    'min_child_weight': 12,
    'reg_alpha': 0.000102,
    'reg_lambda': 17.3739,
    'scale_pos_weight': 1,
    'random_state': 42,
}


X_trainval = np.concatenate([X_train, X_val])
y_trainval = np.concatenate([y_train, y_val])

xgb_final = xgb.XGBClassifier(**xgb_params)
xgb_final.fit(X_trainval, y_trainval)


y_pred_proba = xgb_final.predict_proba(X_test)[:, 1]
y_pred = xgb_final.predict(X_test)

print("Classification Report (TESTE):")
print(classification_report(y_test, y_pred))

print("Matriz de Confusão (TESTE):")
print(confusion_matrix(y_test, y_pred))

print("\nAUC-ROC:", roc_auc_score(y_test, y_pred_proba))
print("AUC-PR:", average_precision_score(y_test, y_pred_proba))
print("Recall:", recall_score(y_test, y_pred))
print("Precision:", precision_score(y_test, y_pred))
print("F1 Score:", f1_score(y_test, y_pred))
```

```
Classification Report (TESTE):
              precision    recall  f1-score   support

           0       0.92      1.00      0.96     42403
           1       0.57      0.04      0.08      3724

    accuracy                           0.92     46127
   macro avg       0.75      0.52      0.52     46127
weighted avg       0.89      0.92      0.89     46127

Matriz de Confusão (TESTE):
[[42290   113]
 [ 3574   150]]

AUC-ROC: 0.795399200495334
AUC-PR: 0.2904329200889078
Recall: 0.040279269602577876
Precision: 0.5703422053231939
F1 Score: 0.07524454477050414
```

In [11]:
```
best_threshold, best_f1 = find_best_threshold(y_test, y_pred_proba, metric="f1")
y_pred_best = (y_pred_proba >= best_threshold).astype(int)

print(f"Melhor threshold para F1: {best_threshold:.4f} (F1: {best_f1:.4f})\n")

print("Classification Report (TESTE):")
print(classification_report(y_test, y_pred_best))

print("Matriz de Confusão (TESTE):")
print(confusion_matrix(y_test, y_pred_best))

print("\nAUC-ROC:", roc_auc_score(y_test, y_pred_proba))
print("AUC-PR:", average_precision_score(y_test, y_pred_proba))
print("Recall:", recall_score(y_test, y_pred_best))
print("Precision:", precision_score(y_test, y_pred_best))
print("F1 Score:", f1_score(y_test, y_pred_best))
```

```
Melhor threshold para F1: 0.1910 (F1: 0.3437)

Classification Report (TESTE):
              precision    recall  f1-score   support

           0       0.94      0.93      0.94     42403
           1       0.31      0.38      0.34      3724

    accuracy                           0.88     46127
   macro avg       0.63      0.65      0.64     46127
weighted avg       0.89      0.88      0.89     46127

Matriz de Confusão (TESTE):
[[39255  3148]
 [ 2298  1426]]

AUC-ROC: 0.795399200495334
AUC-PR: 0.2904329200889078
Recall: 0.382921589688507
Precision: 0.31176213379973766
F1 Score: 0.34369727645215714
```

## 12.1 Training with All Data

In [13]:
```
xgb_params = {
    'booster': 'gbtree',
    'n_estimators': 5116,
    'learning_rate': 0.006466,
    'max_depth': 6,
    'subsample': 0.83743,
    'colsample_bytree': 0.921139,
```

