main

May 6, 2025

1 French Motor dataset

Goal is to predict if customer will have an accident or not. Steps: - Initial analysis (1) - Data preprocessing (2) - modelling (3) - model explanation (4)

[54]:
```
import seaborn as sns
import pandas as pd
from matplotlib import pyplot as plt
import numpy as np

import statsmodels.api as sm

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.feature_selection import SelectKBest, f_classif
from sklearn.metrics import confusion_matrix
from sklearn.ensemble import GradientBoostingClassifier,RandomForestClassifier
from sklearn.utils.class_weight import compute_sample_weight
from sklearn.dummy import DummyClassifier
from sklearn.metrics import␣
 ↪f1_score,accuracy_score,recall_score,precision_score,roc_auc_score,classification_report
from sklearn.model_selection import cross_val_score

from skopt import BayesSearchCV
from skopt.space import Real, Integer

from catboost import CatBoostClassifier
import xgboost as xgb

from tqdm import tqdm
```

[55]:
```
df_og = pd.read_csv('freMTPL2freq.csv')
df = df_og.copy()
```

1.1 Description

Variable	Description
IDpol	Unique identifier for the policy (used to link with claims dataset)
ClaimNb	Number of claims reported during the policy period
Exposure	Duration of the policy (in years, e.g., 1.0 means full year)
Area	Geographic area code where the policyholder resides
VehPower	Vehicle power (ordered categorical)
VehAge	Age of the vehicle in years
DrivAge	Age of the driver in years
BonusMalus	Bonus-malus coefficient: <100 is a discount (bonus), >100 is a penalty
VehBrand	Brand of the vehicle (can include unknown or rare categories)
VehGas	Type of fuel used by the vehicle: Diesel or regular (gasoline)
Density	Population density (inhabitants per km²) of the driver's residence city
Region	Administrative region in France based on standard regional classification

[56]:
```
# Display basic information
print("Dataset Shape:", df.shape)
print("\nData Info:")
df.info()

# Display basic statistics
print("\nNumerical Features Statistics:")
print(df.describe())
```

```
Dataset Shape: (678013, 12)

Data Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 678013 entries, 0 to 678012
Data columns (total 12 columns):
 #   Column      Non-Null Count   Dtype
---  ------      --------------   -----
 0   IDpol       678013 non-null  float64
 1   ClaimNb     678013 non-null  int64
 2   Exposure    678013 non-null  float64
 3   Area        678013 non-null  object
 4   VehPower    678013 non-null  int64
 5   VehAge      678013 non-null  int64
 6   DrivAge     678013 non-null  int64
 7   BonusMalus  678013 non-null  int64
 8   VehBrand    678013 non-null  object
 9   VehGas      678013 non-null  object
 10  Density     678013 non-null  int64
 11  Region      678013 non-null  object
dtypes: float64(2), int64(6), object(4)
memory usage: 62.1+ MB

Numerical Features Statistics:
```

```
              IDpol        ClaimNb       Exposure       VehPower  \
count  6.780130e+05  678013.000000  678013.000000  678013.000000
mean   2.621857e+06       0.053247       0.528750       6.454631
std    1.641783e+06       0.240117       0.364442       2.050906
min    1.000000e+00       0.000000       0.002732       4.000000
25%    1.157951e+06       0.000000       0.180000       5.000000
50%    2.272152e+06       0.000000       0.490000       6.000000
75%    4.046274e+06       0.000000       0.990000       7.000000
max    6.114330e+06      16.000000       2.010000      15.000000

              VehAge        DrivAge     BonusMalus        Density
count  678013.000000  678013.000000  678013.000000  678013.000000
mean        7.044265      45.499122      59.761502    1792.422405
std         5.666232      14.137444      15.636658    3958.646564
min         0.000000      18.000000      50.000000       1.000000
25%         2.000000      34.000000      50.000000      92.000000
50%         6.000000      44.000000      50.000000     393.000000
75%        11.000000      55.000000      64.000000    1658.000000
max       100.000000     100.000000     230.000000   27000.000000
```

[57]:
```
df.head(5)
```

[57]:
```
    IDpol  ClaimNb  Exposure Area  VehPower  VehAge  DrivAge  BonusMalus  \
0     1.0        1      0.10    D         5       0       55          50
1     3.0        1      0.77    D         5       0       55          50
2     5.0        1      0.75    B         6       2       52          50
3    10.0        1      0.09    B         7       0       46          50
4    11.0        1      0.84    B         7       0       46          50

  VehBrand   VehGas  Density Region
0      B12  Regular     1217    R82
1      B12  Regular     1217    R82
2      B12   Diesel       54    R22
3      B12   Diesel       76    R72
4      B12   Diesel       76    R72
```

2 Data encoding

[58]:
```
numeric_columns = []
string_columns = []
for k,v in df.dtypes.items():
    if v == 'object':
        string_columns.append(k)
    else:
        numeric_columns.append(k)
print('numeric columns:',numeric_columns)
print('string columns:',string_columns)
```

```
numeric columns: ['IDpol', 'ClaimNb', 'Exposure', 'VehPower', 'VehAge',
'DrivAge', 'BonusMalus', 'Density']
string columns: ['Area', 'VehBrand', 'VehGas', 'Region']
```

[59]:
```
df = pd.get_dummies(df, drop_first=True, dtype='int')
df.head(5)
```

[59]:

	IDpol	ClaimNb	Exposure	VehPower	VehAge	DrivAge	BonusMalus	Density	\
0	1.0	1	0.10	5	0	55	50	1217	
1	3.0	1	0.77	5	0	55	50	1217	
2	5.0	1	0.75	6	2	52	50	54	
3	10.0	1	0.09	7	0	46	50	76	
4	11.0	1	0.84	7	0	46	50	76	

	Area_B	Area_C	…	Region_R53	Region_R54	Region_R72	Region_R73	\
0	0	0	…	0	0	0	0	
1	0	0	…	0	0	0	0	
2	1	0	…	0	0	0	0	
3	1	0	…	0	0	1	0	
4	1	0	…	0	0	1	0	

	Region_R74	Region_R82	Region_R83	Region_R91	Region_R93	Region_R94
0	0	1	0	0	0	0
1	0	1	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0

[5 rows x 45 columns]

[60]:
```
# add new created columns to num-cat division
categorical_columns = []
for col in df.columns:
    if col.startswith(tuple(string_columns)):
        categorical_columns.append(col)
numeric_columns = list(set(numeric_columns) - {'IDpol','ClaimNb','Exposure'})
print('numerical:',numeric_columns)
print('categorical:',categorical_columns)
```

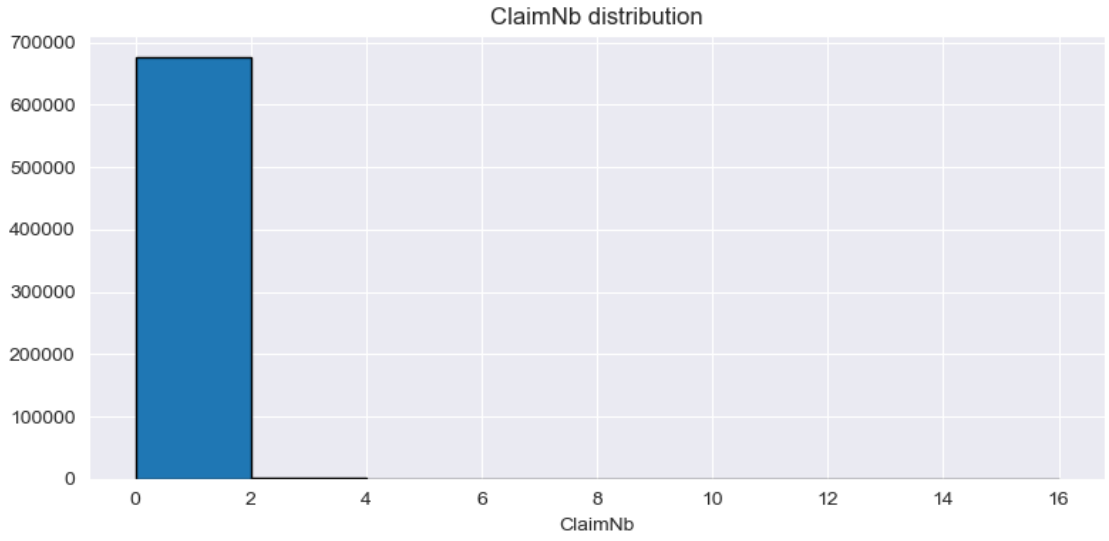
```
numerical: ['BonusMalus', 'DrivAge', 'Density', 'VehPower', 'VehAge']
categorical: ['Area_B', 'Area_C', 'Area_D', 'Area_E', 'Area_F', 'VehBrand_B10',
'VehBrand_B11', 'VehBrand_B12', 'VehBrand_B13', 'VehBrand_B14', 'VehBrand_B2',
'VehBrand_B3', 'VehBrand_B4', 'VehBrand_B5', 'VehBrand_B6', 'VehGas_Regular',
'Region_R21', 'Region_R22', 'Region_R23', 'Region_R24', 'Region_R25',
'Region_R26', 'Region_R31', 'Region_R41', 'Region_R42', 'Region_R43',
'Region_R52', 'Region_R53', 'Region_R54', 'Region_R72', 'Region_R73',
'Region_R74', 'Region_R82', 'Region_R83', 'Region_R91', 'Region_R93',
'Region_R94']
```

3 Data analysis

3.1 Target

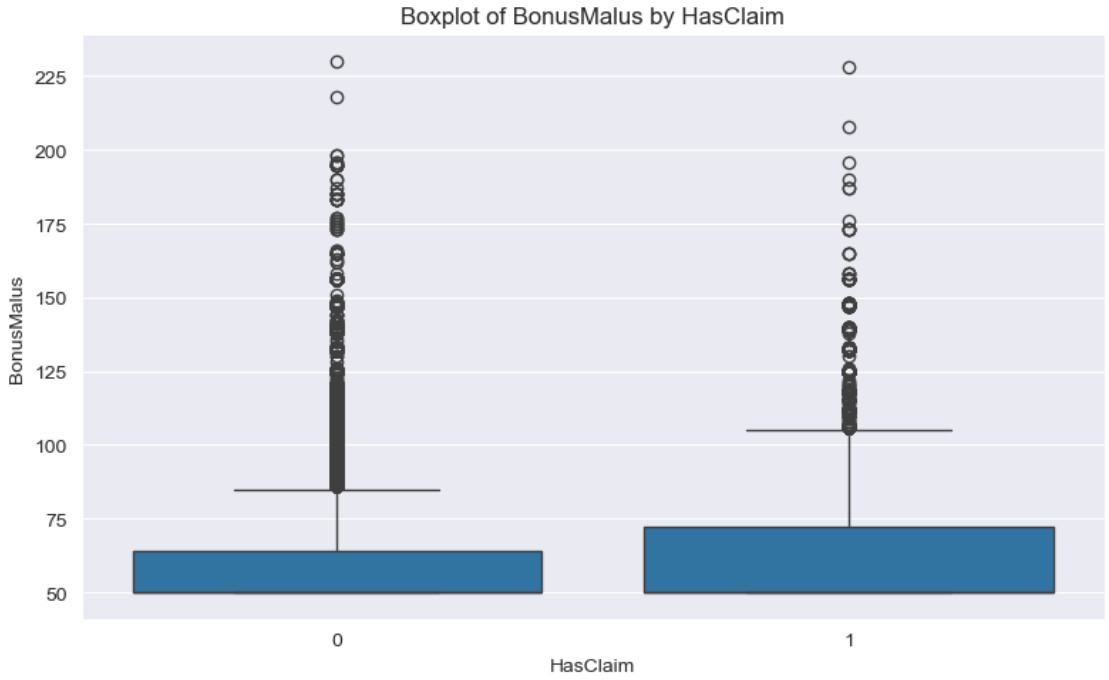
[62]:
```
print(df_og['ClaimNb'].value_counts())

# histogram
plt.figure(figsize=(8, 4))
df['ClaimNb'].hist(bins=8, edgecolor='black')
plt.title(f"ClaimNb distribution")
plt.xlabel("ClaimNb")
plt.tight_layout()
plt.show()
```

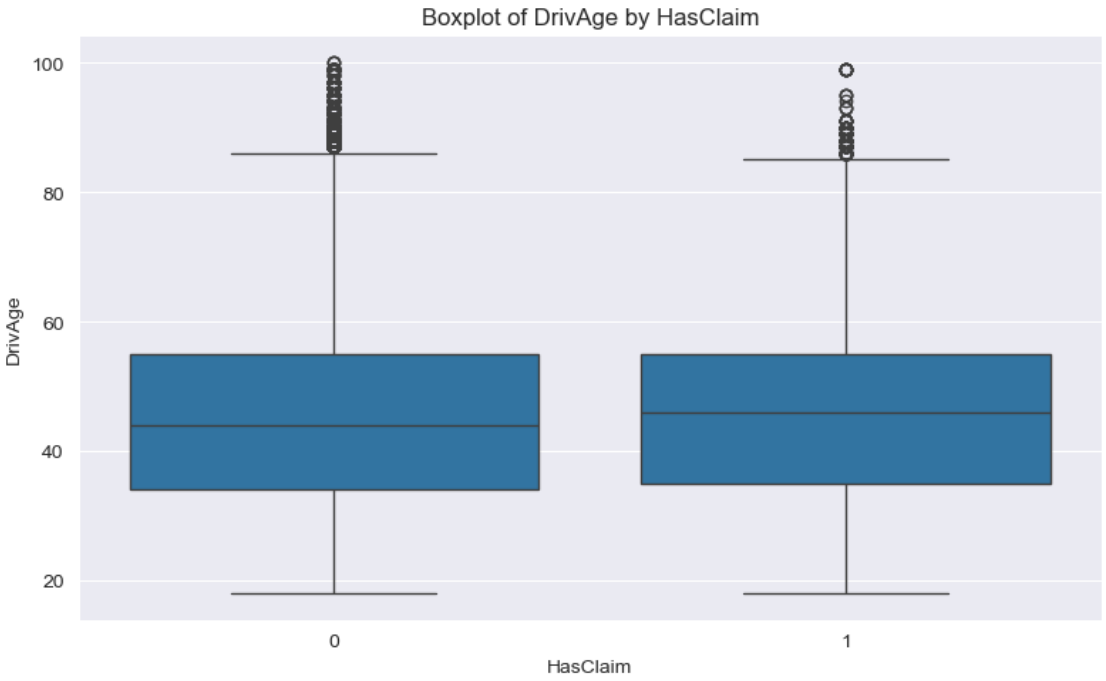
```
ClaimNb
0     643953
1      32178
2       1784
3         82
4          7
11         3
5          2
6          1
8          1
16         1
9          1
Name: count, dtype: int64
```

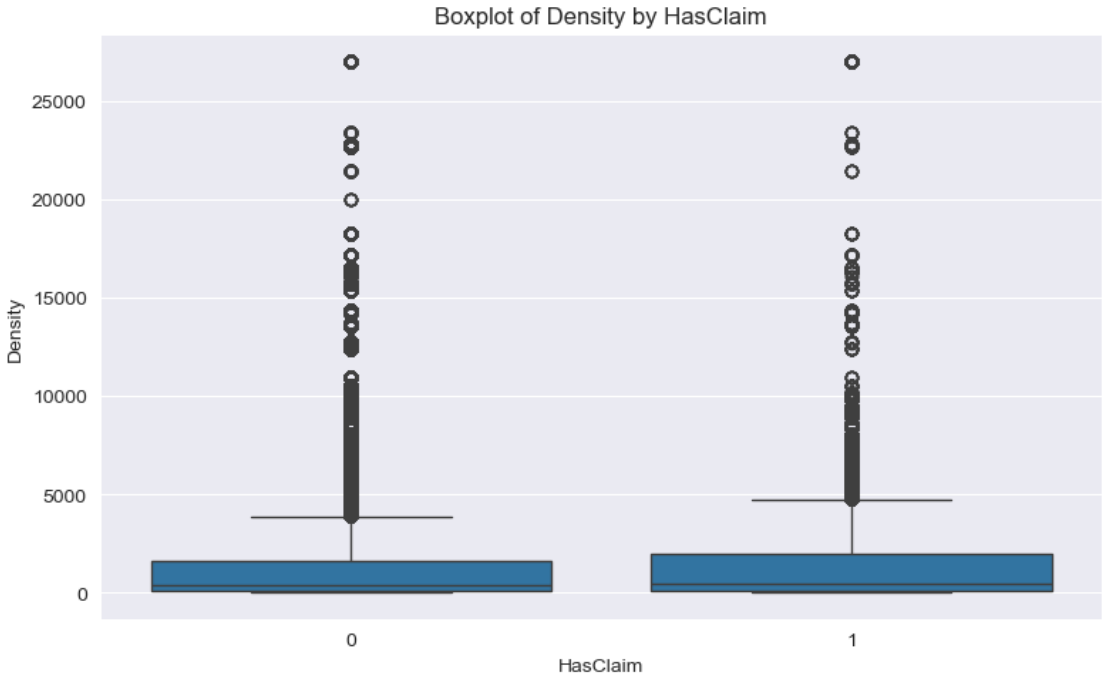


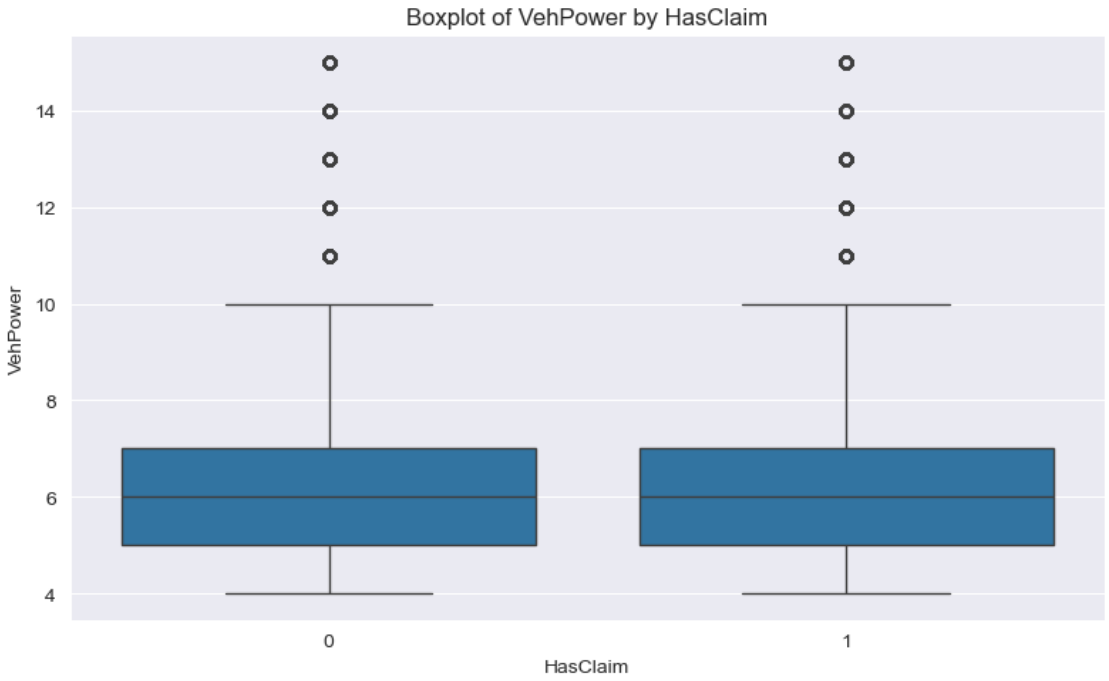
[63]:
```
df = df[df['ClaimNb'] <= 4]

# add binary target
df['HasClaim'] = (df['ClaimNb'] > 0).astype(int)
```

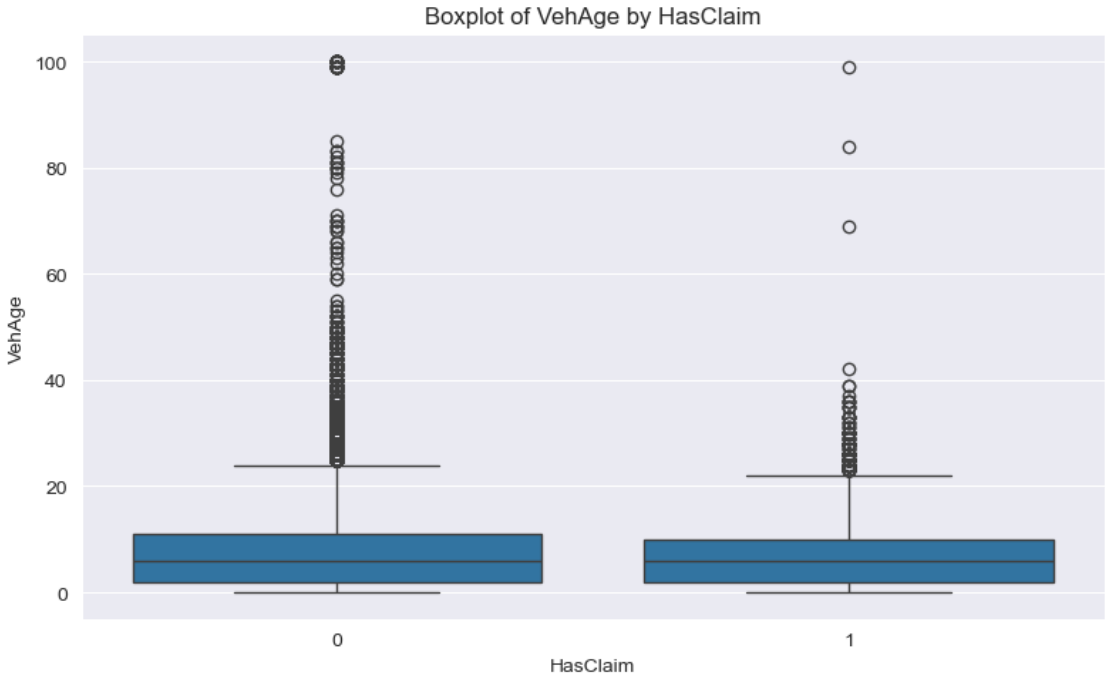
[64]:
```
def plot_variables_by_target(df,selected_columns, target='HasClaim'):
    for col in selected_columns:
        plt.figure(figsize=(8, 5))
        sns.boxplot(x=target, y=col, data=df)
        plt.title(f'Boxplot of {col} by {target}')
        plt.tight_layout()
        plt.show()
plot_variables_by_target(df,list(numeric_columns))
```




Boxplot of DrivAge by HasClaim
DrivAge
100
80
60
40
20
0
1
HasClaim


Boxplot of Density by HasClaim
Density
25000
20000
15000
10000
5000
0
0
1
HasClaim


Boxplot of VehPower by HasClaim
VehPower
14
12
10
8
6
4
0
1
HasClaim

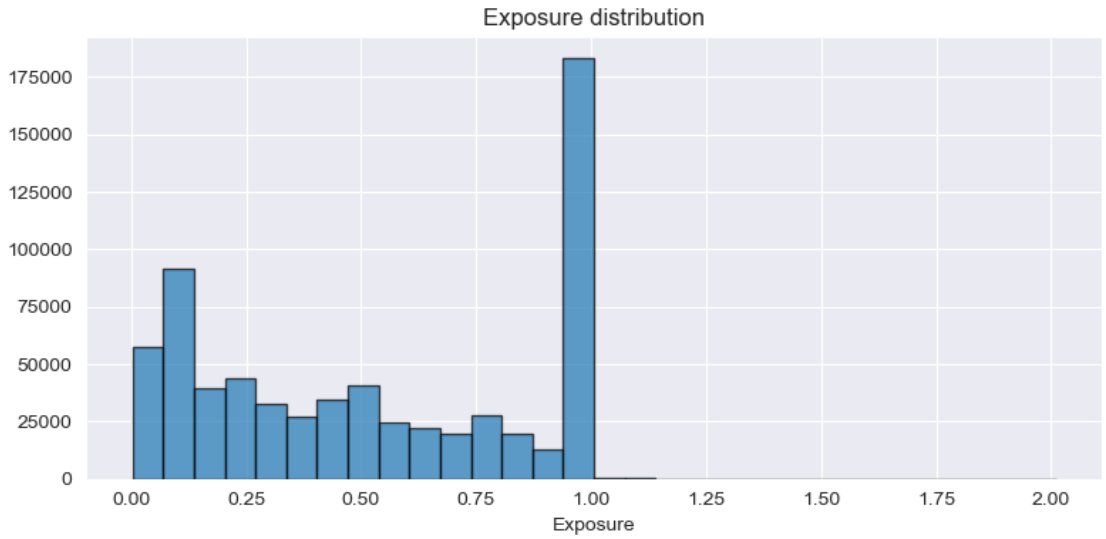

Boxplot of VehAge by HasClaim
VehAge
100
80
60
40
20
0
0
1
HasClaim

3.2 distribution

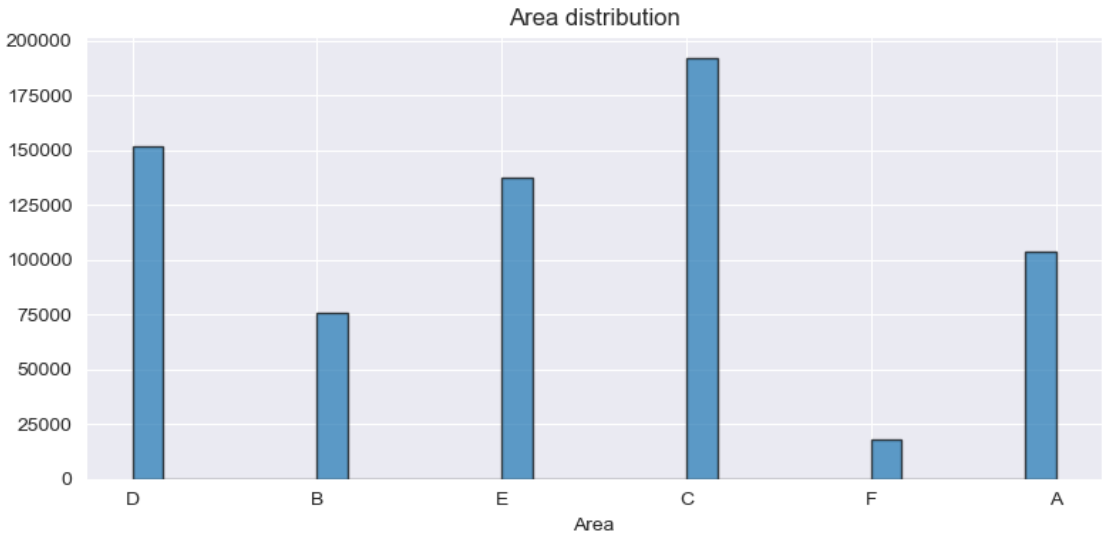
[65]:
```
def hist_and_box_df(df):
    for col in df.columns:

        # columns to skip
        if col in ['ClaimNb','IDpol']:
            continue

        print(df[col].value_counts())

        plt.figure(figsize=(8, 4))
        df[col].hist(bins=30, edgecolor='black', alpha=0.7)

        if col in numeric_columns:
            mean_val = df[col].mean()
            median_val = df[col].median()

            plt.axvline(mean_val, color='red', linestyle='dashed', linewidth=2,␣
 ↪label=f'Mean: {mean_val:.2f}')
            plt.axvline(median_val, color='green', linestyle='dotted',␣
 ↪linewidth=2, label=f'Median: {median_val:.2f}')
            plt.legend()

        plt.title(f"{col} distribution")
        plt.xlabel(col)

        plt.tight_layout()
        plt.show()

        if col in numeric_columns:
            # box plot
            plt.figure(figsize=(8, 4))
            sns.boxplot(x=df[col])
            plt.title(f"Boxplot for {col}")
            plt.xlabel(col)
            plt.grid(True)
            plt.tight_layout()
            plt.show()
hist_and_box_df(df_og)
```

```
Exposure
1.00    168125
0.08     44670
0.07     12969
0.24     12950
0.50     12497
         ...
```

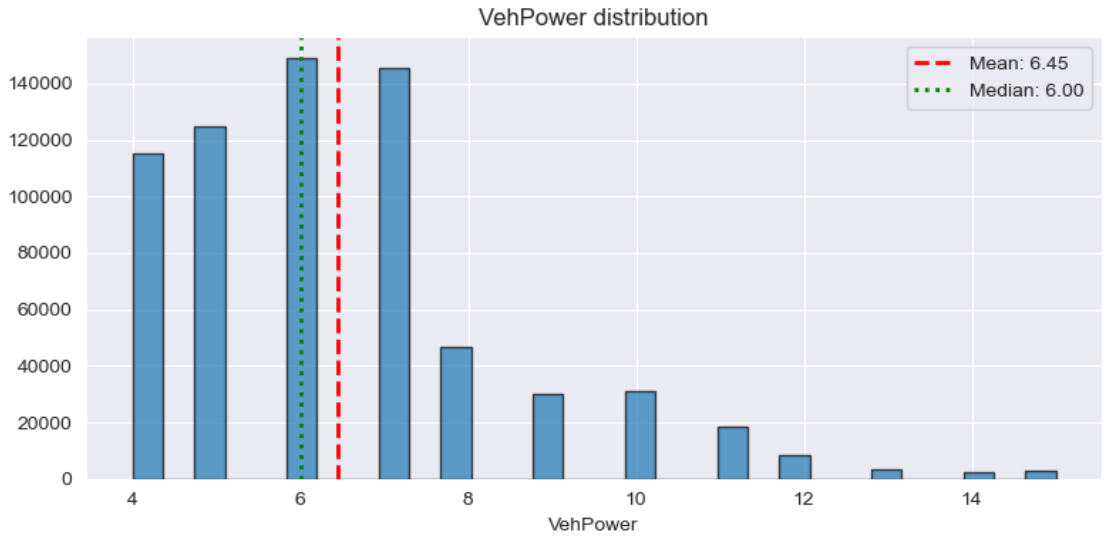
```
1.63         1
1.70         1
1.71         1
1.55         1
1.62         1
Name: count, Length: 187, dtype: int64
```

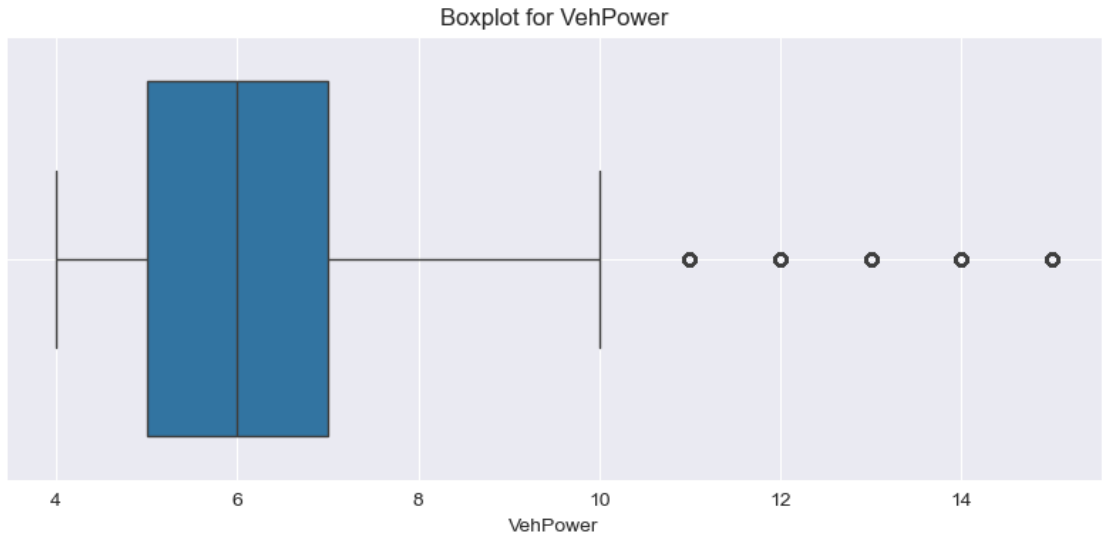



```
Area
C    191880
D    151596
E    137167
A    103957
B     75459
F     17954
Name: count, dtype: int64
```



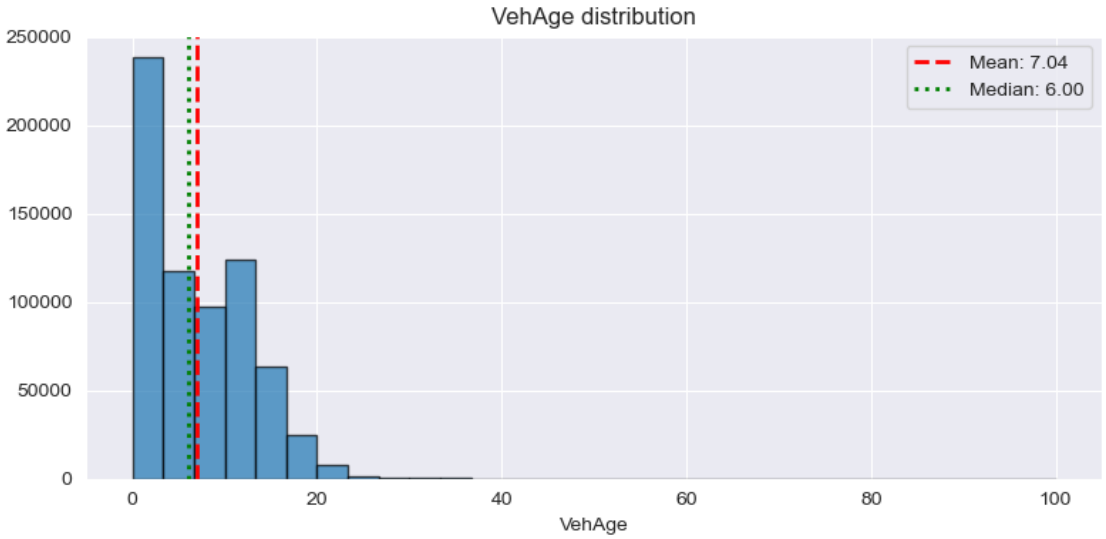

```
VehPower
6      148976
7      145401
5      124821
4      115349
8       46956
10      31354
9       30085
11      18352
12       8214
13       3229
15       2926
14       2350
Name: count, dtype: int64
```

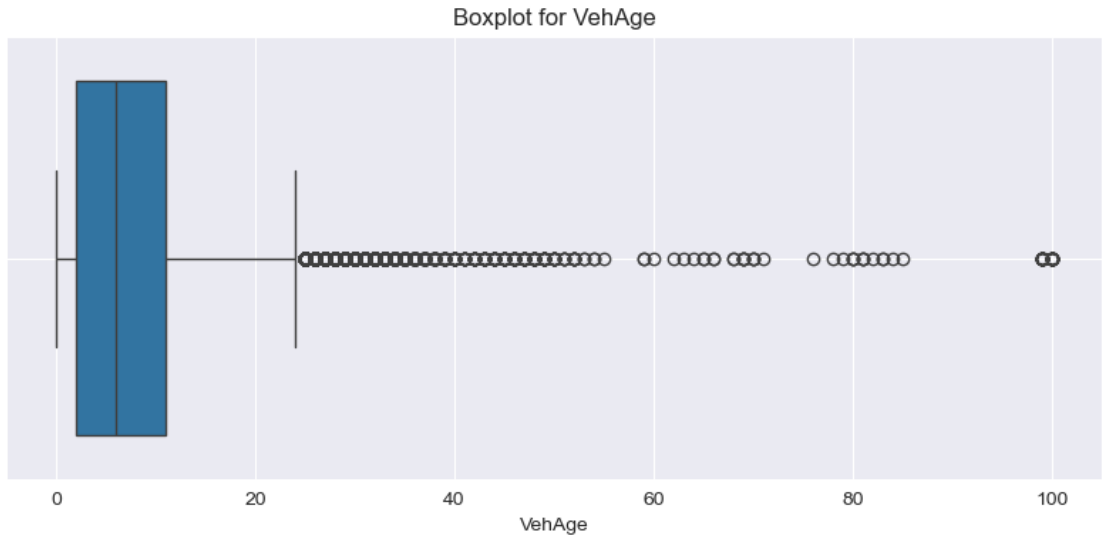





```
VehAge
1       71284
2       59124
0       57739
3       50261
4       43492
        ...
62          1
85          1
60          1
63          1
```

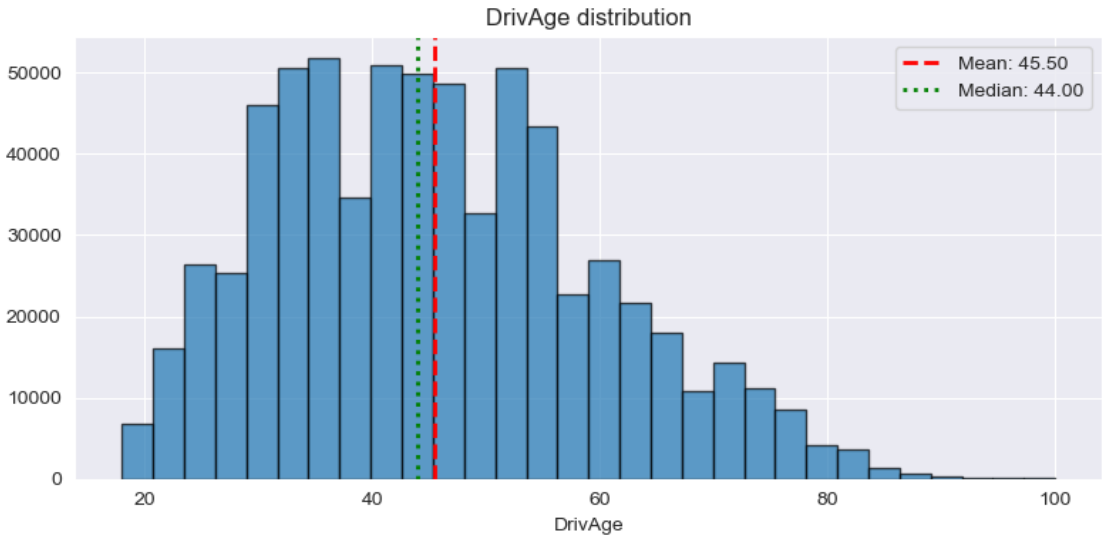
```
71        1
Name: count, Length: 78, dtype: int64
```

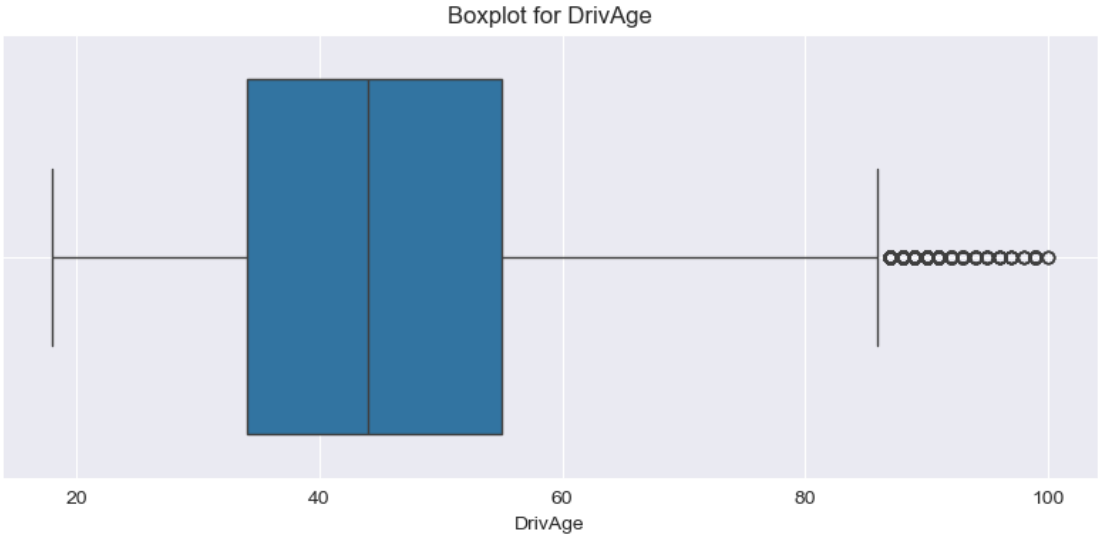





```
DrivAge
36      17530
38      17346
39      17320
37      17295
52      17195
        ...
95         24
```

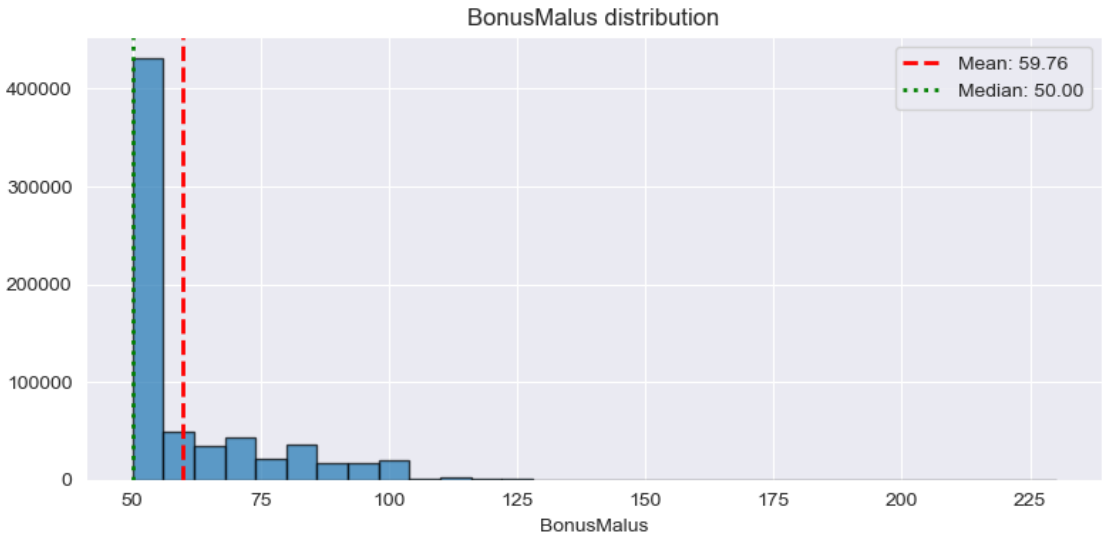
```
96         15
97         10
98          5
100         3
Name: count, Length: 83, dtype: int64
```

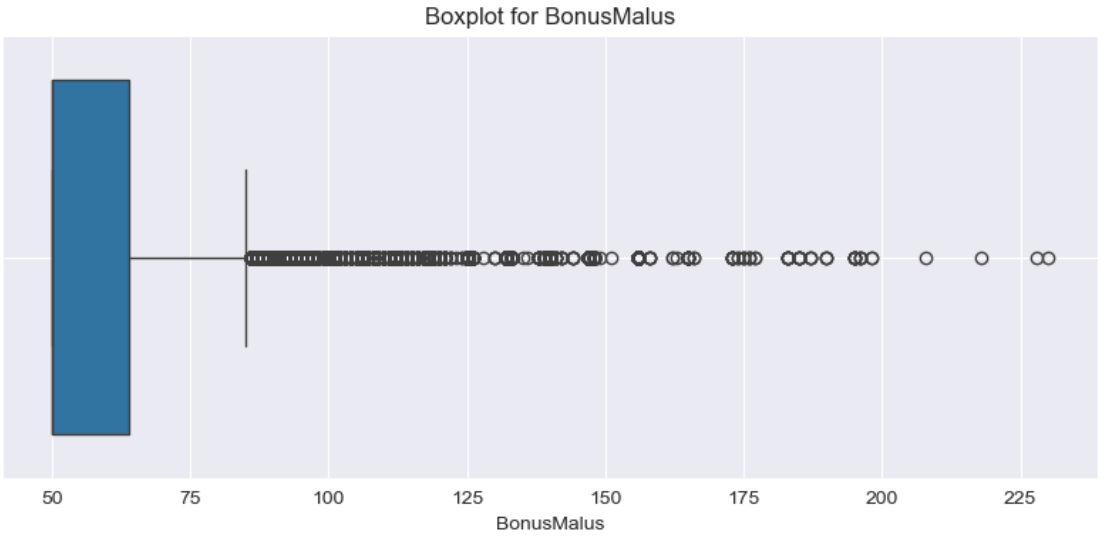





```
BonusMalus
50      384156
100      19530
68       18791
72       18580
```

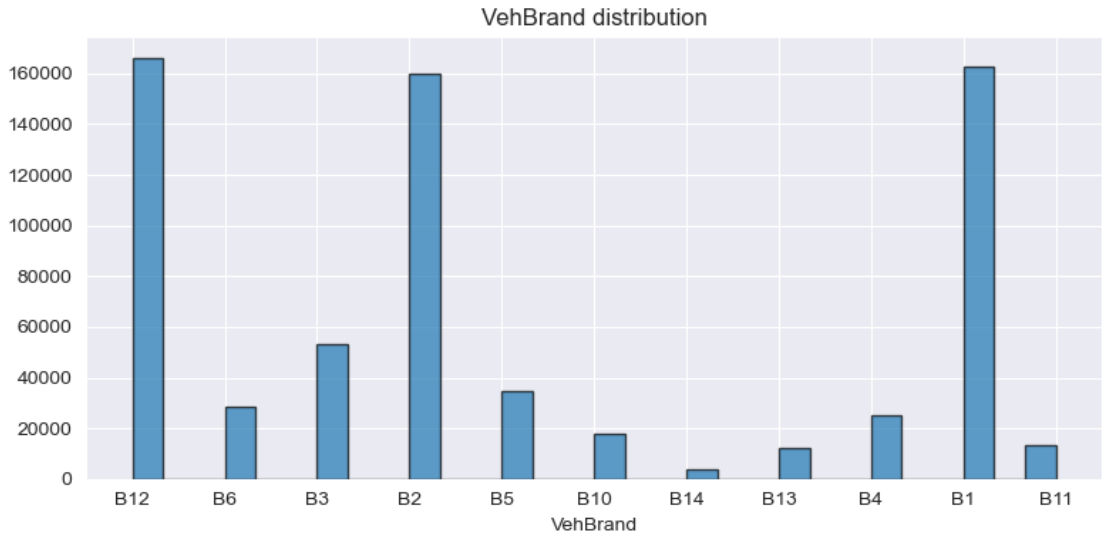
```
76       18226
         ...
163          1
136          1
135          1
123          1
218          1
Name: count, Length: 115, dtype: int64
```



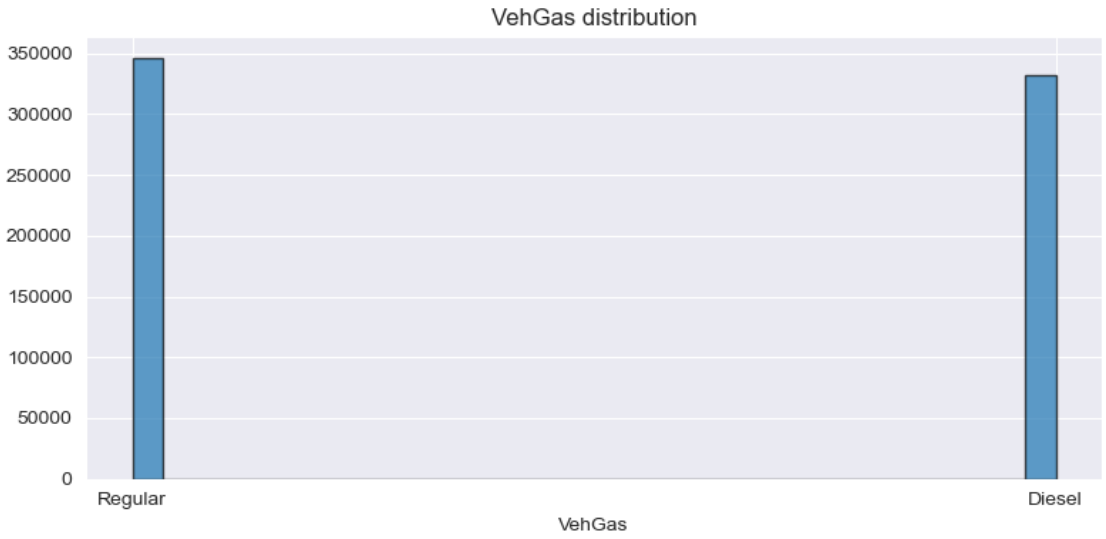



```
VehBrand
B12     166024
```

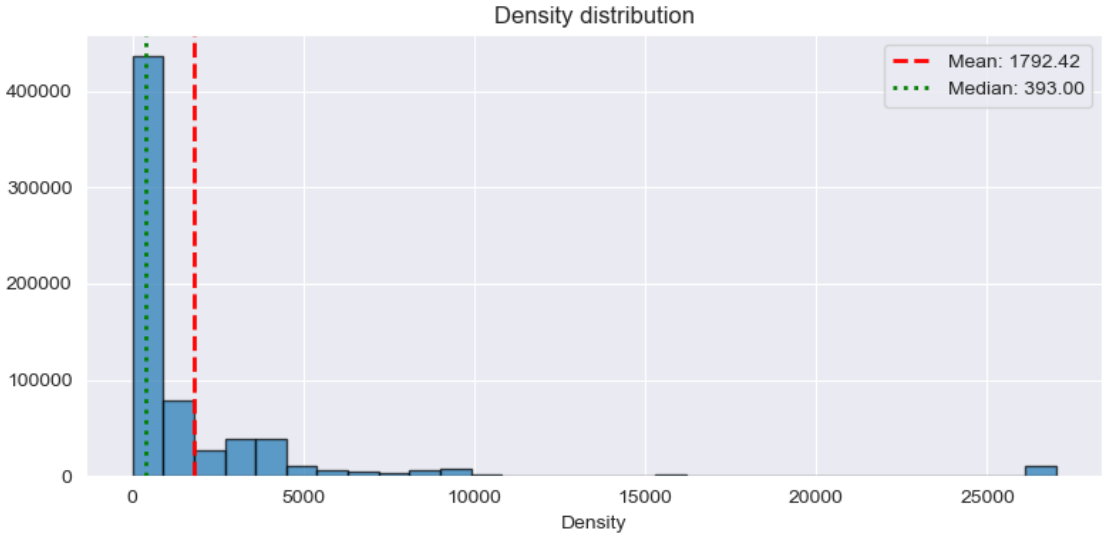
```
B1      162736
B2      159861
B3       53395
B5       34753
B6       28548
B4       25179
B10      17707
B11      13585
B13      12178
B14       4047
Name: count, dtype: int64
```

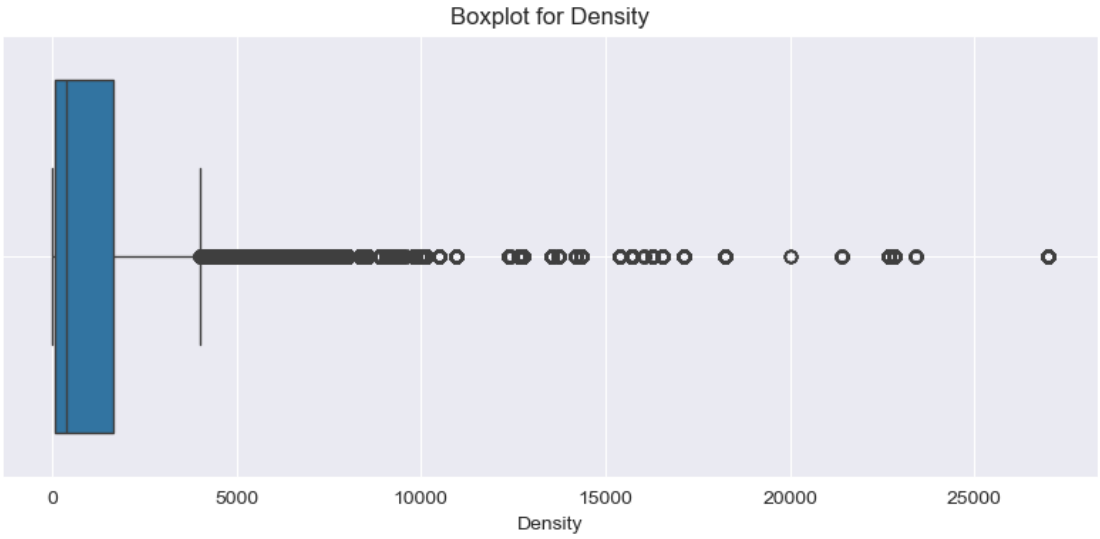



```
VehGas
Regular    345877
Diesel     332136
Name: count, dtype: int64
```

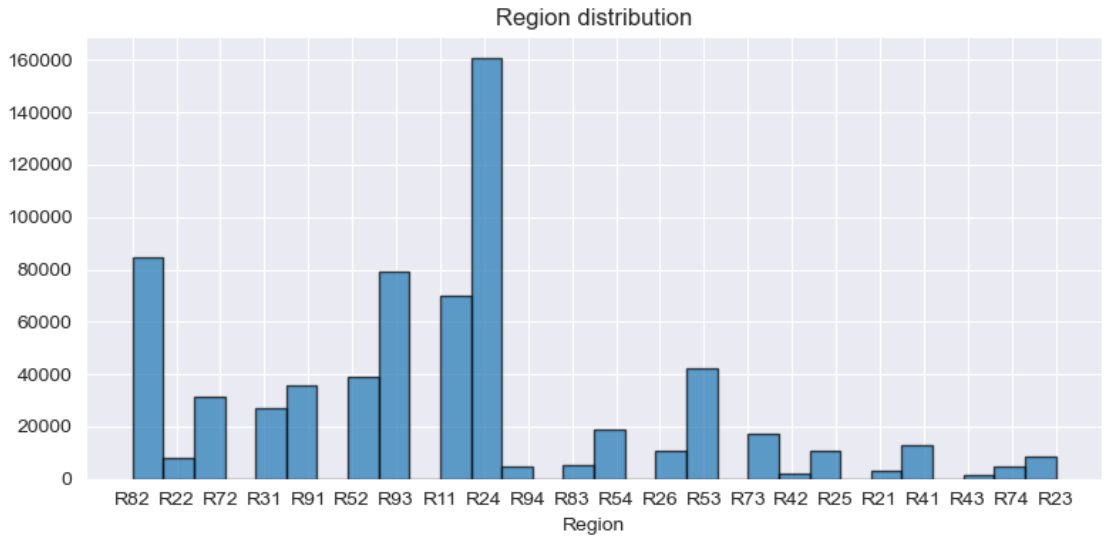



```
Density
27000    10515
3317      9891
1313      7157
9307      5986
3744      5540
          …
773          2
1036         2
1013         2
869          1
1651         1
Name: count, Length: 1607, dtype: int64
```






```
Region
R24    160601
R82     84752
R93     79315
R11     69791
R53     42122
R52     38751
R91     35805
R72     31329
R31     27285
R54     19046
R73     17141
R41     12990
R25     10893
R26     10492
R23      8784
R22      7994
R83      5287
R74      4567
R94      4516
R21      3026
R42      2200
R43      1326
Name: count, dtype: int64
```

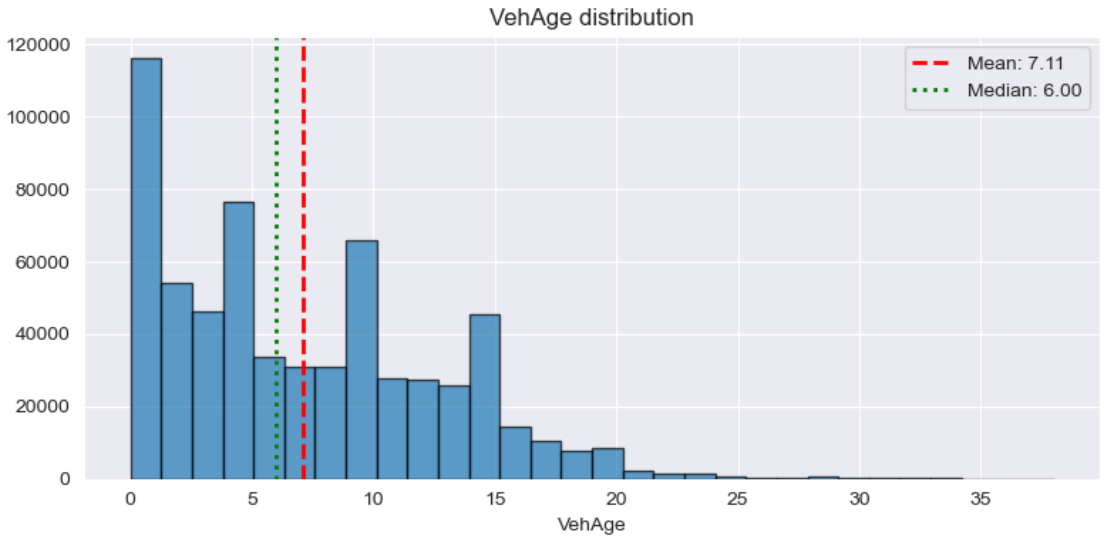


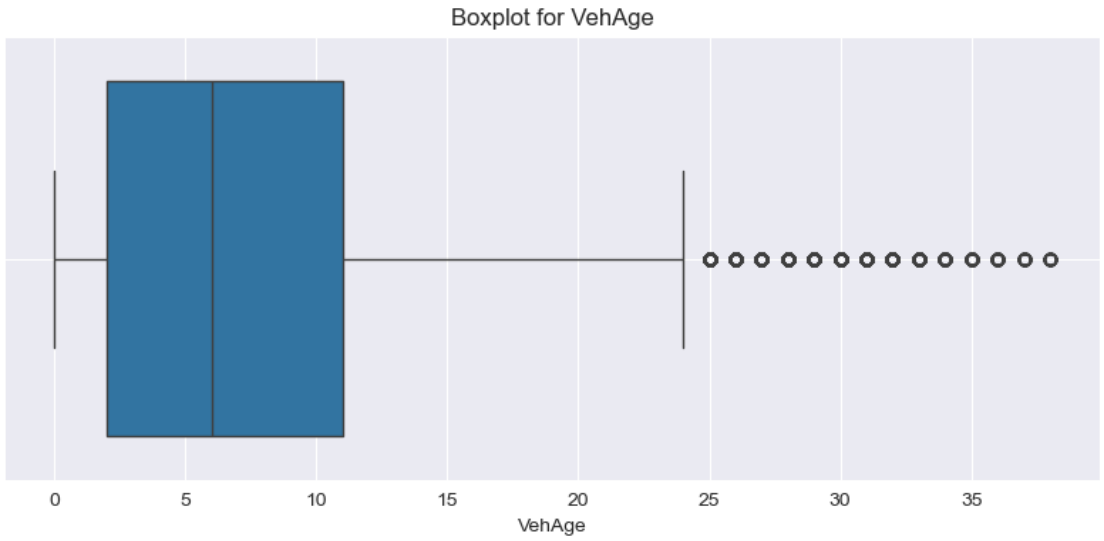
[66]:
```
DROP_OUTLIERS = True
```

[67]:
```
if DROP_OUTLIERS:
    # drop the outliers (only upperbound)
    def drop_outliers_iqr(df, col, multiplier=1.5):
        Q1 = df[col].quantile(0.25)
        Q3 = df[col].quantile(0.75)
        IQR = Q3 - Q1
        #lower_bound = Q1 - multiplier * IQR
        upper_bound = Q3 + multiplier * IQR
        mask = (df[col] <= upper_bound)
        return df[mask]

    df = df[df['Exposure'] <= 1]

    columns_with_outliers = ['VehAge','DrivAge','BonusMalus','Density']
    for col in columns_with_outliers:
        df = drop_outliers_iqr(df, col,multiplier=3)
    hist_and_box_df(df[columns_with_outliers])
```

```
VehAge
1     64403
2     53986
0     51750
3     46404
4     40442
5     36221
10    35839
6     33516
```

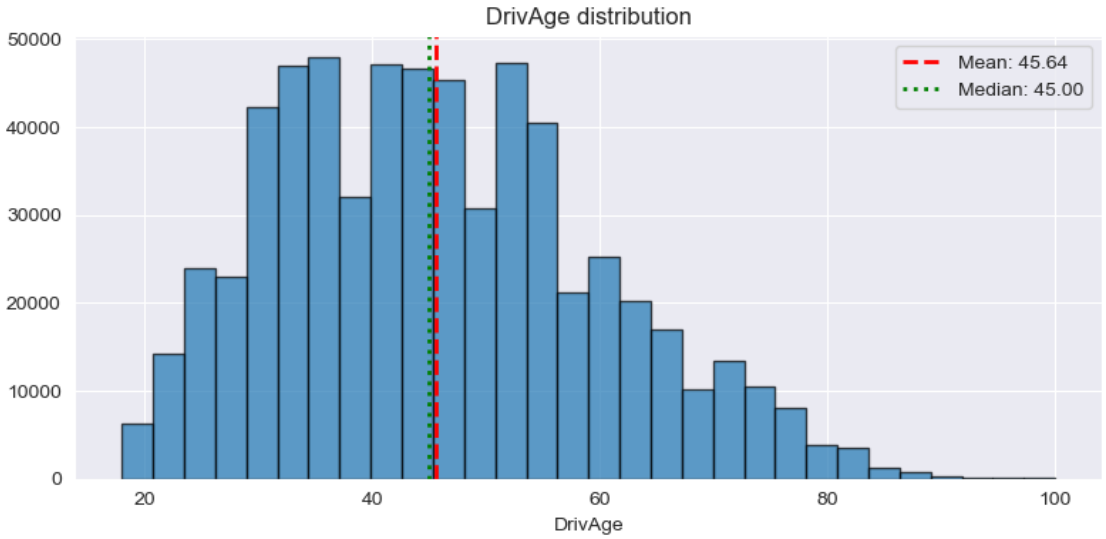
```
7     30982
8     30857
9     30081
11    27781
12    27481
13    25930
14    23292
15    22207
16    14477
17    10583
18     7800
19     5185
20     3220
21     2097
22     1368
23      874
24      634
25      482
26      351
27      311
29      269
28      261
30      242
31      206
32      147
33      118
34       98
35       87
36       69
37       46
38       35
Name: count, dtype: int64
```

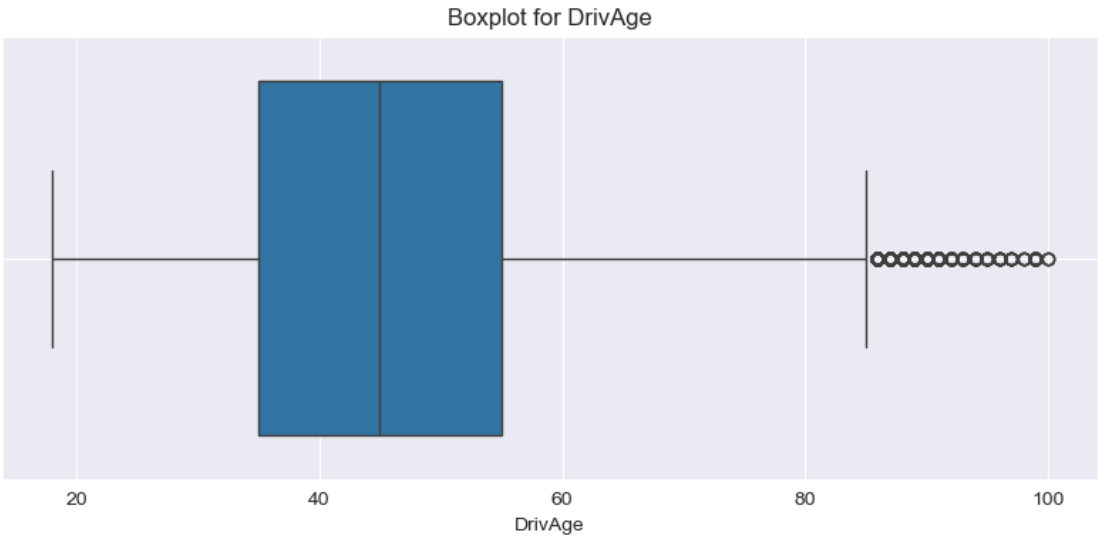





```
DrivAge
36      16236
52      16074
38      16072
37      16040
39      16001
        ...
95         22
96         14
97          9
98          4
```

```
100         3
Name: count, Length: 83, dtype: int64
```

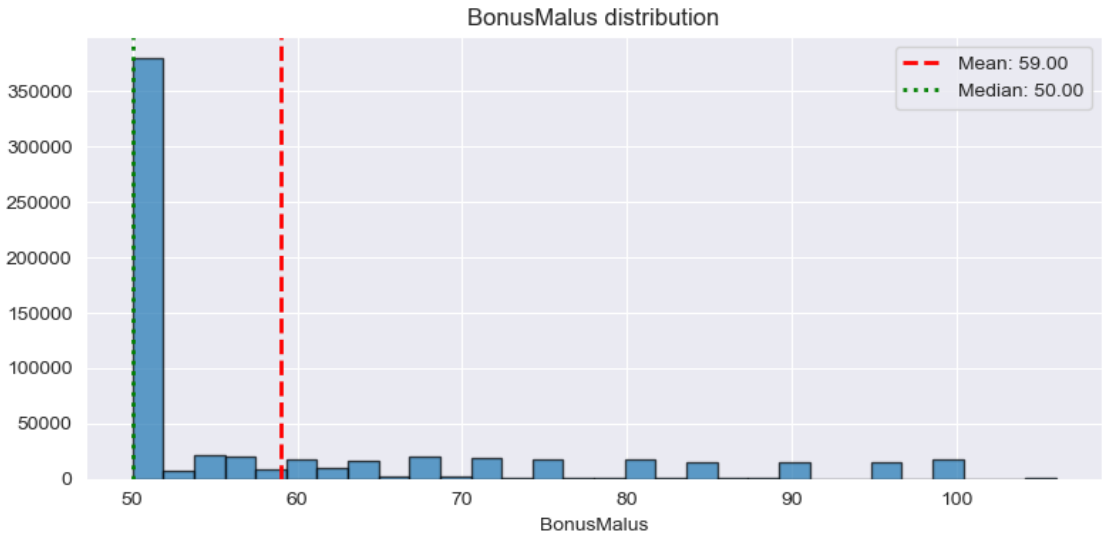


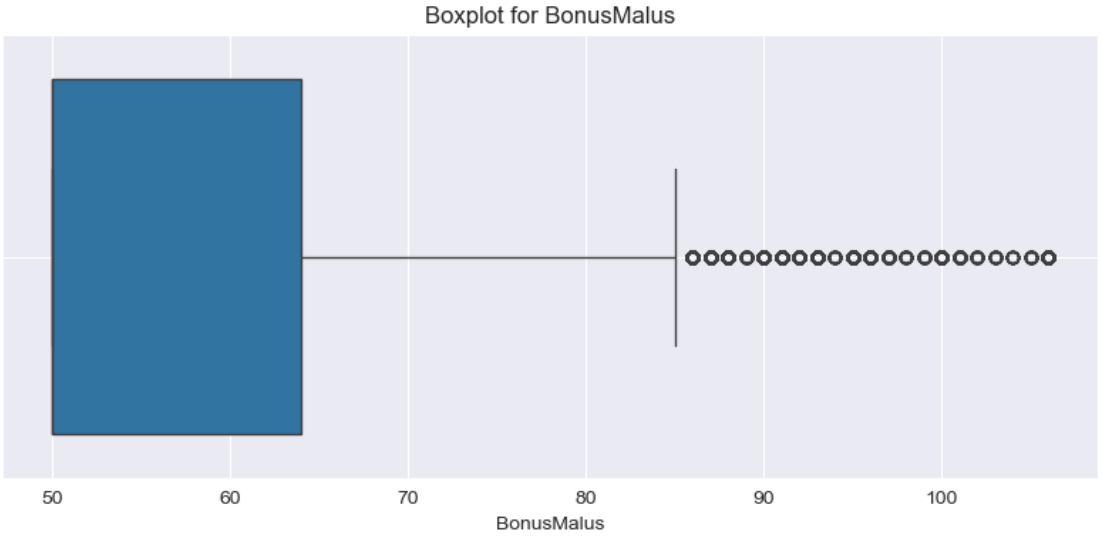



```
BonusMalus
50      365243
100      17488
68       17382
72       17131
64       16838
76       16598
57       16591
```

80	16544
54	16123
60	16010
85	15599
90	15345
95	15326
51	14784
62	6710
58	5594
55	5214
52	4392
56	3173
53	3139
63	2898
59	2593
67	2547
71	1867
61	1592
106	1523
65	1416
75	1207
66	1189
69	1000
70	990
73	895
77	857
74	604
78	582
81	462
83	384
88	281
86	267
82	230
79	218
93	171
91	166
87	165
96	124
92	121
84	110
101	96
97	94
99	47
89	45
102	38
94	31
105	30
98	29

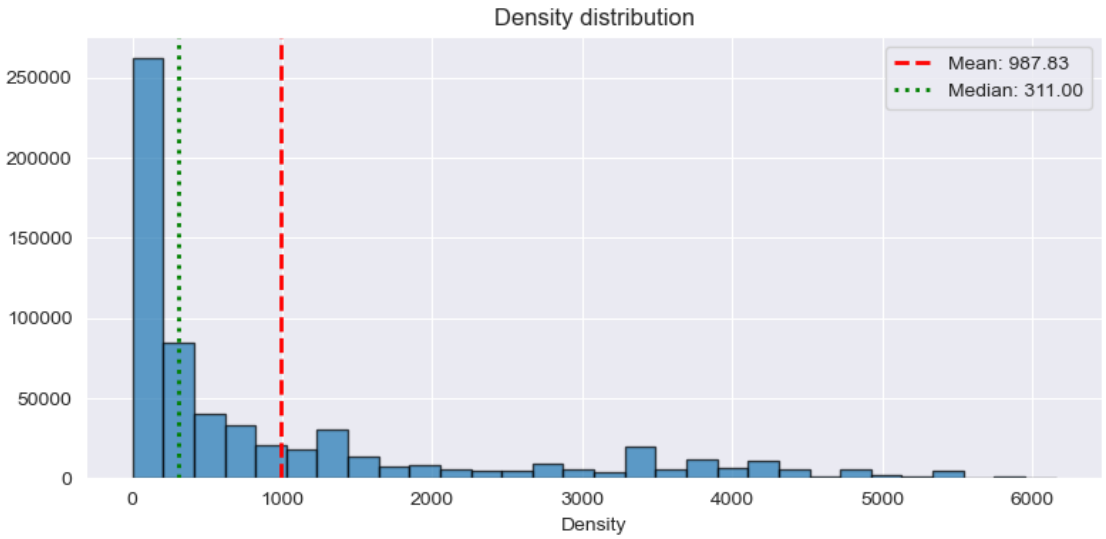
```
103         26
104         13
Name: count, dtype: int64
```

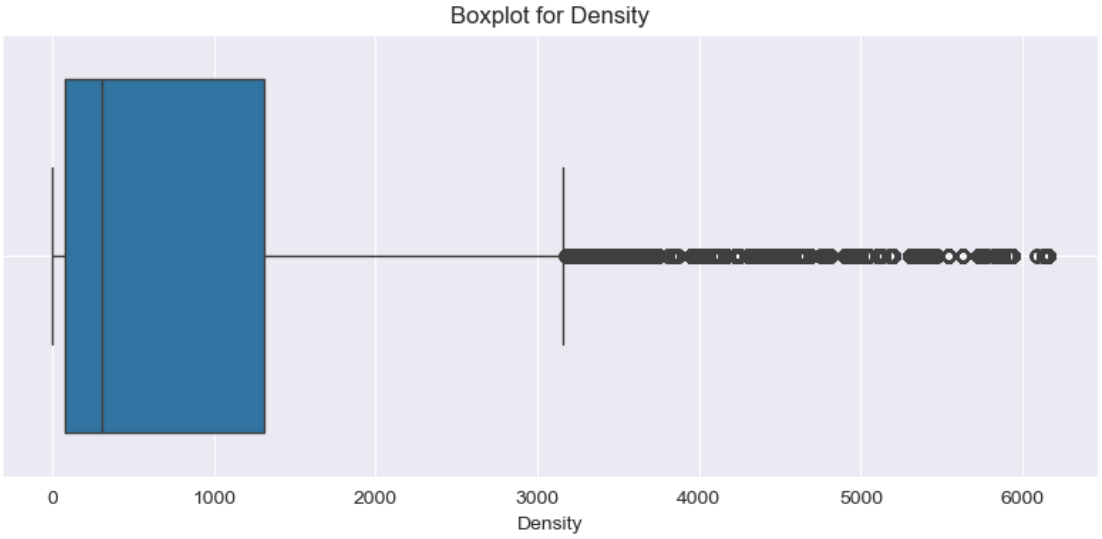





```
Density
3317    9751
1313    7075
3744    5498
1326    5378
405     5147
        …
```

```
1394        2
1525        2
1420        2
1651        1
869         1
Name: count, Length: 1522, dtype: int64
```





[68]:
```
print('og df:',df_og.shape)
print('after removing outliers:',df.shape)
```

```
og df: (678013, 12)
```

```
after removing outliers: (630132, 46)
```

3.3 Correlation analysis

[69]:
```
corr = df[numeric_columns+['ClaimNb']].corr(numeric_only=True)

plt.figure(figsize=(12, 8))
sns.heatmap(corr, annot=True, fmt=".2f", cmap="coolwarm", center=0,␣
 ↪square=True, linewidths=0.5)
plt.title("Linear Correlation")
plt.tight_layout()
plt.show()
```

3.4 Data division and scaling

[71]:
```
# divide into 3 sets for binary classification
X,y = df.drop(columns=['ClaimNb','IDpol','HasClaim'],axis=1),␣
 ↪df[['HasClaim','ClaimNb']]
X_train, X_test, y_train, y_test = train_test_split(X, y['HasClaim'],␣
 ↪test_size=0.4, random_state=123)
X_val,X_test,y_val,y_test = train_test_split(X_test, y_test, test_size=0.5,␣
 ↪random_state=123)

# drop the exposure
exposure_train = X_train['Exposure']
exposure_val = X_val['Exposure']
exposure_test = X_test['Exposure']
X_train.drop('Exposure',axis=1,inplace=True)
X_val.drop('Exposure',axis=1,inplace=True)
X_test.drop('Exposure',axis=1,inplace=True)

# combine train with val for bigger training set
exposure_train_val = np.concatenate([exposure_train, exposure_val], axis=0)
X_train_val = np.concatenate([X_train, X_val], axis=0)
X_train_val = pd.DataFrame(X_train_val, columns=X_train.columns)
y_train_val = np.concatenate([y_train, y_val], axis=0)
```

[79]:
```
# scaling
ss = StandardScaler()
X_train[numeric_columns] = ss.fit_transform(X_train[numeric_columns])
X_val[numeric_columns] = ss.transform(X_val[numeric_columns])
X_test[numeric_columns] = ss.transform(X_test[numeric_columns])
X_train_val[numeric_columns] = ss.transform(X_train_val[numeric_columns])
```

3.5 Feature Engineering

The ROC curve is the plot of the true positive rate (TPR) against the false positive rate (FPR) at each threshold setting. **ROC AUC** - Receiver Operating Characteristic Area Under Curve

[18]:
```
# def evaluate_feature(X_train, y_train, feature, base_score, cv=3):
#     """Adds new feature and check if new feature improves model"""
#     X_copy = X_train.copy()
#     X_copy[feature.name] = feature.values
#
#     model = sm.GLM(y_train, X_copy, family=sm.families.
 ↪Binomial(),freq_weights=exposure_train)
#     result = model.fit()
#     y_pred = result.predict(X_copy)
#
#     new_score = roc_auc_score(y_train,y_pred)
#     print(feature.name,'score:',new_score)
```

```
#     return new_score > base_score + 0.001, new_score
```

[19]:
```
# # 1. base model
# X_train_glm = sm.add_constant(X_train)
# model = sm.GLM(y_train, X_train_glm, family=sm.families.
 ↪Binomial(),freq_weights=exposure_train)
# result = model.fit()
# y_pred = result.predict(X_train_glm)
#
# # Predict on train
# base_score = roc_auc_score(y_train,y_pred)
# print(f"AUC on train(base_score): {base_score:.4f}")
#
# # 2. generate new features
# new_features = []
#
# # Squared
# for col in numeric_columns:
#     new_features.append((f'{col}_squared', X_train[col] ** 2))
#
# # Sqrt
# for col in numeric_columns:
#     new_features.append((f'{col}_sqrt', np.sqrt(X_train[col])))
#
# # Log
# for col in numeric_columns:
#     new_features.append((f'{col}_log1p', np.log1p(X_train[col])))
#
# # Interactions
# for i in range(len(numeric_columns)):
#     for j in range(i+1, len(numeric_columns)):
#         col1 = numeric_columns[i]
#         col2 = numeric_columns[j]
#         new_features.append((f'{col1}_times_{col2}', X_train[col1] *␣
 ↪X_train[col2]))
#         new_features.append((f'{col1}_div_{col2}', X_train[col1] /␣
 ↪(X_train[col2]+1e-5)))
#
# # Binning
# for col in numeric_columns:
#     bins = pd.qcut(X_train[col], q=5, labels=False, duplicates='drop')
#     new_features.append((f'{col}_bin', bins))
# print(len(new_features))
#
# # 3. Test every new feature
# selected_features = {}
# print("\nTesting new features:")
```

```
#
# for name, feat in tqdm(new_features):
#     if bool(feat.isna().sum() > 0):
#         print(f"{name} has null values, skipping...")
#         continue
#     better, new_score = evaluate_feature(X_train_glm, y_train, pd.
 ↪Series(feat, name=name), base_score)
#     if better:
#         selected_features[name] = feat
#         print(f" Added {name} | new AUC: {base_score:.4f}")
```

3.6 data preprocessing for GLM

[80]:
```
X_train_val_glm = sm.add_constant(X_train_val)
X_test_glm = sm.add_constant(X_test)
```

[81]:
```
# worthy features that improves score of glm, DrivAge_bin, DrivAge_squared

X_train_val_glm['DrivAge_squared'] = X_train_val_glm['DrivAge'] ** 2
bins = pd.qcut(X_train_val_glm['DrivAge'], q=5, labels=False, duplicates='drop')
X_train_val_glm['DrivAge_bin'] = bins

X_test_glm['DrivAge_squared'] = X_test_glm['DrivAge'] ** 2
bins = pd.qcut(X_test_glm['DrivAge'], q=5, labels=False, duplicates='drop')
X_test_glm['DrivAge_bin'] = bins
```

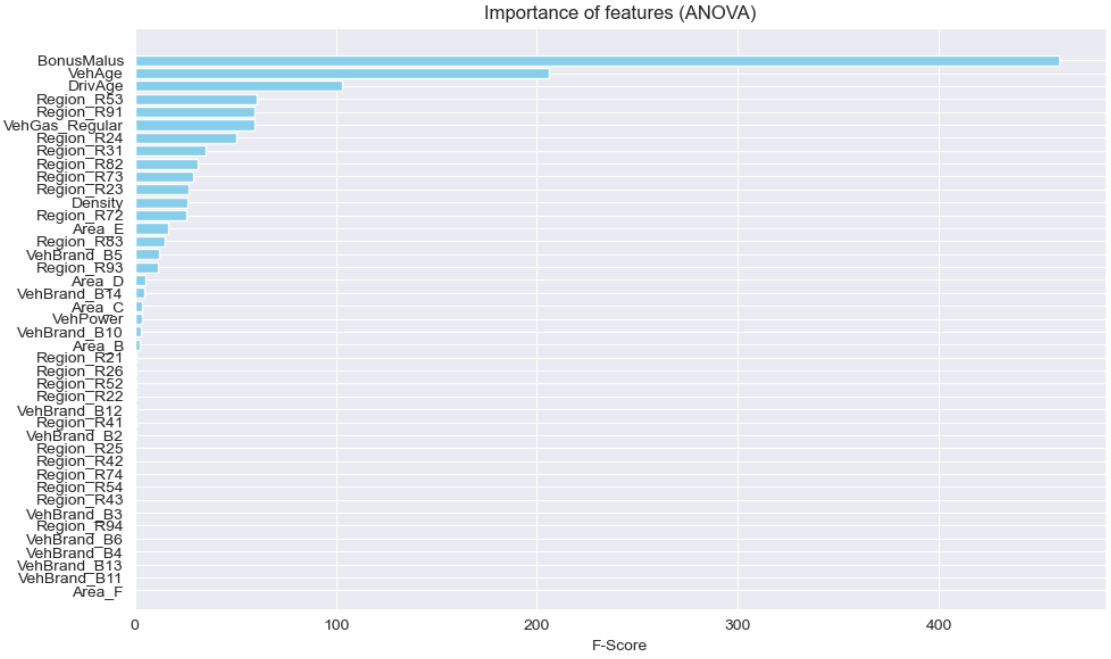
3.7 Feature importance

ANOVA tests whether the mean values differ significantly across the target classes. The F-score is high when the between-class variance is large relative to the within-class variance → meaning the feature is useful.

[83]:
```
selector = SelectKBest(score_func=f_classif, k='all')
selector.fit(X_train, y_train)

scores = selector.scores_
pvalues = selector.pvalues_
feature_scores = pd.DataFrame({
    'Feature': X_train.columns,
    'F-Score': scores,
    'p-Value': pvalues
}).sort_values(by='F-Score', ascending=False)

plt.figure(figsize=(10, 6))
plt.barh(feature_scores['Feature'], feature_scores['F-Score'], color='skyblue')
plt.xlabel('F-Score')
plt.title('Importance of features (ANOVA)')
```

```
plt.gca().invert_yaxis()
plt.tight_layout()
plt.show()

print(feature_scores)
```

```
C:\Users\Aycon\anaconda3\envs\cloud\lib\site-
packages\sklearn\feature_selection\_univariate_selection.py:111: UserWarning:
Features [9] are constant.
  warnings.warn("Features %s are constant." % constant_features_idx,
UserWarning)
C:\Users\Aycon\anaconda3\envs\cloud\lib\site-
packages\sklearn\feature_selection\_univariate_selection.py:112: RuntimeWarning:
invalid value encountered in divide
  f = msb / msw
```



	Feature	F-Score	p-Value
3	BonusMalus	460.036320	5.432221e-102
1	VehAge	206.018323	1.044470e-46
2	DrivAge	102.978795	3.411843e-24
32	Region_R53	60.451730	7.559349e-15
39	Region_R91	59.596601	1.167190e-14
20	VehGas_Regular	59.435766	1.266570e-14
24	Region_R24	50.207649	1.385475e-12
27	Region_R31	35.336566	2.776172e-09
37	Region_R82	31.425655	2.073685e-08

```
35      Region_R73   29.140325   6.736144e-08
23      Region_R23   26.497845   2.639639e-07
4          Density   26.141939   3.173728e-07
34      Region_R72   25.512101   4.398208e-07
8           Area_E   16.292991   5.427497e-05
38      Region_R83   14.909035   1.128401e-04
18     VehBrand_B5   12.277033   4.586197e-04
40      Region_R93   11.233953   8.032225e-04
7           Area_D    5.405498   2.007395e-02
14    VehBrand_B14    4.917898   2.658044e-02
6           Area_C    3.346214   6.736055e-02
0         VehPower    3.341499   6.755382e-02
10    VehBrand_B10    3.158844   7.551746e-02
5           Area_B    2.336239   1.263952e-01
21      Region_R21    0.945531   3.308602e-01
26      Region_R26    0.912176   3.395384e-01
31      Region_R52    0.844079   3.582335e-01
22      Region_R22    0.825925   3.634542e-01
12    VehBrand_B12    0.660799   4.162783e-01
28      Region_R41    0.592460   4.414701e-01
15     VehBrand_B2    0.591623   4.417926e-01
25      Region_R25    0.326738   5.675864e-01
29      Region_R42    0.268448   6.043754e-01
36      Region_R74    0.182310   6.693962e-01
33      Region_R54    0.168558   6.813966e-01
30      Region_R43    0.147139   7.012847e-01
16     VehBrand_B3    0.144127   7.042125e-01
41      Region_R94    0.109455   7.407662e-01
19     VehBrand_B6    0.038848   8.437509e-01
17     VehBrand_B4    0.035459   8.506378e-01
13    VehBrand_B13    0.030034   8.624130e-01
11    VehBrand_B11    0.000677   9.792415e-01
9           Area_F         NaN            NaN
```

Modelling

[84]:
```python
def score_binary_model(y,y_pred_proba,selected_thresh=None):
    """Function to score binary model, needs y_pred to be probabilities"""

    # roc-auc
    auc_score = roc_auc_score(y, y_pred_proba)
    print('ROC-AUC score:',auc_score)

    if not selected_thresh:
        # best threshold
        best_score = -1
        best_thresh = 0
        for i in range(0,100):
```

```
            tmp_y_pred = (y_pred_proba > (i/100)).astype(int)
            f_1 = f1_score(y,tmp_y_pred)
            if f_1 > best_score:
                best_score = f_1
                best_thresh = i/100
    else:
        best_thresh = selected_thresh
    y_pred = (y_pred_proba > best_thresh).astype(int)

    # other metrics
    f_1 = f1_score(y,y_pred)
    accuracy = accuracy_score(y,y_pred)
    recall = recall_score(y,y_pred)
    precision = precision_score(y,y_pred)
    print("F1-score: ",f_1)
    print("Accuracy:",accuracy)
    print("Recall:",recall)
    print("Precision:",precision)

    # confusion matrix
    cm = confusion_matrix(y, y_pred)

    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
    plt.xlabel('Predicted')
    plt.ylabel('Actual')
    plt.title('Confusion Matrix')
    plt.show()
    stats = {
        "roc_auc_score":auc_score,
        "best_threshold":best_thresh,
        "f1-score":f_1,
        "accuracy":accuracy,
        "recall":recall,
        "precision":precision,
        "confusion_matrix":cm
    }
    return stats

def plot_predict_with_feature(X, y, y_pred, feature_name, bins_nb=20):
    """
    Plots feature(histogram) with y_pred and y_true.
    """

    df_help = pd.DataFrame({
        feature_name: X[feature_name],
        'y_true': y,
        'y_pred': y_pred,
```

```
    })

    unique_values_nb = X[feature_name].nunique()
    if unique_values_nb < bins_nb:
        bins_nb = unique_values_nb

    df_help['bin'] = pd.cut(df_help[feature_name], bins=bins_nb)

    # Grouping by bin
    df_grouped = df_help.groupby('bin', observed=True).agg({
        'y_true': 'mean',
        'y_pred': 'mean',
        feature_name: 'count'
    }).rename(columns={feature_name: 'count'}).reset_index()

    # Dodajemy indeks binów i lewą granicę binu jako label
    df_grouped['bin_idx'] = range(len(df_grouped))
    df_grouped['bin_left'] = df_grouped['bin'].apply(lambda x: x.left)

    # Plotting
    fig, ax1 = plt.subplots(figsize=(10, 6))
    ax1.bar(df_grouped['bin_idx'], df_grouped['count'], color='lightblue',␣
↪alpha=0.9, label='quantity')

    ax2 = ax1.twinx()
    ax2.plot(df_grouped['bin_idx'], df_grouped['y_pred'], color='blue',␣
↪label='mean of predicted values')
    ax2.plot(df_grouped['bin_idx'], df_grouped['y_true'], color='green',␣
↪label='mean of true values')

    # Zmiana etykiet osi X na wartości graniczne binów
    ax1.set_xticks(df_grouped['bin_idx'])
    ax1.set_xticklabels([f'{val:.2f}' for val in df_grouped['bin_left']],␣
↪rotation=45)

    ax1.set_xlabel(f'{feature_name} (bin start)')
    ax1.set_ylabel('quantity')
    ax2.set_ylabel('mean value')

    fig.legend(loc='upper right', bbox_to_anchor=(1, 1), bbox_transform=ax1.
↪transAxes)
    plt.title(f'Histogram {feature_name} + predicted values vs true values')
    plt.tight_layout()
    plt.grid(True)
    plt.show()
```

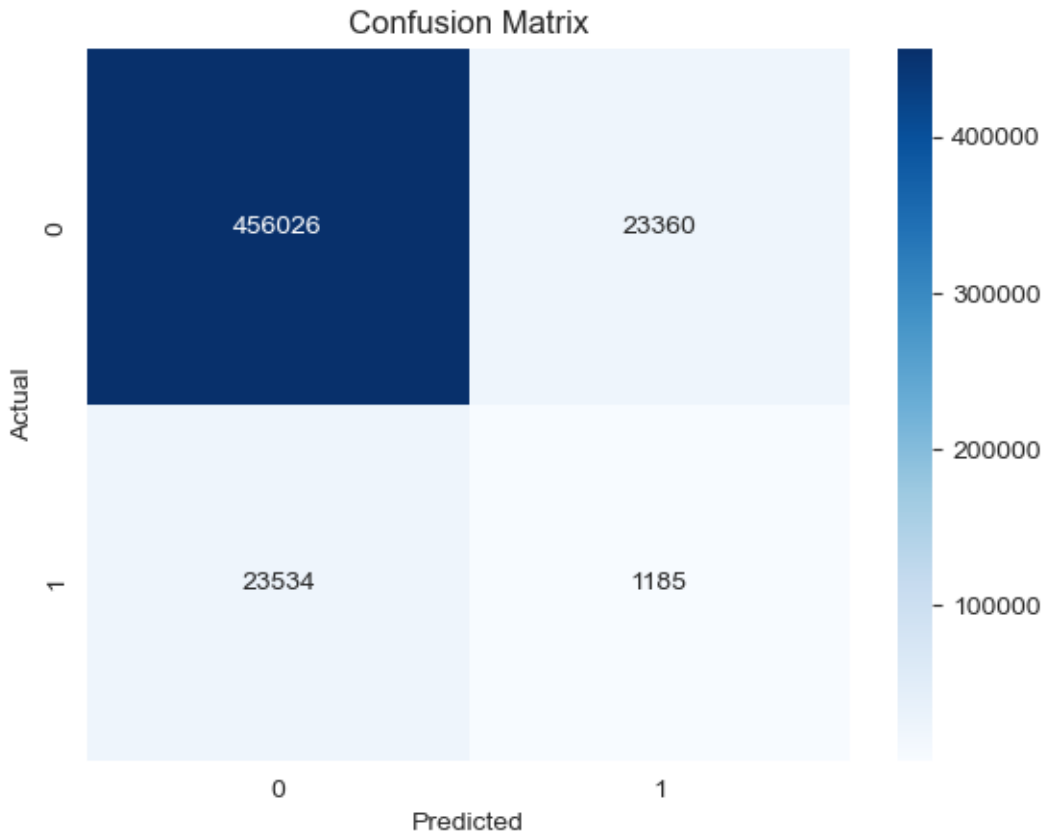
[87]:
```
models_stats_train = {}
models_stats_test = {}

# for plotting
X_test = X_test.reset_index(drop=True)
y_test = y_test.reset_index(drop=True)

# for improving recall
weights = compute_sample_weight(class_weight='balanced', y=y_train_val)
weights_with_exposure_val_train = exposure_train_val * weights
```

[88]:
```
# only for plotting
exposure_train_val_df = pd.DataFrame(np.array(exposure_train_val).reshape(-1,␣
 ↪1), columns=['exposure'])
exposure_test_df = pd.DataFrame(np.array(exposure_test).reshape(-1, 1),␣
 ↪columns=['exposure'])
```

3.8 baseline model (random prediction)

[89]:
```
dummy = DummyClassifier(strategy='stratified')
dummy.fit(X_train,y_train)
dummy_pred = dummy.predict_proba(X_train_val)[:,1]

stats = score_binary_model(y_train_val,dummy_pred)

models_stats_train['dummy_classifier'] = stats
models_stats_test['dummy_classifier'] = stats
```

```
ROC-AUC score: 0.4996049166494633
F1-score:  0.04810815199740175
Accuracy: 0.9069757292627528
Recall: 0.04793883247704195
Precision: 0.04827867182725606
```



3.9 Binary Classification

3.9.1 GLM

[92]:
```
model_bin = sm.GLM(y_train_val, X_train_val_glm, family=sm.families.
↪Binomial(),freq_weights=exposure_train_val)
result_bin = model_bin.fit()

print(result_bin.summary())
```

```
                 Generalized Linear Model Regression Results
==============================================================================
Dep. Variable:                      y   No. Observations:               504105
Model:                            GLM   Df Residuals:                268612.28
Model Family:                Binomial   Df Model:                           43
Link Function:                  Logit   Scale:                          1.0000
Method:                          IRLS   Log-Likelihood:                -59405.
Date:                Tue, 06 May 2025   Deviance:                   1.1881e+05
Time:                        15:57:06   Pearson chi2:                 2.68e+05
No. Iterations:                     6   Pseudo R-squ. (CS):          0.004060
Covariance Type:            nonrobust
```