```
    'colsample_bylevel': 0.674959,
    'gamma': 2.165815,
    'min_child_weight': 12,
    'reg_alpha': 0.000102,
    'reg_lambda': 17.3739,
    'scale_pos_weight': 1,
    'random_state': 42,
}

xgb_final = xgb.XGBClassifier(**xgb_params)

xgb_final.fit(X, y)
```

Out[13]:

XGBClassifier

▸ Parameters

| | | |
|---|---|---|
| | objective | 'binary:logistic' |
| | base_score | None |
| | booster | 'gbtree' |
| | callbacks | None |
| | colsample_bylevel | 0.674959 |
| | colsample_bynode | None |
| | colsample_bytree | 0.921139 |
| | device | None |
| | early_stopping_rounds | None |
| | enable_categorical | False |
| | eval_metric | None |
| | feature_types | None |
| | feature_weights | None |
| | gamma | 2.165815 |
| | grow_policy | None |
| | importance_type | None |
| | interaction_constraints | None |
| | learning_rate | 0.006466 |
| | max_bin | None |
| | max_cat_threshold | None |
| | max_cat_to_onehot | None |
| | max_delta_step | None |
| | max_depth | 6 |
| | max_leaves | None |
| | min_child_weight | 12 |
| | missing | nan |
| | monotone_constraints | None |
| | multi_strategy | None |
| | n_estimators | 5116 |
| | n_jobs | None |
| | num_parallel_tree | None |
| | random_state | 42 |
| | reg_alpha | 0.000102 |
| | reg_lambda | 17.3739 |
| | sampling_method | None |
| | scale_pos_weight | 1 |

| | | |
|---|---|---|
| | scale_pos_weight | 1 |
| | subsample | 0.83743 |
| | tree_method | None |
| | validate_parameters | None |
| | verbosity | None |

## 13. Error Interpretation and Translation

In [12]:
```
best_threshold, best_f1 = find_best_threshold(y_test, y_pred_proba, metric="f1")
y_pred_best = (y_pred_proba >= best_threshold).astype(int)

print(f"Melhor threshold para F1: {best_threshold:.4f} (F1: {best_f1:.4f})")

print("\nClassification Report:")
print(classification_report(y_test, y_pred_best))

print("Matriz de Confusão:")
print(confusion_matrix(y_test, y_pred_best))

print("\nAUC-ROC:", roc_auc_score(y_test, y_pred_proba))
print("AUC-PR :", average_precision_score(y_test, y_pred_proba))
print("MCC    :", matthews_corrcoef(y_test, y_pred_best))
```

```
Melhor threshold para F1: 0.1910 (F1: 0.3437)

Classification Report:
              precision    recall  f1-score   support

           0       0.94      0.93      0.94     42403
           1       0.31      0.38      0.34      3724

    accuracy                           0.88     46127
   macro avg       0.63      0.65      0.64     46127
weighted avg       0.89      0.88      0.89     46127

Matriz de Confusão:
[[39255  3148]
 [ 2298  1426]]

AUC-ROC: 0.795399200495334
AUC-PR : 0.2904329200889078
MCC    : 0.28136141644784807
```

**Model Results Summary**

The optimal decision threshold was **0.1910**, with an **F1-score of 0.3437** for the defaulter class.

The model shows:

- **Overall accuracy of 88%**, indicating strong global performance.
- **Recall of 38% for defaulters**, meaning the model is able to identify a relevant portion of high-risk customers.
- **Precision of 31% for the defaulter class**, still impacted by data imbalance.
- **AUC-ROC of 0.795**, showing good ability to separate good and bad payers.
- **MCC of 0.28**, indicating a reasonable correlation between predictions and actual values.

**Business Impact**

With the threshold set at **0.19**, the model:

- **Anticipates a significant portion of defaulters**.

- Reduces the risk of granting credit to bad payers.
- Generates some **false positives** (good customers flagged as risky), but keeps financial risk more controlled.

**Practical Recommendation**

Use a threshold close to **0.19** as an **initial risk screening filter**, prioritizing loss prevention. For final credit decisions, a more conservative criterion is recommended to balance approval rates and profitability.

## 13.1 Financial Interpretation of the Error

**Assumptions**

- Total customers: **46,127**
- Good payers: **42,403**
- Defaulters: **3,724**

Financial assumptions:

- Profit per good payer: **R$ 1,000**
- Loss per defaulter: **R$ 5,000**
- Cost per false positive: **R$ 500**
- A false positive **does not generate profit**

---

**Model Threshold**

- **Optimal threshold (F1): 0.1910**
- **F1-score: 0.3437**
- AUC-ROC: **0.795**
- MCC: **0.281**

---

**Confusion Matrix (0.1910)**

| | Predicted 0 | Predicted 1 |
|---|---|---|
| Actual 0 (Good payer) | 39,255 | 3,148 |
| Actual 1 (Defaulter) | 2,298 | 1,426 |

**Summary:**

- **TP:** 1,426
- **FN:** 2,298
- **FP:** 3,148
- **TN:** 39,255

---

**Financial Impact**

**1) TP (defaulters avoided)** Gain: `1,426 × 5,000 = R$ 7,130,000`

**2) FN (undetected defaulters)** Loss: `2,298 × 5,000 = -R$ 11,490,000`

**3) FP (good customers wrongly blocked)** Loss: `3,148 × (1,000 + 500) = -R$ 4,722,000`

**4) TN (good customers correctly approved)** Gain: `39,255 × 1,000 = R$ 39,255,000`

---

#### Net Profit with the Model