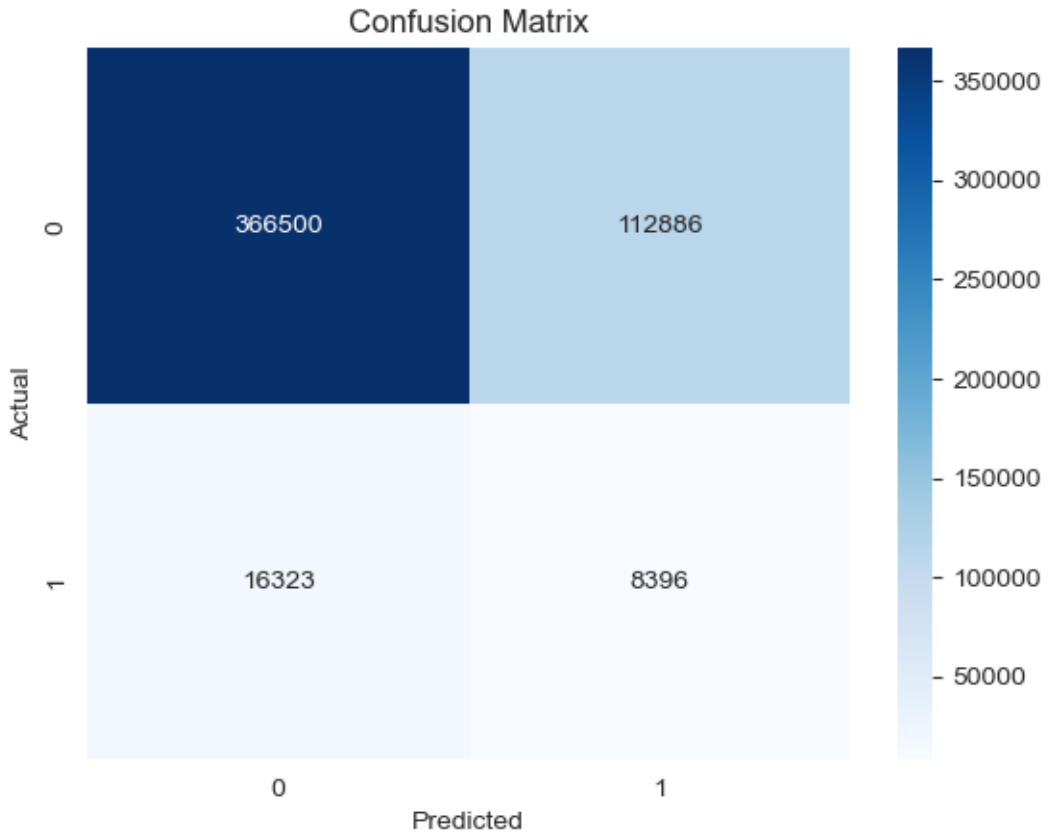
```
==============================================================================
===
                     coef    std err          z      P>|z|      [0.025
0.975]
------------------------------------------------------------------------------
---
const              -2.7563      0.068    -40.620      0.000      -2.889
-2.623
VehPower            0.0453      0.009      4.984      0.000       0.028
0.063
VehAge             -0.2001      0.010    -20.653      0.000      -0.219
-0.181
DrivAge             0.3073      0.034      8.959      0.000       0.240
0.375
BonusMalus          0.3654      0.010     37.584      0.000       0.346
0.385
Density             0.0456      0.026      1.725      0.085      -0.006
0.097
Area_B              0.0437      0.031      1.391      0.164      -0.018
0.105
Area_C              0.0629      0.027      2.372      0.018       0.011
0.115
Area_D              0.1059      0.035      3.059      0.002       0.038
0.174
Area_E              0.0856      0.076      1.130      0.259      -0.063
0.234
Area_F         -1.557e-15   1.47e-15     -1.059      0.290   -4.44e-15
1.32e-15
VehBrand_B10       -0.0919      0.055     -1.662      0.097      -0.200
0.016
VehBrand_B11        0.0167      0.060      0.277      0.782      -0.102
0.135
VehBrand_B12       -0.2645      0.029     -8.999      0.000      -0.322
-0.207
VehBrand_B13        0.0161      0.061      0.263      0.792      -0.103
0.136
VehBrand_B14       -0.1823      0.115     -1.583      0.113      -0.408
0.043
VehBrand_B2        -0.0070      0.022     -0.311      0.755      -0.051
0.037
VehBrand_B3        -0.0147      0.033     -0.442      0.658      -0.080
0.050
VehBrand_B4        -0.0072      0.044     -0.162      0.871      -0.094
0.079
VehBrand_B5         0.0591      0.037      1.598      0.110      -0.013
0.132
VehBrand_B6        -0.0585      0.043     -1.372      0.170      -0.142
0.025
```

```
VehGas_Regular      0.0029      0.017      0.170      0.865      -0.031
0.036
Region_R21         -0.0330      0.152     -0.217      0.828      -0.331
0.265
Region_R22          0.0833      0.088      0.952      0.341      -0.088
0.255
Region_R23         -0.1644      0.102     -1.616      0.106      -0.364
0.035
Region_R24          0.2177      0.042      5.169      0.000       0.135
0.300
Region_R25          0.1576      0.069      2.295      0.022       0.023
0.292
Region_R26          0.0299      0.080      0.375      0.707      -0.126
0.186
Region_R31         -0.0572      0.061     -0.946      0.344      -0.176
0.061
Region_R41         -0.1533      0.071     -2.167      0.030      -0.292
-0.015
Region_R42         -0.0317      0.145     -0.218      0.827      -0.316
0.253
Region_R43         -0.2279      0.241     -0.947      0.344      -0.700
0.244
Region_R52          0.0705      0.050      1.410      0.158      -0.027
0.168
Region_R53          0.2784      0.047      5.905      0.000       0.186
0.371
Region_R54          0.0595      0.061      0.979      0.328      -0.060
0.179
Region_R72         -0.0338      0.056     -0.607      0.544      -0.143
0.075
Region_R73         -0.2060      0.075     -2.734      0.006      -0.354
-0.058
Region_R74          0.2236      0.105      2.128      0.033       0.018
0.430
Region_R82          0.1756      0.044      4.027      0.000       0.090
0.261
Region_R83         -0.1487      0.118     -1.260      0.208      -0.380
0.083
Region_R91         -0.1537      0.057     -2.682      0.007      -0.266
-0.041
Region_R93         -0.0073      0.044     -0.166      0.868      -0.094
0.079
Region_R94         -0.0423      0.124     -0.341      0.733      -0.285
0.201
DrivAge_squared    -0.0727      0.008     -8.571      0.000      -0.089
-0.056
DrivAge_bin        -0.0309      0.022     -1.415      0.157      -0.074
0.012
```

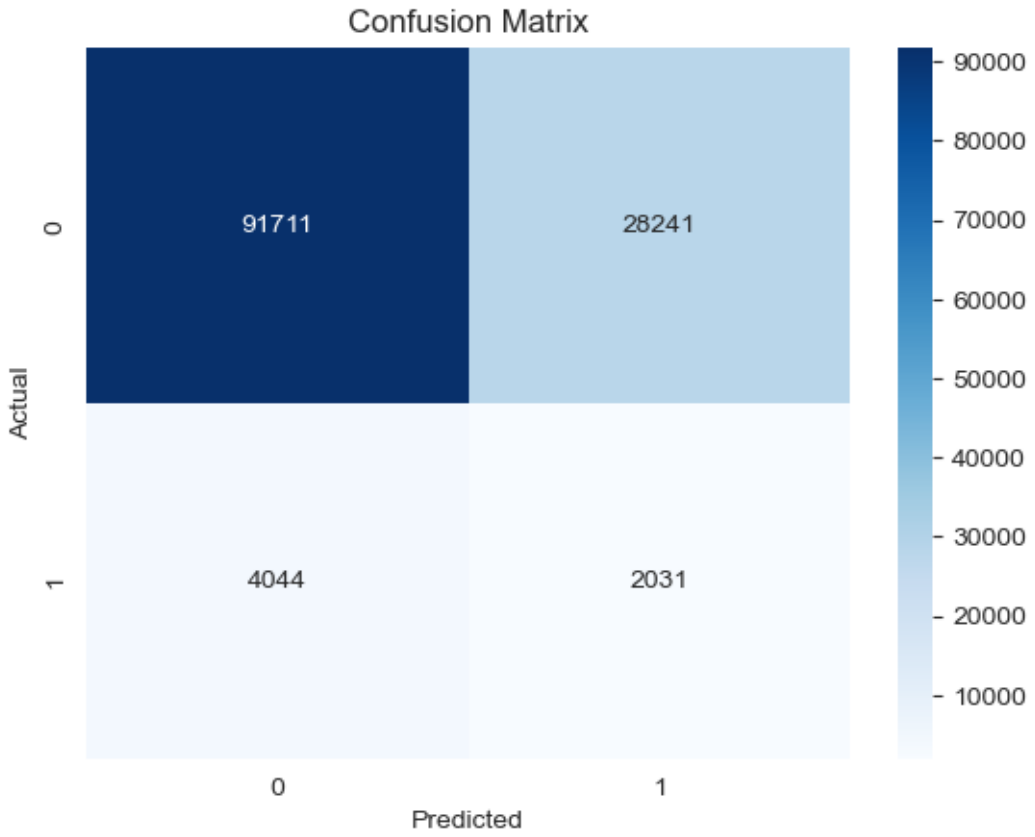
```
================================================================================
===
```

[93]:
```
y_pred = result_bin.predict(X_train_val_glm)
print("TRAIN SCORING")
stats = score_binary_model(y_train_val,y_pred)
models_stats_train['glm_train'] = stats

y_pred = result_bin.predict(X_test_glm)
print("TEST SCORING")
stats =␣
  ↪score_binary_model(y_test,y_pred,models_stats_train['glm_train']['best_threshold'])
models_stats_test['glm_test'] = stats
```

```
TRAIN SCORING
ROC-AUC score: 0.5858560452154848
F1-score:  0.1150129108704735
Accuracy: 0.7436863351881057
Recall: 0.3396577531453538
Precision: 0.06922709058227931
```

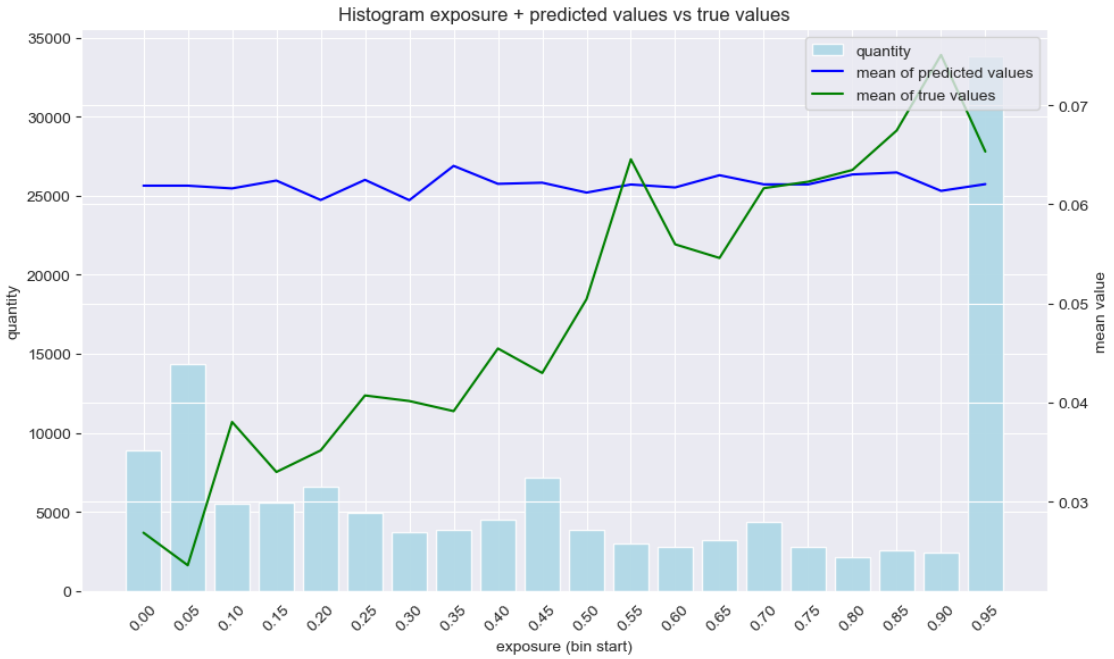


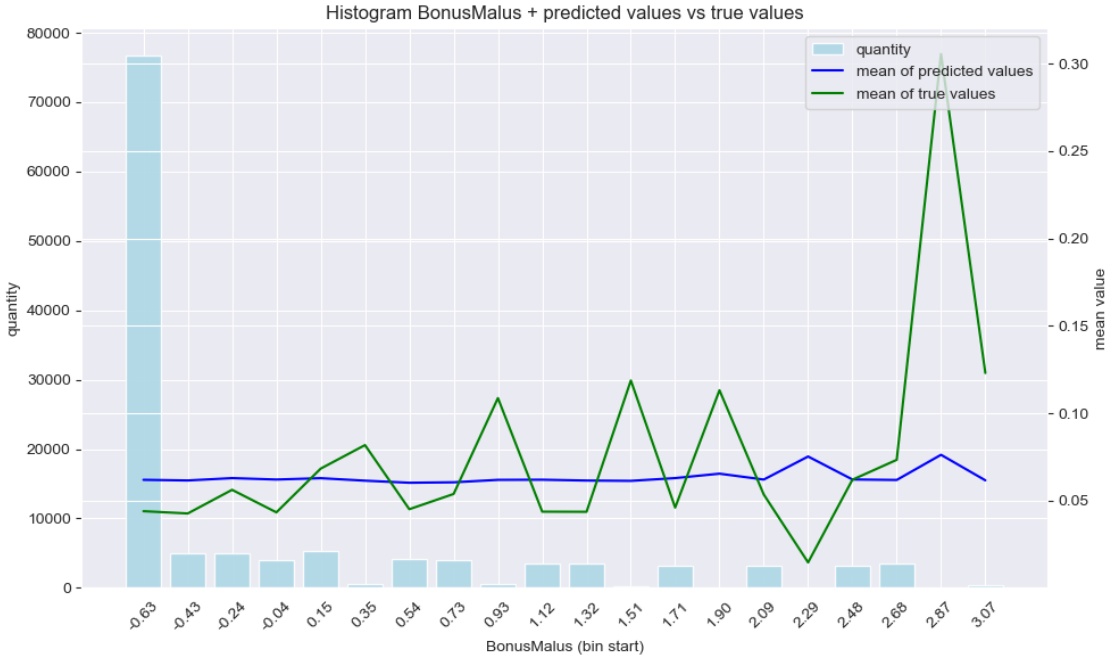
```
TEST SCORING
ROC-AUC score: 0.5871761098129238
F1-score:  0.11175612842875615
Accuracy: 0.7438247359692765
Recall: 0.334320987654321
Precision: 0.06709170190274842
```

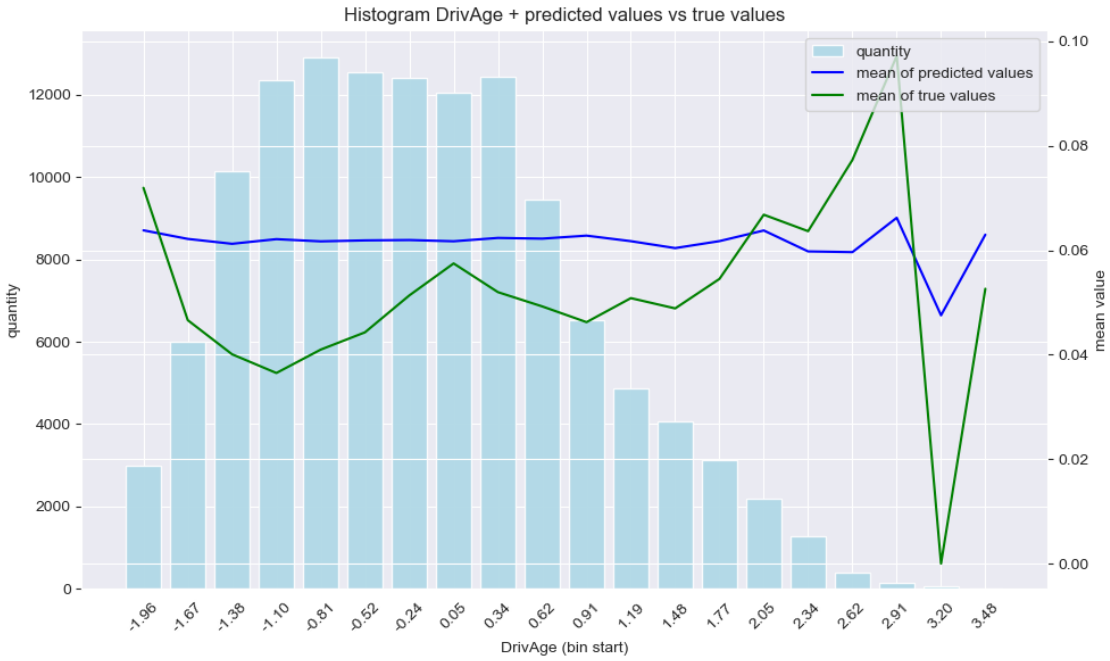


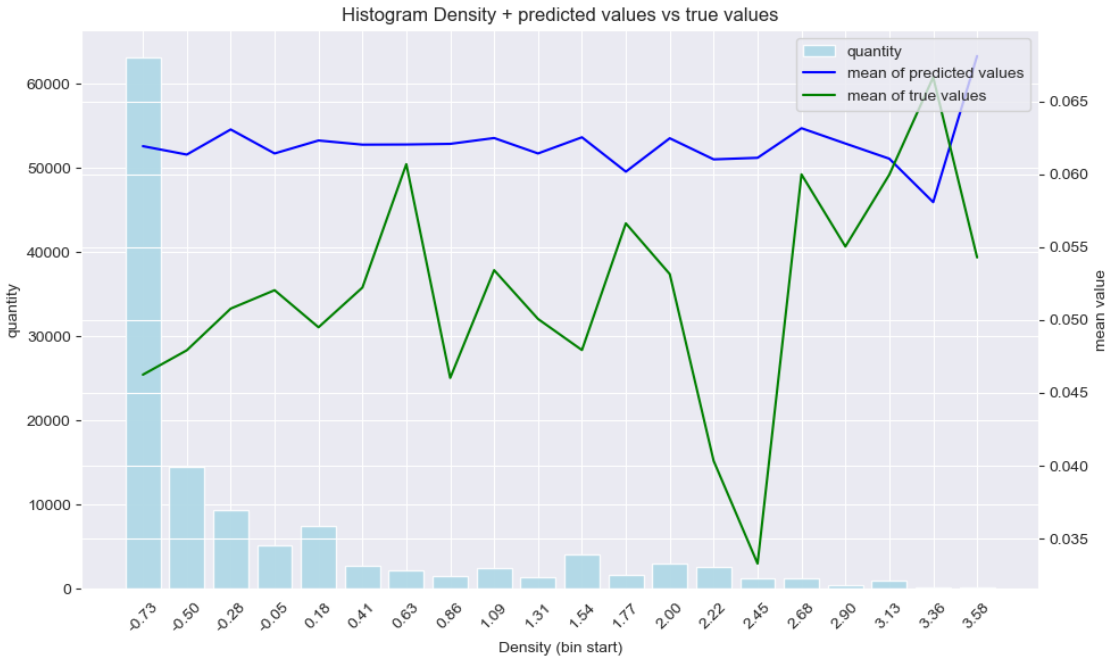
[29]:
```
print("PLOTS FOR TEST-SET")
plot_predict_with_feature(exposure_test_df,y_test,y_pred,'exposure')
for col in numeric_columns:
    plot_predict_with_feature(X_test,y_test,y_pred,col)
```

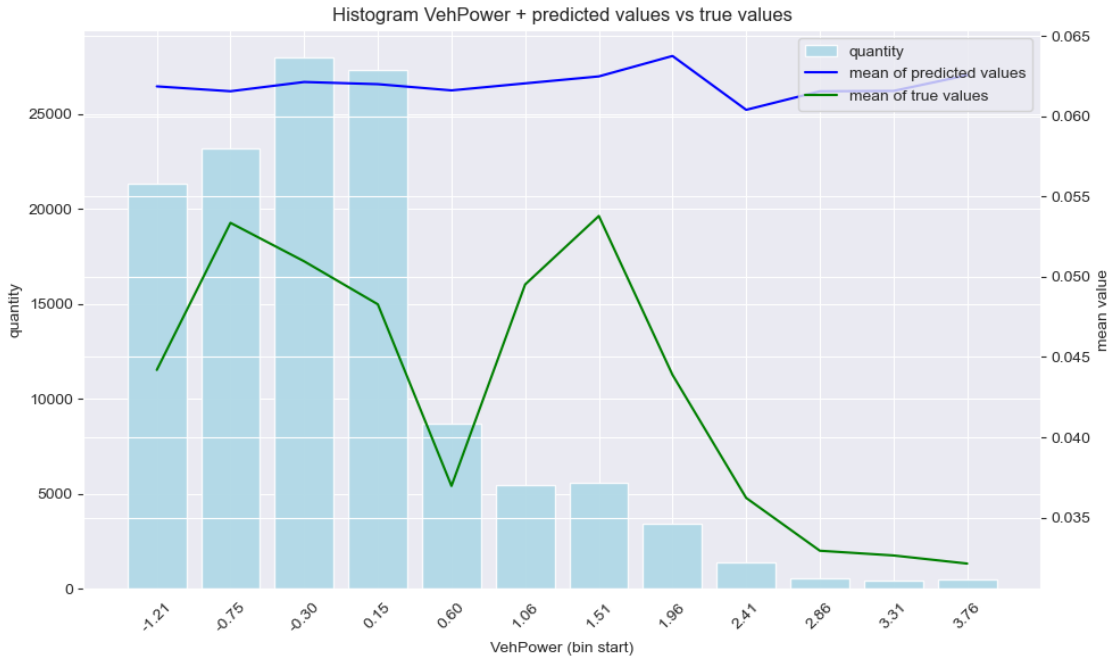
```
PLOTS FOR TEST-SET
```

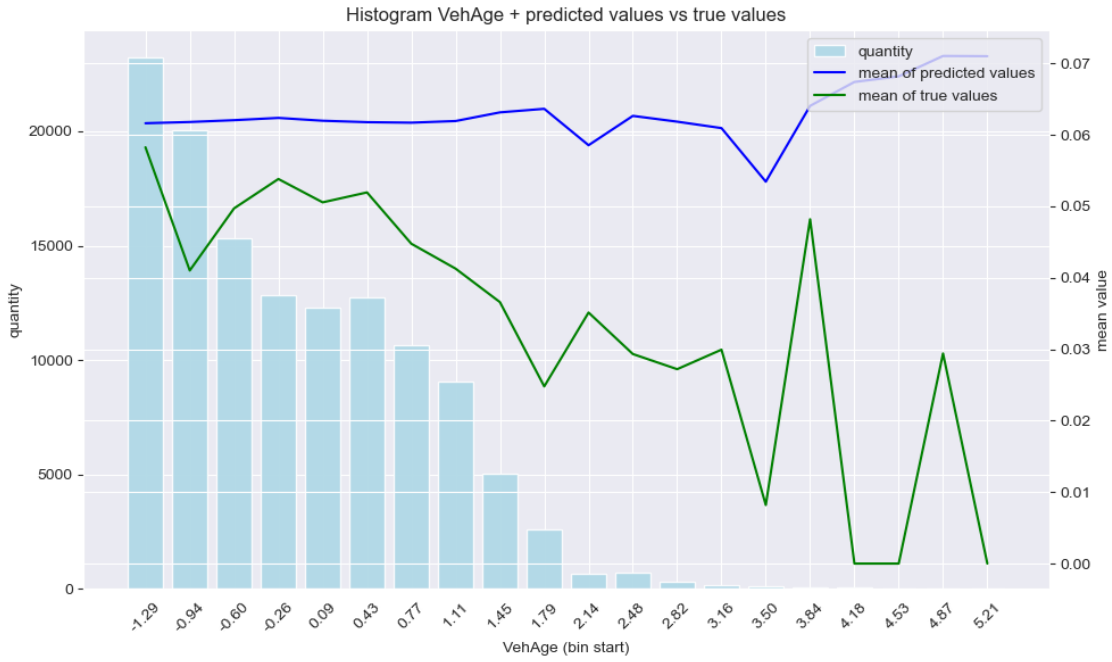

Histogram exposure + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
exposure (bin start)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95


Histogram BonusMalus + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
BonusMalus (bin start)
-0.63
-0.43
-0.24
-0.04
0.15
0.35
0.54
0.73
0.93
1.12
1.32
1.51
1.71
1.90
2.09
2.29
2.48
2.68
2.87
3.07


Histogram DrivAge + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
DrivAge (bin start)
0
2000
4000
6000
8000
10000
12000
0.00
0.02
0.04
0.06
0.08
0.10
-1.96
-1.67
-1.38
-1.10
-0.81
-0.52
-0.24
0.05
0.34
0.62
0.91
1.19
1.48
1.77
2.05
2.34
2.62
2.91
3.20
3.48


Histogram Density + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
Density (bin start)
0
10000
20000
30000
40000
50000
60000
0.035
0.040
0.045
0.050
0.055
0.060
0.065
-0.73
-0.50
-0.28
-0.05
0.18
0.41
0.63
0.86
1.09
1.31
1.54
1.77
2.00
2.22
2.45
2.68
2.90
3.13
3.36
3.58





3.9.2 GBM

Fine-tuning

[30]:
```
# # fine-tuning
# gbc = GradientBoostingClassifier()
#
# search_spaces = {
#     'n_estimators': Integer(100, 600),
#     'learning_rate': Real(0.01, 0.2, prior='log-uniform'),
#     'max_depth': Integer(2, 20),
#     'min_samples_leaf': Integer(1, 30),
#     'subsample': Real(0.6, 1.0),
#     'max_features': Real(0.5, 1.0)
# }
#
#
# opt = BayesSearchCV(
#     estimator=gbc,
#     search_spaces=search_spaces,
#     n_iter=20,
#     scoring=make_scorer(f1_score),
#     cv=3,
#     n_jobs=-1,
#     verbose=1,
#     random_state=42
# )
#
#
# opt.fit(X_train_val, y_train_val, sample_weight=exposure_train_val)
#
# print("Best params:", opt.best_params_)
# print("F1 score:", opt.best_score_)
```

final gbm

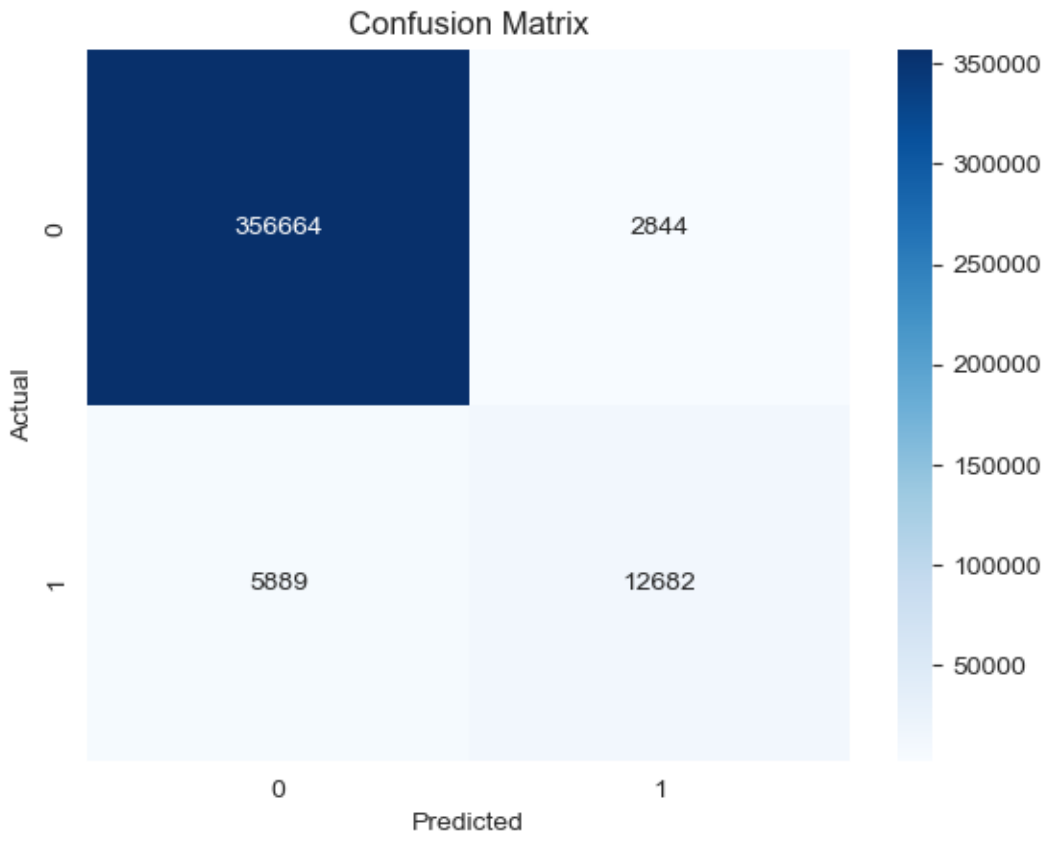
[31]:
```
model =␣
  ↪GradientBoostingClassifier(max_depth=10,min_samples_leaf=1,n_estimators=400,max_features=1.
  ↪0,learning_rate=0.10)
model.fit(X_train, y_train, sample_weight=exposure_train)
```

[31]:
```
GradientBoostingClassifier(max_depth=10, max_features=1.0, n_estimators=400)
```

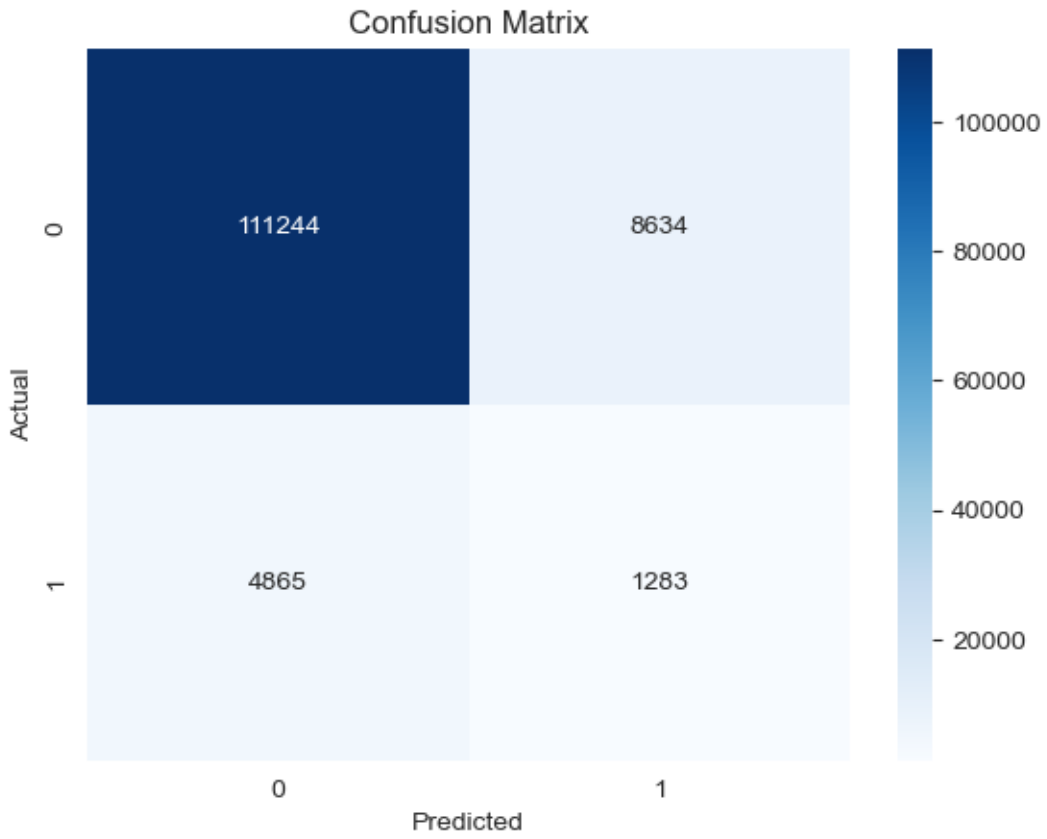
[32]:
```
print("TRAIN-SET SCORING")
y_pred = model.predict_proba(X_train)[:, 1]
score_binary_model(y_train, y_pred)

print("VAL-SET SCORING")
y_pred = model.predict_proba(X_val)[:, 1]
stats = score_binary_model(y_val, y_pred)
best_threshold = stats['best_threshold']
```

```
TRAIN-SET SCORING
```

```
ROC-AUC score: 0.9587496036882365
F1-score:  0.7438777605067894
Accuracy: 0.9769016528291706
Recall: 0.6828926821388186
Precision: 0.8168233930181631
```



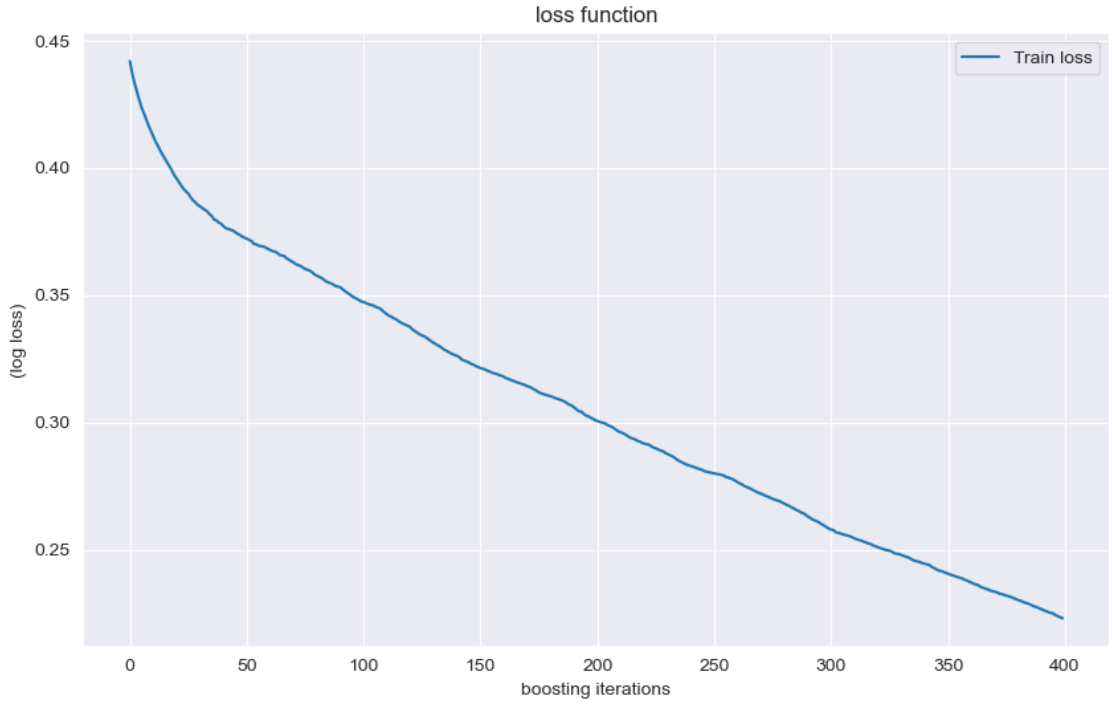

```
VAL-SET SCORING
ROC-AUC score: 0.6204979175966179
F1-score:  0.15972611266728914
Accuracy: 0.8928871820100615
Recall: 0.2086857514638907
Precision: 0.12937380256125844
```



[33]:
```
model =␣
↪GradientBoostingClassifier(max_depth=10,min_samples_leaf=1,n_estimators=400,max_features=1.
↪0,learning_rate=0.10)
model.fit(X_train_val, y_train_val, sample_weight=exposure_train_val)
```

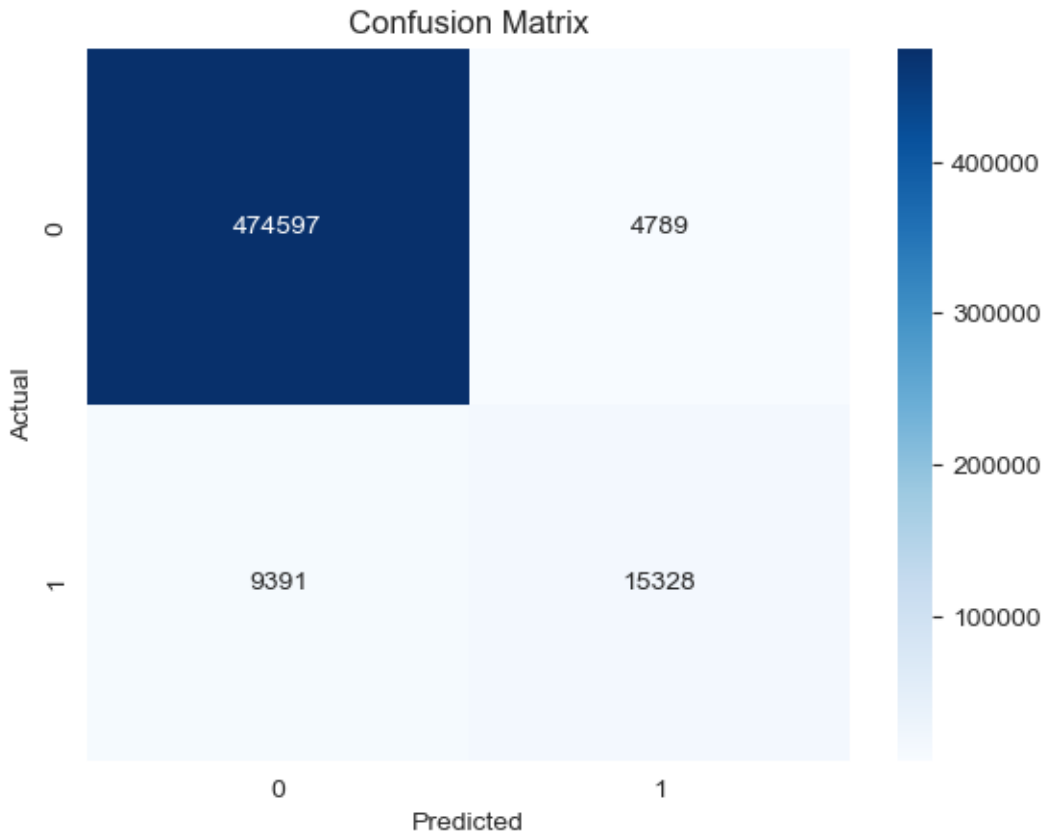
[33]:
```
GradientBoostingClassifier(max_depth=10, max_features=1.0, n_estimators=400)
```

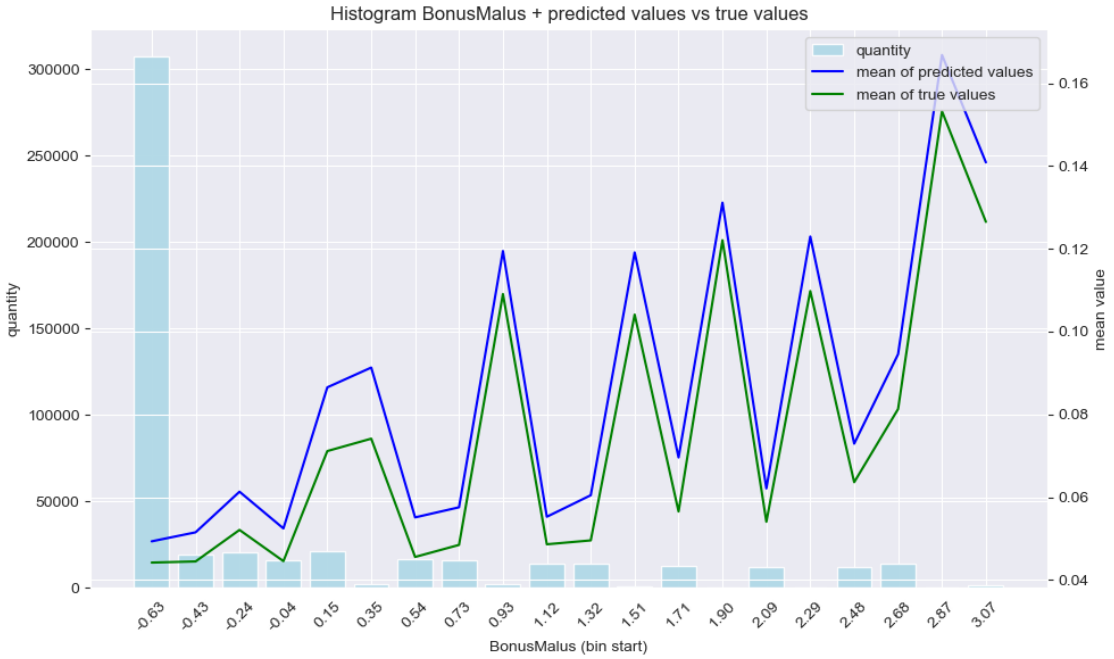
[34]:
```
train_loss = model.train_score_

plt.figure(figsize=(10, 6))
plt.plot(train_loss, label='Train loss')
plt.xlabel('boosting iterations')
plt.ylabel('(log loss)')
plt.title('loss function')
plt.legend()
plt.grid(True)
plt.show()
```

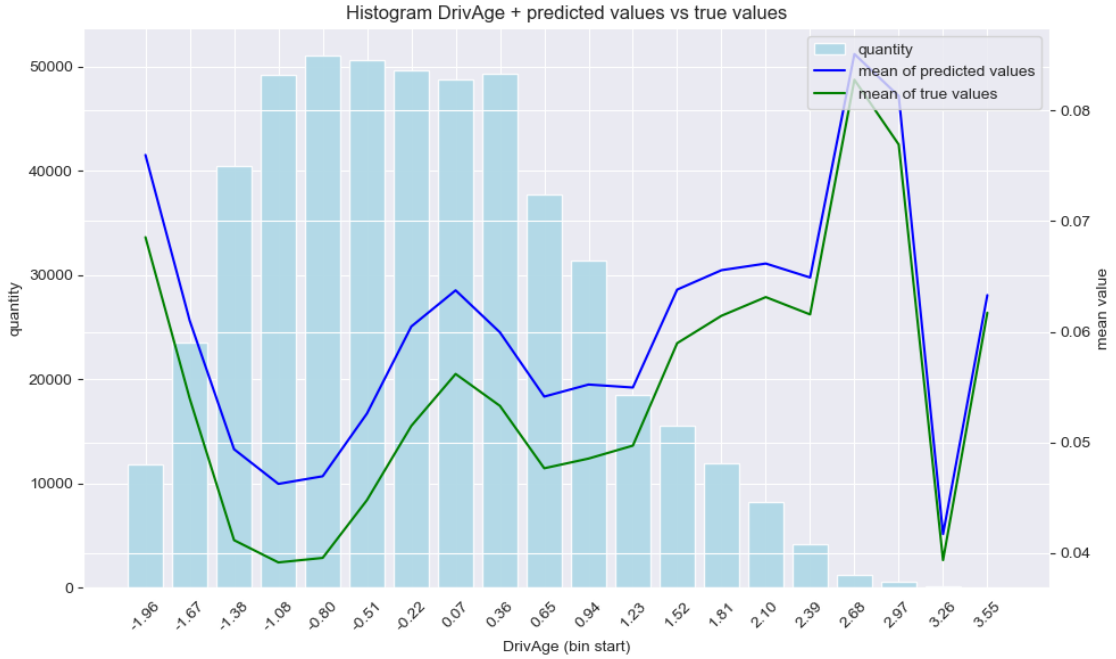


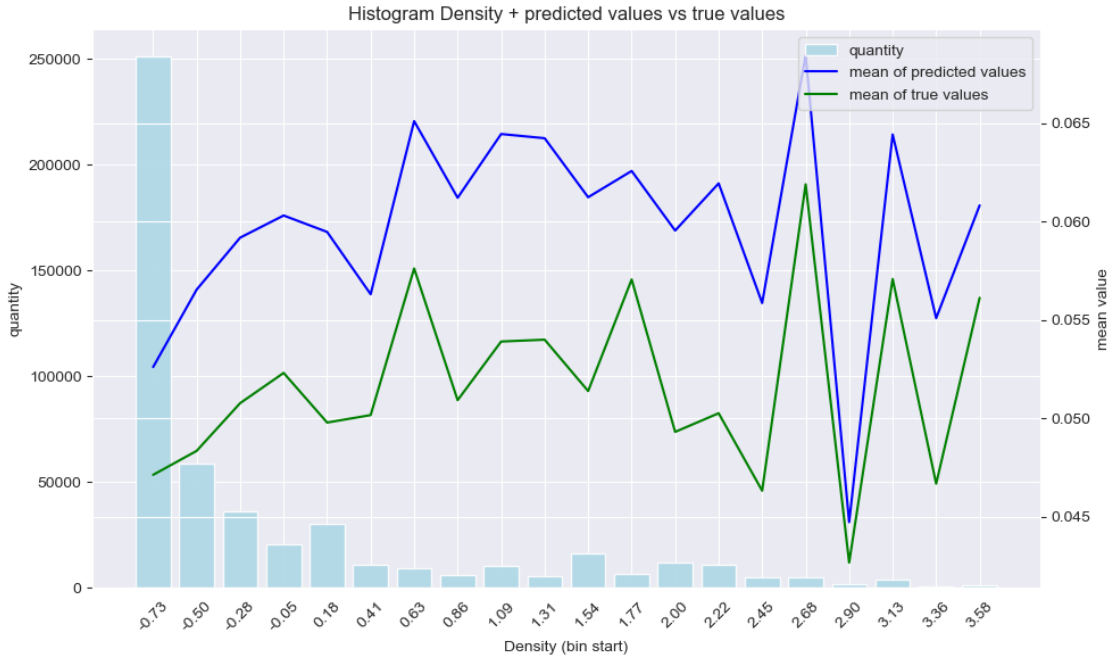
[35]:
```
print("TRAIN-SET SCORING")
X_train_val = pd.DataFrame(X_train_val, columns=X_train.columns)
y_pred = model.predict_proba(X_train_val)[:,1]

stats = score_binary_model(y_train_val,y_pred)
models_stats_train['gbm_train'] = stats

for col in numeric_columns:
    plot_predict_with_feature(X_train_val,y_train_val,y_pred,col)
```

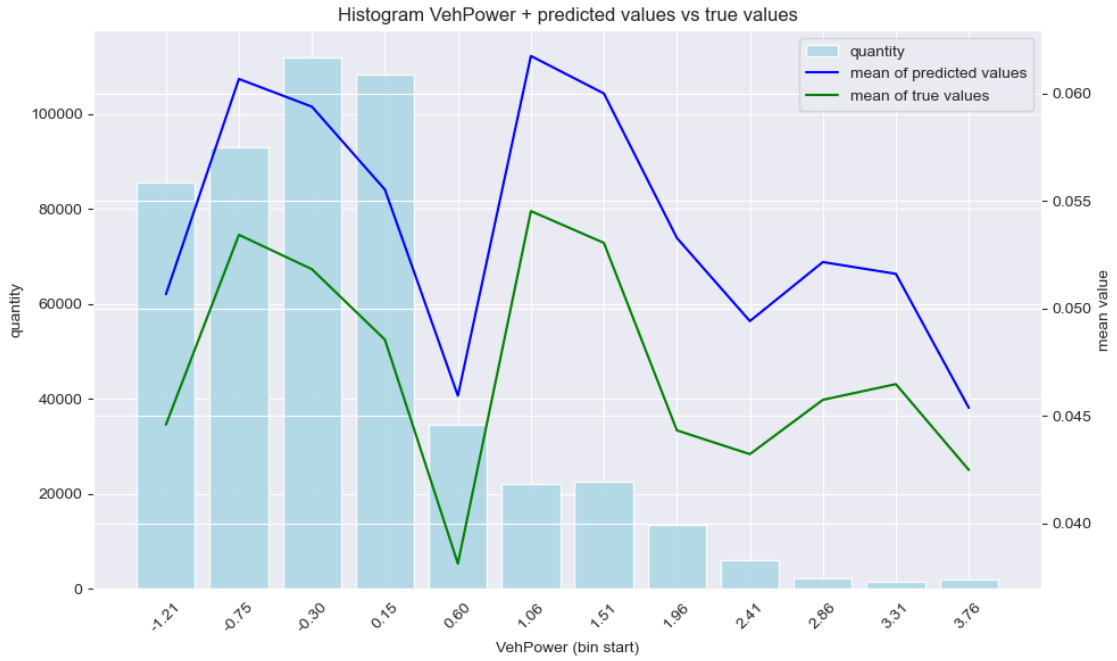
```
TRAIN-SET SCORING
ROC-AUC score: 0.94224552059756
F1-score:  0.6837362833437416
Accuracy: 0.9718709395859989
Recall: 0.6200898094583114
Precision: 0.7619426355818462
```

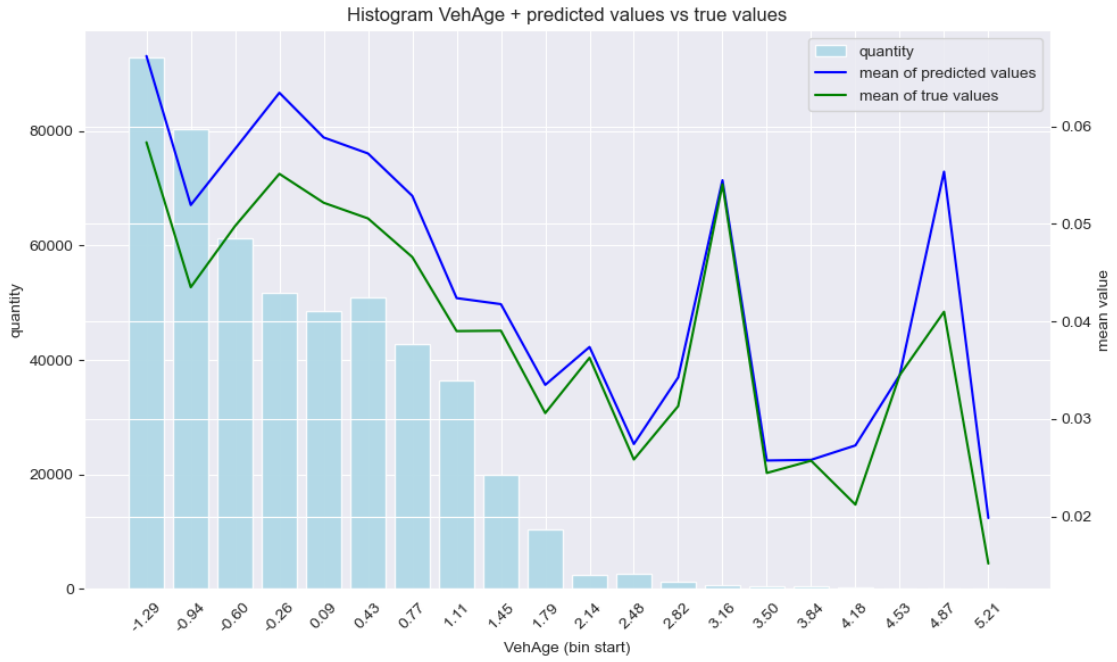

Confusion Matrix
474597
4789
9391
15328
0
1
Actual
0
1
Predicted
400000
300000
200000
100000


Histogram BonusMalus + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
BonusMalus (bin start)
300000
250000
200000
150000
100000
50000
0
0.16
0.14
0.12
0.10
0.08
0.06
0.04
-0.63
-0.43
-0.24
-0.04
0.15
0.35
0.54
0.73
0.93
1.12
1.32
1.51
1.71
1.90
2.09
2.29
2.48
2.68
2.87
3.07


Histogram DrivAge + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
DrivAge (bin start)
0
10000
20000
30000
40000
50000
0.04
0.05
0.06
0.07
0.08
-1.96
-1.67
-1.38
-1.08
-0.80
-0.51
-0.22
0.07
0.36
0.65
0.94
1.23
1.52
1.81
2.10
2.39
2.68
2.97
3.26
3.55


Histogram Density + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
Density (bin start)
0
50000
100000
150000
200000
250000
0.045
0.050
0.055
0.060
0.065
-0.73
-0.50
-0.28
-0.05
0.18
0.41
0.63
0.86
1.09
1.31
1.54
1.77
2.00
2.22
2.45
2.68
2.90
3.13
3.36
3.58

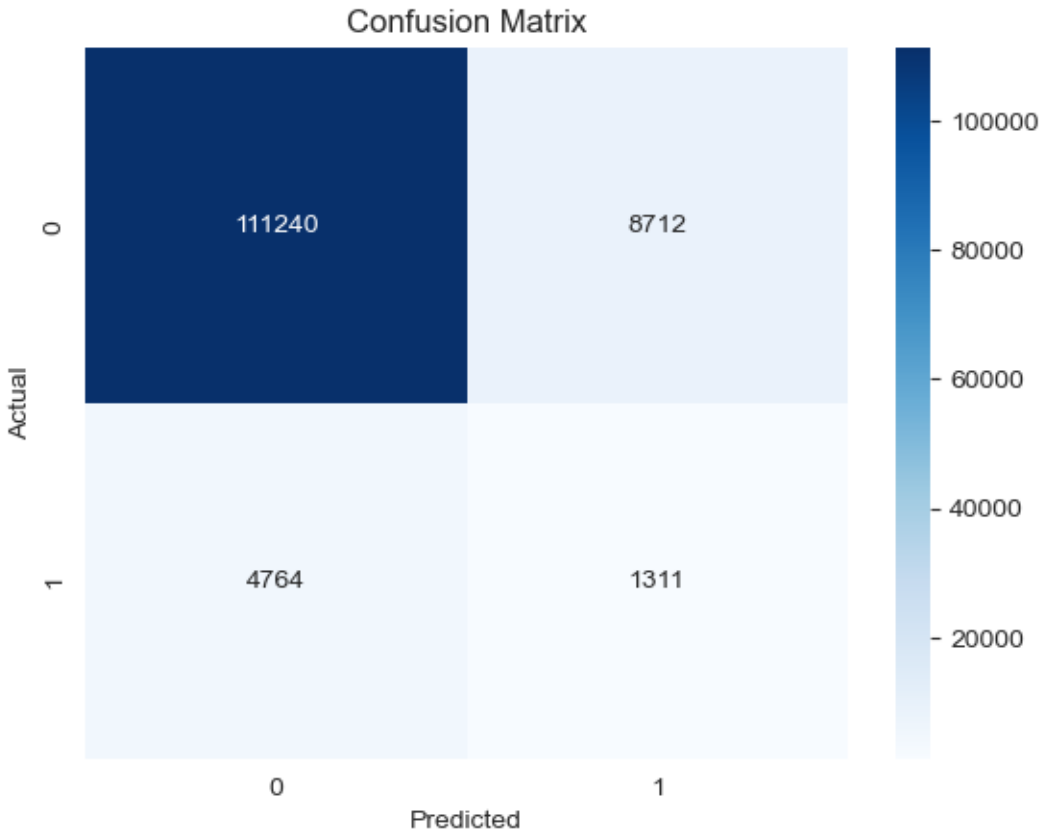


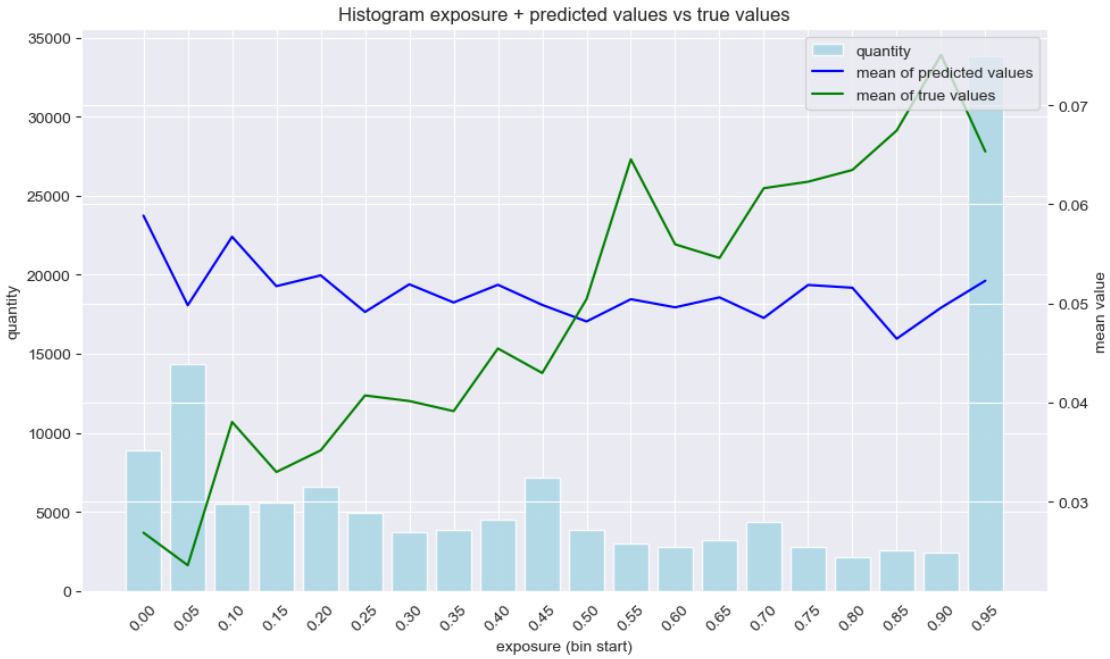


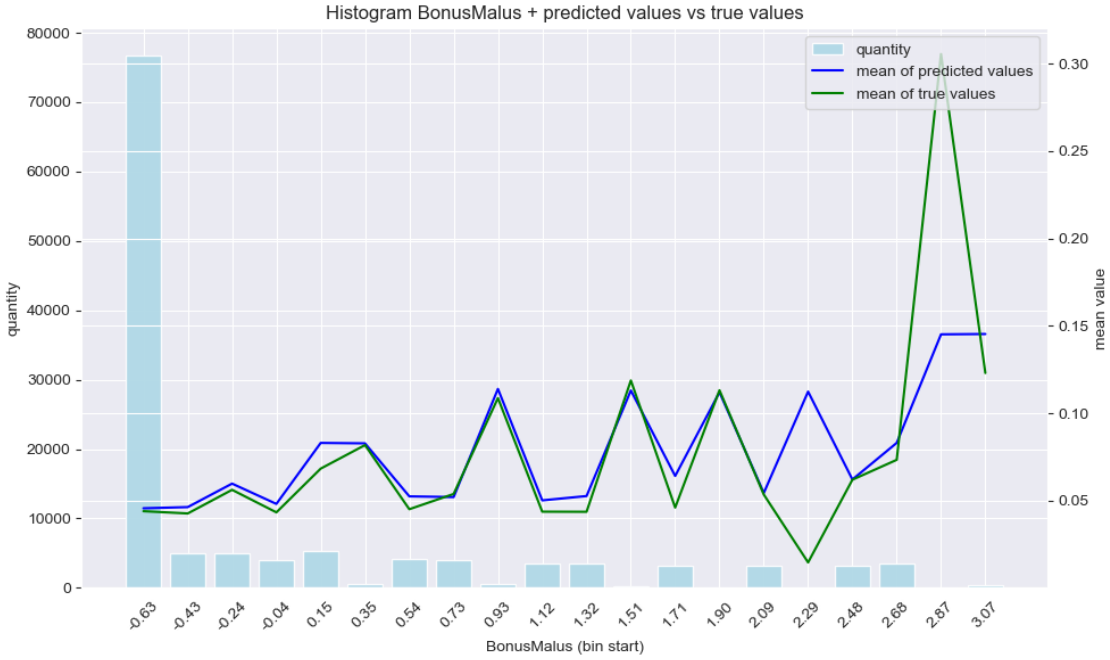
[36]:
```
print("TEST-SET SCORING")
y_pred = model.predict_proba(X_test)[:,1]
```

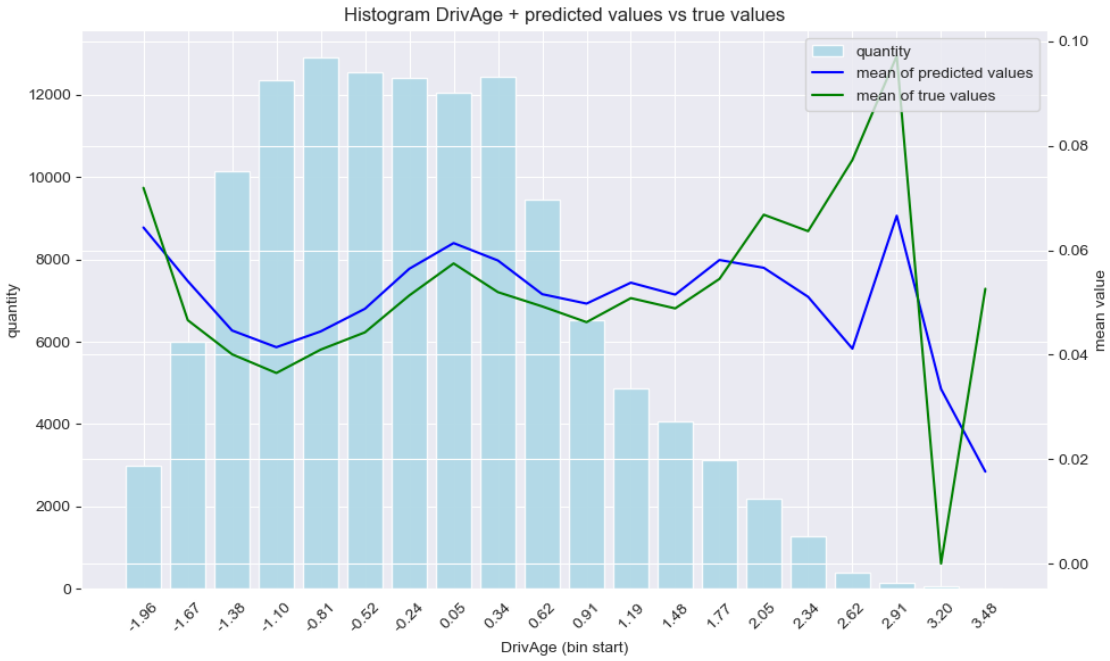
```
stats = score_binary_model(y_test,y_pred,best_threshold)
models_stats_test['gbm_test'] = stats

plot_predict_with_feature(exposure_test_df,y_test,y_pred,'exposure')
for col in numeric_columns:
    plot_predict_with_feature(X_test,y_test,y_pred,col)
```

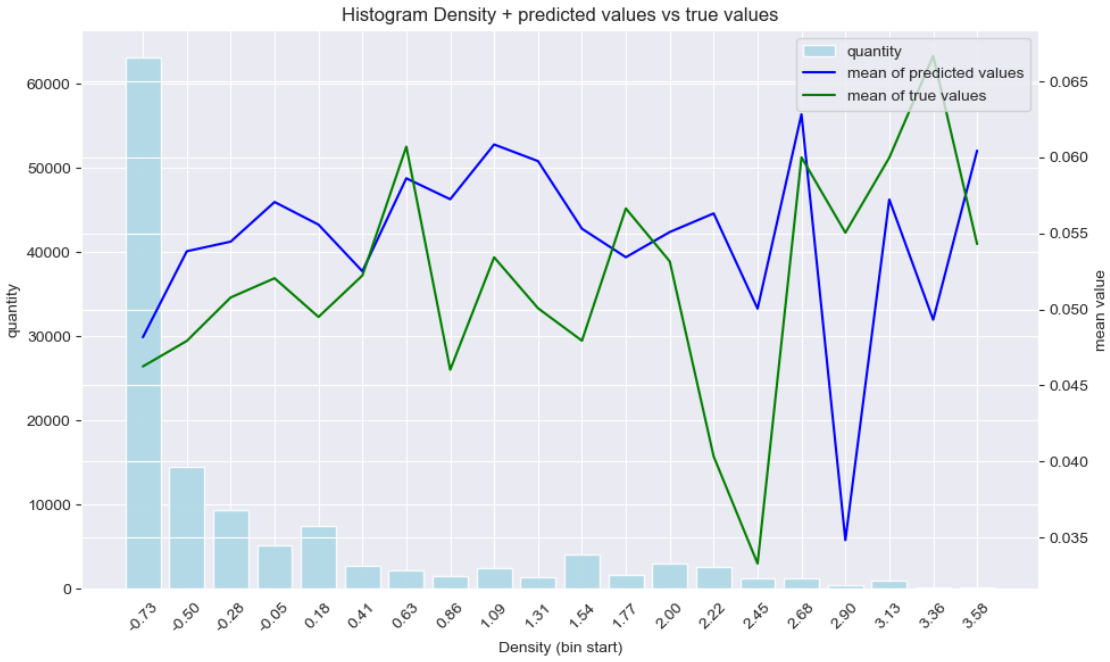
```
TEST-SET SCORING
ROC-AUC score: 0.6394605345567581
F1-score:  0.1628773760715617
Accuracy: 0.8930705325049394
Recall: 0.21580246913580248
Precision: 0.1307991619275666
```

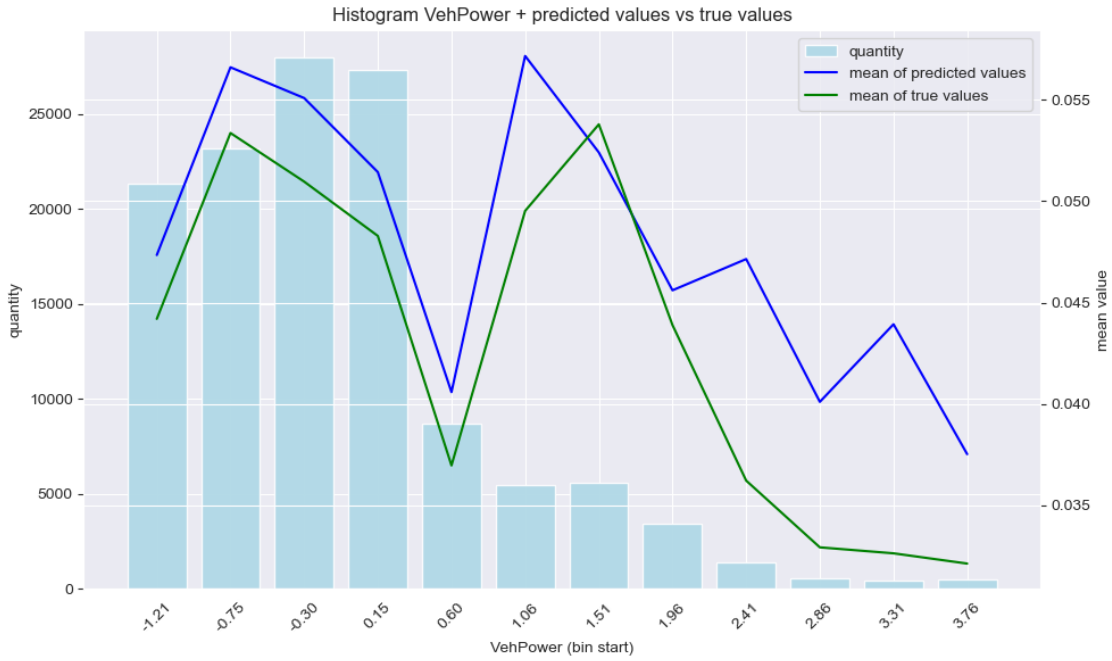


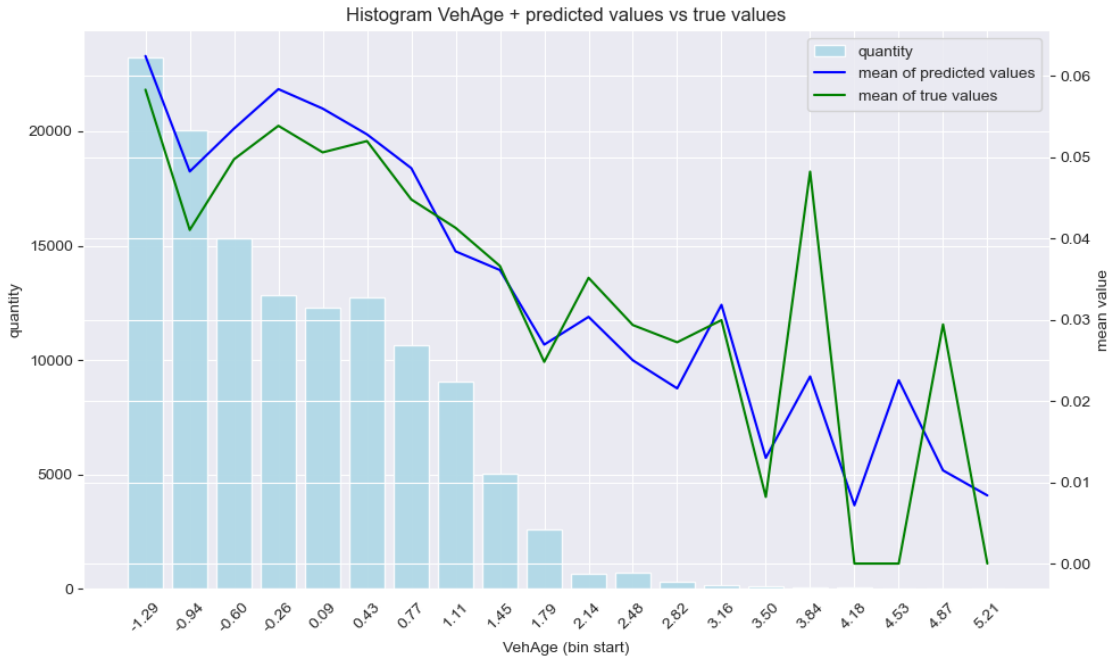

Histogram exposure + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
exposure (bin start)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95


Histogram BonusMalus + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
BonusMalus (bin start)
-0.63
-0.43
-0.24
-0.04
0.15
0.35
0.54
0.73
0.93
1.12
1.32
1.51
1.71
1.90
2.09
2.29
2.48
2.68
2.87
3.07


Histogram DrivAge + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
DrivAge (bin start)
0
2000
4000
6000
8000
10000
12000
0.00
0.02
0.04
0.06
0.08
0.10
-1.96
-1.67
-1.38
-1.10
-0.81
-0.52
-0.24
0.05
0.34
0.62
0.91
1.19
1.48
1.77
2.05
2.34
2.62
2.91
3.20
3.48

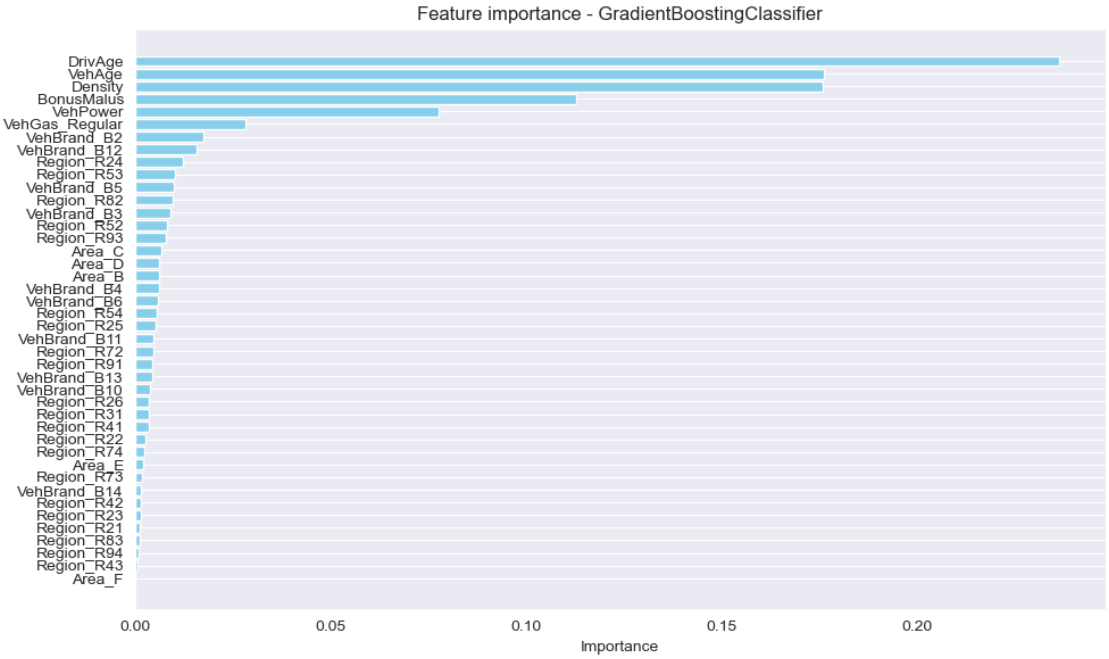

Histogram Density + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
Density (bin start)
0
10000
20000
30000
40000
50000
60000
0.035
0.040
0.045
0.050
0.055
0.060
0.065
-0.73
-0.50
-0.28
-0.05
0.18
0.41
0.63
0.86
1.09
1.31
1.54
1.77
2.00
2.22
2.45
2.68
2.90
3.13
3.36
3.58





[37]:
```
importances = model.feature_importances_
feature_names = X_train.columns
```

```
feat_imp = pd.DataFrame({
    'feature': feature_names,
    'importance': importances
}).sort_values(by='importance', ascending=False)

plt.figure(figsize=(10, 6))
plt.barh(feat_imp['feature'], feat_imp['importance'], color='skyblue')
plt.gca().invert_yaxis()
plt.xlabel('Importance')
plt.title('Feature importance - GradientBoostingClassifier')
plt.grid(axis='x')
plt.tight_layout()
plt.show()
```



3.10 Catboost

[38]:
```
# Without tuning
model = CatBoostClassifier()
model.fit(X_train_val, y_train_val,sample_weight=exposure_train_val)
print("TRAIN-SET SCORING")

y_pred = model.predict_proba(X_train_val)[:,1]
stats = score_binary_model(y_train_val,y_pred)
models_stats_train['catboost_train'] = stats
```

```
print("TEST-SET SCORING")
y_pred = model.predict_proba(X_test)[:,1]
stats =␣
  ↪score_binary_model(y_test,y_pred,models_stats_train['catboost_train']['best_threshold'])
models_stats_test['catboost_test'] = stats
```

```
Learning rate set to 0.146862
0:      learn: 0.5342833        total: 164ms    remaining: 2m 44s
1:      learn: 0.4304406        total: 186ms    remaining: 1m 32s
2:      learn: 0.3605571        total: 206ms    remaining: 1m 8s
3:      learn: 0.3144527        total: 228ms    remaining: 56.9s
4:      learn: 0.2845789        total: 250ms    remaining: 49.8s
5:      learn: 0.2644987        total: 272ms    remaining: 45s
6:      learn: 0.2509273        total: 292ms    remaining: 41.5s
7:      learn: 0.2417486        total: 311ms    remaining: 38.6s
8:      learn: 0.2350865        total: 333ms    remaining: 36.7s
9:      learn: 0.2305359        total: 354ms    remaining: 35.1s
10:     learn: 0.2271327        total: 376ms    remaining: 33.8s
11:     learn: 0.2250918        total: 395ms    remaining: 32.5s
12:     learn: 0.2233283        total: 422ms    remaining: 32s
13:     learn: 0.2218443        total: 442ms    remaining: 31.1s
14:     learn: 0.2206879        total: 463ms    remaining: 30.4s
15:     learn: 0.2199980        total: 485ms    remaining: 29.8s
16:     learn: 0.2195199        total: 509ms    remaining: 29.4s
17:     learn: 0.2189076        total: 527ms    remaining: 28.7s
18:     learn: 0.2185269        total: 548ms    remaining: 28.3s
19:     learn: 0.2182149        total: 568ms    remaining: 27.8s
20:     learn: 0.2179355        total: 589ms    remaining: 27.5s
21:     learn: 0.2177455        total: 610ms    remaining: 27.1s
22:     learn: 0.2176011        total: 631ms    remaining: 26.8s
23:     learn: 0.2174080        total: 654ms    remaining: 26.6s
24:     learn: 0.2172535        total: 681ms    remaining: 26.5s
25:     learn: 0.2171584        total: 700ms    remaining: 26.2s
26:     learn: 0.2170603        total: 723ms    remaining: 26s
27:     learn: 0.2169786        total: 744ms    remaining: 25.8s
28:     learn: 0.2168440        total: 763ms    remaining: 25.5s
29:     learn: 0.2167735        total: 784ms    remaining: 25.3s
30:     learn: 0.2166777        total: 803ms    remaining: 25.1s
31:     learn: 0.2165995        total: 825ms    remaining: 25s
32:     learn: 0.2165442        total: 847ms    remaining: 24.8s
33:     learn: 0.2165034        total: 869ms    remaining: 24.7s
34:     learn: 0.2164476        total: 890ms    remaining: 24.5s
35:     learn: 0.2164177        total: 914ms    remaining: 24.5s
36:     learn: 0.2163480        total: 937ms    remaining: 24.4s
37:     learn: 0.2162763        total: 959ms    remaining: 24.3s
38:     learn: 0.2162252        total: 981ms    remaining: 24.2s
39:     learn: 0.2161763        total: 1s       remaining: 24.1s
40:     learn: 0.2160957        total: 1.02s    remaining: 24s
```