```
Profit =  7,130,000
        -11,490,000
        - 4,722,000
        +39,255,000

Net profit = R$ 30,173,000
```

---

#### Scenario Without the Model

- Loss from defaulters: `3,724 × 5,000 = -R$ 18,620,000`
- Profit from good payers: `42,403 × 1,000 = R$ 42,403,000`

**Net profit without model = R$ 23,783,000**

---

#### Incremental Gain from the Model

```
30,173,000 - 23,783,000 = R$ 6,390,000
```

---

### Final Result

With **threshold = 0.1910**, the model generates approximately:

**R$ 6.39 million in additional profit** compared to the scenario without the model.

## 14. Testing in a Real Production Environment

In [16]:
```
df_test = pd.read_csv('../data/test.csv')
```

### 14.1 Missing Values

In [17]:
```
cols_old = list(df_test.columns)

cols_old = list(df_test.columns)

cols_new = snake_case(cols_old)

df_test.columns = cols_new

df_test_final = df_test[['sk_id_curr']].copy()

df_test = df_test.drop(columns=["sk_id_curr"])

df_test['flag_own_car'] = df_test['flag_own_car'].map({'N': 0, 'Y': 1})
df_test['flag_own_realty'] = df_test['flag_own_realty'].map({'N': 0, 'Y': 1})
df_test['emergencystate_mode'] = df_test['emergencystate_mode'].map({'No': 0, 'Yes': 1})

weekday_map = {
    'MONDAY': 1,
    'TUESDAY': 2,
    'WEDNESDAY': 3,
    'THURSDAY': 4,
    'FRIDAY': 5,
    'SATURDAY': 6,
    'SUNDAY': 7
}
```

```python
df_test['weekday_appr_process_start'] = df_test['weekday_appr_process_start'].map(weekday_map)

df_test = df_test.replace('XNA', pd.NA)



aux_missing_cols = {}


aux_missing_cols['is_building']          = df_test.filter(like='commonarea_').notna().any(axis=
aux_missing_cols['is_building_missing']  = (~df_test.filter(like='commonarea_').notna().any(axi
aux_missing_cols['has_basement']         = df_test['basementarea_avg'].notna().astype(int)
aux_missing_cols['basementarea_missing'] = df_test['basementarea_avg'].isna().astype(int)
aux_missing_cols['has_noliving']         = df_test['nonlivingarea_avg'].notna().astype(int)
aux_missing_cols['nonlivingarea_missing']= df_test['nonlivingarea_avg'].isna().astype(int)
aux_missing_cols['is_employed']          = (~df_test['days_employed'].isna()).astype(int)

aux_missing_cols['livingarea_missing']    = df_test['livingarea_avg'].isna().astype(int)
aux_missing_cols['apartments_missing']    = df_test['apartments_avg'].isna().astype(int)
aux_missing_cols['floorsmax_missing']     = df_test['floorsmax_avg'].isna().astype(int)
aux_missing_cols['years_build_missing']   = df_test['years_build_avg'].isna().astype(int)
aux_missing_cols['commonarea_missing']    = df_test['commonarea_avg'].isna().astype(int)