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41:     learn: 0.2160320        total: 1.05s    remaining: 23.9s
42:     learn: 0.2159548        total: 1.07s    remaining: 23.7s
43:     learn: 0.2158768        total: 1.09s    remaining: 23.6s
44:     learn: 0.2158506        total: 1.11s    remaining: 23.5s
45:     learn: 0.2158156        total: 1.13s    remaining: 23.4s
46:     learn: 0.2157506        total: 1.15s    remaining: 23.3s
47:     learn: 0.2157058        total: 1.18s    remaining: 23.3s
48:     learn: 0.2156546        total: 1.2s     remaining: 23.2s
49:     learn: 0.2156282        total: 1.22s    remaining: 23.1s
50:     learn: 0.2155348        total: 1.24s    remaining: 23s
51:     learn: 0.2154965        total: 1.26s    remaining: 22.9s
52:     learn: 0.2154579        total: 1.28s    remaining: 22.9s
53:     learn: 0.2154039        total: 1.3s     remaining: 22.8s
54:     learn: 0.2153345        total: 1.32s    remaining: 22.7s
55:     learn: 0.2152908        total: 1.34s    remaining: 22.7s
56:     learn: 0.2152580        total: 1.36s    remaining: 22.6s
57:     learn: 0.2152242        total: 1.39s    remaining: 22.5s
58:     learn: 0.2151784        total: 1.41s    remaining: 22.5s
59:     learn: 0.2151248        total: 1.44s    remaining: 22.5s
60:     learn: 0.2150811        total: 1.45s    remaining: 22.4s
61:     learn: 0.2150460        total: 1.48s    remaining: 22.3s
62:     learn: 0.2150198        total: 1.5s     remaining: 22.3s
63:     learn: 0.2149930        total: 1.52s    remaining: 22.2s
64:     learn: 0.2149522        total: 1.54s    remaining: 22.2s
65:     learn: 0.2149130        total: 1.56s    remaining: 22.1s
66:     learn: 0.2148861        total: 1.58s    remaining: 22.1s
67:     learn: 0.2148687        total: 1.6s     remaining: 22s
68:     learn: 0.2148144        total: 1.63s    remaining: 21.9s
69:     learn: 0.2147708        total: 1.65s    remaining: 21.9s
70:     learn: 0.2147228        total: 1.67s    remaining: 21.8s
71:     learn: 0.2147081        total: 1.69s    remaining: 21.8s
72:     learn: 0.2146737        total: 1.72s    remaining: 21.8s
73:     learn: 0.2146478        total: 1.74s    remaining: 21.7s
74:     learn: 0.2145570        total: 1.76s    remaining: 21.7s
75:     learn: 0.2145134        total: 1.78s    remaining: 21.7s
76:     learn: 0.2144922        total: 1.8s     remaining: 21.6s
77:     learn: 0.2144643        total: 1.82s    remaining: 21.5s
78:     learn: 0.2144321        total: 1.84s    remaining: 21.5s
79:     learn: 0.2143722        total: 1.86s    remaining: 21.4s
80:     learn: 0.2143421        total: 1.89s    remaining: 21.4s
81:     learn: 0.2143073        total: 1.91s    remaining: 21.3s
82:     learn: 0.2142690        total: 1.93s    remaining: 21.3s
83:     learn: 0.2142314        total: 1.95s    remaining: 21.3s
84:     learn: 0.2142059        total: 1.98s    remaining: 21.3s
85:     learn: 0.2141834        total: 2s       remaining: 21.2s
86:     learn: 0.2141552        total: 2.02s    remaining: 21.2s
87:     learn: 0.2141318        total: 2.04s    remaining: 21.1s
88:     learn: 0.2141052        total: 2.06s    remaining: 21.1s
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89:     learn: 0.2140554        total: 2.08s    remaining: 21s
90:     learn: 0.2140167        total: 2.1s     remaining: 21s
91:     learn: 0.2139914        total: 2.12s    remaining: 21s
92:     learn: 0.2139694        total: 2.15s    remaining: 20.9s
93:     learn: 0.2139394        total: 2.17s    remaining: 20.9s
94:     learn: 0.2139124        total: 2.19s    remaining: 20.9s
95:     learn: 0.2138679        total: 2.21s    remaining: 20.9s
96:     learn: 0.2138292        total: 2.23s    remaining: 20.8s
97:     learn: 0.2138036        total: 2.26s    remaining: 20.8s
98:     learn: 0.2137667        total: 2.28s    remaining: 20.7s
99:     learn: 0.2137355        total: 2.3s     remaining: 20.7s
100:    learn: 0.2137099        total: 2.32s    remaining: 20.7s
101:    learn: 0.2136799        total: 2.34s    remaining: 20.6s
102:    learn: 0.2136643        total: 2.36s    remaining: 20.6s
103:    learn: 0.2136389        total: 2.38s    remaining: 20.5s
104:    learn: 0.2136088        total: 2.4s     remaining: 20.5s
105:    learn: 0.2135805        total: 2.43s    remaining: 20.5s
106:    learn: 0.2135534        total: 2.45s    remaining: 20.5s
107:    learn: 0.2135207        total: 2.47s    remaining: 20.4s
108:    learn: 0.2134856        total: 2.5s     remaining: 20.4s
109:    learn: 0.2134379        total: 2.52s    remaining: 20.4s
110:    learn: 0.2134138        total: 2.54s    remaining: 20.3s
111:    learn: 0.2133889        total: 2.56s    remaining: 20.3s
112:    learn: 0.2133562        total: 2.58s    remaining: 20.3s
113:    learn: 0.2133191        total: 2.6s     remaining: 20.3s
114:    learn: 0.2132976        total: 2.63s    remaining: 20.2s
115:    learn: 0.2132787        total: 2.65s    remaining: 20.2s
116:    learn: 0.2132397        total: 2.67s    remaining: 20.2s
117:    learn: 0.2132144        total: 2.7s     remaining: 20.2s
118:    learn: 0.2131846        total: 2.72s    remaining: 20.1s
119:    learn: 0.2131617        total: 2.74s    remaining: 20.1s
120:    learn: 0.2131374        total: 2.76s    remaining: 20.1s
121:    learn: 0.2131203        total: 2.78s    remaining: 20s
122:    learn: 0.2130736        total: 2.81s    remaining: 20s
123:    learn: 0.2130427        total: 2.83s    remaining: 20s
124:    learn: 0.2130180        total: 2.85s    remaining: 19.9s
125:    learn: 0.2129925        total: 2.87s    remaining: 19.9s
126:    learn: 0.2129581        total: 2.89s    remaining: 19.9s
127:    learn: 0.2129332        total: 2.91s    remaining: 19.9s
128:    learn: 0.2129056        total: 2.94s    remaining: 19.9s
129:    learn: 0.2128665        total: 2.96s    remaining: 19.8s
130:    learn: 0.2128419        total: 2.98s    remaining: 19.8s
131:    learn: 0.2128237        total: 3s       remaining: 19.8s
132:    learn: 0.2128042        total: 3.03s    remaining: 19.7s
133:    learn: 0.2127724        total: 3.05s    remaining: 19.7s
134:    learn: 0.2127450        total: 3.07s    remaining: 19.7s
135:    learn: 0.2127228        total: 3.09s    remaining: 19.6s
136:    learn: 0.2126751        total: 3.12s    remaining: 19.6s
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137:    learn: 0.2126489        total: 3.14s    remaining: 19.6s
138:    learn: 0.2126259        total: 3.16s    remaining: 19.6s
139:    learn: 0.2125988        total: 3.18s    remaining: 19.6s
140:    learn: 0.2125766        total: 3.21s    remaining: 19.5s
141:    learn: 0.2125591        total: 3.23s    remaining: 19.5s
142:    learn: 0.2125280        total: 3.25s    remaining: 19.5s
143:    learn: 0.2124999        total: 3.27s    remaining: 19.4s
144:    learn: 0.2124792        total: 3.29s    remaining: 19.4s
145:    learn: 0.2124584        total: 3.32s    remaining: 19.4s
146:    learn: 0.2124206        total: 3.34s    remaining: 19.4s
147:    learn: 0.2124066        total: 3.36s    remaining: 19.4s
148:    learn: 0.2123860        total: 3.38s    remaining: 19.3s
149:    learn: 0.2123683        total: 3.4s     remaining: 19.3s
150:    learn: 0.2123437        total: 3.43s    remaining: 19.3s
151:    learn: 0.2123198        total: 3.45s    remaining: 19.3s
152:    learn: 0.2122981        total: 3.48s    remaining: 19.2s
153:    learn: 0.2122648        total: 3.5s     remaining: 19.2s
154:    learn: 0.2122297        total: 3.52s    remaining: 19.2s
155:    learn: 0.2121942        total: 3.54s    remaining: 19.2s
156:    learn: 0.2121631        total: 3.57s    remaining: 19.2s
157:    learn: 0.2121324        total: 3.59s    remaining: 19.1s
158:    learn: 0.2121101        total: 3.61s    remaining: 19.1s
159:    learn: 0.2120884        total: 3.63s    remaining: 19.1s
160:    learn: 0.2120756        total: 3.66s    remaining: 19.1s
161:    learn: 0.2120534        total: 3.68s    remaining: 19s
162:    learn: 0.2120304        total: 3.71s    remaining: 19s
163:    learn: 0.2120102        total: 3.73s    remaining: 19s
164:    learn: 0.2119846        total: 3.75s    remaining: 19s
165:    learn: 0.2119698        total: 3.77s    remaining: 19s
166:    learn: 0.2119572        total: 3.8s     remaining: 18.9s
167:    learn: 0.2119332        total: 3.82s    remaining: 18.9s
168:    learn: 0.2119152        total: 3.84s    remaining: 18.9s
169:    learn: 0.2118970        total: 3.86s    remaining: 18.9s
170:    learn: 0.2118750        total: 3.88s    remaining: 18.8s
171:    learn: 0.2118608        total: 3.9s     remaining: 18.8s
172:    learn: 0.2118419        total: 3.93s    remaining: 18.8s
173:    learn: 0.2118155        total: 3.96s    remaining: 18.8s
174:    learn: 0.2117945        total: 3.98s    remaining: 18.8s
175:    learn: 0.2117663        total: 4s       remaining: 18.7s
176:    learn: 0.2117406        total: 4.02s    remaining: 18.7s
177:    learn: 0.2117064        total: 4.04s    remaining: 18.7s
178:    learn: 0.2116840        total: 4.07s    remaining: 18.6s
179:    learn: 0.2116655        total: 4.09s    remaining: 18.6s
180:    learn: 0.2116502        total: 4.11s    remaining: 18.6s
181:    learn: 0.2116249        total: 4.13s    remaining: 18.6s
182:    learn: 0.2115911        total: 4.15s    remaining: 18.5s
183:    learn: 0.2115687        total: 4.18s    remaining: 18.5s
184:    learn: 0.2115540        total: 4.2s     remaining: 18.5s
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185:    learn: 0.2115408        total: 4.22s    remaining: 18.5s
186:    learn: 0.2115281        total: 4.25s    remaining: 18.5s
187:    learn: 0.2115070        total: 4.27s    remaining: 18.4s
188:    learn: 0.2114722        total: 4.29s    remaining: 18.4s
189:    learn: 0.2114350        total: 4.32s    remaining: 18.4s
190:    learn: 0.2114039        total: 4.34s    remaining: 18.4s
191:    learn: 0.2113844        total: 4.36s    remaining: 18.4s
192:    learn: 0.2113547        total: 4.38s    remaining: 18.3s
193:    learn: 0.2113320        total: 4.41s    remaining: 18.3s
194:    learn: 0.2113159        total: 4.43s    remaining: 18.3s
195:    learn: 0.2112997        total: 4.46s    remaining: 18.3s
196:    learn: 0.2112818        total: 4.48s    remaining: 18.3s
197:    learn: 0.2112661        total: 4.5s     remaining: 18.2s
198:    learn: 0.2112362        total: 4.52s    remaining: 18.2s
199:    learn: 0.2112099        total: 4.55s    remaining: 18.2s
200:    learn: 0.2111906        total: 4.57s    remaining: 18.2s
201:    learn: 0.2111594        total: 4.59s    remaining: 18.1s
202:    learn: 0.2111362        total: 4.62s    remaining: 18.1s
203:    learn: 0.2111210        total: 4.64s    remaining: 18.1s
204:    learn: 0.2110956        total: 4.66s    remaining: 18.1s
205:    learn: 0.2110685        total: 4.68s    remaining: 18.1s
206:    learn: 0.2110485        total: 4.71s    remaining: 18s
207:    learn: 0.2110300        total: 4.73s    remaining: 18s
208:    learn: 0.2110089        total: 4.75s    remaining: 18s
209:    learn: 0.2109896        total: 4.78s    remaining: 18s
210:    learn: 0.2109816        total: 4.8s     remaining: 17.9s
211:    learn: 0.2109537        total: 4.82s    remaining: 17.9s
212:    learn: 0.2109283        total: 4.84s    remaining: 17.9s
213:    learn: 0.2109102        total: 4.86s    remaining: 17.9s
214:    learn: 0.2108887        total: 4.88s    remaining: 17.8s
215:    learn: 0.2108664        total: 4.91s    remaining: 17.8s
216:    learn: 0.2108536        total: 4.93s    remaining: 17.8s
217:    learn: 0.2108329        total: 4.95s    remaining: 17.8s
218:    learn: 0.2108089        total: 4.98s    remaining: 17.7s
219:    learn: 0.2107859        total: 5s       remaining: 17.7s
220:    learn: 0.2107631        total: 5.02s    remaining: 17.7s
221:    learn: 0.2107475        total: 5.04s    remaining: 17.7s
222:    learn: 0.2107242        total: 5.06s    remaining: 17.6s
223:    learn: 0.2107039        total: 5.08s    remaining: 17.6s
224:    learn: 0.2106923        total: 5.1s     remaining: 17.6s
225:    learn: 0.2106754        total: 5.13s    remaining: 17.6s
226:    learn: 0.2106475        total: 5.15s    remaining: 17.5s
227:    learn: 0.2106235        total: 5.17s    remaining: 17.5s
228:    learn: 0.2106074        total: 5.19s    remaining: 17.5s
229:    learn: 0.2105938        total: 5.21s    remaining: 17.5s
230:    learn: 0.2105849        total: 5.24s    remaining: 17.4s
231:    learn: 0.2105623        total: 5.26s    remaining: 17.4s
232:    learn: 0.2105424        total: 5.28s    remaining: 17.4s
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233:    learn: 0.2105301        total: 5.3s     remaining: 17.4s
234:    learn: 0.2105071        total: 5.32s    remaining: 17.3s
235:    learn: 0.2104821        total: 5.34s    remaining: 17.3s
236:    learn: 0.2104530        total: 5.36s    remaining: 17.3s
237:    learn: 0.2104418        total: 5.39s    remaining: 17.2s
238:    learn: 0.2104227        total: 5.41s    remaining: 17.2s
239:    learn: 0.2104019        total: 5.43s    remaining: 17.2s
240:    learn: 0.2103861        total: 5.46s    remaining: 17.2s
241:    learn: 0.2103688        total: 5.48s    remaining: 17.2s
242:    learn: 0.2103472        total: 5.5s     remaining: 17.1s
243:    learn: 0.2103207        total: 5.53s    remaining: 17.1s
244:    learn: 0.2103091        total: 5.55s    remaining: 17.1s
245:    learn: 0.2102922        total: 5.57s    remaining: 17.1s
246:    learn: 0.2102692        total: 5.59s    remaining: 17s
247:    learn: 0.2102418        total: 5.61s    remaining: 17s
248:    learn: 0.2102237        total: 5.63s    remaining: 17s
249:    learn: 0.2102032        total: 5.65s    remaining: 17s
250:    learn: 0.2101755        total: 5.68s    remaining: 16.9s
251:    learn: 0.2101666        total: 5.7s     remaining: 16.9s
252:    learn: 0.2101563        total: 5.73s    remaining: 16.9s
253:    learn: 0.2101343        total: 5.75s    remaining: 16.9s
254:    learn: 0.2101205        total: 5.77s    remaining: 16.9s
255:    learn: 0.2101036        total: 5.79s    remaining: 16.8s
256:    learn: 0.2100925        total: 5.81s    remaining: 16.8s
257:    learn: 0.2100662        total: 5.84s    remaining: 16.8s
258:    learn: 0.2100434        total: 5.86s    remaining: 16.8s
259:    learn: 0.2100210        total: 5.88s    remaining: 16.7s
260:    learn: 0.2100050        total: 5.9s     remaining: 16.7s
261:    learn: 0.2099882        total: 5.93s    remaining: 16.7s
262:    learn: 0.2099709        total: 5.95s    remaining: 16.7s
263:    learn: 0.2099439        total: 5.97s    remaining: 16.7s
264:    learn: 0.2099276        total: 6s       remaining: 16.6s
265:    learn: 0.2099127        total: 6.02s    remaining: 16.6s
266:    learn: 0.2098878        total: 6.04s    remaining: 16.6s
267:    learn: 0.2098716        total: 6.07s    remaining: 16.6s
268:    learn: 0.2098512        total: 6.09s    remaining: 16.5s
269:    learn: 0.2098362        total: 6.11s    remaining: 16.5s
270:    learn: 0.2098067        total: 6.14s    remaining: 16.5s
271:    learn: 0.2097947        total: 6.16s    remaining: 16.5s
272:    learn: 0.2097797        total: 6.18s    remaining: 16.5s
273:    learn: 0.2097615        total: 6.21s    remaining: 16.4s
274:    learn: 0.2097351        total: 6.23s    remaining: 16.4s
275:    learn: 0.2097241        total: 6.25s    remaining: 16.4s
276:    learn: 0.2097071        total: 6.27s    remaining: 16.4s
277:    learn: 0.2096868        total: 6.29s    remaining: 16.4s
278:    learn: 0.2096686        total: 6.32s    remaining: 16.3s
279:    learn: 0.2096448        total: 6.34s    remaining: 16.3s
280:    learn: 0.2096294        total: 6.36s    remaining: 16.3s
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281:    learn: 0.2096099        total: 6.38s    remaining: 16.3s
282:    learn: 0.2095984        total: 6.4s     remaining: 16.2s
283:    learn: 0.2095768        total: 6.42s    remaining: 16.2s
284:    learn: 0.2095580        total: 6.45s    remaining: 16.2s
285:    learn: 0.2095324        total: 6.47s    remaining: 16.2s
286:    learn: 0.2095049        total: 6.49s    remaining: 16.1s
287:    learn: 0.2094775        total: 6.51s    remaining: 16.1s
288:    learn: 0.2094553        total: 6.54s    remaining: 16.1s
289:    learn: 0.2094421        total: 6.56s    remaining: 16.1s
290:    learn: 0.2094282        total: 6.58s    remaining: 16s
291:    learn: 0.2094073        total: 6.6s     remaining: 16s
292:    learn: 0.2093949        total: 6.62s    remaining: 16s
293:    learn: 0.2093799        total: 6.64s    remaining: 16s
294:    learn: 0.2093573        total: 6.67s    remaining: 15.9s
295:    learn: 0.2093475        total: 6.69s    remaining: 15.9s
296:    learn: 0.2093295        total: 6.71s    remaining: 15.9s
297:    learn: 0.2093053        total: 6.73s    remaining: 15.9s
298:    learn: 0.2092965        total: 6.75s    remaining: 15.8s
299:    learn: 0.2092889        total: 6.78s    remaining: 15.8s
300:    learn: 0.2092755        total: 6.8s     remaining: 15.8s
301:    learn: 0.2092568        total: 6.82s    remaining: 15.8s
302:    learn: 0.2092281        total: 6.84s    remaining: 15.7s
303:    learn: 0.2092019        total: 6.86s    remaining: 15.7s
304:    learn: 0.2091820        total: 6.88s    remaining: 15.7s
305:    learn: 0.2091610        total: 6.9s     remaining: 15.7s
306:    learn: 0.2091478        total: 6.92s    remaining: 15.6s
307:    learn: 0.2091369        total: 6.95s    remaining: 15.6s
308:    learn: 0.2091225        total: 6.97s    remaining: 15.6s
309:    learn: 0.2091056        total: 6.99s    remaining: 15.6s
310:    learn: 0.2090860        total: 7.01s    remaining: 15.5s
311:    learn: 0.2090598        total: 7.04s    remaining: 15.5s
312:    learn: 0.2090350        total: 7.06s    remaining: 15.5s
313:    learn: 0.2090193        total: 7.08s    remaining: 15.5s
314:    learn: 0.2089957        total: 7.1s     remaining: 15.4s
315:    learn: 0.2089882        total: 7.12s    remaining: 15.4s
316:    learn: 0.2089707        total: 7.14s    remaining: 15.4s
317:    learn: 0.2089456        total: 7.16s    remaining: 15.4s
318:    learn: 0.2089223        total: 7.18s    remaining: 15.3s
319:    learn: 0.2089099        total: 7.21s    remaining: 15.3s
320:    learn: 0.2088980        total: 7.23s    remaining: 15.3s
321:    learn: 0.2088791        total: 7.25s    remaining: 15.3s
322:    learn: 0.2088689        total: 7.27s    remaining: 15.2s
323:    learn: 0.2088584        total: 7.29s    remaining: 15.2s
324:    learn: 0.2088463        total: 7.31s    remaining: 15.2s
325:    learn: 0.2088228        total: 7.33s    remaining: 15.2s
326:    learn: 0.2088099        total: 7.35s    remaining: 15.1s
327:    learn: 0.2087992        total: 7.37s    remaining: 15.1s
328:    learn: 0.2087801        total: 7.39s    remaining: 15.1s
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329:    learn: 0.2087585        total: 7.41s    remaining: 15.1s
330:    learn: 0.2087351        total: 7.44s    remaining: 15s
331:    learn: 0.2087187        total: 7.46s    remaining: 15s
332:    learn: 0.2086934        total: 7.49s    remaining: 15s
333:    learn: 0.2086783        total: 7.51s    remaining: 15s
334:    learn: 0.2086651        total: 7.53s    remaining: 14.9s
335:    learn: 0.2086535        total: 7.55s    remaining: 14.9s
336:    learn: 0.2086275        total: 7.57s    remaining: 14.9s
337:    learn: 0.2086050        total: 7.59s    remaining: 14.9s
338:    learn: 0.2085907        total: 7.62s    remaining: 14.8s
339:    learn: 0.2085679        total: 7.64s    remaining: 14.8s
340:    learn: 0.2085564        total: 7.66s    remaining: 14.8s
341:    learn: 0.2085323        total: 7.68s    remaining: 14.8s
342:    learn: 0.2085198        total: 7.7s     remaining: 14.8s
343:    learn: 0.2085031        total: 7.73s    remaining: 14.7s
344:    learn: 0.2084789        total: 7.75s    remaining: 14.7s
345:    learn: 0.2084695        total: 7.77s    remaining: 14.7s
346:    learn: 0.2084585        total: 7.79s    remaining: 14.7s
347:    learn: 0.2084373        total: 7.81s    remaining: 14.6s
348:    learn: 0.2084235        total: 7.83s    remaining: 14.6s
349:    learn: 0.2083978        total: 7.86s    remaining: 14.6s
350:    learn: 0.2083821        total: 7.88s    remaining: 14.6s
351:    learn: 0.2083680        total: 7.9s     remaining: 14.5s
352:    learn: 0.2083470        total: 7.92s    remaining: 14.5s
353:    learn: 0.2083311        total: 7.94s    remaining: 14.5s
354:    learn: 0.2083124        total: 7.97s    remaining: 14.5s
355:    learn: 0.2083001        total: 7.99s    remaining: 14.5s
356:    learn: 0.2082841        total: 8.01s    remaining: 14.4s
357:    learn: 0.2082618        total: 8.03s    remaining: 14.4s
358:    learn: 0.2082551        total: 8.05s    remaining: 14.4s
359:    learn: 0.2082418        total: 8.07s    remaining: 14.4s
360:    learn: 0.2082265        total: 8.1s     remaining: 14.3s
361:    learn: 0.2082002        total: 8.12s    remaining: 14.3s
362:    learn: 0.2081876        total: 8.14s    remaining: 14.3s
363:    learn: 0.2081562        total: 8.16s    remaining: 14.3s
364:    learn: 0.2081322        total: 8.18s    remaining: 14.2s
365:    learn: 0.2081110        total: 8.21s    remaining: 14.2s
366:    learn: 0.2080942        total: 8.23s    remaining: 14.2s
367:    learn: 0.2080860        total: 8.25s    remaining: 14.2s
368:    learn: 0.2080699        total: 8.27s    remaining: 14.1s
369:    learn: 0.2080475        total: 8.29s    remaining: 14.1s
370:    learn: 0.2080329        total: 8.31s    remaining: 14.1s
371:    learn: 0.2080175        total: 8.34s    remaining: 14.1s
372:    learn: 0.2080064        total: 8.36s    remaining: 14.1s
373:    learn: 0.2079894        total: 8.38s    remaining: 14s
374:    learn: 0.2079794        total: 8.4s     remaining: 14s
375:    learn: 0.2079677        total: 8.42s    remaining: 14s
376:    learn: 0.2079483        total: 8.44s    remaining: 14s
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377:    learn: 0.2079300        total: 8.47s    remaining: 13.9s
378:    learn: 0.2079123        total: 8.49s    remaining: 13.9s
379:    learn: 0.2079025        total: 8.51s    remaining: 13.9s
380:    learn: 0.2078968        total: 8.53s    remaining: 13.9s
381:    learn: 0.2078849        total: 8.55s    remaining: 13.8s
382:    learn: 0.2078590        total: 8.57s    remaining: 13.8s
383:    learn: 0.2078432        total: 8.6s     remaining: 13.8s
384:    learn: 0.2078188        total: 8.62s    remaining: 13.8s
385:    learn: 0.2077962        total: 8.64s    remaining: 13.7s
386:    learn: 0.2077858        total: 8.66s    remaining: 13.7s
387:    learn: 0.2077494        total: 8.68s    remaining: 13.7s
388:    learn: 0.2077318        total: 8.7s     remaining: 13.7s
389:    learn: 0.2077146        total: 8.72s    remaining: 13.6s
390:    learn: 0.2076999        total: 8.75s    remaining: 13.6s
391:    learn: 0.2076785        total: 8.77s    remaining: 13.6s
392:    learn: 0.2076595        total: 8.79s    remaining: 13.6s
393:    learn: 0.2076457        total: 8.81s    remaining: 13.6s
394:    learn: 0.2076225        total: 8.84s    remaining: 13.5s
395:    learn: 0.2076090        total: 8.86s    remaining: 13.5s
396:    learn: 0.2075911        total: 8.88s    remaining: 13.5s
397:    learn: 0.2075767        total: 8.9s     remaining: 13.5s
398:    learn: 0.2075668        total: 8.92s    remaining: 13.4s
399:    learn: 0.2075469        total: 8.94s    remaining: 13.4s
400:    learn: 0.2075279        total: 8.96s    remaining: 13.4s
401:    learn: 0.2075088        total: 8.99s    remaining: 13.4s
402:    learn: 0.2075002        total: 9.01s    remaining: 13.3s
403:    learn: 0.2074829        total: 9.03s    remaining: 13.3s
404:    learn: 0.2074728        total: 9.05s    remaining: 13.3s
405:    learn: 0.2074586        total: 9.07s    remaining: 13.3s
406:    learn: 0.2074422        total: 9.1s     remaining: 13.3s
407:    learn: 0.2074226        total: 9.12s    remaining: 13.2s
408:    learn: 0.2074083        total: 9.14s    remaining: 13.2s
409:    learn: 0.2073943        total: 9.16s    remaining: 13.2s
410:    learn: 0.2073726        total: 9.18s    remaining: 13.2s
411:    learn: 0.2073455        total: 9.2s     remaining: 13.1s
412:    learn: 0.2073310        total: 9.23s    remaining: 13.1s
413:    learn: 0.2073201        total: 9.25s    remaining: 13.1s
414:    learn: 0.2072972        total: 9.27s    remaining: 13.1s
415:    learn: 0.2072856        total: 9.29s    remaining: 13s
416:    learn: 0.2072752        total: 9.31s    remaining: 13s
417:    learn: 0.2072641        total: 9.33s    remaining: 13s
418:    learn: 0.2072560        total: 9.35s    remaining: 13s
419:    learn: 0.2072495        total: 9.38s    remaining: 12.9s
420:    learn: 0.2072238        total: 9.4s     remaining: 12.9s
421:    learn: 0.2072110        total: 9.42s    remaining: 12.9s
422:    learn: 0.2071836        total: 9.44s    remaining: 12.9s
423:    learn: 0.2071730        total: 9.46s    remaining: 12.9s
424:    learn: 0.2071438        total: 9.49s    remaining: 12.8s
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425:    learn: 0.2071323        total: 9.51s    remaining: 12.8s
426:    learn: 0.2071184        total: 9.53s    remaining: 12.8s
427:    learn: 0.2071047        total: 9.55s    remaining: 12.8s
428:    learn: 0.2070872        total: 9.57s    remaining: 12.7s
429:    learn: 0.2070651        total: 9.6s     remaining: 12.7s
430:    learn: 0.2070498        total: 9.62s    remaining: 12.7s
431:    learn: 0.2070401        total: 9.64s    remaining: 12.7s
432:    learn: 0.2070320        total: 9.66s    remaining: 12.6s
433:    learn: 0.2070179        total: 9.68s    remaining: 12.6s
434:    learn: 0.2069943        total: 9.7s     remaining: 12.6s
435:    learn: 0.2069784        total: 9.73s    remaining: 12.6s
436:    learn: 0.2069549        total: 9.75s    remaining: 12.6s
437:    learn: 0.2069375        total: 9.77s    remaining: 12.5s
438:    learn: 0.2069292        total: 9.79s    remaining: 12.5s
439:    learn: 0.2069124        total: 9.81s    remaining: 12.5s
440:    learn: 0.2068979        total: 9.84s    remaining: 12.5s
441:    learn: 0.2068771        total: 9.86s    remaining: 12.4s
442:    learn: 0.2068624        total: 9.88s    remaining: 12.4s
443:    learn: 0.2068544        total: 9.9s     remaining: 12.4s
444:    learn: 0.2068429        total: 9.92s    remaining: 12.4s
445:    learn: 0.2068238        total: 9.94s    remaining: 12.4s
446:    learn: 0.2068041        total: 9.96s    remaining: 12.3s
447:    learn: 0.2067951        total: 9.99s    remaining: 12.3s
448:    learn: 0.2067855        total: 10s      remaining: 12.3s
449:    learn: 0.2067797        total: 10s      remaining: 12.3s
450:    learn: 0.2067739        total: 10.1s    remaining: 12.2s
451:    learn: 0.2067620        total: 10.1s    remaining: 12.2s
452:    learn: 0.2067501        total: 10.1s    remaining: 12.2s
453:    learn: 0.2067355        total: 10.1s    remaining: 12.2s
454:    learn: 0.2067102        total: 10.1s    remaining: 12.1s
455:    learn: 0.2066776        total: 10.2s    remaining: 12.1s
456:    learn: 0.2066662        total: 10.2s    remaining: 12.1s
457:    learn: 0.2066445        total: 10.2s    remaining: 12.1s
458:    learn: 0.2066314        total: 10.2s    remaining: 12s
459:    learn: 0.2066113        total: 10.2s    remaining: 12s
460:    learn: 0.2065851        total: 10.3s    remaining: 12s
461:    learn: 0.2065725        total: 10.3s    remaining: 12s
462:    learn: 0.2065635        total: 10.3s    remaining: 12s
463:    learn: 0.2065467        total: 10.3s    remaining: 11.9s
464:    learn: 0.2065371        total: 10.4s    remaining: 11.9s
465:    learn: 0.2065289        total: 10.4s    remaining: 11.9s
466:    learn: 0.2065116        total: 10.4s    remaining: 11.9s
467:    learn: 0.2064925        total: 10.4s    remaining: 11.8s
468:    learn: 0.2064708        total: 10.4s    remaining: 11.8s
469:    learn: 0.2064496        total: 10.5s    remaining: 11.8s
470:    learn: 0.2064267        total: 10.5s    remaining: 11.8s
471:    learn: 0.2064149        total: 10.5s    remaining: 11.8s
472:    learn: 0.2064057        total: 10.5s    remaining: 11.7s
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473:    learn: 0.2063887        total: 10.6s    remaining: 11.7s
474:    learn: 0.2063627        total: 10.6s    remaining: 11.7s
475:    learn: 0.2063429        total: 10.6s    remaining: 11.7s
476:    learn: 0.2063261        total: 10.6s    remaining: 11.6s
477:    learn: 0.2063086        total: 10.6s    remaining: 11.6s
478:    learn: 0.2062925        total: 10.7s    remaining: 11.6s
479:    learn: 0.2062792        total: 10.7s    remaining: 11.6s
480:    learn: 0.2062693        total: 10.7s    remaining: 11.5s
481:    learn: 0.2062509        total: 10.7s    remaining: 11.5s
482:    learn: 0.2062304        total: 10.7s    remaining: 11.5s
483:    learn: 0.2062124        total: 10.8s    remaining: 11.5s
484:    learn: 0.2062011        total: 10.8s    remaining: 11.5s
485:    learn: 0.2061748        total: 10.8s    remaining: 11.4s
486:    learn: 0.2061613        total: 10.8s    remaining: 11.4s
487:    learn: 0.2061507        total: 10.9s    remaining: 11.4s
488:    learn: 0.2061315        total: 10.9s    remaining: 11.4s
489:    learn: 0.2061158        total: 10.9s    remaining: 11.3s
490:    learn: 0.2060952        total: 10.9s    remaining: 11.3s
491:    learn: 0.2060836        total: 10.9s    remaining: 11.3s
492:    learn: 0.2060657        total: 11s      remaining: 11.3s
493:    learn: 0.2060444        total: 11s      remaining: 11.3s
494:    learn: 0.2060242        total: 11s      remaining: 11.2s
495:    learn: 0.2060003        total: 11s      remaining: 11.2s
496:    learn: 0.2059874        total: 11.1s    remaining: 11.2s
497:    learn: 0.2059636        total: 11.1s    remaining: 11.2s
498:    learn: 0.2059500        total: 11.1s    remaining: 11.1s
499:    learn: 0.2059333        total: 11.1s    remaining: 11.1s
500:    learn: 0.2059226        total: 11.1s    remaining: 11.1s
501:    learn: 0.2059067        total: 11.2s    remaining: 11.1s
502:    learn: 0.2058932        total: 11.2s    remaining: 11.1s
503:    learn: 0.2058901        total: 11.2s    remaining: 11s
504:    learn: 0.2058829        total: 11.2s    remaining: 11s
505:    learn: 0.2058744        total: 11.2s    remaining: 11s
506:    learn: 0.2058625        total: 11.3s    remaining: 11s
507:    learn: 0.2058509        total: 11.3s    remaining: 10.9s
508:    learn: 0.2058340        total: 11.3s    remaining: 10.9s
509:    learn: 0.2058281        total: 11.3s    remaining: 10.9s
510:    learn: 0.2058210        total: 11.4s    remaining: 10.9s
511:    learn: 0.2058001        total: 11.4s    remaining: 10.8s
512:    learn: 0.2057857        total: 11.4s    remaining: 10.8s
513:    learn: 0.2057669        total: 11.4s    remaining: 10.8s
514:    learn: 0.2057507        total: 11.4s    remaining: 10.8s
515:    learn: 0.2057400        total: 11.5s    remaining: 10.8s
516:    learn: 0.2057229        total: 11.5s    remaining: 10.7s
517:    learn: 0.2057160        total: 11.5s    remaining: 10.7s
518:    learn: 0.2057010        total: 11.5s    remaining: 10.7s
519:    learn: 0.2056843        total: 11.6s    remaining: 10.7s
520:    learn: 0.2056743        total: 11.6s    remaining: 10.6s
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521:    learn: 0.2056644        total: 11.6s    remaining: 10.6s
522:    learn: 0.2056531        total: 11.6s    remaining: 10.6s
523:    learn: 0.2056358        total: 11.6s    remaining: 10.6s
524:    learn: 0.2056159        total: 11.7s    remaining: 10.6s
525:    learn: 0.2055928        total: 11.7s    remaining: 10.5s
526:    learn: 0.2055799        total: 11.7s    remaining: 10.5s
527:    learn: 0.2055713        total: 11.7s    remaining: 10.5s
528:    learn: 0.2055577        total: 11.7s    remaining: 10.5s
529:    learn: 0.2055490        total: 11.8s    remaining: 10.4s
530:    learn: 0.2055402        total: 11.8s    remaining: 10.4s
531:    learn: 0.2055253        total: 11.8s    remaining: 10.4s
532:    learn: 0.2055027        total: 11.8s    remaining: 10.4s
533:    learn: 0.2054826        total: 11.9s    remaining: 10.4s
534:    learn: 0.2054712        total: 11.9s    remaining: 10.3s
535:    learn: 0.2054509        total: 11.9s    remaining: 10.3s
536:    learn: 0.2054337        total: 11.9s    remaining: 10.3s
537:    learn: 0.2054224        total: 11.9s    remaining: 10.3s
538:    learn: 0.2054087        total: 12s      remaining: 10.2s
539:    learn: 0.2054017        total: 12s      remaining: 10.2s
540:    learn: 0.2053893        total: 12s      remaining: 10.2s
541:    learn: 0.2053797        total: 12s      remaining: 10.2s
542:    learn: 0.2053625        total: 12.1s    remaining: 10.1s
543:    learn: 0.2053504        total: 12.1s    remaining: 10.1s
544:    learn: 0.2053309        total: 12.1s    remaining: 10.1s
545:    learn: 0.2053145        total: 12.1s    remaining: 10.1s
546:    learn: 0.2052974        total: 12.1s    remaining: 10.1s
547:    learn: 0.2052732        total: 12.2s    remaining: 10s
548:    learn: 0.2052595        total: 12.2s    remaining: 10s
549:    learn: 0.2052488        total: 12.2s    remaining: 9.98s
550:    learn: 0.2052307        total: 12.2s    remaining: 9.96s
551:    learn: 0.2052131        total: 12.2s    remaining: 9.94s
552:    learn: 0.2051956        total: 12.3s    remaining: 9.91s
553:    learn: 0.2051863        total: 12.3s    remaining: 9.89s
554:    learn: 0.2051784        total: 12.3s    remaining: 9.87s
555:    learn: 0.2051687        total: 12.3s    remaining: 9.85s
556:    learn: 0.2051447        total: 12.4s    remaining: 9.83s
557:    learn: 0.2051241        total: 12.4s    remaining: 9.8s
558:    learn: 0.2051158        total: 12.4s    remaining: 9.78s
559:    learn: 0.2050987        total: 12.4s    remaining: 9.76s
560:    learn: 0.2050865        total: 12.4s    remaining: 9.74s
561:    learn: 0.2050750        total: 12.5s    remaining: 9.71s
562:    learn: 0.2050629        total: 12.5s    remaining: 9.69s
563:    learn: 0.2050500        total: 12.5s    remaining: 9.67s
564:    learn: 0.2050302        total: 12.5s    remaining: 9.65s
565:    learn: 0.2050147        total: 12.6s    remaining: 9.63s
566:    learn: 0.2050068        total: 12.6s    remaining: 9.6s
567:    learn: 0.2049895        total: 12.6s    remaining: 9.58s
568:    learn: 0.2049759        total: 12.6s    remaining: 9.56s
```

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569:    learn: 0.2049680        total: 12.6s    remaining: 9.54s
570:    learn: 0.2049535        total: 12.7s    remaining: 9.51s
571:    learn: 0.2049448        total: 12.7s    remaining: 9.49s
572:    learn: 0.2049331        total: 12.7s    remaining: 9.47s
573:    learn: 0.2049303        total: 12.7s    remaining: 9.44s
574:    learn: 0.2049170        total: 12.7s    remaining: 9.42s
575:    learn: 0.2049102        total: 12.8s    remaining: 9.4s
576:    learn: 0.2048945        total: 12.8s    remaining: 9.38s
577:    learn: 0.2048709        total: 12.8s    remaining: 9.36s
578:    learn: 0.2048523        total: 12.8s    remaining: 9.33s
579:    learn: 0.2048414        total: 12.9s    remaining: 9.31s
580:    learn: 0.2048265        total: 12.9s    remaining: 9.29s
581:    learn: 0.2047974        total: 12.9s    remaining: 9.27s
582:    learn: 0.2047822        total: 12.9s    remaining: 9.24s
583:    learn: 0.2047700        total: 12.9s    remaining: 9.22s
584:    learn: 0.2047589        total: 13s      remaining: 9.2s
585:    learn: 0.2047411        total: 13s      remaining: 9.18s
586:    learn: 0.2047363        total: 13s      remaining: 9.15s
587:    learn: 0.2047289        total: 13s      remaining: 9.13s
588:    learn: 0.2047111        total: 13.1s    remaining: 9.11s
589:    learn: 0.2047009        total: 13.1s    remaining: 9.09s
590:    learn: 0.2046878        total: 13.1s    remaining: 9.06s
591:    learn: 0.2046742        total: 13.1s    remaining: 9.04s
592:    learn: 0.2046592        total: 13.1s    remaining: 9.02s
593:    learn: 0.2046467        total: 13.2s    remaining: 9s
594:    learn: 0.2046297        total: 13.2s    remaining: 8.97s
595:    learn: 0.2046091        total: 13.2s    remaining: 8.95s
596:    learn: 0.2046027        total: 13.2s    remaining: 8.93s
597:    learn: 0.2045884        total: 13.2s    remaining: 8.9s
598:    learn: 0.2045796        total: 13.3s    remaining: 8.88s
599:    learn: 0.2045731        total: 13.3s    remaining: 8.86s
600:    learn: 0.2045603        total: 13.3s    remaining: 8.84s
601:    learn: 0.2045485        total: 13.3s    remaining: 8.82s
602:    learn: 0.2045377        total: 13.4s    remaining: 8.79s
603:    learn: 0.2045293        total: 13.4s    remaining: 8.77s
604:    learn: 0.2045136        total: 13.4s    remaining: 8.75s
605:    learn: 0.2045046        total: 13.4s    remaining: 8.72s
606:    learn: 0.2044872        total: 13.4s    remaining: 8.7s
607:    learn: 0.2044796        total: 13.5s    remaining: 8.68s
608:    learn: 0.2044708        total: 13.5s    remaining: 8.66s
609:    learn: 0.2044625        total: 13.5s    remaining: 8.63s
610:    learn: 0.2044577        total: 13.5s    remaining: 8.61s
611:    learn: 0.2044427        total: 13.5s    remaining: 8.59s
612:    learn: 0.2044201        total: 13.6s    remaining: 8.57s
613:    learn: 0.2044069        total: 13.6s    remaining: 8.54s
614:    learn: 0.2043893        total: 13.6s    remaining: 8.52s
615:    learn: 0.2043811        total: 13.6s    remaining: 8.5s
616:    learn: 0.2043682        total: 13.7s    remaining: 8.48s
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617:    learn: 0.2043573        total: 13.7s    remaining: 8.46s
618:    learn: 0.2043448        total: 13.7s    remaining: 8.43s
619:    learn: 0.2043269        total: 13.7s    remaining: 8.41s
620:    learn: 0.2043113        total: 13.7s    remaining: 8.39s
621:    learn: 0.2043060        total: 13.8s    remaining: 8.37s
622:    learn: 0.2042918        total: 13.8s    remaining: 8.34s
623:    learn: 0.2042809        total: 13.8s    remaining: 8.32s
624:    learn: 0.2042718        total: 13.8s    remaining: 8.3s
625:    learn: 0.2042573        total: 13.9s    remaining: 8.28s
626:    learn: 0.2042490        total: 13.9s    remaining: 8.26s
627:    learn: 0.2042378        total: 13.9s    remaining: 8.23s
628:    learn: 0.2042135        total: 13.9s    remaining: 8.21s
629:    learn: 0.2041958        total: 13.9s    remaining: 8.19s
630:    learn: 0.2041792        total: 14s      remaining: 8.17s
631:    learn: 0.2041666        total: 14s      remaining: 8.14s
632:    learn: 0.2041525        total: 14s      remaining: 8.12s
633:    learn: 0.2041319        total: 14s      remaining: 8.1s
634:    learn: 0.2041162        total: 14.1s    remaining: 8.08s
635:    learn: 0.2041000        total: 14.1s    remaining: 8.05s
636:    learn: 0.2040921        total: 14.1s    remaining: 8.03s
637:    learn: 0.2040777        total: 14.1s    remaining: 8.01s
638:    learn: 0.2040626        total: 14.1s    remaining: 7.99s
639:    learn: 0.2040538        total: 14.2s    remaining: 7.97s
640:    learn: 0.2040340        total: 14.2s    remaining: 7.94s
641:    learn: 0.2040256        total: 14.2s    remaining: 7.92s
642:    learn: 0.2040161        total: 14.2s    remaining: 7.9s
643:    learn: 0.2040061        total: 14.2s    remaining: 7.88s
644:    learn: 0.2039856        total: 14.3s    remaining: 7.85s
645:    learn: 0.2039767        total: 14.3s    remaining: 7.83s
646:    learn: 0.2039625        total: 14.3s    remaining: 7.81s
647:    learn: 0.2039582        total: 14.3s    remaining: 7.79s
648:    learn: 0.2039448        total: 14.4s    remaining: 7.76s
649:    learn: 0.2039254        total: 14.4s    remaining: 7.74s
650:    learn: 0.2039155        total: 14.4s    remaining: 7.72s
651:    learn: 0.2038976        total: 14.4s    remaining: 7.69s
652:    learn: 0.2038877        total: 14.4s    remaining: 7.67s
653:    learn: 0.2038774        total: 14.5s    remaining: 7.65s
654:    learn: 0.2038640        total: 14.5s    remaining: 7.63s
655:    learn: 0.2038532        total: 14.5s    remaining: 7.6s
656:    learn: 0.2038410        total: 14.5s    remaining: 7.58s
657:    learn: 0.2038281        total: 14.5s    remaining: 7.56s
658:    learn: 0.2038201        total: 14.6s    remaining: 7.54s
659:    learn: 0.2038014        total: 14.6s    remaining: 7.51s
660:    learn: 0.2037874        total: 14.6s    remaining: 7.49s
661:    learn: 0.2037722        total: 14.6s    remaining: 7.47s
662:    learn: 0.2037567        total: 14.7s    remaining: 7.45s
663:    learn: 0.2037393        total: 14.7s    remaining: 7.42s
664:    learn: 0.2037245        total: 14.7s    remaining: 7.4s
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665:    learn: 0.2037056        total: 14.7s    remaining: 7.38s
666:    learn: 0.2036902        total: 14.7s    remaining: 7.36s
667:    learn: 0.2036797        total: 14.8s    remaining: 7.33s
668:    learn: 0.2036628        total: 14.8s    remaining: 7.31s
669:    learn: 0.2036481        total: 14.8s    remaining: 7.29s
670:    learn: 0.2036328        total: 14.8s    remaining: 7.27s
671:    learn: 0.2036157        total: 14.8s    remaining: 7.25s
672:    learn: 0.2036109        total: 14.9s    remaining: 7.22s
673:    learn: 0.2035901        total: 14.9s    remaining: 7.2s
674:    learn: 0.2035798        total: 14.9s    remaining: 7.18s
675:    learn: 0.2035698        total: 14.9s    remaining: 7.16s
676:    learn: 0.2035510        total: 15s      remaining: 7.13s
677:    learn: 0.2035407        total: 15s      remaining: 7.11s
678:    learn: 0.2035301        total: 15s      remaining: 7.09s
679:    learn: 0.2035161        total: 15s      remaining: 7.07s
680:    learn: 0.2035035        total: 15s      remaining: 7.04s
681:    learn: 0.2034886        total: 15.1s    remaining: 7.02s
682:    learn: 0.2034760        total: 15.1s    remaining: 7s
683:    learn: 0.2034626        total: 15.1s    remaining: 6.98s
684:    learn: 0.2034533        total: 15.1s    remaining: 6.95s
685:    learn: 0.2034512        total: 15.1s    remaining: 6.93s
686:    learn: 0.2034374        total: 15.2s    remaining: 6.91s
687:    learn: 0.2034258        total: 15.2s    remaining: 6.89s
688:    learn: 0.2034120        total: 15.2s    remaining: 6.86s
689:    learn: 0.2034021        total: 15.2s    remaining: 6.84s
690:    learn: 0.2033804        total: 15.2s    remaining: 6.82s
691:    learn: 0.2033678        total: 15.3s    remaining: 6.8s
692:    learn: 0.2033568        total: 15.3s    remaining: 6.77s
693:    learn: 0.2033438        total: 15.3s    remaining: 6.75s
694:    learn: 0.2033268        total: 15.3s    remaining: 6.73s
695:    learn: 0.2033090        total: 15.4s    remaining: 6.71s
696:    learn: 0.2032891        total: 15.4s    remaining: 6.69s
697:    learn: 0.2032777        total: 15.4s    remaining: 6.66s
698:    learn: 0.2032612        total: 15.4s    remaining: 6.64s
699:    learn: 0.2032549        total: 15.4s    remaining: 6.62s
700:    learn: 0.2032394        total: 15.5s    remaining: 6.6s
701:    learn: 0.2032215        total: 15.5s    remaining: 6.58s
702:    learn: 0.2032096        total: 15.5s    remaining: 6.55s
703:    learn: 0.2031986        total: 15.5s    remaining: 6.53s
704:    learn: 0.2031841        total: 15.6s    remaining: 6.51s
705:    learn: 0.2031698        total: 15.6s    remaining: 6.49s
706:    learn: 0.2031585        total: 15.6s    remaining: 6.46s
707:    learn: 0.2031288        total: 15.6s    remaining: 6.44s
708:    learn: 0.2031198        total: 15.6s    remaining: 6.42s
709:    learn: 0.2031065        total: 15.7s    remaining: 6.4s
710:    learn: 0.2030786        total: 15.7s    remaining: 6.37s
711:    learn: 0.2030640        total: 15.7s    remaining: 6.35s
712:    learn: 0.2030392        total: 15.7s    remaining: 6.33s
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713:    learn: 0.2030258        total: 15.7s    remaining: 6.31s
714:    learn: 0.2030209        total: 15.8s    remaining: 6.29s
715:    learn: 0.2030063        total: 15.8s    remaining: 6.26s
716:    learn: 0.2029899        total: 15.8s    remaining: 6.24s
717:    learn: 0.2029692        total: 15.8s    remaining: 6.22s
718:    learn: 0.2029535        total: 15.9s    remaining: 6.2s
719:    learn: 0.2029434        total: 15.9s    remaining: 6.17s
720:    learn: 0.2029356        total: 15.9s    remaining: 6.15s
721:    learn: 0.2029171        total: 15.9s    remaining: 6.13s
722:    learn: 0.2029067        total: 15.9s    remaining: 6.11s
723:    learn: 0.2029049        total: 16s      remaining: 6.09s
724:    learn: 0.2028831        total: 16s      remaining: 6.06s
725:    learn: 0.2028740        total: 16s      remaining: 6.04s
726:    learn: 0.2028666        total: 16s      remaining: 6.02s
727:    learn: 0.2028545        total: 16.1s    remaining: 6s
728:    learn: 0.2028465        total: 16.1s    remaining: 5.97s
729:    learn: 0.2028292        total: 16.1s    remaining: 5.95s
730:    learn: 0.2028222        total: 16.1s    remaining: 5.93s
731:    learn: 0.2028122        total: 16.1s    remaining: 5.91s
732:    learn: 0.2028013        total: 16.2s    remaining: 5.89s
733:    learn: 0.2027878        total: 16.2s    remaining: 5.86s
734:    learn: 0.2027720        total: 16.2s    remaining: 5.84s
735:    learn: 0.2027556        total: 16.2s    remaining: 5.82s
736:    learn: 0.2027333        total: 16.2s    remaining: 5.8s
737:    learn: 0.2027276        total: 16.3s    remaining: 5.77s
738:    learn: 0.2027056        total: 16.3s    remaining: 5.75s
739:    learn: 0.2026937        total: 16.3s    remaining: 5.73s
740:    learn: 0.2026744        total: 16.3s    remaining: 5.71s
741:    learn: 0.2026634        total: 16.4s    remaining: 5.69s
742:    learn: 0.2026419        total: 16.4s    remaining: 5.66s
743:    learn: 0.2026293        total: 16.4s    remaining: 5.64s
744:    learn: 0.2026183        total: 16.4s    remaining: 5.62s
745:    learn: 0.2026092        total: 16.4s    remaining: 5.6s
746:    learn: 0.2026030        total: 16.5s    remaining: 5.58s
747:    learn: 0.2025887        total: 16.5s    remaining: 5.55s
748:    learn: 0.2025782        total: 16.5s    remaining: 5.53s
749:    learn: 0.2025647        total: 16.5s    remaining: 5.51s
750:    learn: 0.2025510        total: 16.5s    remaining: 5.49s
751:    learn: 0.2025347        total: 16.6s    remaining: 5.46s
752:    learn: 0.2025234        total: 16.6s    remaining: 5.44s
753:    learn: 0.2025118        total: 16.6s    remaining: 5.42s
754:    learn: 0.2025061        total: 16.6s    remaining: 5.4s
755:    learn: 0.2024955        total: 16.7s    remaining: 5.38s
756:    learn: 0.2024832        total: 16.7s    remaining: 5.35s
757:    learn: 0.2024630        total: 16.7s    remaining: 5.33s
758:    learn: 0.2024420        total: 16.7s    remaining: 5.31s
759:    learn: 0.2024330        total: 16.7s    remaining: 5.29s
760:    learn: 0.2024206        total: 16.8s    remaining: 5.26s
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761:    learn: 0.2024090        total: 16.8s    remaining: 5.24s
762:    learn: 0.2023890        total: 16.8s    remaining: 5.22s
763:    learn: 0.2023832        total: 16.8s    remaining: 5.2s
764:    learn: 0.2023799        total: 16.9s    remaining: 5.18s
765:    learn: 0.2023645        total: 16.9s    remaining: 5.16s
766:    learn: 0.2023476        total: 16.9s    remaining: 5.13s
767:    learn: 0.2023398        total: 16.9s    remaining: 5.11s
768:    learn: 0.2023334        total: 16.9s    remaining: 5.09s
769:    learn: 0.2023206        total: 17s      remaining: 5.07s
770:    learn: 0.2023074        total: 17s      remaining: 5.04s
771:    learn: 0.2022966        total: 17s      remaining: 5.02s
772:    learn: 0.2022769        total: 17s      remaining: 5s
773:    learn: 0.2022641        total: 17.1s    remaining: 4.98s
774:    learn: 0.2022459        total: 17.1s    remaining: 4.96s
775:    learn: 0.2022311        total: 17.1s    remaining: 4.94s
776:    learn: 0.2022132        total: 17.1s    remaining: 4.91s
777:    learn: 0.2021990        total: 17.1s    remaining: 4.89s
778:    learn: 0.2021769        total: 17.2s    remaining: 4.87s
779:    learn: 0.2021657        total: 17.2s    remaining: 4.85s
780:    learn: 0.2021545        total: 17.2s    remaining: 4.83s
781:    learn: 0.2021384        total: 17.2s    remaining: 4.8s
782:    learn: 0.2021269        total: 17.3s    remaining: 4.78s
783:    learn: 0.2021127        total: 17.3s    remaining: 4.76s
784:    learn: 0.2021054        total: 17.3s    remaining: 4.74s
785:    learn: 0.2020974        total: 17.3s    remaining: 4.71s
786:    learn: 0.2020871        total: 17.3s    remaining: 4.69s
787:    learn: 0.2020781        total: 17.4s    remaining: 4.67s
788:    learn: 0.2020589        total: 17.4s    remaining: 4.65s
789:    learn: 0.2020493        total: 17.4s    remaining: 4.63s
790:    learn: 0.2020315        total: 17.4s    remaining: 4.61s
791:    learn: 0.2020157        total: 17.5s    remaining: 4.58s
792:    learn: 0.2020044        total: 17.5s    remaining: 4.56s
793:    learn: 0.2019861        total: 17.5s    remaining: 4.54s
794:    learn: 0.2019734        total: 17.5s    remaining: 4.52s
795:    learn: 0.2019625        total: 17.5s    remaining: 4.5s
796:    learn: 0.2019518        total: 17.6s    remaining: 4.47s
797:    learn: 0.2019314        total: 17.6s    remaining: 4.45s
798:    learn: 0.2019137        total: 17.6s    remaining: 4.43s
799:    learn: 0.2018997        total: 17.6s    remaining: 4.41s
800:    learn: 0.2018855        total: 17.7s    remaining: 4.38s
801:    learn: 0.2018749        total: 17.7s    remaining: 4.36s
802:    learn: 0.2018648        total: 17.7s    remaining: 4.34s
803:    learn: 0.2018518        total: 17.7s    remaining: 4.32s
804:    learn: 0.2018381        total: 17.7s    remaining: 4.3s
805:    learn: 0.2018244        total: 17.8s    remaining: 4.27s
806:    learn: 0.2018131        total: 17.8s    remaining: 4.25s
807:    learn: 0.2017986        total: 17.8s    remaining: 4.23s
808:    learn: 0.2017877        total: 17.8s    remaining: 4.21s
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809:    learn: 0.2017689        total: 17.9s    remaining: 4.19s
810:    learn: 0.2017576        total: 17.9s    remaining: 4.17s
811:    learn: 0.2017487        total: 17.9s    remaining: 4.14s
812:    learn: 0.2017299        total: 17.9s    remaining: 4.12s
813:    learn: 0.2017173        total: 17.9s    remaining: 4.1s
814:    learn: 0.2016955        total: 18s      remaining: 4.08s
815:    learn: 0.2016851        total: 18s      remaining: 4.05s
816:    learn: 0.2016750        total: 18s      remaining: 4.03s
817:    learn: 0.2016594        total: 18s      remaining: 4.01s
818:    learn: 0.2016459        total: 18s      remaining: 3.99s
819:    learn: 0.2016403        total: 18.1s    remaining: 3.97s
820:    learn: 0.2016266        total: 18.1s    remaining: 3.94s
821:    learn: 0.2016120        total: 18.1s    remaining: 3.92s
822:    learn: 0.2015910        total: 18.1s    remaining: 3.9s
823:    learn: 0.2015838        total: 18.2s    remaining: 3.88s
824:    learn: 0.2015765        total: 18.2s    remaining: 3.85s
825:    learn: 0.2015676        total: 18.2s    remaining: 3.83s
826:    learn: 0.2015438        total: 18.2s    remaining: 3.81s
827:    learn: 0.2015291        total: 18.2s    remaining: 3.79s
828:    learn: 0.2015176        total: 18.3s    remaining: 3.77s
829:    learn: 0.2015001        total: 18.3s    remaining: 3.74s
830:    learn: 0.2014910        total: 18.3s    remaining: 3.72s
831:    learn: 0.2014818        total: 18.3s    remaining: 3.7s
832:    learn: 0.2014709        total: 18.4s    remaining: 3.68s
833:    learn: 0.2014601        total: 18.4s    remaining: 3.66s
834:    learn: 0.2014489        total: 18.4s    remaining: 3.63s
835:    learn: 0.2014373        total: 18.4s    remaining: 3.61s
836:    learn: 0.2014317        total: 18.4s    remaining: 3.59s
837:    learn: 0.2014274        total: 18.5s    remaining: 3.57s
838:    learn: 0.2014171        total: 18.5s    remaining: 3.55s
839:    learn: 0.2014043        total: 18.5s    remaining: 3.52s
840:    learn: 0.2013901        total: 18.5s    remaining: 3.5s
841:    learn: 0.2013723        total: 18.5s    remaining: 3.48s
842:    learn: 0.2013658        total: 18.6s    remaining: 3.46s
843:    learn: 0.2013547        total: 18.6s    remaining: 3.44s
844:    learn: 0.2013439        total: 18.6s    remaining: 3.41s
845:    learn: 0.2013260        total: 18.6s    remaining: 3.39s
846:    learn: 0.2013145        total: 18.7s    remaining: 3.37s
847:    learn: 0.2013058        total: 18.7s    remaining: 3.35s
848:    learn: 0.2012959        total: 18.7s    remaining: 3.33s
849:    learn: 0.2012831        total: 18.7s    remaining: 3.3s
850:    learn: 0.2012710        total: 18.7s    remaining: 3.28s
851:    learn: 0.2012494        total: 18.8s    remaining: 3.26s
852:    learn: 0.2012357        total: 18.8s    remaining: 3.24s
853:    learn: 0.2012234        total: 18.8s    remaining: 3.21s
854:    learn: 0.2012167        total: 18.8s    remaining: 3.19s
855:    learn: 0.2011996        total: 18.9s    remaining: 3.17s
856:    learn: 0.2011935        total: 18.9s    remaining: 3.15s
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857:    learn: 0.2011781        total: 18.9s    remaining: 3.13s
858:    learn: 0.2011691        total: 18.9s    remaining: 3.1s
859:    learn: 0.2011527        total: 18.9s    remaining: 3.08s
860:    learn: 0.2011391        total: 19s      remaining: 3.06s
861:    learn: 0.2011315        total: 19s      remaining: 3.04s
862:    learn: 0.2011206        total: 19s      remaining: 3.02s
863:    learn: 0.2011158        total: 19s      remaining: 2.99s
864:    learn: 0.2010947        total: 19s      remaining: 2.97s
865:    learn: 0.2010739        total: 19.1s    remaining: 2.95s
866:    learn: 0.2010556        total: 19.1s    remaining: 2.93s
867:    learn: 0.2010422        total: 19.1s    remaining: 2.91s
868:    learn: 0.2010266        total: 19.1s    remaining: 2.88s
869:    learn: 0.2010141        total: 19.2s    remaining: 2.86s
870:    learn: 0.2010049        total: 19.2s    remaining: 2.84s
871:    learn: 0.2009891        total: 19.2s    remaining: 2.82s
872:    learn: 0.2009828        total: 19.2s    remaining: 2.79s
873:    learn: 0.2009702        total: 19.2s    remaining: 2.77s
874:    learn: 0.2009599        total: 19.3s    remaining: 2.75s
875:    learn: 0.2009524        total: 19.3s    remaining: 2.73s
876:    learn: 0.2009467        total: 19.3s    remaining: 2.71s
877:    learn: 0.2009350        total: 19.3s    remaining: 2.69s
878:    learn: 0.2009236        total: 19.3s    remaining: 2.66s
879:    learn: 0.2009150        total: 19.4s    remaining: 2.64s
880:    learn: 0.2009051        total: 19.4s    remaining: 2.62s
881:    learn: 0.2008950        total: 19.4s    remaining: 2.6s
882:    learn: 0.2008897        total: 19.4s    remaining: 2.58s
883:    learn: 0.2008733        total: 19.5s    remaining: 2.55s
884:    learn: 0.2008600        total: 19.5s    remaining: 2.53s
885:    learn: 0.2008544        total: 19.5s    remaining: 2.51s
886:    learn: 0.2008438        total: 19.5s    remaining: 2.49s
887:    learn: 0.2008347        total: 19.5s    remaining: 2.46s
888:    learn: 0.2008207        total: 19.6s    remaining: 2.44s
889:    learn: 0.2008111        total: 19.6s    remaining: 2.42s
890:    learn: 0.2007979        total: 19.6s    remaining: 2.4s
891:    learn: 0.2007819        total: 19.6s    remaining: 2.38s
892:    learn: 0.2007746        total: 19.7s    remaining: 2.35s
893:    learn: 0.2007562        total: 19.7s    remaining: 2.33s
894:    learn: 0.2007401        total: 19.7s    remaining: 2.31s
895:    learn: 0.2007305        total: 19.7s    remaining: 2.29s
896:    learn: 0.2007158        total: 19.8s    remaining: 2.27s
897:    learn: 0.2007104        total: 19.8s    remaining: 2.25s
898:    learn: 0.2007056        total: 19.8s    remaining: 2.22s
899:    learn: 0.2007023        total: 19.8s    remaining: 2.2s
900:    learn: 0.2006903        total: 19.8s    remaining: 2.18s
901:    learn: 0.2006829        total: 19.9s    remaining: 2.16s
902:    learn: 0.2006757        total: 19.9s    remaining: 2.13s
903:    learn: 0.2006688        total: 19.9s    remaining: 2.11s
904:    learn: 0.2006608        total: 19.9s    remaining: 2.09s
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905:    learn: 0.2006519        total: 19.9s    remaining: 2.07s
906:    learn: 0.2006271        total: 20s      remaining: 2.05s
907:    learn: 0.2006219        total: 20s      remaining: 2.02s
908:    learn: 0.2006120        total: 20s      remaining: 2s
909:    learn: 0.2006018        total: 20s      remaining: 1.98s
910:    learn: 0.2005880        total: 20.1s    remaining: 1.96s
911:    learn: 0.2005727        total: 20.1s    remaining: 1.94s
912:    learn: 0.2005586        total: 20.1s    remaining: 1.92s
913:    learn: 0.2005433        total: 20.1s    remaining: 1.89s
914:    learn: 0.2005315        total: 20.1s    remaining: 1.87s
915:    learn: 0.2005276        total: 20.2s    remaining: 1.85s
916:    learn: 0.2005141        total: 20.2s    remaining: 1.83s
917:    learn: 0.2005098        total: 20.2s    remaining: 1.8s
918:    learn: 0.2004961        total: 20.2s    remaining: 1.78s
919:    learn: 0.2004812        total: 20.3s    remaining: 1.76s
920:    learn: 0.2004752        total: 20.3s    remaining: 1.74s
921:    learn: 0.2004597        total: 20.3s    remaining: 1.72s
922:    learn: 0.2004490        total: 20.3s    remaining: 1.69s
923:    learn: 0.2004427        total: 20.3s    remaining: 1.67s
924:    learn: 0.2004300        total: 20.4s    remaining: 1.65s
925:    learn: 0.2004136        total: 20.4s    remaining: 1.63s
926:    learn: 0.2004031        total: 20.4s    remaining: 1.61s
927:    learn: 0.2003974        total: 20.4s    remaining: 1.58s
928:    learn: 0.2003808        total: 20.5s    remaining: 1.56s
929:    learn: 0.2003663        total: 20.5s    remaining: 1.54s
930:    learn: 0.2003598        total: 20.5s    remaining: 1.52s
931:    learn: 0.2003506        total: 20.5s    remaining: 1.5s
932:    learn: 0.2003435        total: 20.5s    remaining: 1.47s
933:    learn: 0.2003332        total: 20.6s    remaining: 1.45s
934:    learn: 0.2003169        total: 20.6s    remaining: 1.43s
935:    learn: 0.2003122        total: 20.6s    remaining: 1.41s
936:    learn: 0.2003005        total: 20.6s    remaining: 1.39s
937:    learn: 0.2002881        total: 20.6s    remaining: 1.36s
938:    learn: 0.2002819        total: 20.7s    remaining: 1.34s
939:    learn: 0.2002695        total: 20.7s    remaining: 1.32s
940:    learn: 0.2002512        total: 20.7s    remaining: 1.3s
941:    learn: 0.2002426        total: 20.7s    remaining: 1.28s
942:    learn: 0.2002390        total: 20.8s    remaining: 1.25s
943:    learn: 0.2002245        total: 20.8s    remaining: 1.23s
944:    learn: 0.2002089        total: 20.8s    remaining: 1.21s
945:    learn: 0.2001853        total: 20.8s    remaining: 1.19s
946:    learn: 0.2001688        total: 20.8s    remaining: 1.17s
947:    learn: 0.2001532        total: 20.9s    remaining: 1.14s
948:    learn: 0.2001479        total: 20.9s    remaining: 1.12s
949:    learn: 0.2001256        total: 20.9s    remaining: 1.1s
950:    learn: 0.2001101        total: 20.9s    remaining: 1.08s
951:    learn: 0.2000965        total: 21s      remaining: 1.06s
952:    learn: 0.2000837        total: 21s      remaining: 1.03s
```
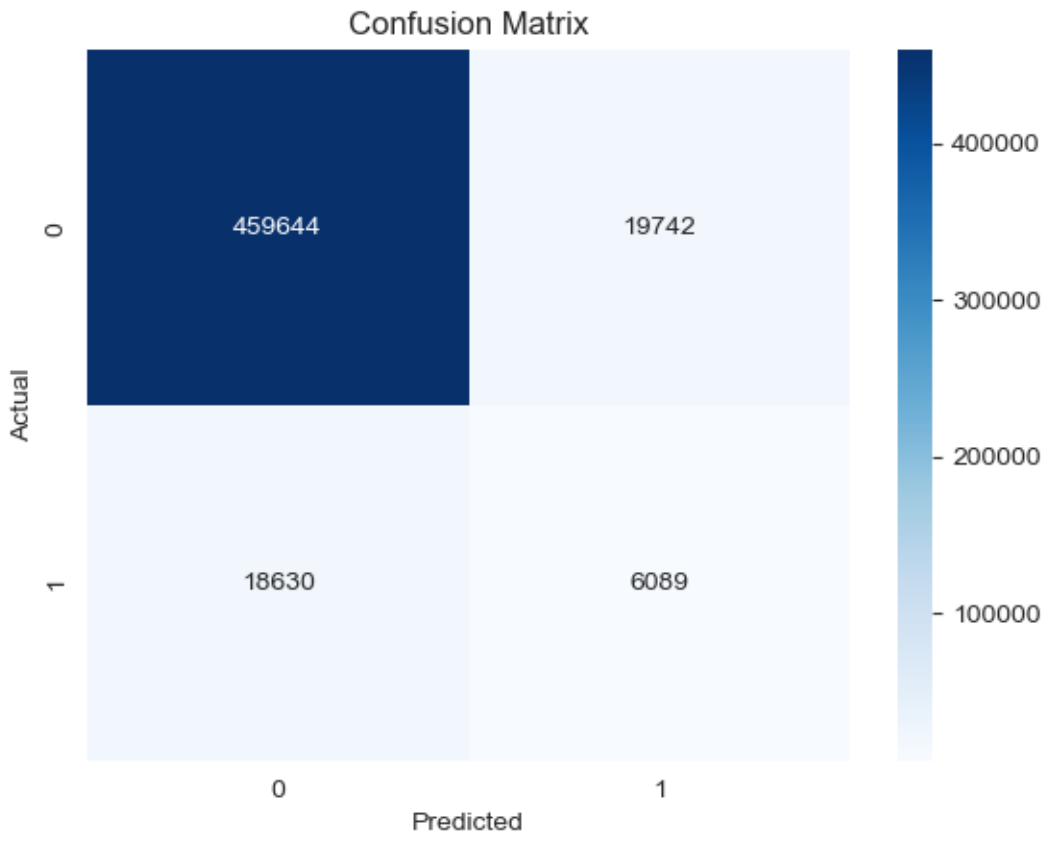
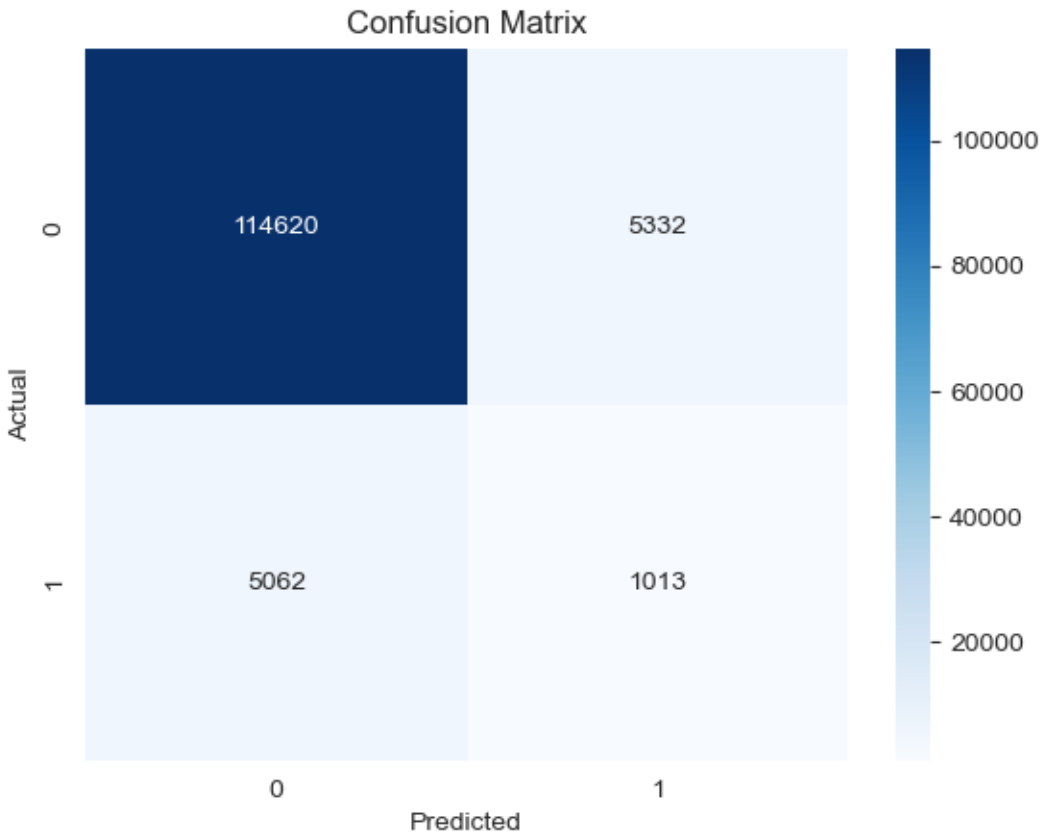

```
953:    learn: 0.2000711        total: 21s      remaining: 1.01s
954:    learn: 0.2000622        total: 21s      remaining: 990ms
955:    learn: 0.2000482        total: 21s      remaining: 968ms
956:    learn: 0.2000409        total: 21.1s    remaining: 946ms
957:    learn: 0.2000266        total: 21.1s    remaining: 924ms
958:    learn: 0.2000110        total: 21.1s    remaining: 903ms
959:    learn: 0.1999952        total: 21.1s    remaining: 881ms
960:    learn: 0.1999729        total: 21.2s    remaining: 859ms
961:    learn: 0.1999629        total: 21.2s    remaining: 836ms
962:    learn: 0.1999552        total: 21.2s    remaining: 814ms
963:    learn: 0.1999482        total: 21.2s    remaining: 792ms
964:    learn: 0.1999243        total: 21.2s    remaining: 770ms
965:    learn: 0.1999215        total: 21.3s    remaining: 748ms
966:    learn: 0.1999169        total: 21.3s    remaining: 726ms
967:    learn: 0.1999106        total: 21.3s    remaining: 704ms
968:    learn: 0.1999041        total: 21.3s    remaining: 682ms
969:    learn: 0.1998837        total: 21.3s    remaining: 660ms
970:    learn: 0.1998711        total: 21.4s    remaining: 638ms
971:    learn: 0.1998613        total: 21.4s    remaining: 616ms
972:    learn: 0.1998535        total: 21.4s    remaining: 594ms
973:    learn: 0.1998485        total: 21.4s    remaining: 572ms
974:    learn: 0.1998362        total: 21.5s    remaining: 550ms
975:    learn: 0.1998242        total: 21.5s    remaining: 528ms
976:    learn: 0.1998108        total: 21.5s    remaining: 506ms
977:    learn: 0.1998000        total: 21.5s    remaining: 484ms
978:    learn: 0.1997860        total: 21.6s    remaining: 462ms
979:    learn: 0.1997770        total: 21.6s    remaining: 440ms
980:    learn: 0.1997664        total: 21.6s    remaining: 418ms
981:    learn: 0.1997523        total: 21.6s    remaining: 396ms
982:    learn: 0.1997380        total: 21.6s    remaining: 374ms
983:    learn: 0.1997315        total: 21.7s    remaining: 352ms
984:    learn: 0.1997191        total: 21.7s    remaining: 330ms
985:    learn: 0.1997119        total: 21.7s    remaining: 308ms
986:    learn: 0.1996951        total: 21.7s    remaining: 286ms
987:    learn: 0.1996867        total: 21.7s    remaining: 264ms
988:    learn: 0.1996766        total: 21.8s    remaining: 242ms
989:    learn: 0.1996674        total: 21.8s    remaining: 220ms
990:    learn: 0.1996565        total: 21.8s    remaining: 198ms
991:    learn: 0.1996488        total: 21.8s    remaining: 176ms
992:    learn: 0.1996462        total: 21.9s    remaining: 154ms
993:    learn: 0.1996344        total: 21.9s    remaining: 132ms
994:    learn: 0.1996278        total: 21.9s    remaining: 110ms
995:    learn: 0.1996201        total: 21.9s    remaining: 88.1ms
996:    learn: 0.1996087        total: 22s      remaining: 66.1ms
997:    learn: 0.1995947        total: 22s      remaining: 44ms
998:    learn: 0.1995893        total: 22s      remaining: 22ms
999:    learn: 0.1995649        total: 22s      remaining: 0us
TRAIN-SET SCORING
```

```
ROC-AUC score: 0.727224435753538
F1-score:  0.24090999010880315
Accuracy: 0.9238809375030995
Recall: 0.24632873498118857
Precision: 0.2357245170531532
```




```
TEST-SET SCORING
ROC-AUC score: 0.6536855139861156
F1-score:  0.16312399355877616
Accuracy: 0.9175256095915955
Recall: 0.16674897119341564
Precision: 0.15965327029156817
```



[39]:
```
# model = CatBoostClassifier(random_state=123)
#
# search = BayesSearchCV(
#     estimator=model,
#     search_spaces={
#         'depth': (2, 15),
#         'learning_rate': (0.01, 0.2, 'log-uniform'),
#         'l2_leaf_reg': (1, 30),
#         'iterations': (100, 1000),
#         'bagging_temperature':(0,1),
#         'random_strength':(0,10)
#     },
#     scoring='roc_auc',
#     n_iter=50,
#     cv=3,
#     n_jobs=-1,
# )
#
# search.fit(X_train_val, y_train_val)
# print("Best params:", search.best_params_)
```

- after 25 iterations Best params: OrderedDict([('bagging_temperature', 1), ('depth', 8), ('iterations', 661), ('l2_leaf_reg', 8), ('learning_rate', 0.055324002607054404), ('random_strength', 0)])
- – after 50 Best params: OrderedDict([('bagging_temperature', 1), ('depth', 9), ('iterations', 1000), ('l2_leaf_reg', 30), ('learning_rate', 0.04114929872310554), ('random_strength', 6)])

[40]:
```
model = CatBoostClassifier(
    bagging_temperature=1,
    depth=9,
    iterations=1000,
    l2_leaf_reg=30,
    learning_rate=0.0411,
    random_strength=6
)
model.fit(X_train_val, y_train_val,sample_weight=exposure_train_val)
```

```
0:      learn: 0.6443211        total: 33.3ms   remaining: 33.3s
1:      learn: 0.6004508        total: 63.9ms   remaining: 31.9s
2:      learn: 0.5612470        total: 93.9ms   remaining: 31.2s
3:      learn: 0.5264801        total: 115ms    remaining: 28.6s
4:      learn: 0.4953951        total: 148ms    remaining: 29.5s
5:      learn: 0.4674723        total: 178ms    remaining: 29.5s
6:      learn: 0.4423572        total: 203ms    remaining: 28.8s
7:      learn: 0.4201514        total: 233ms    remaining: 28.9s
8:      learn: 0.4002230        total: 264ms    remaining: 29s
9:      learn: 0.3822781        total: 295ms    remaining: 29.2s
10:     learn: 0.3658688        total: 325ms    remaining: 29.3s
11:     learn: 0.3517220        total: 347ms    remaining: 28.5s
12:     learn: 0.3390683        total: 388ms    remaining: 29.4s
13:     learn: 0.3275759        total: 420ms    remaining: 29.6s
14:     learn: 0.3172607        total: 444ms    remaining: 29.1s
15:     learn: 0.3081285        total: 468ms    remaining: 28.8s
16:     learn: 0.2998245        total: 498ms    remaining: 28.8s
17:     learn: 0.2923740        total: 529ms    remaining: 28.9s
18:     learn: 0.2856986        total: 559ms    remaining: 28.9s
19:     learn: 0.2798037        total: 580ms    remaining: 28.4s
20:     learn: 0.2744330        total: 609ms    remaining: 28.4s
21:     learn: 0.2695689        total: 639ms    remaining: 28.4s
22:     learn: 0.2650407        total: 669ms    remaining: 28.4s
23:     learn: 0.2611222        total: 699ms    remaining: 28.4s
24:     learn: 0.2575776        total: 727ms    remaining: 28.4s
25:     learn: 0.2541796        total: 755ms    remaining: 28.3s
26:     learn: 0.2510491        total: 784ms    remaining: 28.2s
27:     learn: 0.2483815        total: 813ms    remaining: 28.2s
28:     learn: 0.2460316        total: 837ms    remaining: 28s
29:     learn: 0.2438575        total: 865ms    remaining: 28s
30:     learn: 0.2418053        total: 901ms    remaining: 28.2s
```

```
31:     learn: 0.2398462        total: 933ms    remaining: 28.2s
32:     learn: 0.2381924        total: 961ms    remaining: 28.2s
33:     learn: 0.2367237        total: 981ms    remaining: 27.9s
34:     learn: 0.2352401        total: 1.01s    remaining: 27.8s
35:     learn: 0.2339468        total: 1.04s    remaining: 27.8s
36:     learn: 0.2328599        total: 1.06s    remaining: 27.5s
37:     learn: 0.2318693        total: 1.08s    remaining: 27.3s
38:     learn: 0.2308854        total: 1.11s    remaining: 27.3s
39:     learn: 0.2299132        total: 1.13s    remaining: 27.2s
40:     learn: 0.2291545        total: 1.17s    remaining: 27.3s
41:     learn: 0.2283809        total: 1.19s    remaining: 27.2s
42:     learn: 0.2276503        total: 1.22s    remaining: 27.2s
43:     learn: 0.2271013        total: 1.25s    remaining: 27.1s
44:     learn: 0.2266128        total: 1.26s    remaining: 26.9s
45:     learn: 0.2260473        total: 1.29s    remaining: 26.9s
46:     learn: 0.2254456        total: 1.32s    remaining: 26.9s
47:     learn: 0.2250407        total: 1.35s    remaining: 26.7s
48:     learn: 0.2245743        total: 1.38s    remaining: 26.8s
49:     learn: 0.2240484        total: 1.41s    remaining: 26.8s
50:     learn: 0.2237736        total: 1.43s    remaining: 26.6s
51:     learn: 0.2234418        total: 1.46s    remaining: 26.6s
52:     learn: 0.2231888        total: 1.49s    remaining: 26.6s
53:     learn: 0.2229751        total: 1.51s    remaining: 26.4s
54:     learn: 0.2226700        total: 1.53s    remaining: 26.3s
55:     learn: 0.2223709        total: 1.56s    remaining: 26.3s
56:     learn: 0.2220701        total: 1.59s    remaining: 26.3s
57:     learn: 0.2219243        total: 1.61s    remaining: 26.2s
58:     learn: 0.2216156        total: 1.65s    remaining: 26.2s
59:     learn: 0.2214533        total: 1.67s    remaining: 26.1s
60:     learn: 0.2213439        total: 1.69s    remaining: 25.9s
61:     learn: 0.2211642        total: 1.71s    remaining: 25.9s
62:     learn: 0.2209811        total: 1.73s    remaining: 25.8s
63:     learn: 0.2208816        total: 1.76s    remaining: 25.8s
64:     learn: 0.2207531        total: 1.79s    remaining: 25.8s
65:     learn: 0.2205706        total: 1.82s    remaining: 25.8s
66:     learn: 0.2203421        total: 1.86s    remaining: 25.9s
67:     learn: 0.2202031        total: 1.89s    remaining: 25.9s
68:     learn: 0.2199653        total: 1.92s    remaining: 25.9s
69:     learn: 0.2197983        total: 1.95s    remaining: 25.9s
70:     learn: 0.2196894        total: 1.98s    remaining: 25.9s
71:     learn: 0.2195279        total: 2.01s    remaining: 25.9s
72:     learn: 0.2194178        total: 2.04s    remaining: 25.9s
73:     learn: 0.2193860        total: 2.06s    remaining: 25.7s
74:     learn: 0.2191829        total: 2.08s    remaining: 25.7s
75:     learn: 0.2190628        total: 2.12s    remaining: 25.7s
76:     learn: 0.2189931        total: 2.15s    remaining: 25.8s
77:     learn: 0.2189215        total: 2.18s    remaining: 25.8s
78:     learn: 0.2188056        total: 2.21s    remaining: 25.8s
```

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79:     learn: 0.2187476        total: 2.24s    remaining: 25.8s
80:     learn: 0.2187061        total: 2.27s    remaining: 25.8s
81:     learn: 0.2186363        total: 2.29s    remaining: 25.6s
82:     learn: 0.2185264        total: 2.32s    remaining: 25.6s
83:     learn: 0.2185134        total: 2.34s    remaining: 25.5s
84:     learn: 0.2184713        total: 2.37s    remaining: 25.5s
85:     learn: 0.2183629        total: 2.4s     remaining: 25.6s
86:     learn: 0.2182839        total: 2.44s    remaining: 25.6s
87:     learn: 0.2182373        total: 2.47s    remaining: 25.6s
88:     learn: 0.2182117        total: 2.5s     remaining: 25.6s
89:     learn: 0.2181478        total: 2.53s    remaining: 25.5s
90:     learn: 0.2180796        total: 2.56s    remaining: 25.5s
91:     learn: 0.2180291        total: 2.59s    remaining: 25.5s
92:     learn: 0.2179599        total: 2.61s    remaining: 25.5s
93:     learn: 0.2178848        total: 2.65s    remaining: 25.5s
94:     learn: 0.2178071        total: 2.68s    remaining: 25.5s
95:     learn: 0.2177837        total: 2.71s    remaining: 25.5s
96:     learn: 0.2177794        total: 2.72s    remaining: 25.4s
97:     learn: 0.2177379        total: 2.74s    remaining: 25.3s
98:     learn: 0.2176998        total: 2.77s    remaining: 25.2s
99:     learn: 0.2176123        total: 2.8s     remaining: 25.2s
100:    learn: 0.2175380        total: 2.83s    remaining: 25.2s
101:    learn: 0.2175121        total: 2.86s    remaining: 25.2s
102:    learn: 0.2174528        total: 2.89s    remaining: 25.2s
103:    learn: 0.2173922        total: 2.93s    remaining: 25.2s
104:    learn: 0.2173733        total: 2.95s    remaining: 25.2s
105:    learn: 0.2173096        total: 2.98s    remaining: 25.1s
106:    learn: 0.2172498        total: 3.01s    remaining: 25.1s
107:    learn: 0.2172003        total: 3.04s    remaining: 25.1s
108:    learn: 0.2171745        total: 3.07s    remaining: 25.1s
109:    learn: 0.2171534        total: 3.09s    remaining: 25s
110:    learn: 0.2171200        total: 3.12s    remaining: 25s
111:    learn: 0.2170663        total: 3.16s    remaining: 25s
112:    learn: 0.2170202        total: 3.19s    remaining: 25s
113:    learn: 0.2170072        total: 3.21s    remaining: 25s
114:    learn: 0.2169997        total: 3.23s    remaining: 24.9s
115:    learn: 0.2169753        total: 3.26s    remaining: 24.8s
116:    learn: 0.2169394        total: 3.29s    remaining: 24.8s
117:    learn: 0.2168871        total: 3.32s    remaining: 24.8s
118:    learn: 0.2168575        total: 3.36s    remaining: 24.9s
119:    learn: 0.2168345        total: 3.39s    remaining: 24.9s
120:    learn: 0.2167957        total: 3.43s    remaining: 24.9s
121:    learn: 0.2167680        total: 3.46s    remaining: 24.9s
122:    learn: 0.2167017        total: 3.49s    remaining: 24.9s
123:    learn: 0.2166471        total: 3.52s    remaining: 24.9s
124:    learn: 0.2166172        total: 3.55s    remaining: 24.9s
125:    learn: 0.2165613        total: 3.58s    remaining: 24.8s
126:    learn: 0.2165295        total: 3.61s    remaining: 24.8s
```

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127:    learn: 0.2165090        total: 3.65s    remaining: 24.8s
128:    learn: 0.2164667        total: 3.67s    remaining: 24.8s
129:    learn: 0.2164338        total: 3.71s    remaining: 24.8s
130:    learn: 0.2164084        total: 3.73s    remaining: 24.7s
131:    learn: 0.2163529        total: 3.76s    remaining: 24.7s
132:    learn: 0.2163234        total: 3.79s    remaining: 24.7s
133:    learn: 0.2162946        total: 3.82s    remaining: 24.7s
134:    learn: 0.2162743        total: 3.85s    remaining: 24.7s
135:    learn: 0.2162567        total: 3.88s    remaining: 24.7s
136:    learn: 0.2162518        total: 3.9s     remaining: 24.6s
137:    learn: 0.2162295        total: 3.93s    remaining: 24.6s
138:    learn: 0.2162059        total: 3.96s    remaining: 24.6s
139:    learn: 0.2161867        total: 3.98s    remaining: 24.5s
140:    learn: 0.2161418        total: 4.01s    remaining: 24.5s
141:    learn: 0.2161199        total: 4.04s    remaining: 24.4s
142:    learn: 0.2160919        total: 4.08s    remaining: 24.4s
143:    learn: 0.2160835        total: 4.1s     remaining: 24.4s
144:    learn: 0.2160823        total: 4.12s    remaining: 24.3s
145:    learn: 0.2160572        total: 4.15s    remaining: 24.3s
146:    learn: 0.2160469        total: 4.18s    remaining: 24.2s
147:    learn: 0.2160286        total: 4.21s    remaining: 24.2s
148:    learn: 0.2159974        total: 4.24s    remaining: 24.2s
149:    learn: 0.2159888        total: 4.27s    remaining: 24.2s
150:    learn: 0.2159520        total: 4.3s     remaining: 24.2s
151:    learn: 0.2159291        total: 4.33s    remaining: 24.1s
152:    learn: 0.2158820        total: 4.36s    remaining: 24.1s
153:    learn: 0.2158706        total: 4.38s    remaining: 24.1s
154:    learn: 0.2158543        total: 4.42s    remaining: 24.1s
155:    learn: 0.2158251        total: 4.45s    remaining: 24.1s
156:    learn: 0.2158197        total: 4.47s    remaining: 24s
157:    learn: 0.2157969        total: 4.5s     remaining: 24s
158:    learn: 0.2157615        total: 4.54s    remaining: 24s
159:    learn: 0.2157394        total: 4.57s    remaining: 24s
160:    learn: 0.2157241        total: 4.6s     remaining: 24s
161:    learn: 0.2156851        total: 4.62s    remaining: 23.9s
162:    learn: 0.2156641        total: 4.66s    remaining: 23.9s
163:    learn: 0.2156256        total: 4.69s    remaining: 23.9s
164:    learn: 0.2155965        total: 4.72s    remaining: 23.9s
165:    learn: 0.2155846        total: 4.75s    remaining: 23.9s
166:    learn: 0.2155785        total: 4.77s    remaining: 23.8s
167:    learn: 0.2155653        total: 4.8s     remaining: 23.8s
168:    learn: 0.2155548        total: 4.83s    remaining: 23.7s
169:    learn: 0.2155399        total: 4.86s    remaining: 23.7s
170:    learn: 0.2155399        total: 4.87s    remaining: 23.6s
171:    learn: 0.2155125        total: 4.9s     remaining: 23.6s
172:    learn: 0.2154963        total: 4.93s    remaining: 23.6s
173:    learn: 0.2154764        total: 4.96s    remaining: 23.5s
174:    learn: 0.2154536        total: 4.99s    remaining: 23.5s
```

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175:    learn: 0.2154288        total: 5.02s    remaining: 23.5s
176:    learn: 0.2153971        total: 5.05s    remaining: 23.5s
177:    learn: 0.2153636        total: 5.08s    remaining: 23.5s
178:    learn: 0.2153503        total: 5.11s    remaining: 23.4s
179:    learn: 0.2153264        total: 5.14s    remaining: 23.4s
180:    learn: 0.2153064        total: 5.17s    remaining: 23.4s
181:    learn: 0.2152874        total: 5.21s    remaining: 23.4s
182:    learn: 0.2152673        total: 5.23s    remaining: 23.4s
183:    learn: 0.2152574        total: 5.26s    remaining: 23.3s
184:    learn: 0.2152557        total: 5.28s    remaining: 23.3s
185:    learn: 0.2152441        total: 5.31s    remaining: 23.2s
186:    learn: 0.2152140        total: 5.34s    remaining: 23.2s
187:    learn: 0.2151926        total: 5.37s    remaining: 23.2s
188:    learn: 0.2151784        total: 5.4s     remaining: 23.2s
189:    learn: 0.2151558        total: 5.44s    remaining: 23.2s
190:    learn: 0.2151400        total: 5.47s    remaining: 23.2s
191:    learn: 0.2151239        total: 5.5s     remaining: 23.1s
192:    learn: 0.2151065        total: 5.53s    remaining: 23.1s
193:    learn: 0.2150794        total: 5.56s    remaining: 23.1s
194:    learn: 0.2150566        total: 5.59s    remaining: 23.1s
195:    learn: 0.2150453        total: 5.62s    remaining: 23.1s
196:    learn: 0.2150396        total: 5.65s    remaining: 23s
197:    learn: 0.2150394        total: 5.67s    remaining: 23s
198:    learn: 0.2150241        total: 5.7s     remaining: 22.9s
199:    learn: 0.2149992        total: 5.73s    remaining: 22.9s
200:    learn: 0.2149831        total: 5.76s    remaining: 22.9s
201:    learn: 0.2149705        total: 5.79s    remaining: 22.9s
202:    learn: 0.2149667        total: 5.81s    remaining: 22.8s
203:    learn: 0.2149608        total: 5.83s    remaining: 22.8s
204:    learn: 0.2149423        total: 5.87s    remaining: 22.7s
205:    learn: 0.2149317        total: 5.89s    remaining: 22.7s
206:    learn: 0.2149075        total: 5.93s    remaining: 22.7s
207:    learn: 0.2148980        total: 5.96s    remaining: 22.7s
208:    learn: 0.2148797        total: 5.99s    remaining: 22.7s
209:    learn: 0.2148771        total: 6s       remaining: 22.6s
210:    learn: 0.2148703        total: 6.04s    remaining: 22.6s
211:    learn: 0.2148460        total: 6.07s    remaining: 22.5s
212:    learn: 0.2148317        total: 6.09s    remaining: 22.5s
213:    learn: 0.2148231        total: 6.12s    remaining: 22.5s
214:    learn: 0.2148051        total: 6.15s    remaining: 22.5s
215:    learn: 0.2147860        total: 6.19s    remaining: 22.5s
216:    learn: 0.2147767        total: 6.22s    remaining: 22.4s
217:    learn: 0.2147694        total: 6.25s    remaining: 22.4s
218:    learn: 0.2147444        total: 6.28s    remaining: 22.4s
219:    learn: 0.2147317        total: 6.31s    remaining: 22.4s
220:    learn: 0.2147308        total: 6.33s    remaining: 22.3s
221:    learn: 0.2147174        total: 6.36s    remaining: 22.3s
222:    learn: 0.2147027        total: 6.39s    remaining: 22.3s
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223:    learn: 0.2146872        total: 6.42s    remaining: 22.2s
224:    learn: 0.2146784        total: 6.45s    remaining: 22.2s
225:    learn: 0.2146593        total: 6.48s    remaining: 22.2s
226:    learn: 0.2146483        total: 6.52s    remaining: 22.2s
227:    learn: 0.2146441        total: 6.54s    remaining: 22.1s
228:    learn: 0.2146197        total: 6.57s    remaining: 22.1s
229:    learn: 0.2146133        total: 6.6s     remaining: 22.1s
230:    learn: 0.2146081        total: 6.63s    remaining: 22.1s
231:    learn: 0.2145993        total: 6.66s    remaining: 22s
232:    learn: 0.2145777        total: 6.69s    remaining: 22s
233:    learn: 0.2145623        total: 6.72s    remaining: 22s
234:    learn: 0.2145352        total: 6.75s    remaining: 22s
235:    learn: 0.2144977        total: 6.78s    remaining: 22s
236:    learn: 0.2144886        total: 6.81s    remaining: 21.9s
237:    learn: 0.2144886        total: 6.83s    remaining: 21.9s
238:    learn: 0.2144758        total: 6.86s    remaining: 21.8s
239:    learn: 0.2144546        total: 6.89s    remaining: 21.8s
240:    learn: 0.2144415        total: 6.92s    remaining: 21.8s
241:    learn: 0.2144254        total: 6.95s    remaining: 21.8s
242:    learn: 0.2144161        total: 6.98s    remaining: 21.7s
243:    learn: 0.2143903        total: 7.01s    remaining: 21.7s
244:    learn: 0.2143810        total: 7.04s    remaining: 21.7s
245:    learn: 0.2143583        total: 7.07s    remaining: 21.7s
246:    learn: 0.2143219        total: 7.1s     remaining: 21.7s
247:    learn: 0.2143156        total: 7.13s    remaining: 21.6s
248:    learn: 0.2143031        total: 7.17s    remaining: 21.6s
249:    learn: 0.2142810        total: 7.2s     remaining: 21.6s
250:    learn: 0.2142641        total: 7.23s    remaining: 21.6s
251:    learn: 0.2142621        total: 7.25s    remaining: 21.5s
252:    learn: 0.2142616        total: 7.27s    remaining: 21.5s
253:    learn: 0.2142595        total: 7.29s    remaining: 21.4s
254:    learn: 0.2142438        total: 7.32s    remaining: 21.4s
255:    learn: 0.2142358        total: 7.35s    remaining: 21.4s
256:    learn: 0.2142175        total: 7.38s    remaining: 21.3s
257:    learn: 0.2142174        total: 7.4s     remaining: 21.3s
258:    learn: 0.2141903        total: 7.44s    remaining: 21.3s
259:    learn: 0.2141823        total: 7.47s    remaining: 21.3s
260:    learn: 0.2141693        total: 7.5s     remaining: 21.2s
261:    learn: 0.2141591        total: 7.52s    remaining: 21.2s
262:    learn: 0.2141546        total: 7.55s    remaining: 21.2s
263:    learn: 0.2141349        total: 7.58s    remaining: 21.1s
264:    learn: 0.2141171        total: 7.62s    remaining: 21.1s
265:    learn: 0.2140989        total: 7.64s    remaining: 21.1s
266:    learn: 0.2140853        total: 7.68s    remaining: 21.1s
267:    learn: 0.2140675        total: 7.71s    remaining: 21.1s
268:    learn: 0.2140456        total: 7.74s    remaining: 21s
269:    learn: 0.2140349        total: 7.77s    remaining: 21s
270:    learn: 0.2140245        total: 7.8s     remaining: 21s
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271:    learn: 0.2140186        total: 7.83s    remaining: 21s
272:    learn: 0.2140044        total: 7.87s    remaining: 20.9s
273:    learn: 0.2140017        total: 7.89s    remaining: 20.9s
274:    learn: 0.2139927        total: 7.92s    remaining: 20.9s
275:    learn: 0.2139677        total: 7.95s    remaining: 20.9s
276:    learn: 0.2139565        total: 7.98s    remaining: 20.8s
277:    learn: 0.2139494        total: 8.01s    remaining: 20.8s
278:    learn: 0.2139363        total: 8.04s    remaining: 20.8s
279:    learn: 0.2139236        total: 8.07s    remaining: 20.7s
280:    learn: 0.2139047        total: 8.1s     remaining: 20.7s
281:    learn: 0.2138982        total: 8.13s    remaining: 20.7s
282:    learn: 0.2138925        total: 8.16s    remaining: 20.7s
283:    learn: 0.2138778        total: 8.2s     remaining: 20.7s
284:    learn: 0.2138672        total: 8.22s    remaining: 20.6s
285:    learn: 0.2138514        total: 8.26s    remaining: 20.6s
286:    learn: 0.2138261        total: 8.29s    remaining: 20.6s
287:    learn: 0.2138025        total: 8.32s    remaining: 20.6s
288:    learn: 0.2137784        total: 8.35s    remaining: 20.5s
289:    learn: 0.2137597        total: 8.38s    remaining: 20.5s
290:    learn: 0.2137591        total: 8.4s     remaining: 20.5s
291:    learn: 0.2137462        total: 8.44s    remaining: 20.5s
292:    learn: 0.2137346        total: 8.47s    remaining: 20.4s
293:    learn: 0.2137063        total: 8.5s     remaining: 20.4s
294:    learn: 0.2136858        total: 8.54s    remaining: 20.4s
295:    learn: 0.2136775        total: 8.56s    remaining: 20.4s
296:    learn: 0.2136622        total: 8.59s    remaining: 20.3s
297:    learn: 0.2136602        total: 8.61s    remaining: 20.3s
298:    learn: 0.2136462        total: 8.64s    remaining: 20.2s
299:    learn: 0.2136251        total: 8.67s    remaining: 20.2s
300:    learn: 0.2136126        total: 8.7s     remaining: 20.2s
301:    learn: 0.2135989        total: 8.73s    remaining: 20.2s
302:    learn: 0.2135827        total: 8.76s    remaining: 20.2s
303:    learn: 0.2135584        total: 8.79s    remaining: 20.1s
304:    learn: 0.2135434        total: 8.82s    remaining: 20.1s
305:    learn: 0.2135425        total: 8.84s    remaining: 20s
306:    learn: 0.2135401        total: 8.86s    remaining: 20s
307:    learn: 0.2135260        total: 8.89s    remaining: 20s
308:    learn: 0.2135114        total: 8.92s    remaining: 19.9s
309:    learn: 0.2134980        total: 8.95s    remaining: 19.9s
310:    learn: 0.2134960        total: 8.97s    remaining: 19.9s
311:    learn: 0.2134849        total: 9s       remaining: 19.9s
312:    learn: 0.2134847        total: 9.02s    remaining: 19.8s
313:    learn: 0.2134847        total: 9.04s    remaining: 19.7s
314:    learn: 0.2134581        total: 9.07s    remaining: 19.7s
315:    learn: 0.2134435        total: 9.1s     remaining: 19.7s
316:    learn: 0.2134211        total: 9.13s    remaining: 19.7s
317:    learn: 0.2134151        total: 9.16s    remaining: 19.6s
318:    learn: 0.2133980        total: 9.19s    remaining: 19.6s
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319:    learn: 0.2133691        total: 9.22s    remaining: 19.6s
320:    learn: 0.2133527        total: 9.26s    remaining: 19.6s
321:    learn: 0.2133368        total: 9.29s    remaining: 19.6s
322:    learn: 0.2133134        total: 9.31s    remaining: 19.5s
323:    learn: 0.2132920        total: 9.35s    remaining: 19.5s
324:    learn: 0.2132779        total: 9.38s    remaining: 19.5s
325:    learn: 0.2132600        total: 9.41s    remaining: 19.4s
326:    learn: 0.2132490        total: 9.44s    remaining: 19.4s
327:    learn: 0.2132334        total: 9.47s    remaining: 19.4s
328:    learn: 0.2132209        total: 9.5s     remaining: 19.4s
329:    learn: 0.2131989        total: 9.53s    remaining: 19.4s
330:    learn: 0.2131895        total: 9.56s    remaining: 19.3s
331:    learn: 0.2131699        total: 9.59s    remaining: 19.3s
332:    learn: 0.2131528        total: 9.62s    remaining: 19.3s
333:    learn: 0.2131368        total: 9.65s    remaining: 19.2s
334:    learn: 0.2131267        total: 9.68s    remaining: 19.2s
335:    learn: 0.2130963        total: 9.71s    remaining: 19.2s
336:    learn: 0.2130736        total: 9.75s    remaining: 19.2s
337:    learn: 0.2130582        total: 9.78s    remaining: 19.2s
338:    learn: 0.2130331        total: 9.81s    remaining: 19.1s
339:    learn: 0.2130017        total: 9.84s    remaining: 19.1s
340:    learn: 0.2129771        total: 9.87s    remaining: 19.1s
341:    learn: 0.2129550        total: 9.9s     remaining: 19.1s
342:    learn: 0.2129298        total: 9.93s    remaining: 19s
343:    learn: 0.2128959        total: 9.97s    remaining: 19s
344:    learn: 0.2128799        total: 10s      remaining: 19s
345:    learn: 0.2128513        total: 10s      remaining: 19s
346:    learn: 0.2128373        total: 10.1s    remaining: 18.9s
347:    learn: 0.2128278        total: 10.1s    remaining: 18.9s
348:    learn: 0.2128051        total: 10.1s    remaining: 18.9s
349:    learn: 0.2127866        total: 10.2s    remaining: 18.9s
350:    learn: 0.2127565        total: 10.2s    remaining: 18.9s
351:    learn: 0.2127281        total: 10.2s    remaining: 18.8s
352:    learn: 0.2127159        total: 10.3s    remaining: 18.8s
353:    learn: 0.2126919        total: 10.3s    remaining: 18.8s
354:    learn: 0.2126706        total: 10.3s    remaining: 18.8s
355:    learn: 0.2126408        total: 10.4s    remaining: 18.7s
356:    learn: 0.2126265        total: 10.4s    remaining: 18.7s
357:    learn: 0.2126048        total: 10.4s    remaining: 18.7s
358:    learn: 0.2125742        total: 10.5s    remaining: 18.7s
359:    learn: 0.2125526        total: 10.5s    remaining: 18.6s
360:    learn: 0.2125368        total: 10.5s    remaining: 18.6s
361:    learn: 0.2125145        total: 10.6s    remaining: 18.6s
362:    learn: 0.2125049        total: 10.6s    remaining: 18.6s
363:    learn: 0.2124773        total: 10.6s    remaining: 18.5s
364:    learn: 0.2124475        total: 10.6s    remaining: 18.5s
365:    learn: 0.2124289        total: 10.7s    remaining: 18.5s
366:    learn: 0.2123963        total: 10.7s    remaining: 18.5s
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367:    learn: 0.2123680        total: 10.7s    remaining: 18.5s
368:    learn: 0.2123502        total: 10.8s    remaining: 18.4s
369:    learn: 0.2123177        total: 10.8s    remaining: 18.4s
370:    learn: 0.2122916        total: 10.8s    remaining: 18.4s
371:    learn: 0.2122732        total: 10.9s    remaining: 18.4s
372:    learn: 0.2122618        total: 10.9s    remaining: 18.3s
373:    learn: 0.2122436        total: 10.9s    remaining: 18.3s
374:    learn: 0.2122277        total: 11s      remaining: 18.3s
375:    learn: 0.2122065        total: 11s      remaining: 18.3s
376:    learn: 0.2121786        total: 11s      remaining: 18.2s
377:    learn: 0.2121557        total: 11.1s    remaining: 18.2s
378:    learn: 0.2121249        total: 11.1s    remaining: 18.2s
379:    learn: 0.2121077        total: 11.1s    remaining: 18.2s
380:    learn: 0.2120837        total: 11.2s    remaining: 18.1s
381:    learn: 0.2120647        total: 11.2s    remaining: 18.1s
382:    learn: 0.2120374        total: 11.2s    remaining: 18.1s
383:    learn: 0.2120235        total: 11.3s    remaining: 18.1s
384:    learn: 0.2120110        total: 11.3s    remaining: 18s
385:    learn: 0.2119968        total: 11.3s    remaining: 18s
386:    learn: 0.2119795        total: 11.3s    remaining: 18s
387:    learn: 0.2119628        total: 11.4s    remaining: 17.9s
388:    learn: 0.2119418        total: 11.4s    remaining: 17.9s
389:    learn: 0.2119305        total: 11.4s    remaining: 17.9s
390:    learn: 0.2118990        total: 11.5s    remaining: 17.9s
391:    learn: 0.2118812        total: 11.5s    remaining: 17.8s
392:    learn: 0.2118494        total: 11.5s    remaining: 17.8s
393:    learn: 0.2118362        total: 11.6s    remaining: 17.8s
394:    learn: 0.2118161        total: 11.6s    remaining: 17.8s
395:    learn: 0.2118004        total: 11.6s    remaining: 17.7s
396:    learn: 0.2117873        total: 11.7s    remaining: 17.7s
397:    learn: 0.2117647        total: 11.7s    remaining: 17.7s
398:    learn: 0.2117478        total: 11.7s    remaining: 17.6s
399:    learn: 0.2117335        total: 11.7s    remaining: 17.6s
400:    learn: 0.2117169        total: 11.8s    remaining: 17.6s
401:    learn: 0.2116990        total: 11.8s    remaining: 17.6s
402:    learn: 0.2116704        total: 11.8s    remaining: 17.5s
403:    learn: 0.2116581        total: 11.9s    remaining: 17.5s
404:    learn: 0.2116414        total: 11.9s    remaining: 17.5s
405:    learn: 0.2116214        total: 11.9s    remaining: 17.5s
406:    learn: 0.2115932        total: 12s      remaining: 17.4s
407:    learn: 0.2115690        total: 12s      remaining: 17.4s
408:    learn: 0.2115398        total: 12s      remaining: 17.4s
409:    learn: 0.2115194        total: 12.1s    remaining: 17.4s
410:    learn: 0.2115027        total: 12.1s    remaining: 17.3s
411:    learn: 0.2114802        total: 12.1s    remaining: 17.3s
412:    learn: 0.2114572        total: 12.1s    remaining: 17.3s
413:    learn: 0.2114445        total: 12.2s    remaining: 17.2s
414:    learn: 0.2114313        total: 12.2s    remaining: 17.2s
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415:    learn: 0.2114077        total: 12.2s    remaining: 17.2s
416:    learn: 0.2113828        total: 12.3s    remaining: 17.2s
417:    learn: 0.2113703        total: 12.3s    remaining: 17.1s
418:    learn: 0.2113485        total: 12.3s    remaining: 17.1s
419:    learn: 0.2113276        total: 12.4s    remaining: 17.1s
420:    learn: 0.2112999        total: 12.4s    remaining: 17.1s
421:    learn: 0.2112825        total: 12.4s    remaining: 17s
422:    learn: 0.2112573        total: 12.5s    remaining: 17s
423:    learn: 0.2112358        total: 12.5s    remaining: 17s
424:    learn: 0.2112249        total: 12.5s    remaining: 17s
425:    learn: 0.2112089        total: 12.6s    remaining: 16.9s
426:    learn: 0.2111938        total: 12.6s    remaining: 16.9s
427:    learn: 0.2111741        total: 12.6s    remaining: 16.9s
428:    learn: 0.2111613        total: 12.7s    remaining: 16.9s
429:    learn: 0.2111394        total: 12.7s    remaining: 16.8s
430:    learn: 0.2111165        total: 12.7s    remaining: 16.8s
431:    learn: 0.2110968        total: 12.8s    remaining: 16.8s
432:    learn: 0.2110808        total: 12.8s    remaining: 16.8s
433:    learn: 0.2110674        total: 12.8s    remaining: 16.7s
434:    learn: 0.2110507        total: 12.9s    remaining: 16.7s
435:    learn: 0.2110341        total: 12.9s    remaining: 16.7s
436:    learn: 0.2110144        total: 12.9s    remaining: 16.7s
437:    learn: 0.2109896        total: 13s      remaining: 16.6s
438:    learn: 0.2109761        total: 13s      remaining: 16.6s
439:    learn: 0.2109514        total: 13s      remaining: 16.6s
440:    learn: 0.2109294        total: 13.1s    remaining: 16.5s
441:    learn: 0.2109103        total: 13.1s    remaining: 16.5s
442:    learn: 0.2108949        total: 13.1s    remaining: 16.5s
443:    learn: 0.2108842        total: 13.1s    remaining: 16.5s
444:    learn: 0.2108725        total: 13.2s    remaining: 16.4s
445:    learn: 0.2108615        total: 13.2s    remaining: 16.4s
446:    learn: 0.2108495        total: 13.2s    remaining: 16.4s
447:    learn: 0.2108379        total: 13.3s    remaining: 16.3s
448:    learn: 0.2108248        total: 13.3s    remaining: 16.3s
449:    learn: 0.2108067        total: 13.3s    remaining: 16.3s
450:    learn: 0.2107862        total: 13.4s    remaining: 16.3s
451:    learn: 0.2107657        total: 13.4s    remaining: 16.2s
452:    learn: 0.2107499        total: 13.4s    remaining: 16.2s
453:    learn: 0.2107263        total: 13.5s    remaining: 16.2s
454:    learn: 0.2107017        total: 13.5s    remaining: 16.2s
455:    learn: 0.2106790        total: 13.5s    remaining: 16.1s
456:    learn: 0.2106563        total: 13.6s    remaining: 16.1s
457:    learn: 0.2106440        total: 13.6s    remaining: 16.1s
458:    learn: 0.2106127        total: 13.6s    remaining: 16.1s
459:    learn: 0.2105943        total: 13.6s    remaining: 16s
460:    learn: 0.2105779        total: 13.7s    remaining: 16s
461:    learn: 0.2105618        total: 13.7s    remaining: 16s
462:    learn: 0.2105453        total: 13.7s    remaining: 15.9s
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463:    learn: 0.2105231        total: 13.8s    remaining: 15.9s
464:    learn: 0.2105022        total: 13.8s    remaining: 15.9s
465:    learn: 0.2104764        total: 13.8s    remaining: 15.9s
466:    learn: 0.2104455        total: 13.9s    remaining: 15.8s
467:    learn: 0.2104296        total: 13.9s    remaining: 15.8s
468:    learn: 0.2104143        total: 13.9s    remaining: 15.8s
469:    learn: 0.2103968        total: 14s      remaining: 15.7s
470:    learn: 0.2103772        total: 14s      remaining: 15.7s
471:    learn: 0.2103589        total: 14s      remaining: 15.7s
472:    learn: 0.2103431        total: 14.1s    remaining: 15.7s
473:    learn: 0.2103216        total: 14.1s    remaining: 15.6s
474:    learn: 0.2102958        total: 14.1s    remaining: 15.6s
475:    learn: 0.2102791        total: 14.2s    remaining: 15.6s
476:    learn: 0.2102674        total: 14.2s    remaining: 15.6s
477:    learn: 0.2102567        total: 14.2s    remaining: 15.5s
478:    learn: 0.2102367        total: 14.2s    remaining: 15.5s
479:    learn: 0.2102200        total: 14.3s    remaining: 15.5s
480:    learn: 0.2102097        total: 14.3s    remaining: 15.4s
481:    learn: 0.2101913        total: 14.3s    remaining: 15.4s
482:    learn: 0.2101732        total: 14.4s    remaining: 15.4s
483:    learn: 0.2101516        total: 14.4s    remaining: 15.4s
484:    learn: 0.2101319        total: 14.4s    remaining: 15.3s
485:    learn: 0.2101138        total: 14.5s    remaining: 15.3s
486:    learn: 0.2101008        total: 14.5s    remaining: 15.3s
487:    learn: 0.2100760        total: 14.5s    remaining: 15.2s
488:    learn: 0.2100592        total: 14.6s    remaining: 15.2s
489:    learn: 0.2100538        total: 14.6s    remaining: 15.2s
490:    learn: 0.2100359        total: 14.6s    remaining: 15.1s
491:    learn: 0.2100181        total: 14.6s    remaining: 15.1s
492:    learn: 0.2100036        total: 14.7s    remaining: 15.1s
493:    learn: 0.2099839        total: 14.7s    remaining: 15.1s
494:    learn: 0.2099719        total: 14.7s    remaining: 15s
495:    learn: 0.2099566        total: 14.8s    remaining: 15s
496:    learn: 0.2099380        total: 14.8s    remaining: 15s
497:    learn: 0.2099280        total: 14.8s    remaining: 14.9s
498:    learn: 0.2099151        total: 14.9s    remaining: 14.9s
499:    learn: 0.2099019        total: 14.9s    remaining: 14.9s
500:    learn: 0.2098918        total: 14.9s    remaining: 14.9s
501:    learn: 0.2098696        total: 15s      remaining: 14.8s
502:    learn: 0.2098408        total: 15s      remaining: 14.8s
503:    learn: 0.2098212        total: 15s      remaining: 14.8s
504:    learn: 0.2097969        total: 15.1s    remaining: 14.8s
505:    learn: 0.2097761        total: 15.1s    remaining: 14.7s
506:    learn: 0.2097625        total: 15.1s    remaining: 14.7s
507:    learn: 0.2097463        total: 15.1s    remaining: 14.7s
508:    learn: 0.2097353        total: 15.2s    remaining: 14.6s
509:    learn: 0.2097190        total: 15.2s    remaining: 14.6s
510:    learn: 0.2096972        total: 15.2s    remaining: 14.6s
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511:    learn: 0.2096808        total: 15.3s    remaining: 14.5s
512:    learn: 0.2096599        total: 15.3s    remaining: 14.5s
513:    learn: 0.2096391        total: 15.3s    remaining: 14.5s
514:    learn: 0.2096216        total: 15.4s    remaining: 14.5s
515:    learn: 0.2095945        total: 15.4s    remaining: 14.4s
516:    learn: 0.2095793        total: 15.4s    remaining: 14.4s
517:    learn: 0.2095592        total: 15.5s    remaining: 14.4s
518:    learn: 0.2095418        total: 15.5s    remaining: 14.4s
519:    learn: 0.2095261        total: 15.5s    remaining: 14.3s
520:    learn: 0.2095099        total: 15.6s    remaining: 14.3s
521:    learn: 0.2094898        total: 15.6s    remaining: 14.3s
522:    learn: 0.2094728        total: 15.6s    remaining: 14.2s
523:    learn: 0.2094523        total: 15.6s    remaining: 14.2s
524:    learn: 0.2094308        total: 15.7s    remaining: 14.2s
525:    learn: 0.2094119        total: 15.7s    remaining: 14.2s
526:    learn: 0.2093968        total: 15.7s    remaining: 14.1s
527:    learn: 0.2093761        total: 15.8s    remaining: 14.1s
528:    learn: 0.2093556        total: 15.8s    remaining: 14.1s
529:    learn: 0.2093413        total: 15.8s    remaining: 14s
530:    learn: 0.2093280        total: 15.9s    remaining: 14s
531:    learn: 0.2093131        total: 15.9s    remaining: 14s
532:    learn: 0.2092888        total: 15.9s    remaining: 14s
533:    learn: 0.2092785        total: 16s      remaining: 13.9s
534:    learn: 0.2092683        total: 16s      remaining: 13.9s
535:    learn: 0.2092554        total: 16s      remaining: 13.9s
536:    learn: 0.2092371        total: 16.1s    remaining: 13.8s
537:    learn: 0.2092127        total: 16.1s    remaining: 13.8s
538:    learn: 0.2091998        total: 16.1s    remaining: 13.8s
539:    learn: 0.2091820        total: 16.1s    remaining: 13.8s
540:    learn: 0.2091688        total: 16.2s    remaining: 13.7s
541:    learn: 0.2091482        total: 16.2s    remaining: 13.7s
542:    learn: 0.2091266        total: 16.2s    remaining: 13.7s
543:    learn: 0.2091125        total: 16.3s    remaining: 13.6s
544:    learn: 0.2090967        total: 16.3s    remaining: 13.6s
545:    learn: 0.2090787        total: 16.3s    remaining: 13.6s
546:    learn: 0.2090599        total: 16.4s    remaining: 13.6s
547:    learn: 0.2090460        total: 16.4s    remaining: 13.5s
548:    learn: 0.2090275        total: 16.4s    remaining: 13.5s
549:    learn: 0.2090114        total: 16.5s    remaining: 13.5s
550:    learn: 0.2089985        total: 16.5s    remaining: 13.4s
551:    learn: 0.2089846        total: 16.5s    remaining: 13.4s
552:    learn: 0.2089615        total: 16.6s    remaining: 13.4s
553:    learn: 0.2089582        total: 16.6s    remaining: 13.4s
554:    learn: 0.2089372        total: 16.6s    remaining: 13.3s
555:    learn: 0.2089201        total: 16.6s    remaining: 13.3s
556:    learn: 0.2089006        total: 16.7s    remaining: 13.3s
557:    learn: 0.2088916        total: 16.7s    remaining: 13.2s
558:    learn: 0.2088796        total: 16.7s    remaining: 13.2s
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559:    learn: 0.2088629        total: 16.8s    remaining: 13.2s
560:    learn: 0.2088448        total: 16.8s    remaining: 13.2s
561:    learn: 0.2088379        total: 16.8s    remaining: 13.1s
562:    learn: 0.2088273        total: 16.9s    remaining: 13.1s
563:    learn: 0.2088243        total: 16.9s    remaining: 13.1s
564:    learn: 0.2088156        total: 16.9s    remaining: 13s
565:    learn: 0.2088024        total: 17s      remaining: 13s
566:    learn: 0.2087886        total: 17s      remaining: 13s
567:    learn: 0.2087752        total: 17s      remaining: 12.9s
568:    learn: 0.2087624        total: 17.1s    remaining: 12.9s
569:    learn: 0.2087477        total: 17.1s    remaining: 12.9s
570:    learn: 0.2087362        total: 17.1s    remaining: 12.9s
571:    learn: 0.2087255        total: 17.1s    remaining: 12.8s
572:    learn: 0.2087121        total: 17.2s    remaining: 12.8s
573:    learn: 0.2086891        total: 17.2s    remaining: 12.8s
574:    learn: 0.2086706        total: 17.2s    remaining: 12.7s
575:    learn: 0.2086600        total: 17.3s    remaining: 12.7s
576:    learn: 0.2086467        total: 17.3s    remaining: 12.7s
577:    learn: 0.2086340        total: 17.3s    remaining: 12.7s
578:    learn: 0.2086210        total: 17.4s    remaining: 12.6s
579:    learn: 0.2086180        total: 17.4s    remaining: 12.6s
580:    learn: 0.2086120        total: 17.4s    remaining: 12.6s
581:    learn: 0.2086064        total: 17.4s    remaining: 12.5s
582:    learn: 0.2085948        total: 17.5s    remaining: 12.5s
583:    learn: 0.2085821        total: 17.5s    remaining: 12.5s
584:    learn: 0.2085674        total: 17.5s    remaining: 12.4s
585:    learn: 0.2085591        total: 17.6s    remaining: 12.4s
586:    learn: 0.2085462        total: 17.6s    remaining: 12.4s
587:    learn: 0.2085350        total: 17.6s    remaining: 12.4s
588:    learn: 0.2085227        total: 17.7s    remaining: 12.3s
589:    learn: 0.2085104        total: 17.7s    remaining: 12.3s
590:    learn: 0.2084998        total: 17.7s    remaining: 12.3s
591:    learn: 0.2084884        total: 17.8s    remaining: 12.2s
592:    learn: 0.2084698        total: 17.8s    remaining: 12.2s
593:    learn: 0.2084539        total: 17.8s    remaining: 12.2s
594:    learn: 0.2084513        total: 17.8s    remaining: 12.1s
595:    learn: 0.2084392        total: 17.9s    remaining: 12.1s
596:    learn: 0.2084252        total: 17.9s    remaining: 12.1s
597:    learn: 0.2084128        total: 17.9s    remaining: 12.1s
598:    learn: 0.2084005        total: 18s      remaining: 12s
599:    learn: 0.2083916        total: 18s      remaining: 12s
600:    learn: 0.2083770        total: 18s      remaining: 12s
601:    learn: 0.2083630        total: 18.1s    remaining: 11.9s
602:    learn: 0.2083442        total: 18.1s    remaining: 11.9s
603:    learn: 0.2083298        total: 18.1s    remaining: 11.9s
604:    learn: 0.2083073        total: 18.1s    remaining: 11.8s
605:    learn: 0.2082913        total: 18.2s    remaining: 11.8s
606:    learn: 0.2082796        total: 18.2s    remaining: 11.8s
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607:    learn: 0.2082642        total: 18.2s    remaining: 11.8s
608:    learn: 0.2082485        total: 18.3s    remaining: 11.7s
609:    learn: 0.2082309        total: 18.3s    remaining: 11.7s
610:    learn: 0.2082121        total: 18.3s    remaining: 11.7s
611:    learn: 0.2081984        total: 18.4s    remaining: 11.7s
612:    learn: 0.2081905        total: 18.4s    remaining: 11.6s
613:    learn: 0.2081822        total: 18.4s    remaining: 11.6s
614:    learn: 0.2081707        total: 18.5s    remaining: 11.6s
615:    learn: 0.2081575        total: 18.5s    remaining: 11.5s
616:    learn: 0.2081431        total: 18.5s    remaining: 11.5s
617:    learn: 0.2081246        total: 18.6s    remaining: 11.5s
618:    learn: 0.2081109        total: 18.6s    remaining: 11.4s
619:    learn: 0.2080953        total: 18.6s    remaining: 11.4s
620:    learn: 0.2080839        total: 18.7s    remaining: 11.4s
621:    learn: 0.2080752        total: 18.7s    remaining: 11.4s
622:    learn: 0.2080547        total: 18.7s    remaining: 11.3s
623:    learn: 0.2080397        total: 18.7s    remaining: 11.3s
624:    learn: 0.2080295        total: 18.8s    remaining: 11.3s
625:    learn: 0.2080193        total: 18.8s    remaining: 11.2s
626:    learn: 0.2080087        total: 18.8s    remaining: 11.2s
627:    learn: 0.2079902        total: 18.9s    remaining: 11.2s
628:    learn: 0.2079820        total: 18.9s    remaining: 11.1s
629:    learn: 0.2079702        total: 18.9s    remaining: 11.1s
630:    learn: 0.2079502        total: 19s      remaining: 11.1s
631:    learn: 0.2079393        total: 19s      remaining: 11.1s
632:    learn: 0.2079269        total: 19s      remaining: 11s
633:    learn: 0.2079152        total: 19s      remaining: 11s
634:    learn: 0.2079028        total: 19.1s    remaining: 11s
635:    learn: 0.2078833        total: 19.1s    remaining: 10.9s
636:    learn: 0.2078720        total: 19.1s    remaining: 10.9s
637:    learn: 0.2078635        total: 19.2s    remaining: 10.9s
638:    learn: 0.2078395        total: 19.2s    remaining: 10.8s
639:    learn: 0.2078312        total: 19.2s    remaining: 10.8s
640:    learn: 0.2078135        total: 19.3s    remaining: 10.8s
641:    learn: 0.2077990        total: 19.3s    remaining: 10.8s
642:    learn: 0.2077869        total: 19.3s    remaining: 10.7s
643:    learn: 0.2077739        total: 19.4s    remaining: 10.7s
644:    learn: 0.2077602        total: 19.4s    remaining: 10.7s
645:    learn: 0.2077446        total: 19.4s    remaining: 10.6s
646:    learn: 0.2077331        total: 19.5s    remaining: 10.6s
647:    learn: 0.2077259        total: 19.5s    remaining: 10.6s
648:    learn: 0.2077051        total: 19.5s    remaining: 10.6s
649:    learn: 0.2076941        total: 19.5s    remaining: 10.5s
650:    learn: 0.2076843        total: 19.6s    remaining: 10.5s
651:    learn: 0.2076749        total: 19.6s    remaining: 10.5s
652:    learn: 0.2076661        total: 19.6s    remaining: 10.4s
653:    learn: 0.2076540        total: 19.7s    remaining: 10.4s
654:    learn: 0.2076461        total: 19.7s    remaining: 10.4s
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655:    learn: 0.2076324        total: 19.7s    remaining: 10.3s
656:    learn: 0.2076161        total: 19.8s    remaining: 10.3s
657:    learn: 0.2076035        total: 19.8s    remaining: 10.3s
658:    learn: 0.2075909        total: 19.8s    remaining: 10.3s
659:    learn: 0.2075829        total: 19.9s    remaining: 10.2s
660:    learn: 0.2075711        total: 19.9s    remaining: 10.2s
661:    learn: 0.2075640        total: 19.9s    remaining: 10.2s
662:    learn: 0.2075535        total: 19.9s    remaining: 10.1s
663:    learn: 0.2075441        total: 20s      remaining: 10.1s
664:    learn: 0.2075342        total: 20s      remaining: 10.1s
665:    learn: 0.2075230        total: 20s      remaining: 10s
666:    learn: 0.2075137        total: 20.1s    remaining: 10s
667:    learn: 0.2074951        total: 20.1s    remaining: 9.98s
668:    learn: 0.2074841        total: 20.1s    remaining: 9.96s
669:    learn: 0.2074760        total: 20.1s    remaining: 9.92s
670:    learn: 0.2074673        total: 20.2s    remaining: 9.89s
671:    learn: 0.2074509        total: 20.2s    remaining: 9.86s
672:    learn: 0.2074369        total: 20.2s    remaining: 9.83s
673:    learn: 0.2074256        total: 20.3s    remaining: 9.8s
674:    learn: 0.2074141        total: 20.3s    remaining: 9.77s
675:    learn: 0.2074048        total: 20.3s    remaining: 9.74s
676:    learn: 0.2073931        total: 20.4s    remaining: 9.72s
677:    learn: 0.2073752        total: 20.4s    remaining: 9.69s
678:    learn: 0.2073616        total: 20.4s    remaining: 9.66s
679:    learn: 0.2073519        total: 20.5s    remaining: 9.63s
680:    learn: 0.2073429        total: 20.5s    remaining: 9.6s
681:    learn: 0.2073304        total: 20.5s    remaining: 9.57s
682:    learn: 0.2073174        total: 20.5s    remaining: 9.54s
683:    learn: 0.2073068        total: 20.6s    remaining: 9.51s
684:    learn: 0.2072884        total: 20.6s    remaining: 9.48s
685:    learn: 0.2072804        total: 20.6s    remaining: 9.45s
686:    learn: 0.2072634        total: 20.7s    remaining: 9.42s
687:    learn: 0.2072560        total: 20.7s    remaining: 9.39s
688:    learn: 0.2072462        total: 20.7s    remaining: 9.36s
689:    learn: 0.2072338        total: 20.8s    remaining: 9.33s
690:    learn: 0.2072238        total: 20.8s    remaining: 9.3s
691:    learn: 0.2072062        total: 20.8s    remaining: 9.27s
692:    learn: 0.2071869        total: 20.9s    remaining: 9.24s
693:    learn: 0.2071748        total: 20.9s    remaining: 9.21s
694:    learn: 0.2071619        total: 20.9s    remaining: 9.18s
695:    learn: 0.2071515        total: 20.9s    remaining: 9.15s
696:    learn: 0.2071328        total: 21s      remaining: 9.12s
697:    learn: 0.2071245        total: 21s      remaining: 9.09s
698:    learn: 0.2071113        total: 21s      remaining: 9.06s
699:    learn: 0.2070944        total: 21.1s    remaining: 9.03s
700:    learn: 0.2070823        total: 21.1s    remaining: 9s
701:    learn: 0.2070729        total: 21.1s    remaining: 8.97s
702:    learn: 0.2070538        total: 21.2s    remaining: 8.95s
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703:    learn: 0.2070477        total: 21.2s    remaining: 8.92s
704:    learn: 0.2070336        total: 21.2s    remaining: 8.89s
705:    learn: 0.2070245        total: 21.3s    remaining: 8.86s
706:    learn: 0.2070104        total: 21.3s    remaining: 8.83s
707:    learn: 0.2069901        total: 21.3s    remaining: 8.8s
708:    learn: 0.2069778        total: 21.4s    remaining: 8.77s
709:    learn: 0.2069636        total: 21.4s    remaining: 8.74s
710:    learn: 0.2069536        total: 21.4s    remaining: 8.71s
711:    learn: 0.2069453        total: 21.5s    remaining: 8.68s
712:    learn: 0.2069328        total: 21.5s    remaining: 8.65s
713:    learn: 0.2069165        total: 21.5s    remaining: 8.62s
714:    learn: 0.2069027        total: 21.6s    remaining: 8.59s
715:    learn: 0.2068933        total: 21.6s    remaining: 8.56s
716:    learn: 0.2068801        total: 21.6s    remaining: 8.53s
717:    learn: 0.2068724        total: 21.6s    remaining: 8.5s
718:    learn: 0.2068611        total: 21.7s    remaining: 8.47s
719:    learn: 0.2068470        total: 21.7s    remaining: 8.44s
720:    learn: 0.2068246        total: 21.7s    remaining: 8.41s
721:    learn: 0.2068175        total: 21.8s    remaining: 8.38s
722:    learn: 0.2067991        total: 21.8s    remaining: 8.35s
723:    learn: 0.2067942        total: 21.8s    remaining: 8.32s
724:    learn: 0.2067837        total: 21.9s    remaining: 8.29s
725:    learn: 0.2067780        total: 21.9s    remaining: 8.26s
726:    learn: 0.2067726        total: 21.9s    remaining: 8.23s
727:    learn: 0.2067582        total: 22s      remaining: 8.2s
728:    learn: 0.2067465        total: 22s      remaining: 8.17s
729:    learn: 0.2067251        total: 22s      remaining: 8.14s
730:    learn: 0.2067036        total: 22s      remaining: 8.11s
731:    learn: 0.2066949        total: 22.1s    remaining: 8.08s
732:    learn: 0.2066805        total: 22.1s    remaining: 8.05s
733:    learn: 0.2066728        total: 22.1s    remaining: 8.02s
734:    learn: 0.2066596        total: 22.2s    remaining: 7.99s
735:    learn: 0.2066405        total: 22.2s    remaining: 7.96s
736:    learn: 0.2066314        total: 22.2s    remaining: 7.93s
737:    learn: 0.2066291        total: 22.3s    remaining: 7.9s
738:    learn: 0.2066165        total: 22.3s    remaining: 7.87s
739:    learn: 0.2066086        total: 22.3s    remaining: 7.84s
740:    learn: 0.2065971        total: 22.4s    remaining: 7.81s
741:    learn: 0.2065871        total: 22.4s    remaining: 7.78s
742:    learn: 0.2065748        total: 22.4s    remaining: 7.75s
743:    learn: 0.2065675        total: 22.4s    remaining: 7.72s
744:    learn: 0.2065558        total: 22.5s    remaining: 7.69s
745:    learn: 0.2065391        total: 22.5s    remaining: 7.66s
746:    learn: 0.2065299        total: 22.5s    remaining: 7.63s
747:    learn: 0.2065111        total: 22.6s    remaining: 7.6s
748:    learn: 0.2065088        total: 22.6s    remaining: 7.57s
749:    learn: 0.2065043        total: 22.6s    remaining: 7.54s
750:    learn: 0.2064916        total: 22.7s    remaining: 7.51s
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751:    learn: 0.2064881        total: 22.7s    remaining: 7.48s
752:    learn: 0.2064740        total: 22.7s    remaining: 7.45s
753:    learn: 0.2064707        total: 22.7s    remaining: 7.42s
754:    learn: 0.2064619        total: 22.8s    remaining: 7.39s
755:    learn: 0.2064522        total: 22.8s    remaining: 7.36s
756:    learn: 0.2064425        total: 22.8s    remaining: 7.33s
757:    learn: 0.2064226        total: 22.9s    remaining: 7.3s
758:    learn: 0.2064098        total: 22.9s    remaining: 7.27s
759:    learn: 0.2064048        total: 22.9s    remaining: 7.24s
760:    learn: 0.2063835        total: 23s      remaining: 7.21s
761:    learn: 0.2063681        total: 23s      remaining: 7.18s
762:    learn: 0.2063551        total: 23s      remaining: 7.15s
763:    learn: 0.2063477        total: 23.1s    remaining: 7.12s
764:    learn: 0.2063415        total: 23.1s    remaining: 7.09s
765:    learn: 0.2063332        total: 23.1s    remaining: 7.06s
766:    learn: 0.2063183        total: 23.1s    remaining: 7.03s
767:    learn: 0.2063091        total: 23.2s    remaining: 7s
768:    learn: 0.2063033        total: 23.2s    remaining: 6.97s
769:    learn: 0.2062979        total: 23.2s    remaining: 6.94s
770:    learn: 0.2062934        total: 23.3s    remaining: 6.91s
771:    learn: 0.2062803        total: 23.3s    remaining: 6.88s
772:    learn: 0.2062724        total: 23.3s    remaining: 6.85s
773:    learn: 0.2062620        total: 23.4s    remaining: 6.82s
774:    learn: 0.2062480        total: 23.4s    remaining: 6.79s
775:    learn: 0.2062447        total: 23.4s    remaining: 6.76s
776:    learn: 0.2062348        total: 23.4s    remaining: 6.73s
777:    learn: 0.2062269        total: 23.5s    remaining: 6.7s
778:    learn: 0.2062183        total: 23.5s    remaining: 6.67s
779:    learn: 0.2062059        total: 23.5s    remaining: 6.64s
780:    learn: 0.2062003        total: 23.6s    remaining: 6.61s
781:    learn: 0.2061879        total: 23.6s    remaining: 6.58s
782:    learn: 0.2061797        total: 23.6s    remaining: 6.55s
783:    learn: 0.2061751        total: 23.7s    remaining: 6.52s
784:    learn: 0.2061686        total: 23.7s    remaining: 6.49s
785:    learn: 0.2061534        total: 23.7s    remaining: 6.46s
786:    learn: 0.2061465        total: 23.8s    remaining: 6.43s
787:    learn: 0.2061319        total: 23.8s    remaining: 6.4s
788:    learn: 0.2061241        total: 23.8s    remaining: 6.37s
789:    learn: 0.2061169        total: 23.8s    remaining: 6.34s
790:    learn: 0.2061009        total: 23.9s    remaining: 6.31s
791:    learn: 0.2060876        total: 23.9s    remaining: 6.28s
792:    learn: 0.2060798        total: 23.9s    remaining: 6.25s
793:    learn: 0.2060669        total: 24s      remaining: 6.22s
794:    learn: 0.2060507        total: 24s      remaining: 6.19s
795:    learn: 0.2060396        total: 24s      remaining: 6.16s
796:    learn: 0.2060272        total: 24.1s    remaining: 6.13s
797:    learn: 0.2060203        total: 24.1s    remaining: 6.1s
798:    learn: 0.2060185        total: 24.1s    remaining: 6.07s
```