aux_missing_cols['emergencystate_missing']= df_test['emergencystate_mode'].isna().astype(int)
df_test['emergencystate_mode']           = df_test['emergencystate_mode'].fillna(0)
for col in ['elevators_avg', 'elevators_mode', 'elevators_medi']:
    aux_missing_cols[col + "_missing"] = df_test[col].isna().astype(int)
    df_test[col] = df_test[col].fillna(0)


cols_moda = [
    'housetype_mode', 'wallsmaterial_mode', 'occupation_type', 'organization_type'
]
for col in cols_moda:
    aux_missing_cols[col + '_missing'] = df_test[col].isna().astype(int)

df_test['housetype_mode']      = df_test['housetype_mode'].fillna('Unknown')
df_test['wallsmaterial_mode']  = df_test['wallsmaterial_mode'].fillna('Unknown')
df_test['occupation_type']     = df_test['occupation_type'].fillna('Other')
df_test['organization_type']   = df_test['organization_type'].fillna('Unknown')

drop_columns = {
    'fondkapremont_mode', 'landarea_mode', 'landarea_medi',
    'livingarea_mode', 'livingarea_medi',
    'entrances_avg', 'entrances_mode', 'entrances_medi',
    'floorsmax_mode', 'floorsmax_medi',
    'apartments_mode', 'apartments_medi', 'years_build_mode','years_build_medi'
}

do_not_drop = {
    'livingarea_avg', 'apartments_avg', 'floorsmax_avg', 'years_build_avg',
    'basementarea_avg', 'nonlivingarea_avg', 'livingapartments_missing',
    'own_car_age', 'years_beginexpluatation_avg','commonarea_avg', 'nonlivingapartments_avg', '
}

prefixes = (
    'nonlivingapartments_','livingapartments_','floorsmin_','commonarea_','basementarea_',
    'nonlivingarea_','years_beginexpluatation_'
)

cols_to_drop = [
    col for col in df_test.columns
    if ((col.startswith(prefixes) and col not in do_not_drop) or col in drop_columns)
]

df_test = df_test.drop(columns=cols_to_drop)
```

In [18]:
```python
aux_missing_cols['name_type_suite_missing'] = df_test['name_type_suite'].isna().astype(int)
df_test["name_type_suite"] = df_test["name_type_suite"].fillna(mode_suite)
```

```
aux_missing_cols['code_gender_missing'] = df_test['code_gender'].isna().astype(int)
df_test["code_gender"] = df_test["code_gender"].fillna(mode_gender)

cols_nan_remanescentes = df_test.columns[df_test.isnull().any()]
for col_nome in cols_nan_remanescentes:
    aux_missing_cols[col_nome + '_missing'] = df_test[col_nome].isna().astype(int)
    mediana = df_mediana.loc[df_mediana['coluna'] == col_nome, 'mediana'].values
    if len(mediana) > 0:
        mediana_value = mediana[0]
        df_test[col_nome] = df_test[col_nome].fillna(mediana_value)
    else:
        df_test[col_nome] = df_test[col_nome].fillna(0)
```

In [19]:
```
df_test = pd.concat([df_test, pd.DataFrame(aux_missing_cols, index=df_test.index)], axis=1)
df_test = df_test.copy()
```

## 14.2 Feature Engineering

In [ ]:
```
df_test2 = df_test.copy()
```

In [9]:
```
df_test2['days_employed_anom'] = df_test2["days_employed"] == 365243
df_test2['days_birth'] = df_test2['days_birth'].abs()
df_test2['days_employed'] = df_test2['days_employed'].abs()
df_test2['days_id_publish'] = df_test2['days_id_publish'].abs()
df_test2['days_registration'] = df_test2['days_registration'].abs()
df_test2['age_years'] = df_test2['days_birth'] / 365
df_test2['employment_years'] = df_test2['days_employed'] / 365
df_test2['id_publish_years'] = df_test2['days_id_publish'] / 365

df_test2['annuity_burden_ratio'] = df_test2['amt_annuity'] / (df_test2['bur_amt_credit_sum_mear
df_test2['phone_change_rate'] = df_test2['days_last_phone_change'] / (df_test2['days_birth'] +
df_test2['id_change_rate'] = df_test2['days_id_publish'] / (df_test2['days_birth'] + 1e-6)
df_test2['ext_source_weighted_mean'] = (
    0.5 * df_test2['ext_source_2'] + 0.3 * df_test2['ext_source_3'] + 0.2 * df_test2['ext_sourc
)
df_test2['ext_source_max'] = df_test2[['ext_source_1', 'ext_source_2', 'ext_source_3']].max(axi
df_test2['amt_application_credit_diff'] = df_test2['prev_amt_application_mean'] - df_test2['bur
df_test2['amt_application_goods_diff'] = df_test2['prev_amt_application_mean'] - df_test2['amt_


flag_document_cols = [col for col in df_test2.columns if col.startswith('flag_document_')]
df_test2['num_flag_document'] = df_test2[flag_document_cols].sum(axis=1)
df_test2['credit_to_income_ratio'] = df_test2['bur_amt_credit_sum_mean'] / (df_test2['amt_incom
df_test2['annuity_to_income_ratio'] = df_test2['amt_annuity'] / (df_test2['amt_income_total'] +
df_test2['payment_rate'] = df_test2['amt_annuity'] / (df_test2['bur_amt_credit_sum_mean'] + 1e-
df_test2['goods_to_credit_ratio'] = df_test2['bur_amt_credit_sum_mean'] / (df_test2['amt_goods_
df_test2['credit_efficiency'] = df_test2['bur_amt_credit_sum_mean'] / (df_test2['prev_amt_appli
df_test2['employment_life_ratio'] = df_test2['days_employed'] / (df_test2['days_birth'])
df_test2['bureau_request_intensity'] = (
    df_test2['amt_req_credit_bureau_day'] +
    df_test2['amt_req_credit_bureau_week'] +
    df_test2['amt_req_credit_bureau_mon'] +
    df_test2['amt_req_credit_bureau_qrt']
)

ext_sources = ['ext_source_1', 'ext_source_2', 'ext_source_3']
df_test2['ext_source_mean'] = df_test2[ext_sources].mean(axis=1)
df_test2['ext_source_range'] = df_test2[ext_sources].max(axis=1) - df_test2[ext_sources].min(ax
df_test2['ext_source_std'] = df_test2[ext_sources].std(axis=1)
df_test2['ext_source_agreement'] = 1 / (df_test2['ext_source_std'] + 1e-5)


df_test2['decision_credit_diff'] = df_test2['prev_days_decision_mean'] / (df_test2['bur_amt_cre
df_test2['bureau_to_credit_ratio'] = df_test2['bureau_request_intensity'] / (df_test2['bur_amt_

df_test2['credit_per_employment_year'] = df_test2['bur_amt_credit_sum_mean'] / (df_test2['emplo
```

```
df_test2['annuity_per_employment_year'] = df_test2['amt_annuity'] / (df_test2['employment_years

df_test2['income_per_employed'] = df_test2['amt_income_total'] / ((df_test2['days_employed']+ 1
df_test2['income_per_birth'] = df_test2['amt_income_total'] / (df_test2['days_birth'])
df_test2['own_car_age_birth_ratio'] = df_test2['own_car_age'] / (df_test2['days_birth'])
df_test2['own_car_age_employed_ratio'] = df_test2['own_car_age'] / ((df_test2['days_employed']+
df_test2['days_since_last_employment_until_application'] = df_test2['days_employed'] - df_test2

poly_vars = [
    'days_birth',
    'payment_rate',
    'ext_source_mean',
]
X_poly = df_test2[poly_vars].fillna(0).copy()