```
799:    learn: 0.2060129        total: 24.2s    remaining: 6.04s
800:    learn: 0.2060046        total: 24.2s    remaining: 6.01s
801:    learn: 0.2060007        total: 24.2s    remaining: 5.98s
802:    learn: 0.2059897        total: 24.2s    remaining: 5.95s
803:    learn: 0.2059825        total: 24.3s    remaining: 5.92s
804:    learn: 0.2059762        total: 24.3s    remaining: 5.89s
805:    learn: 0.2059607        total: 24.3s    remaining: 5.86s
806:    learn: 0.2059455        total: 24.4s    remaining: 5.83s
807:    learn: 0.2059277        total: 24.4s    remaining: 5.8s
808:    learn: 0.2059164        total: 24.4s    remaining: 5.77s
809:    learn: 0.2059091        total: 24.5s    remaining: 5.74s
810:    learn: 0.2059009        total: 24.5s    remaining: 5.71s
811:    learn: 0.2058945        total: 24.5s    remaining: 5.68s
812:    learn: 0.2058807        total: 24.6s    remaining: 5.65s
813:    learn: 0.2058558        total: 24.6s    remaining: 5.62s
814:    learn: 0.2058468        total: 24.6s    remaining: 5.59s
815:    learn: 0.2058352        total: 24.6s    remaining: 5.56s
816:    learn: 0.2058303        total: 24.7s    remaining: 5.53s
817:    learn: 0.2058191        total: 24.7s    remaining: 5.5s
818:    learn: 0.2058166        total: 24.7s    remaining: 5.47s
819:    learn: 0.2058010        total: 24.8s    remaining: 5.44s
820:    learn: 0.2057920        total: 24.8s    remaining: 5.41s
821:    learn: 0.2057810        total: 24.8s    remaining: 5.38s
822:    learn: 0.2057667        total: 24.9s    remaining: 5.34s
823:    learn: 0.2057504        total: 24.9s    remaining: 5.32s
824:    learn: 0.2057447        total: 24.9s    remaining: 5.29s
825:    learn: 0.2057345        total: 25s      remaining: 5.26s
826:    learn: 0.2057281        total: 25s      remaining: 5.23s
827:    learn: 0.2057143        total: 25s      remaining: 5.2s
828:    learn: 0.2056968        total: 25.1s    remaining: 5.17s
829:    learn: 0.2056865        total: 25.1s    remaining: 5.14s
830:    learn: 0.2056663        total: 25.1s    remaining: 5.11s
831:    learn: 0.2056597        total: 25.1s    remaining: 5.08s
832:    learn: 0.2056478        total: 25.2s    remaining: 5.05s
833:    learn: 0.2056360        total: 25.2s    remaining: 5.02s
834:    learn: 0.2056284        total: 25.2s    remaining: 4.99s
835:    learn: 0.2056132        total: 25.3s    remaining: 4.96s
836:    learn: 0.2055999        total: 25.3s    remaining: 4.93s
837:    learn: 0.2055863        total: 25.3s    remaining: 4.9s
838:    learn: 0.2055762        total: 25.4s    remaining: 4.87s
839:    learn: 0.2055647        total: 25.4s    remaining: 4.84s
840:    learn: 0.2055584        total: 25.4s    remaining: 4.81s
841:    learn: 0.2055472        total: 25.5s    remaining: 4.78s
842:    learn: 0.2055338        total: 25.5s    remaining: 4.75s
843:    learn: 0.2055174        total: 25.5s    remaining: 4.72s
844:    learn: 0.2055067        total: 25.6s    remaining: 4.69s
845:    learn: 0.2054941        total: 25.6s    remaining: 4.66s
846:    learn: 0.2054919        total: 25.6s    remaining: 4.63s
```

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847:    learn: 0.2054860        total: 25.6s    remaining: 4.6s
848:    learn: 0.2054829        total: 25.7s    remaining: 4.57s
849:    learn: 0.2054634        total: 25.7s    remaining: 4.54s
850:    learn: 0.2054538        total: 25.7s    remaining: 4.5s
851:    learn: 0.2054467        total: 25.8s    remaining: 4.47s
852:    learn: 0.2054350        total: 25.8s    remaining: 4.45s
853:    learn: 0.2054329        total: 25.8s    remaining: 4.41s
854:    learn: 0.2054211        total: 25.9s    remaining: 4.38s
855:    learn: 0.2054113        total: 25.9s    remaining: 4.35s
856:    learn: 0.2054048        total: 25.9s    remaining: 4.32s
857:    learn: 0.2053937        total: 25.9s    remaining: 4.29s
858:    learn: 0.2053837        total: 26s      remaining: 4.26s
859:    learn: 0.2053817        total: 26s      remaining: 4.23s
860:    learn: 0.2053745        total: 26s      remaining: 4.2s
861:    learn: 0.2053667        total: 26.1s    remaining: 4.17s
862:    learn: 0.2053625        total: 26.1s    remaining: 4.14s
863:    learn: 0.2053526        total: 26.1s    remaining: 4.11s
864:    learn: 0.2053374        total: 26.2s    remaining: 4.08s
865:    learn: 0.2053311        total: 26.2s    remaining: 4.05s
866:    learn: 0.2053292        total: 26.2s    remaining: 4.02s
867:    learn: 0.2053148        total: 26.2s    remaining: 3.99s
868:    learn: 0.2053043        total: 26.3s    remaining: 3.96s
869:    learn: 0.2053015        total: 26.3s    remaining: 3.93s
870:    learn: 0.2052932        total: 26.3s    remaining: 3.9s
871:    learn: 0.2052825        total: 26.4s    remaining: 3.87s
872:    learn: 0.2052726        total: 26.4s    remaining: 3.84s
873:    learn: 0.2052665        total: 26.4s    remaining: 3.81s
874:    learn: 0.2052614        total: 26.5s    remaining: 3.78s
875:    learn: 0.2052489        total: 26.5s    remaining: 3.75s
876:    learn: 0.2052437        total: 26.5s    remaining: 3.72s
877:    learn: 0.2052384        total: 26.5s    remaining: 3.69s
878:    learn: 0.2052318        total: 26.6s    remaining: 3.66s
879:    learn: 0.2052229        total: 26.6s    remaining: 3.63s
880:    learn: 0.2052169        total: 26.6s    remaining: 3.6s
881:    learn: 0.2052031        total: 26.7s    remaining: 3.57s
882:    learn: 0.2051933        total: 26.7s    remaining: 3.54s
883:    learn: 0.2051901        total: 26.7s    remaining: 3.51s
884:    learn: 0.2051840        total: 26.8s    remaining: 3.48s
885:    learn: 0.2051696        total: 26.8s    remaining: 3.44s
886:    learn: 0.2051678        total: 26.8s    remaining: 3.42s
887:    learn: 0.2051629        total: 26.8s    remaining: 3.38s
888:    learn: 0.2051502        total: 26.9s    remaining: 3.35s
889:    learn: 0.2051422        total: 26.9s    remaining: 3.32s
890:    learn: 0.2051349        total: 26.9s    remaining: 3.29s
891:    learn: 0.2051203        total: 27s      remaining: 3.26s
892:    learn: 0.2051150        total: 27s      remaining: 3.23s
893:    learn: 0.2051130        total: 27s      remaining: 3.2s
894:    learn: 0.2051082        total: 27.1s    remaining: 3.17s
```

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895:    learn: 0.2051036        total: 27.1s    remaining: 3.14s
896:    learn: 0.2050848        total: 27.1s    remaining: 3.11s
897:    learn: 0.2050792        total: 27.1s    remaining: 3.08s
898:    learn: 0.2050734        total: 27.2s    remaining: 3.05s
899:    learn: 0.2050629        total: 27.2s    remaining: 3.02s
900:    learn: 0.2050571        total: 27.2s    remaining: 2.99s
901:    learn: 0.2050502        total: 27.3s    remaining: 2.96s
902:    learn: 0.2050448        total: 27.3s    remaining: 2.93s
903:    learn: 0.2050431        total: 27.3s    remaining: 2.9s
904:    learn: 0.2050321        total: 27.4s    remaining: 2.87s
905:    learn: 0.2050261        total: 27.4s    remaining: 2.84s
906:    learn: 0.2050110        total: 27.4s    remaining: 2.81s
907:    learn: 0.2050019        total: 27.4s    remaining: 2.78s
908:    learn: 0.2049919        total: 27.5s    remaining: 2.75s
909:    learn: 0.2049808        total: 27.5s    remaining: 2.72s
910:    learn: 0.2049757        total: 27.5s    remaining: 2.69s
911:    learn: 0.2049734        total: 27.6s    remaining: 2.66s
912:    learn: 0.2049598        total: 27.6s    remaining: 2.63s
913:    learn: 0.2049550        total: 27.6s    remaining: 2.6s
914:    learn: 0.2049481        total: 27.7s    remaining: 2.57s
915:    learn: 0.2049426        total: 27.7s    remaining: 2.54s
916:    learn: 0.2049319        total: 27.7s    remaining: 2.51s
917:    learn: 0.2049230        total: 27.8s    remaining: 2.48s
918:    learn: 0.2049025        total: 27.8s    remaining: 2.45s
919:    learn: 0.2048958        total: 27.8s    remaining: 2.42s
920:    learn: 0.2048875        total: 27.9s    remaining: 2.39s
921:    learn: 0.2048826        total: 27.9s    remaining: 2.36s
922:    learn: 0.2048718        total: 27.9s    remaining: 2.33s
923:    learn: 0.2048578        total: 27.9s    remaining: 2.3s
924:    learn: 0.2048497        total: 28s      remaining: 2.27s
925:    learn: 0.2048479        total: 28s      remaining: 2.24s
926:    learn: 0.2048363        total: 28s      remaining: 2.21s
927:    learn: 0.2048303        total: 28.1s    remaining: 2.18s
928:    learn: 0.2048162        total: 28.1s    remaining: 2.15s
929:    learn: 0.2048045        total: 28.1s    remaining: 2.12s
930:    learn: 0.2047814        total: 28.2s    remaining: 2.09s
931:    learn: 0.2047798        total: 28.2s    remaining: 2.06s
932:    learn: 0.2047736        total: 28.2s    remaining: 2.03s
933:    learn: 0.2047570        total: 28.3s    remaining: 2s
934:    learn: 0.2047443        total: 28.3s    remaining: 1.97s
935:    learn: 0.2047382        total: 28.3s    remaining: 1.94s
936:    learn: 0.2047366        total: 28.3s    remaining: 1.91s
937:    learn: 0.2047216        total: 28.4s    remaining: 1.88s
938:    learn: 0.2047139        total: 28.4s    remaining: 1.84s
939:    learn: 0.2047121        total: 28.4s    remaining: 1.81s
940:    learn: 0.2047101        total: 28.5s    remaining: 1.78s
941:    learn: 0.2047082        total: 28.5s    remaining: 1.75s
942:    learn: 0.2046904        total: 28.5s    remaining: 1.72s
```

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943:    learn: 0.2046801        total: 28.5s    remaining: 1.69s
944:    learn: 0.2046723        total: 28.6s    remaining: 1.66s
945:    learn: 0.2046606        total: 28.6s    remaining: 1.63s
946:    learn: 0.2046542        total: 28.6s    remaining: 1.6s
947:    learn: 0.2046464        total: 28.7s    remaining: 1.57s
948:    learn: 0.2046449        total: 28.7s    remaining: 1.54s
949:    learn: 0.2046340        total: 28.7s    remaining: 1.51s
950:    learn: 0.2046199        total: 28.8s    remaining: 1.48s
951:    learn: 0.2046074        total: 28.8s    remaining: 1.45s
952:    learn: 0.2045977        total: 28.8s    remaining: 1.42s
953:    learn: 0.2045936        total: 28.9s    remaining: 1.39s
954:    learn: 0.2045835        total: 28.9s    remaining: 1.36s
955:    learn: 0.2045756        total: 28.9s    remaining: 1.33s
956:    learn: 0.2045643        total: 29s      remaining: 1.3s
957:    learn: 0.2045629        total: 29s      remaining: 1.27s
958:    learn: 0.2045494        total: 29s      remaining: 1.24s
959:    learn: 0.2045388        total: 29s      remaining: 1.21s
960:    learn: 0.2045287        total: 29.1s    remaining: 1.18s
961:    learn: 0.2045152        total: 29.1s    remaining: 1.15s
962:    learn: 0.2045068        total: 29.1s    remaining: 1.12s
963:    learn: 0.2044912        total: 29.2s    remaining: 1.09s
964:    learn: 0.2044867        total: 29.2s    remaining: 1.06s
965:    learn: 0.2044842        total: 29.2s    remaining: 1.03s
966:    learn: 0.2044795        total: 29.3s    remaining: 998ms
967:    learn: 0.2044584        total: 29.3s    remaining: 968ms
968:    learn: 0.2044506        total: 29.3s    remaining: 938ms
969:    learn: 0.2044443        total: 29.3s    remaining: 908ms
970:    learn: 0.2044378        total: 29.4s    remaining: 877ms
971:    learn: 0.2044334        total: 29.4s    remaining: 847ms
972:    learn: 0.2044273        total: 29.4s    remaining: 817ms
973:    learn: 0.2044162        total: 29.5s    remaining: 787ms
974:    learn: 0.2044103        total: 29.5s    remaining: 757ms
975:    learn: 0.2044002        total: 29.5s    remaining: 726ms
976:    learn: 0.2043929        total: 29.6s    remaining: 696ms
977:    learn: 0.2043886        total: 29.6s    remaining: 666ms
978:    learn: 0.2043788        total: 29.6s    remaining: 635ms
979:    learn: 0.2043615        total: 29.7s    remaining: 605ms
980:    learn: 0.2043601        total: 29.7s    remaining: 575ms
981:    learn: 0.2043525        total: 29.7s    remaining: 545ms
982:    learn: 0.2043489        total: 29.7s    remaining: 514ms
983:    learn: 0.2043324        total: 29.8s    remaining: 484ms
984:    learn: 0.2043310        total: 29.8s    remaining: 454ms
985:    learn: 0.2043248        total: 29.8s    remaining: 424ms
986:    learn: 0.2043139        total: 29.9s    remaining: 393ms
987:    learn: 0.2043011        total: 29.9s    remaining: 363ms
988:    learn: 0.2042988        total: 29.9s    remaining: 333ms
989:    learn: 0.2042966        total: 30s      remaining: 303ms
990:    learn: 0.2042826        total: 30s      remaining: 272ms
```
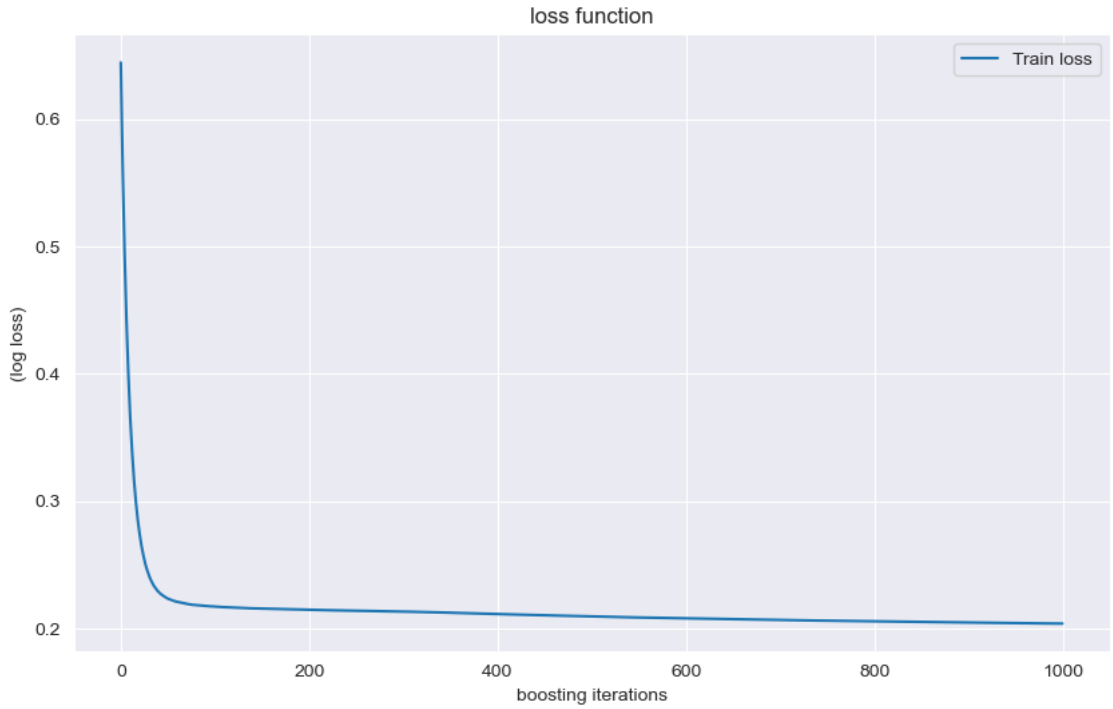

```
991:    learn: 0.2042743        total: 30s      remaining: 242ms
992:    learn: 0.2042691        total: 30s      remaining: 212ms
993:    learn: 0.2042649        total: 30.1s    remaining: 182ms
994:    learn: 0.2042589        total: 30.1s    remaining: 151ms
995:    learn: 0.2042544        total: 30.1s    remaining: 121ms
996:    learn: 0.2042535        total: 30.2s    remaining: 90.8ms
997:    learn: 0.2042453        total: 30.2s    remaining: 60.5ms
998:    learn: 0.2042363        total: 30.2s    remaining: 30.3ms
999:    learn: 0.2042324        total: 30.3s    remaining: 0us
```

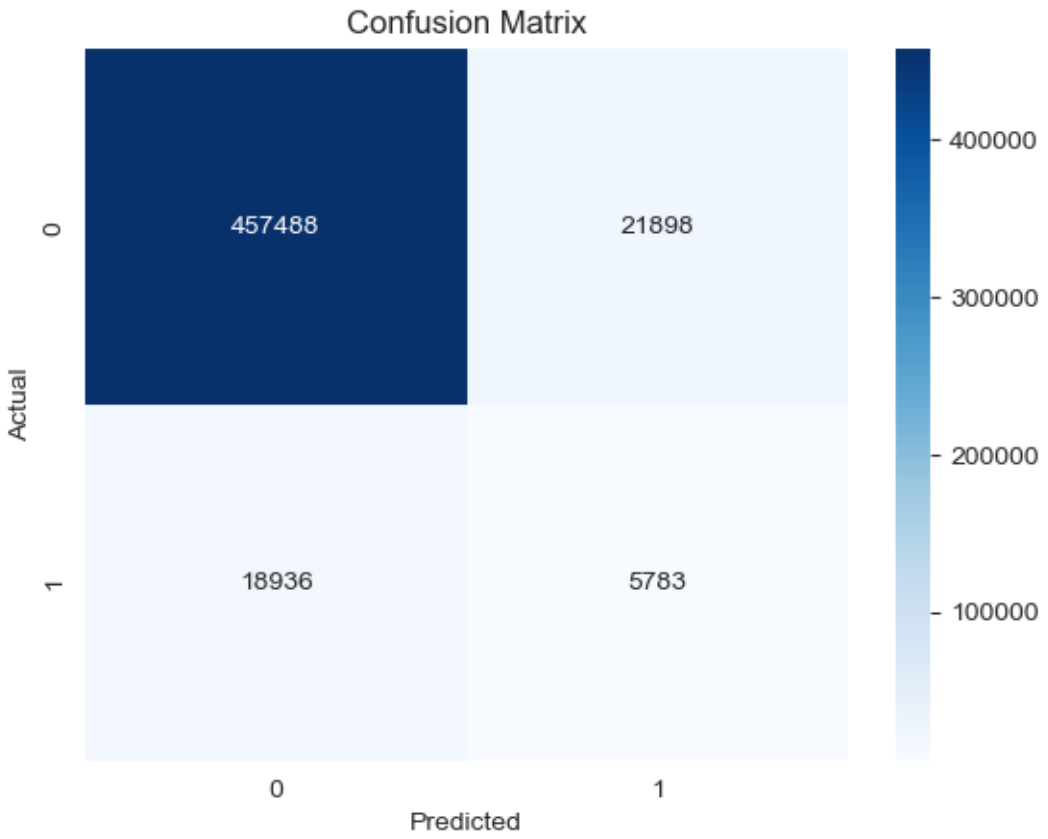
[40]: `<catboost.core.CatBoostClassifier at 0x1fac36852d0>`

[41]:
```
train_loss = model.get_evals_result()['learn']['Logloss']

plt.figure(figsize=(10, 6))
plt.plot(train_loss, label='Train loss')
plt.xlabel('boosting iterations')
plt.ylabel('(log loss)')
plt.title('loss function')
plt.legend()
plt.grid(True)
plt.show()
```

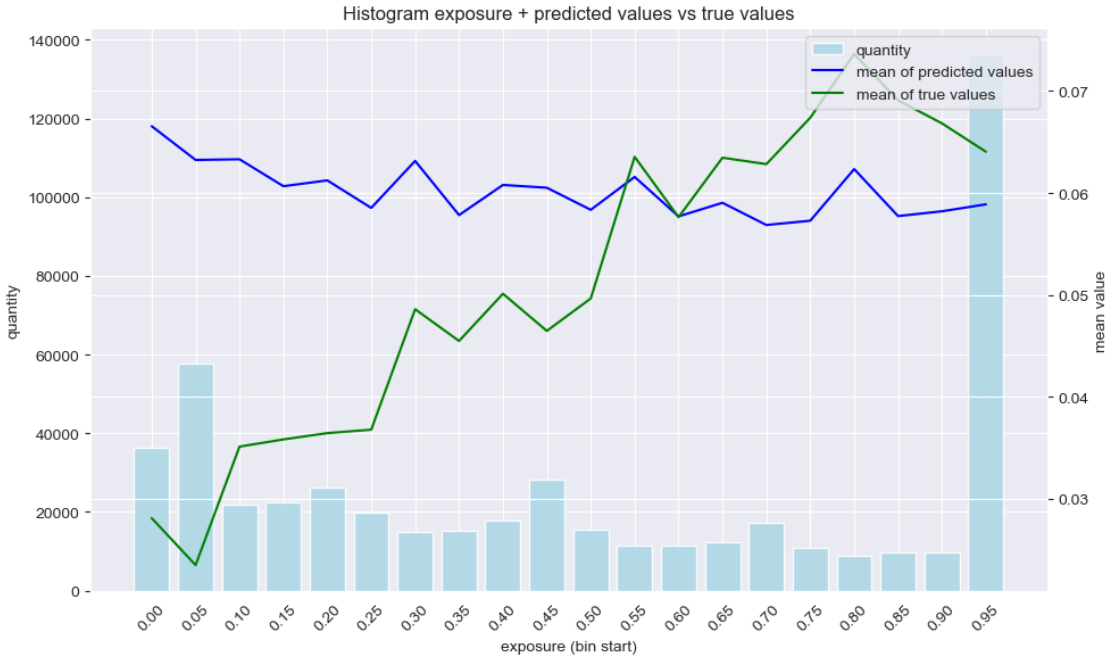


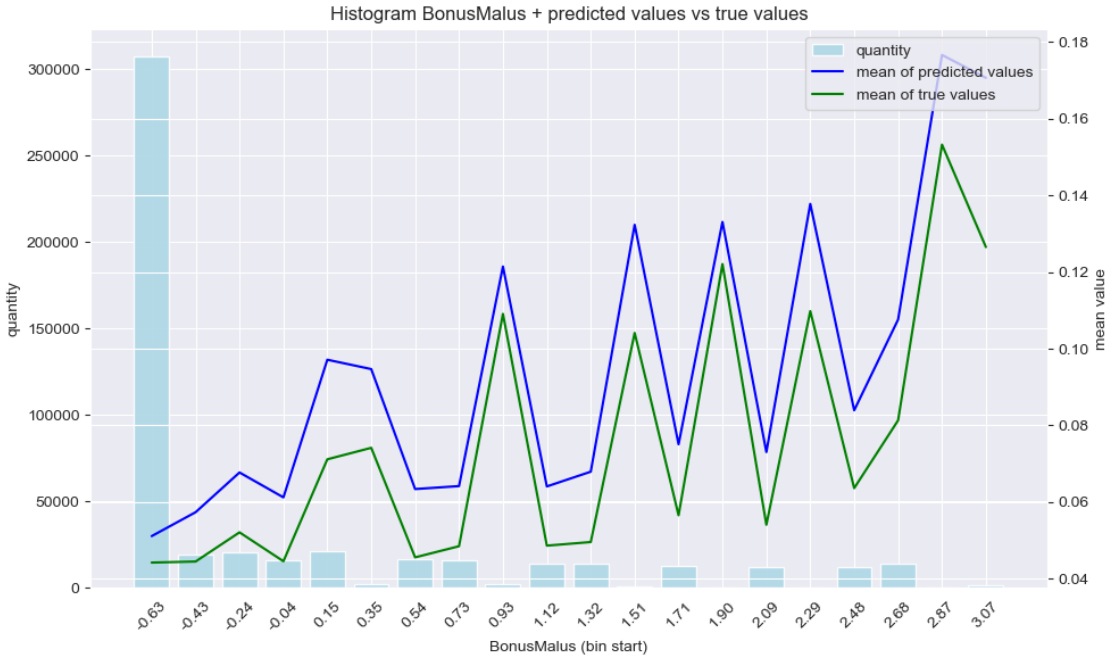
[42]:
```
print("TRAIN-SET SCORING")
y_pred = model.predict_proba(X_train_val)[:,1]
stats = score_binary_model(y_train_val,y_pred)
models_stats_train['catboost_tuned_train'] = stats

print("TRAIN-SET PLOTTING")
plot_predict_with_feature(exposure_train_val_df,y_train_val,y_pred,'exposure')
for col in numeric_columns:
    plot_predict_with_feature(X_train_val,y_train_val,y_pred,col)

print("TEST-SET SCORING")
y_pred = model.predict_proba(X_test)[:,1]
stats =␣
 ↪score_binary_model(y_test,y_pred,models_stats_train['catboost_tuned_train']['best_threshold
models_stats_test['catboost_tuned_test'] = stats

print("TEST-SET PLOTTING")
plot_predict_with_feature(exposure_test_df,y_test,y_pred,'exposure')
for col in numeric_columns:
    plot_predict_with_feature(X_test,y_test,y_pred,col)
```