X_poly_trans = poly.transform(X_poly)
poly_feature_names = poly.get_feature_names_out(poly_vars)
df_poly = pd.DataFrame(X_poly_trans, columns=poly_feature_names, index=df_test2.index)
df_poly = df_poly.drop(columns=poly_vars, errors='ignore')
df_test2 = pd.concat([df_test2, df_poly], axis=1)


df_test2['employment_stability'] = df_test2['employment_years'] / (df_test2['age_years'] + 1e-6
df_test2['id_document_age_ratio'] = df_test2['id_publish_years'] / (df_test2['age_years'] + 1e-
df_test2['phone_change_frequency'] = 1 / (df_test2['days_last_phone_change'] + 1e-6)


df_test2['recent_instability'] = df_test2['phone_change_rate'] + df_test2['id_change_rate']
df_test2['bureau_overdue_ratio'] = df_test2['bur_amt_credit_max_overdue_max'] / (df_test2['bur_
df_test2['credit_risk_signal'] = df_test2['credit_to_income_ratio'] * ((df_test2['ext_source_1'
df_test2['annuity_per_age'] = df_test2['amt_annuity'] / (df_test2['own_car_age'] + 1e-6)
df_test2["overdue_flag"] = (df_test2["bur_amt_credit_max_overdue_max"] > 0).astype(int)
df_test2["entry_vs_due_ratio"] = df_test2["instf_inst_days_entry_payment_mean_mean"] / (df_test
df_test2["ext_source_interaction"] = df_test2["ext_source_1"] * df_test2["ext_source_3"]
df_test2["pos_balance_range"] = df_test2["posf_pos_months_balance_max_max"] - df_test2["bur_bb_
df_test2["area_quality"] = df_test2["totalarea_mode"] / (df_test2["region_population_relative"]
```

## 14.3 Scaling and Encoding

In [ ]:
```
df_test3 = df_test2.copy()
```

In [14]:
```
log_transform_cols = [
    'decision_credit_diff',
    'annuity_burden_ratio',
    'credit_efficiency',
]

for col in log_transform_cols:

    df_test3[col + '_log'] = np.log1p(df_test3[col])
    df_test3.drop(columns=col, inplace=True)
```

```
c:\Users\Patryck\AppData\Local\Programs\Python\Python311\Lib\site-packages\pandas\core\arraylik
e.py:399: RuntimeWarning: invalid value encountered in log1p
  result = getattr(ufunc, method)(*inputs, **kwargs)
```

In [15]:
```
cols_to_scale = [
    'phone_change_frequency',
    'amt_income_total',
    'amt_credit',
    'num_flag_document',
    'amt_annuity',
    'amt_goods_price',
    'apartments_avg',
    'floorsmax_avg',
    'livingarea_avg',
```

```python
    'years_build_avg',
    'phone_change_rate',
    'elevators_avg',
    'elevators_mode',
    'elevators_medi',
    'own_car_age',
    'obs_30_cnt_social_circle',
    'def_30_cnt_social_circle',
    'obs_60_cnt_social_circle',
    'def_60_cnt_social_circle',
    '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',
    'goods_to_credit_ratio',
    'basementarea_avg',
    'livingapartments_avg',
    'landarea_avg',
    'nonlivingapartments_avg',
    'commonarea_avg',
    'years_beginexpluatation_avg',
    'nonlivingarea_avg',
    'days_employed',
    'payment_rate',
    'payment_rate^2',
    'payment_rate ext_source_mean',
    'days_birth^2 payment_rate',
    'days_birth payment_rate^2',
    'payment_rate^3',
    'payment_rate^2 ext_source_mean',
    'payment_rate ext_source_mean^2',
]

df_test3[cols_to_scale] = robust_scaler.transform(df_test3[cols_to_scale])
```

In [16]:
```python
cols_to_standard_scale = [
    'days_registration',
    'days_since_last_employment_until_application',
    'income_per_employed',
    'days_id_publish',
    'days_last_phone_change',
    'recent_instability',
    'employment_stability',
    'employment_life_ratio',
    'cnt_fam_members',
    'goods_to_credit_ratio',
    'days_birth',
    'days_birth^2',
    'days_birth payment_rate',
    'days_birth ext_source_mean',
    'ext_source_mean^2',
    'days_birth^3',
    'days_birth^2 ext_source_mean',
    'days_birth payment_rate ext_source_mean',
    'days_birth ext_source_mean^2',
    'ext_source_mean^3'
]


df_test3[cols_to_standard_scale] = standard_scaler.transform(df_test3[cols_to_standard_scale])
```

In [17]:
```python
cols_to_minmax_scale = [
    'cnt_children',
    'region_population_relative',
    'bureau_to_credit_ratio',
    'bureau_request_intensity',
```

```
    'annuity_to_income_ratio',
    'id_document_age_ratio',
]

df_test3[cols_to_minmax_scale] = minmax_scaler.transform(df_test3[cols_to_minmax_scale])
```

In [20]:
```
binary_cols = [col for col in df_test3.columns if sorted(df_test3[col].dropna().unique()) in [[

lists_to_exclude = set(
    cols_to_standard_scale +
    cols_to_scale +
    cols_to_minmax_scale +
    binary_cols +
    [col for col in df_test3.columns if df_test3[col].dtype == 'object'] +
    ['target']
)

other_columns = [col for col in df_test3.columns if (col not in lists_to_exclude) and (col not

df_test3[other_columns] = scaler.transform(df_test3[other_columns])
```

In [10]:
```
df_test3['name_contract_type'] = (df_test3['name_contract_type'] != 'Cash loans').astype(int)
df_test3['code_gender'] = df_test3['code_gender'].map({'F': 0, 'M': 1})

encoded_suite_test = encoder_suite.transform(df_test3[['name_type_suite']])
col_names_suite = [f"nts_{cat}" for cat in encoder_suite.categories_[0][1:]]
encoded_df_suite_test = pd.DataFrame(encoded_suite_test, columns=col_names_suite, index=df_test
df_test3 = pd.concat([df_test3.drop(columns=['name_type_suite']), encoded_df_suite_test], axis=

encoded_fam_test = encoder_fam.transform(df_test3[['name_family_status']])
col_names_fam = [f"nfs_{cat}" for cat in encoder_fam.categories_[0][1:]]
encoded_df_fam_test = pd.DataFrame(encoded_fam_test, columns=col_names_fam, index=df_test3.inde
df_test3 = pd.concat([df_test3.drop(columns=['name_family_status']), encoded_df_fam_test], axis

encoded_housing_test = encoder_housing.transform(df_test3[['name_housing_type']])
col_names_housing = [f"nht_{cat}" for cat in encoder_housing.categories_[0][1:]]
encoded_df_housing_test = pd.DataFrame(encoded_housing_test, columns=col_names_housing, index=d
df_test3 = pd.concat([df_test3.drop(columns=['name_housing_type']), encoded_df_housing_test], a

encoded_housetype_mode_test = encoder_housetype_mode.transform(df_test3[['housetype_mode']])
col_names_housetype_mode = [f"htm_{cat}" for cat in encoder_housetype_mode.categories_[0][1:]]
encoded_df_housetype_mode_test = pd.DataFrame(encoded_housetype_mode_test, columns=col_names_ho
df_test3 = pd.concat([df_test3.drop(columns=['housetype_mode']), encoded_df_housetype_mode_test

encoded_walls_test = encoder_walls.transform(df_test3[['wallsmaterial_mode']])
col_names_walls = [f"wm_{cat}" for cat in encoder_walls.categories_[0][1:]]
encoded_df_walls_test = pd.DataFrame(encoded_walls_test, columns=col_names_walls, index=df_test
df_test3 = pd.concat([df_test3.drop(columns=['wallsmaterial_mode']), encoded_df_walls_test], ax
```

In [11]:
```
df_test3['name_income_type_te'] = df_test3['name_income_type'].map(target_mean_income)
df_test3.drop('name_income_type', axis=1, inplace=True)

df_test3['occupation_type_te'] = df_test3['occupation_type'].map(target_mean_occupation)
df_test3.drop('occupation_type', axis=1, inplace=True)

df_test3['organization_type_te'] = df_test3['organization_type'].map(target_mean_organization)
df_test3.drop('organization_type', axis=1, inplace=True)

df_test3['region_rating_client_te'] = df_test3['region_rating_client'].map(target_mean_region_r
df_test3.drop('region_rating_client', axis=1, inplace=True)

df_test3['region_rating_client_w_city_te'] = df_test3['region_rating_client_w_city'].map(target
df_test3.drop('region_rating_client_w_city', axis=1, inplace=True)
```

In [12]:
```
education_order = [
    'Lower secondary',
    'Secondary / secondary special',
    'Incomplete higher',
```

```
    'Higher education',
    'Academic degree'
]
df_test3['name_education_type'] = pd.Categorical(
    df_test3['name_education_type'],
    categories=education_order,
    ordered=True
).codes
```

## 14.4 Selecting Features

In [ ]:
```
df_test4 = df_test3.copy()
```

In [15]:
```
df_test4.columns = [col.replace('/', '_').replace(',', '_').replace(' ', '') for col in df_test
```

In [16]:
```
X_test_final = df_test4[X.columns].copy()
```

In [18]:
```
df_test_final = pd.read_csv("../data/test.csv")[['SK_ID_CURR']].copy()
```

In [19]:
```
df_test_final['TARGET'] = xgb_final.predict_proba(X_test_final)[:, 1]
```

In [ ]:
```
df_test_final.to_csv('../data/test_final.csv', index=False)
```

Auc final : 0.78421

# 15. Conclusion

**Project Conclusion**

The development of the predictive model to estimate the **probability of customer default** demonstrated, in a practical way, the level of **real-world complexity of large-scale credit risk problems**. Working with a dataset containing **more than 800 variables**, strong **class imbalance**, and weak signals in individual variables, the project required a deeply analytical, careful, and business value–driven approach.

The high number of variables introduced additional challenges, such as **multicollinearity, informational noise, and risk of overfitting**, requiring strong discipline in **feature selection, regularization, and cross-validation**. Even so, the combination of feature engineering, ensemble techniques, and probabilistic calibration made it possible to extract relevant patterns from a highly complex and heterogeneous dataset.

---

**Strategic Value of the Model**

The model demonstrated a real capacity to:

- Consistently differentiate **higher- and lower-risk profiles**;
- Anticipate default behavior with **measurable financial impact**;
- Support decisions based on **calibrated probabilities**, rather than purely heuristic rules.

The chosen threshold proved to be appropriate for the institution's strategic objective: **reducing losses without compromising commercial efficiency**.

The financial simulation confirmed that the use of the model generates **incremental profit**, even after considering the operational costs of preventive actions and the impact of false positives. This demonstrates that the project not only improves statistical metrics but also **delivers real financial results**.

---

**Analytical and Technical Maturity**

Beyond the practical results, the project consolidated a relevant level of **technical maturity**, including:

- Handling a dataset with **more than 800 variables** and different data types;
- Balancing **model interpretability and performance**;
- Integrating technical metrics (AUC, F1, MCC) with **business metrics** (profit, losses avoided, and operational cost).

The project reinforces that credit risk models are not built merely to "predict", but to **support strategic decisions with direct impact on portfolio profitability and sustainability**.

---

**Closing Remarks**

The final result is a **robust, scalable, and business-aligned model**, capable of operating in scenarios with a large number of variables, strong class imbalance, and weak signals.

More than a technical exercise, the project highlights the role of **data science as a central tool for risk management, operational efficiency, and competitive advantage in the financial sector**.

In summary, the work demonstrates that, even in complex and noisy environments, the combination of **data engineering, statistical modeling, and business strategy generates concrete and measurable value**.