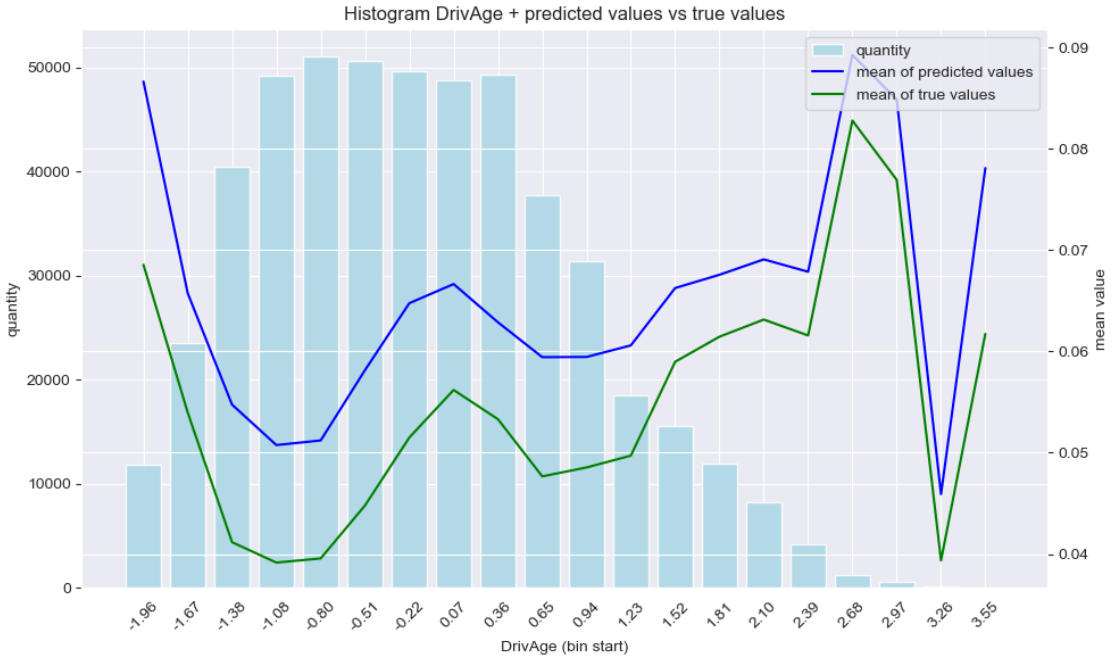
```
TRAIN-SET SCORING
ROC-AUC score: 0.713484418278108
F1-score:  0.22072519083969466
Accuracy: 0.918997034348003
Recall: 0.23394959343015495
Precision: 0.20891586286622593
```

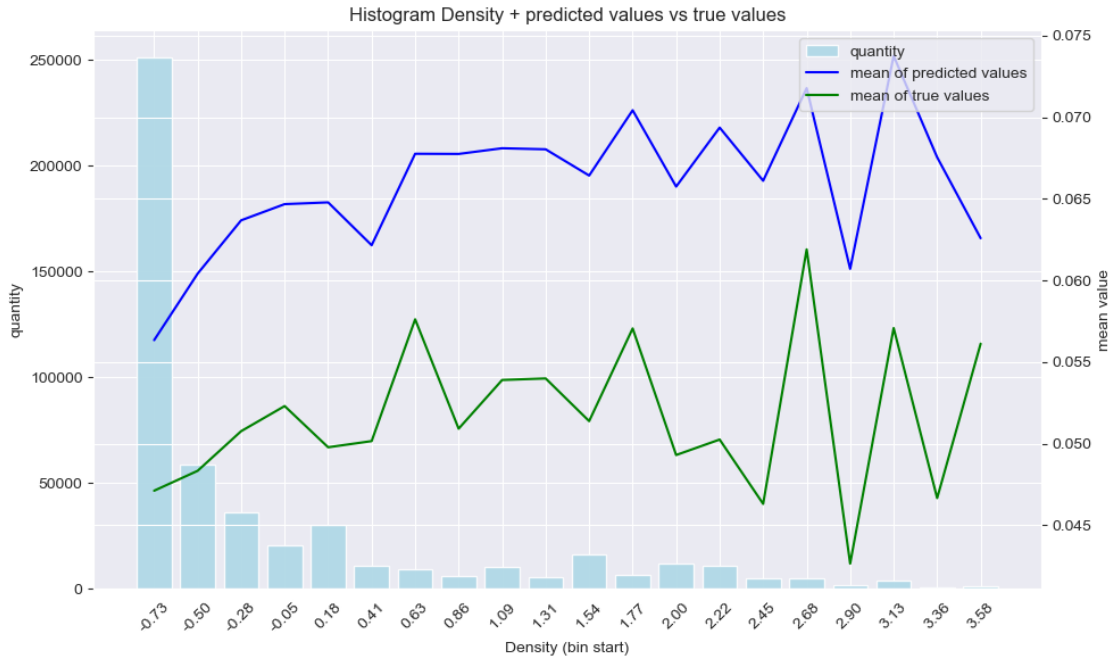


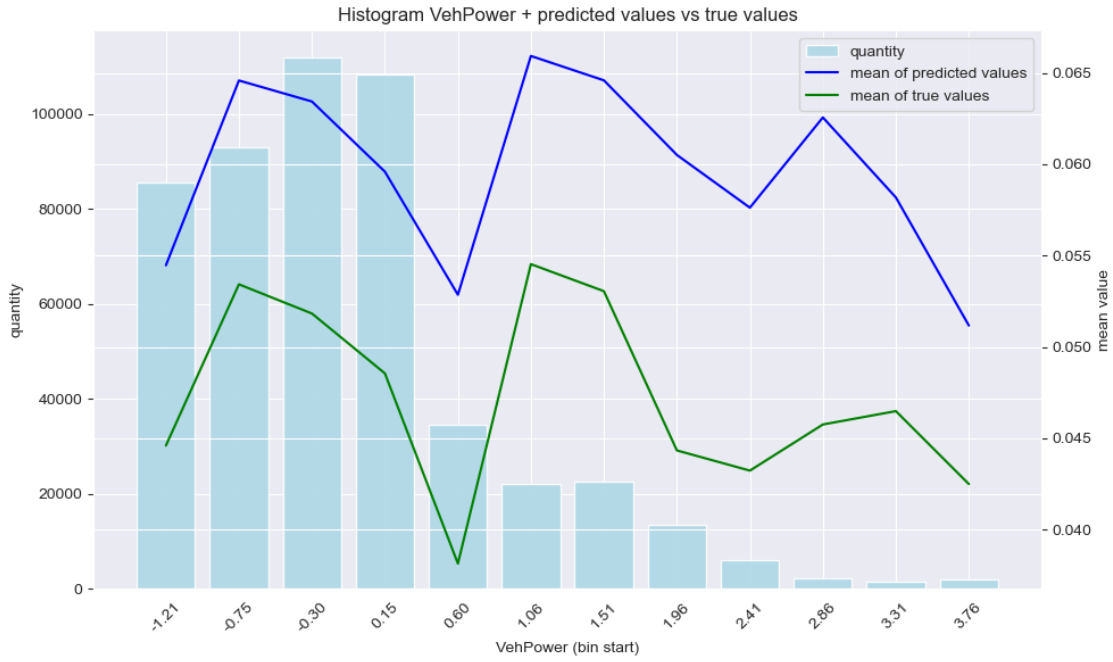
TRAIN-SET PLOTTING

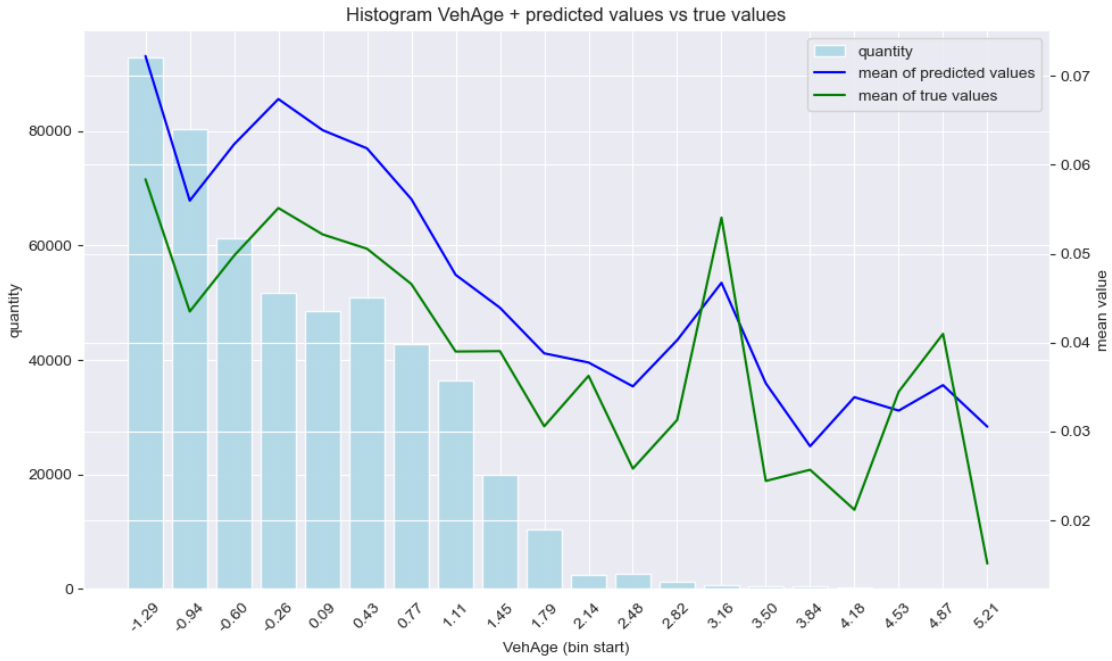



Histogram BonusMalus + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
BonusMalus (bin start)
300000
250000
200000
150000
100000
50000
0
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
-0.63
-0.43
-0.24
-0.04
0.15
0.35
0.54
0.73
0.93
1.12
1.32
1.51
1.71
1.90
2.09
2.29
2.48
2.68
2.87
3.07

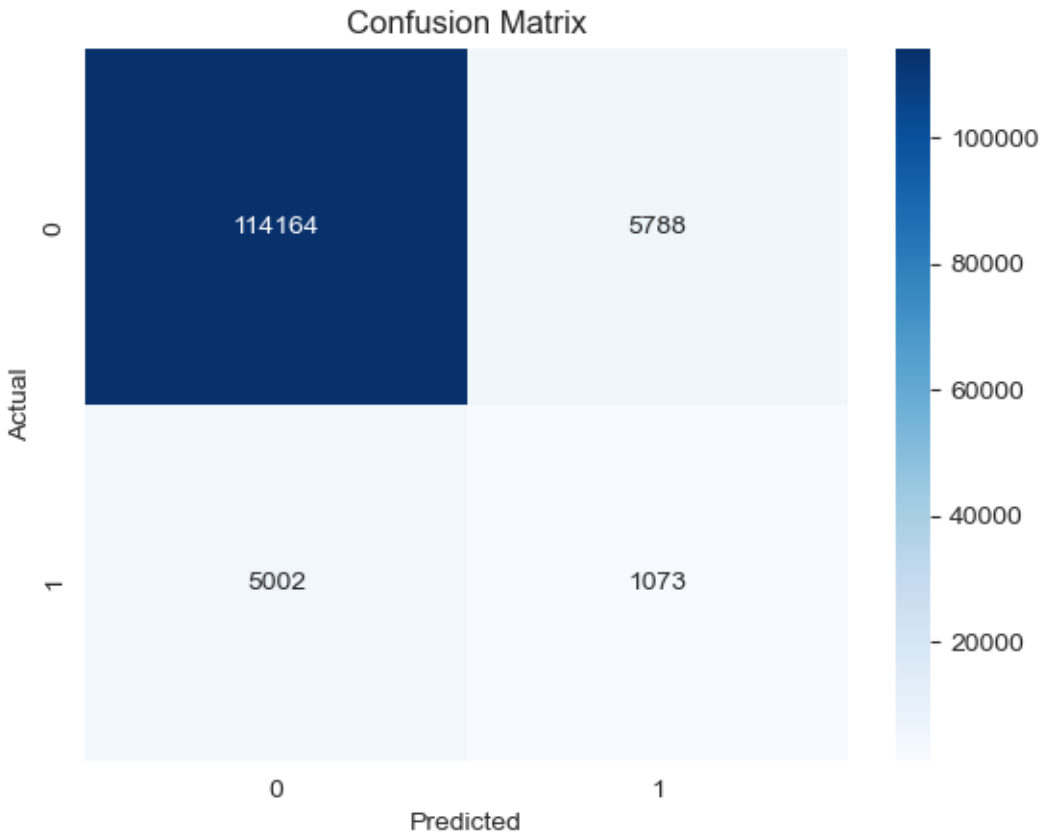

Histogram DrivAge + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
DrivAge (bin start)
50000
40000
30000
20000
10000
0
0.09
0.08
0.07
0.06
0.05
0.04
-1.96
-1.67
-1.38
-1.08
-0.80
-0.51
-0.22
0.07
0.36
0.65
0.94
1.23
1.52
1.81
2.10
2.39
2.68
2.97
3.26
3.55


Histogram Density + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
Density (bin start)
250000
200000
150000
100000
50000
0
0.075
0.070
0.065
0.060
0.055
0.050
0.045
-0.73
-0.50
-0.28
-0.05
0.18
0.41
0.63
0.86
1.09
1.31
1.54
1.77
2.00
2.22
2.45
2.68
2.90
3.13
3.36
3.58

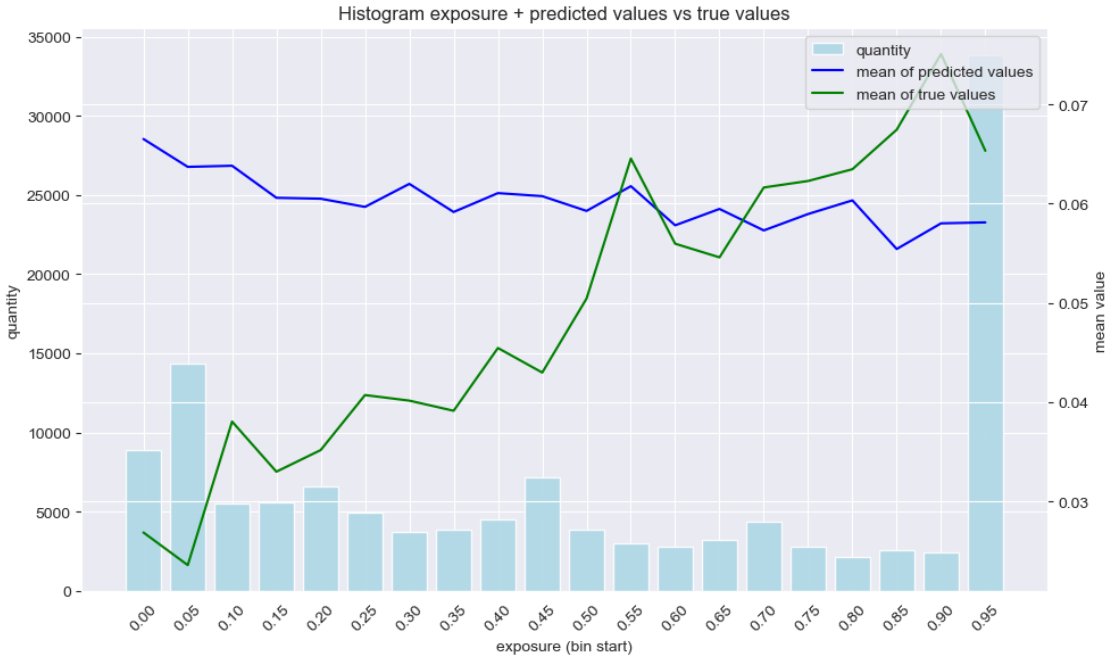

Histogram VehPower + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
VehPower (bin start)
100000
80000
60000
40000
20000
0
0.065
0.060
0.055
0.050
0.045
0.040
-1.21
-0.75
-0.30
0.15
0.60
1.06
1.51
1.96
2.41
2.86
3.31
3.76

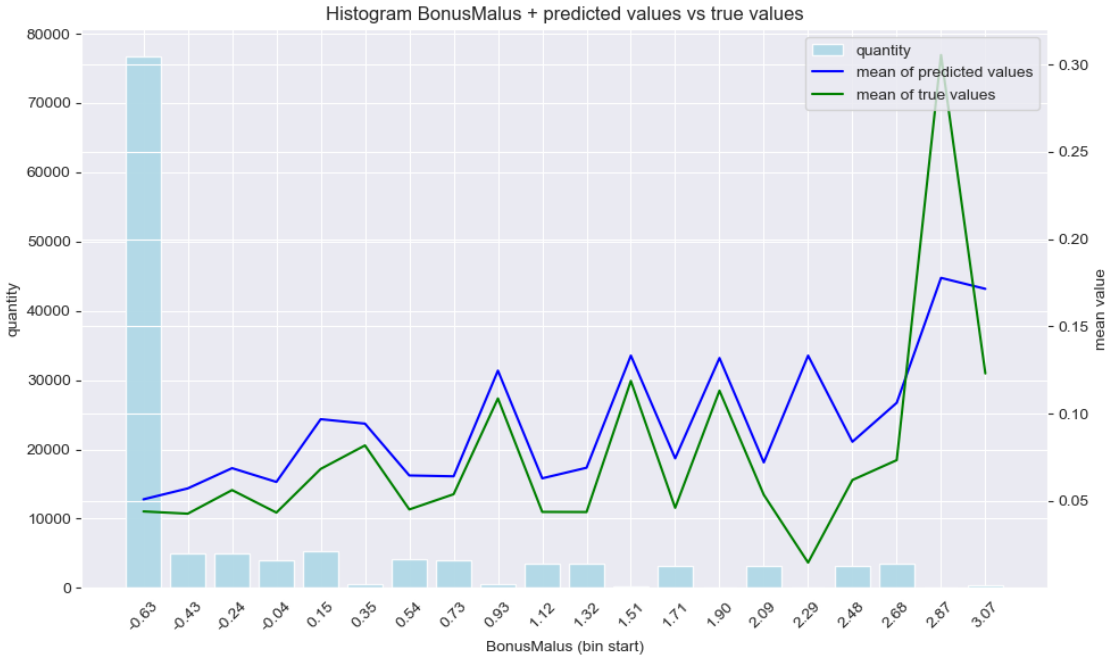


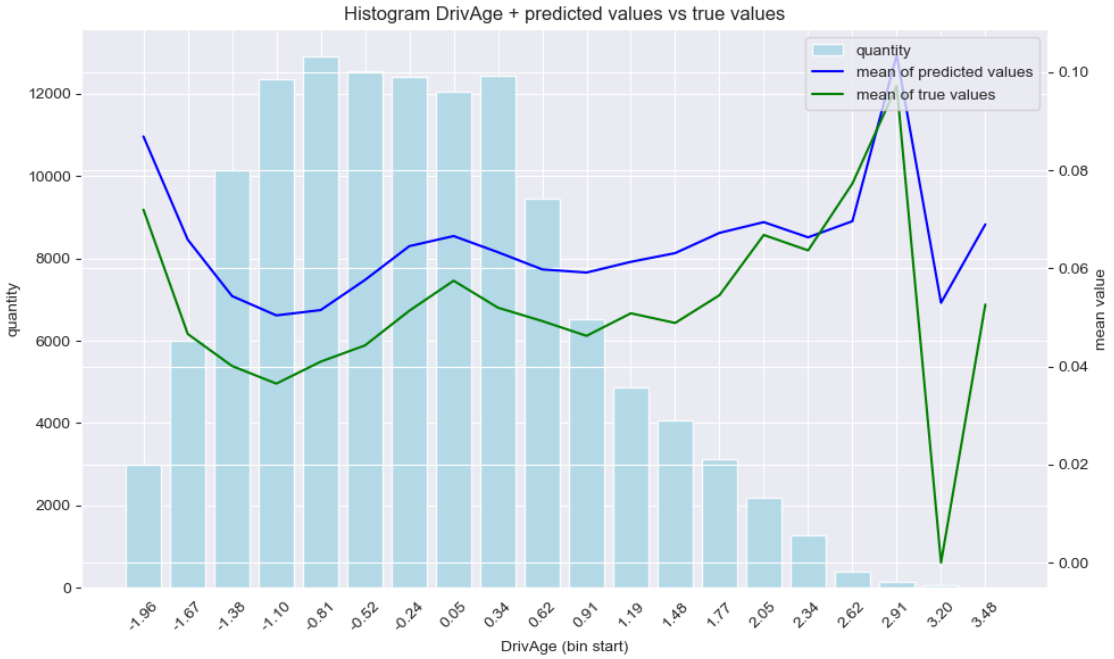

```
TEST-SET SCORING
ROC-AUC score: 0.6571653229192912
F1-score:  0.16589363017934447
Accuracy: 0.9143834257738421
Recall: 0.1766255144032922
Precision: 0.15639119661856873
```

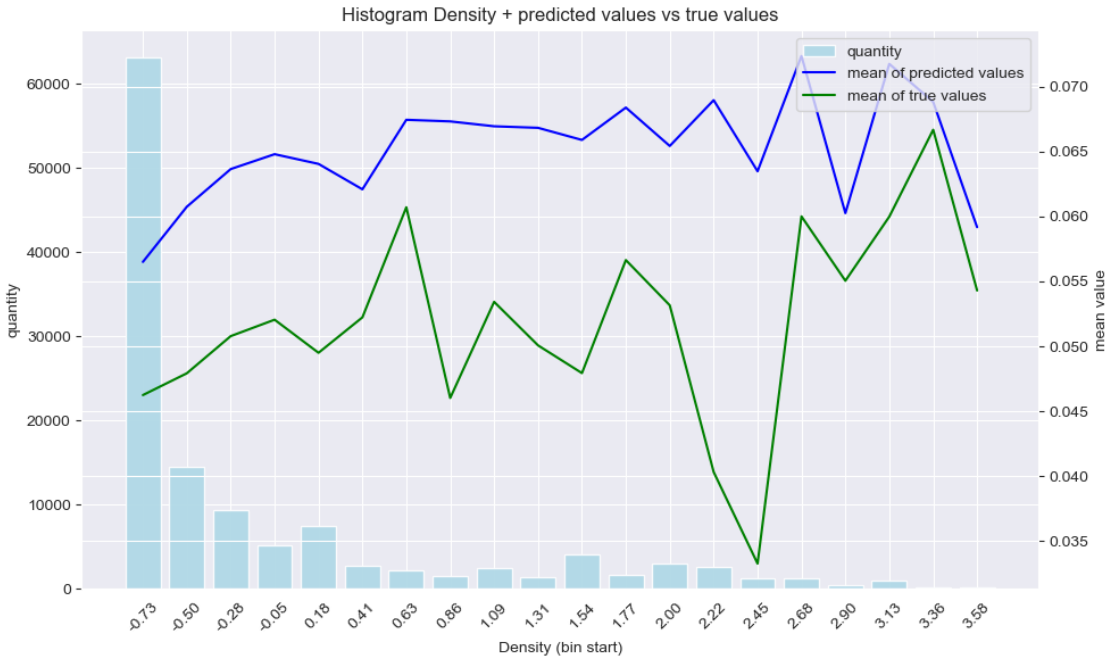


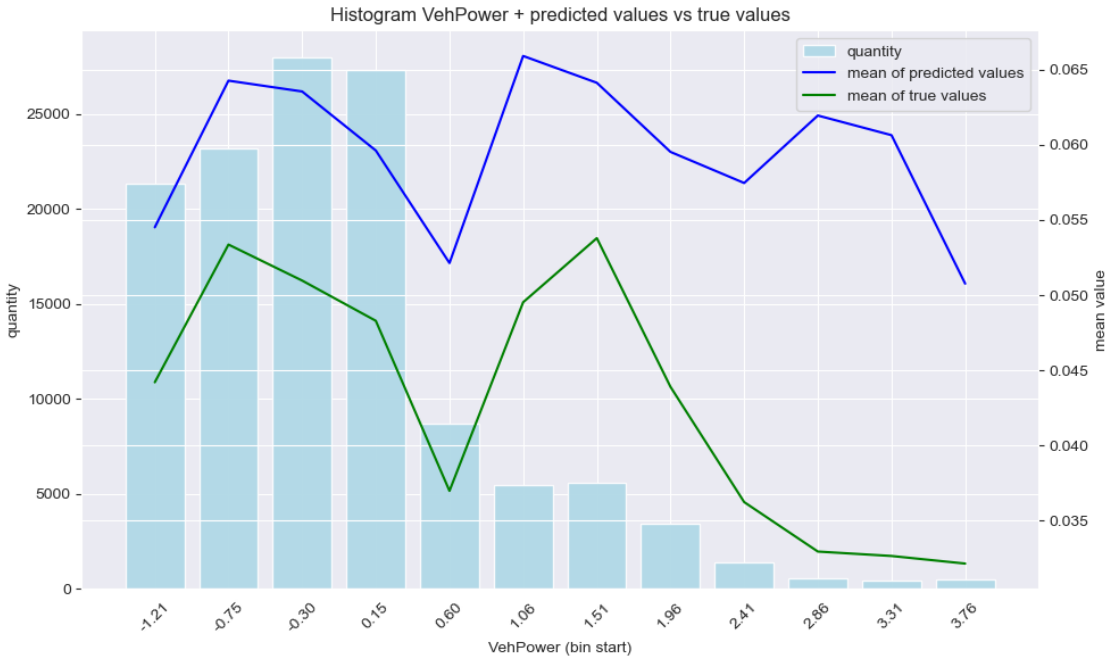
TEST-SET PLOTTING

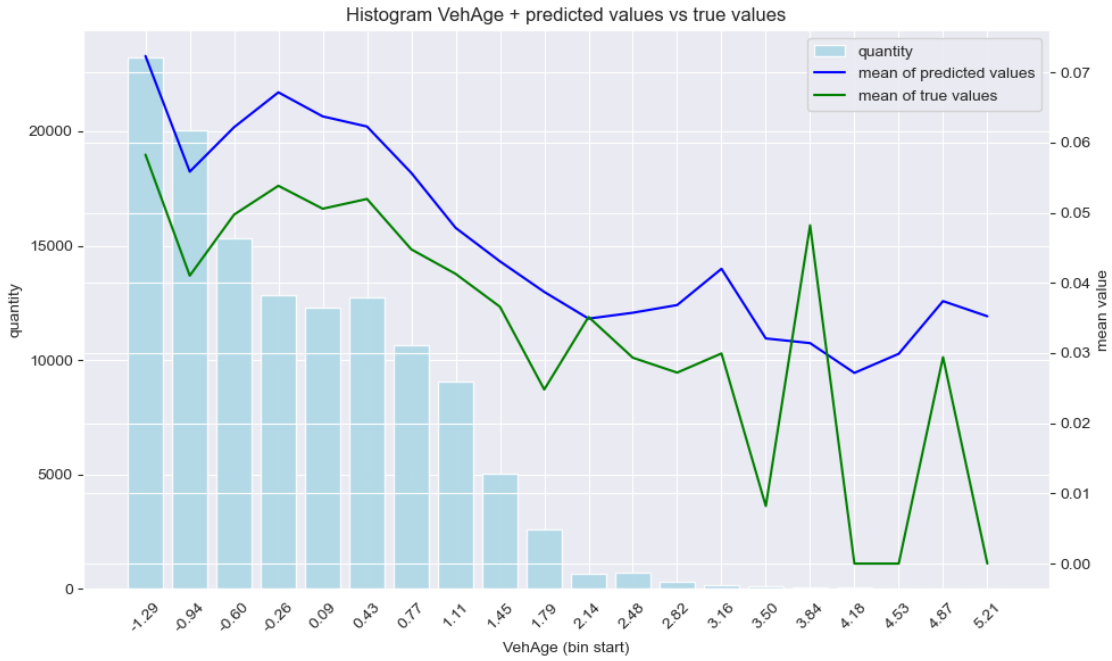



Histogram BonusMalus + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
BonusMalus (bin start)
80000
70000
60000
50000
40000
30000
20000
10000
0
0.30
0.25
0.20
0.15
0.10
0.05
-0.63
-0.43
-0.24
-0.04
0.15
0.35
0.54
0.73
0.93
1.12
1.32
1.51
1.71
1.90
2.09
2.29
2.48
2.68
2.87
3.07

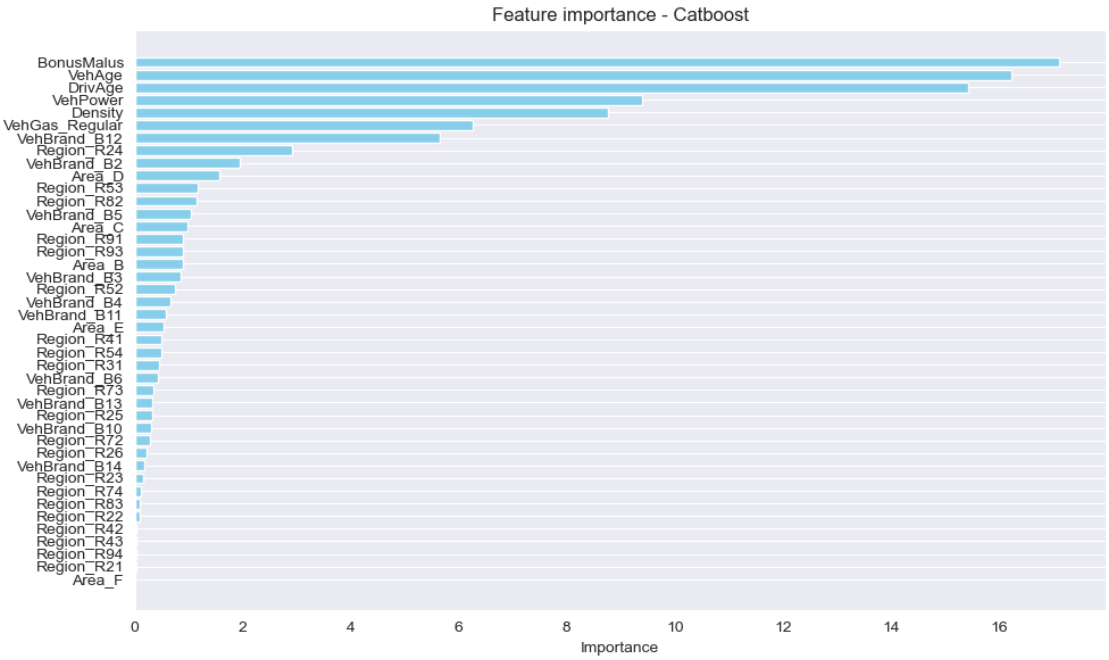

Histogram DrivAge + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
DrivAge (bin start)
12000
10000
8000
6000
4000
2000
0
0.10
0.08
0.06
0.04
0.02
0.00
-1.96
-1.67
-1.38
-1.10
-0.81
-0.52
-0.24
0.05
0.34
0.62
0.91
1.19
1.48
1.77
2.05
2.34
2.62
2.91
3.20
3.48


Histogram Density + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
Density (bin start)
-0.73
-0.50
-0.28
-0.05
0.18
0.41
0.63
0.86
1.09
1.31
1.54
1.77
2.00
2.22
2.45
2.68
2.90
3.13
3.36
3.58


Histogram VehPower + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
VehPower (bin start)
-1.21
-0.75
-0.30
0.15
0.60
1.06
1.51
1.96
2.41
2.86
3.31
3.76



[43]:
```
importances = model.feature_importances_
feature_names = X_train.columns

feat_imp = pd.DataFrame({
    'feature': feature_names,
    'importance': importances
}).sort_values(by='importance', ascending=False)

plt.figure(figsize=(10, 6))
plt.barh(feat_imp['feature'], feat_imp['importance'], color='skyblue')
plt.gca().invert_yaxis()
plt.xlabel('Importance')
plt.title('Feature importance - Catboost')
plt.grid(axis='x')
plt.tight_layout()
plt.show()
```



3.10.1 catboost with more weighted target to improve recall

[44]:
```
catboost = CatBoostClassifier(
    bagging_temperature=1,
    depth=9,
    iterations=1000,
    l2_leaf_reg=30,
    learning_rate=0.0411,
    random_strength=6
)
catboost.fit(X_train_val,␣
 ↪y_train_val,sample_weight=weights_with_exposure_val_train)
```

```
0:      learn: 0.6915181        total: 32ms     remaining: 32s
1:      learn: 0.6897459        total: 62.6ms   remaining: 31.2s
2:      learn: 0.6883258        total: 91.8ms   remaining: 30.5s
3:      learn: 0.6867881        total: 120ms    remaining: 29.9s
4:      learn: 0.6854369        total: 150ms    remaining: 29.9s
5:      learn: 0.6841201        total: 181ms    remaining: 29.9s
6:      learn: 0.6831504        total: 212ms    remaining: 30.1s
7:      learn: 0.6821424        total: 246ms    remaining: 30.6s
8:      learn: 0.6810505        total: 277ms    remaining: 30.5s
9:      learn: 0.6799481        total: 308ms    remaining: 30.4s
10:     learn: 0.6791650        total: 338ms    remaining: 30.4s
11:     learn: 0.6783088        total: 359ms    remaining: 29.5s
12:     learn: 0.6775896        total: 388ms    remaining: 29.5s
```

```
13:     learn: 0.6769089        total: 415ms    remaining: 29.2s
14:     learn: 0.6762916        total: 445ms    remaining: 29.2s
15:     learn: 0.6755966        total: 469ms    remaining: 28.9s
16:     learn: 0.6750570        total: 498ms    remaining: 28.8s
17:     learn: 0.6743316        total: 530ms    remaining: 28.9s
18:     learn: 0.6737333        total: 561ms    remaining: 29s
19:     learn: 0.6731188        total: 592ms    remaining: 29s
20:     learn: 0.6720989        total: 625ms    remaining: 29.1s
21:     learn: 0.6714880        total: 656ms    remaining: 29.2s
22:     learn: 0.6711203        total: 689ms    remaining: 29.3s
23:     learn: 0.6703079        total: 721ms    remaining: 29.3s
24:     learn: 0.6696050        total: 756ms    remaining: 29.5s
25:     learn: 0.6691759        total: 786ms    remaining: 29.4s
26:     learn: 0.6686610        total: 819ms    remaining: 29.5s
27:     learn: 0.6681830        total: 845ms    remaining: 29.3s
28:     learn: 0.6679721        total: 875ms    remaining: 29.3s
29:     learn: 0.6674754        total: 905ms    remaining: 29.3s
30:     learn: 0.6669250        total: 939ms    remaining: 29.4s
31:     learn: 0.6663286        total: 971ms    remaining: 29.4s
32:     learn: 0.6659718        total: 1.01s    remaining: 29.6s
33:     learn: 0.6655925        total: 1.04s    remaining: 29.6s
34:     learn: 0.6652990        total: 1.07s    remaining: 29.4s
35:     learn: 0.6649543        total: 1.1s     remaining: 29.4s
36:     learn: 0.6648425        total: 1.12s    remaining: 29.1s
37:     learn: 0.6644438        total: 1.15s    remaining: 29.1s
38:     learn: 0.6643551        total: 1.17s    remaining: 28.8s
39:     learn: 0.6638965        total: 1.2s     remaining: 28.8s
40:     learn: 0.6636851        total: 1.23s    remaining: 28.8s
41:     learn: 0.6633809        total: 1.27s    remaining: 28.9s
42:     learn: 0.6631327        total: 1.3s     remaining: 28.9s
43:     learn: 0.6628278        total: 1.33s    remaining: 28.9s
44:     learn: 0.6626461        total: 1.36s    remaining: 28.9s
45:     learn: 0.6624564        total: 1.39s    remaining: 28.9s
46:     learn: 0.6623632        total: 1.41s    remaining: 28.7s
47:     learn: 0.6620649        total: 1.45s    remaining: 28.7s
48:     learn: 0.6617483        total: 1.48s    remaining: 28.7s
49:     learn: 0.6615959        total: 1.51s    remaining: 28.7s
50:     learn: 0.6614359        total: 1.54s    remaining: 28.7s
51:     learn: 0.6612110        total: 1.57s    remaining: 28.7s
52:     learn: 0.6609764        total: 1.6s     remaining: 28.7s
53:     learn: 0.6608202        total: 1.64s    remaining: 28.7s
54:     learn: 0.6606403        total: 1.67s    remaining: 28.6s
55:     learn: 0.6605119        total: 1.7s     remaining: 28.6s
56:     learn: 0.6602649        total: 1.72s    remaining: 28.4s
57:     learn: 0.6601184        total: 1.75s    remaining: 28.4s
58:     learn: 0.6600382        total: 1.78s    remaining: 28.4s
59:     learn: 0.6600173        total: 1.8s     remaining: 28.2s
60:     learn: 0.6598348        total: 1.83s    remaining: 28.2s
```

```
61:     learn: 0.6596414        total: 1.86s    remaining: 28.1s
62:     learn: 0.6595301        total: 1.89s    remaining: 28s
63:     learn: 0.6591711        total: 1.92s    remaining: 28s
64:     learn: 0.6588870        total: 1.95s    remaining: 28s
65:     learn: 0.6587525        total: 1.98s    remaining: 28s
66:     learn: 0.6586675        total: 2.01s    remaining: 28.1s
67:     learn: 0.6584565        total: 2.04s    remaining: 28s
68:     learn: 0.6584212        total: 2.06s    remaining: 27.8s
69:     learn: 0.6583211        total: 2.09s    remaining: 27.8s
70:     learn: 0.6582515        total: 2.11s    remaining: 27.7s
71:     learn: 0.6581901        total: 2.14s    remaining: 27.6s
72:     learn: 0.6579540        total: 2.17s    remaining: 27.6s
73:     learn: 0.6577589        total: 2.21s    remaining: 27.6s
74:     learn: 0.6577103        total: 2.24s    remaining: 27.6s
75:     learn: 0.6576641        total: 2.26s    remaining: 27.5s
76:     learn: 0.6576311        total: 2.28s    remaining: 27.3s
77:     learn: 0.6575305        total: 2.3s     remaining: 27.2s
78:     learn: 0.6573896        total: 2.33s    remaining: 27.2s
79:     learn: 0.6572818        total: 2.36s    remaining: 27.2s
80:     learn: 0.6570326        total: 2.39s    remaining: 27.2s
81:     learn: 0.6569899        total: 2.42s    remaining: 27.1s
82:     learn: 0.6568220        total: 2.46s    remaining: 27.1s
83:     learn: 0.6567256        total: 2.49s    remaining: 27.2s
84:     learn: 0.6566142        total: 2.52s    remaining: 27.2s
85:     learn: 0.6565706        total: 2.55s    remaining: 27.1s
86:     learn: 0.6564047        total: 2.58s    remaining: 27.1s
87:     learn: 0.6562988        total: 2.61s    remaining: 27.1s
88:     learn: 0.6561053        total: 2.64s    remaining: 27s
89:     learn: 0.6558403        total: 2.67s    remaining: 27s
90:     learn: 0.6555797        total: 2.7s     remaining: 27s
91:     learn: 0.6555366        total: 2.72s    remaining: 26.8s
92:     learn: 0.6554799        total: 2.75s    remaining: 26.8s
93:     learn: 0.6553806        total: 2.78s    remaining: 26.8s
94:     learn: 0.6553634        total: 2.8s     remaining: 26.6s
95:     learn: 0.6553437        total: 2.82s    remaining: 26.5s
96:     learn: 0.6552140        total: 2.85s    remaining: 26.5s
97:     learn: 0.6551041        total: 2.88s    remaining: 26.5s
98:     learn: 0.6550317        total: 2.91s    remaining: 26.5s
99:     learn: 0.6548536        total: 2.94s    remaining: 26.5s
100:    learn: 0.6548264        total: 2.96s    remaining: 26.4s
101:    learn: 0.6547326        total: 2.99s    remaining: 26.4s
102:    learn: 0.6546679        total: 3.02s    remaining: 26.3s
103:    learn: 0.6545867        total: 3.05s    remaining: 26.3s
104:    learn: 0.6544234        total: 3.08s    remaining: 26.3s
105:    learn: 0.6542861        total: 3.12s    remaining: 26.3s
106:    learn: 0.6542150        total: 3.15s    remaining: 26.3s
107:    learn: 0.6541148        total: 3.18s    remaining: 26.2s
108:    learn: 0.6540201        total: 3.21s    remaining: 26.2s
```

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109:    learn: 0.6538641        total: 3.23s    remaining: 26.1s
110:    learn: 0.6538313        total: 3.25s    remaining: 26.1s
111:    learn: 0.6537821        total: 3.28s    remaining: 26s
112:    learn: 0.6535820        total: 3.31s    remaining: 26s
113:    learn: 0.6534858        total: 3.35s    remaining: 26s
114:    learn: 0.6534124        total: 3.38s    remaining: 26s
115:    learn: 0.6532872        total: 3.41s    remaining: 26s
116:    learn: 0.6531809        total: 3.44s    remaining: 26s
117:    learn: 0.6530457        total: 3.47s    remaining: 25.9s
118:    learn: 0.6529017        total: 3.51s    remaining: 26s
119:    learn: 0.6528560        total: 3.53s    remaining: 25.9s
120:    learn: 0.6528560        total: 3.55s    remaining: 25.8s
121:    learn: 0.6527592        total: 3.58s    remaining: 25.7s
122:    learn: 0.6526878        total: 3.61s    remaining: 25.7s
123:    learn: 0.6524924        total: 3.64s    remaining: 25.7s
124:    learn: 0.6523504        total: 3.67s    remaining: 25.7s
125:    learn: 0.6522576        total: 3.7s     remaining: 25.7s
126:    learn: 0.6522077        total: 3.73s    remaining: 25.6s
127:    learn: 0.6521207        total: 3.76s    remaining: 25.6s
128:    learn: 0.6520026        total: 3.79s    remaining: 25.6s
129:    learn: 0.6518527        total: 3.82s    remaining: 25.6s
130:    learn: 0.6516667        total: 3.85s    remaining: 25.6s
131:    learn: 0.6516000        total: 3.88s    remaining: 25.5s
132:    learn: 0.6515011        total: 3.92s    remaining: 25.5s
133:    learn: 0.6514693        total: 3.94s    remaining: 25.5s
134:    learn: 0.6514031        total: 3.97s    remaining: 25.4s
135:    learn: 0.6513949        total: 3.99s    remaining: 25.3s
136:    learn: 0.6513640        total: 4.02s    remaining: 25.3s
137:    learn: 0.6512157        total: 4.05s    remaining: 25.3s
138:    learn: 0.6510810        total: 4.08s    remaining: 25.3s
139:    learn: 0.6510092        total: 4.11s    remaining: 25.3s
140:    learn: 0.6508539        total: 4.14s    remaining: 25.2s
141:    learn: 0.6507697        total: 4.17s    remaining: 25.2s
142:    learn: 0.6506739        total: 4.2s     remaining: 25.2s
143:    learn: 0.6506145        total: 4.23s    remaining: 25.2s
144:    learn: 0.6505173        total: 4.27s    remaining: 25.2s
145:    learn: 0.6504376        total: 4.3s     remaining: 25.1s
146:    learn: 0.6503464        total: 4.33s    remaining: 25.1s
147:    learn: 0.6502863        total: 4.36s    remaining: 25.1s
148:    learn: 0.6501248        total: 4.39s    remaining: 25.1s
149:    learn: 0.6499496        total: 4.42s    remaining: 25s
150:    learn: 0.6499225        total: 4.45s    remaining: 25s
151:    learn: 0.6498402        total: 4.48s    remaining: 25s
152:    learn: 0.6497834        total: 4.51s    remaining: 25s
153:    learn: 0.6497690        total: 4.53s    remaining: 24.9s
154:    learn: 0.6496893        total: 4.56s    remaining: 24.9s
155:    learn: 0.6496512        total: 4.59s    remaining: 24.8s
156:    learn: 0.6495581        total: 4.62s    remaining: 24.8s
```

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157:    learn: 0.6495155        total: 4.65s    remaining: 24.8s
158:    learn: 0.6495125        total: 4.67s    remaining: 24.7s
159:    learn: 0.6495033        total: 4.7s     remaining: 24.7s
160:    learn: 0.6494601        total: 4.72s    remaining: 24.6s
161:    learn: 0.6493832        total: 4.75s    remaining: 24.6s
162:    learn: 0.6492876        total: 4.79s    remaining: 24.6s
163:    learn: 0.6492183        total: 4.82s    remaining: 24.6s
164:    learn: 0.6492046        total: 4.84s    remaining: 24.5s
165:    learn: 0.6491845        total: 4.86s    remaining: 24.4s
166:    learn: 0.6490807        total: 4.89s    remaining: 24.4s
167:    learn: 0.6489832        total: 4.92s    remaining: 24.4s
168:    learn: 0.6489557        total: 4.95s    remaining: 24.4s
169:    learn: 0.6488470        total: 4.98s    remaining: 24.3s
170:    learn: 0.6488257        total: 5.01s    remaining: 24.3s
171:    learn: 0.6486627        total: 5.04s    remaining: 24.3s
172:    learn: 0.6486553        total: 5.06s    remaining: 24.2s
173:    learn: 0.6485853        total: 5.09s    remaining: 24.2s
174:    learn: 0.6484793        total: 5.13s    remaining: 24.2s
175:    learn: 0.6484282        total: 5.17s    remaining: 24.2s
176:    learn: 0.6484083        total: 5.2s     remaining: 24.2s
177:    learn: 0.6483306        total: 5.22s    remaining: 24.1s
178:    learn: 0.6482388        total: 5.25s    remaining: 24.1s
179:    learn: 0.6481568        total: 5.29s    remaining: 24.1s
180:    learn: 0.6481542        total: 5.31s    remaining: 24s
181:    learn: 0.6481041        total: 5.34s    remaining: 24s
182:    learn: 0.6479987        total: 5.37s    remaining: 24s
183:    learn: 0.6478971        total: 5.41s    remaining: 24s
184:    learn: 0.6478201        total: 5.44s    remaining: 24s
185:    learn: 0.6477384        total: 5.47s    remaining: 23.9s
186:    learn: 0.6477382        total: 5.49s    remaining: 23.9s
187:    learn: 0.6477382        total: 5.5s     remaining: 23.8s
188:    learn: 0.6477302        total: 5.53s    remaining: 23.7s
189:    learn: 0.6476985        total: 5.56s    remaining: 23.7s
190:    learn: 0.6476209        total: 5.59s    remaining: 23.7s
191:    learn: 0.6475610        total: 5.62s    remaining: 23.7s
192:    learn: 0.6475549        total: 5.64s    remaining: 23.6s
193:    learn: 0.6474513        total: 5.67s    remaining: 23.6s
194:    learn: 0.6473640        total: 5.71s    remaining: 23.6s
195:    learn: 0.6471742        total: 5.74s    remaining: 23.5s
196:    learn: 0.6471704        total: 5.75s    remaining: 23.5s
197:    learn: 0.6470728        total: 5.79s    remaining: 23.5s
198:    learn: 0.6470538        total: 5.82s    remaining: 23.4s
199:    learn: 0.6469121        total: 5.85s    remaining: 23.4s
200:    learn: 0.6468882        total: 5.87s    remaining: 23.3s
201:    learn: 0.6468227        total: 5.9s     remaining: 23.3s
202:    learn: 0.6467562        total: 5.93s    remaining: 23.3s
203:    learn: 0.6467347        total: 5.95s    remaining: 23.2s
204:    learn: 0.6466157        total: 5.98s    remaining: 23.2s
```

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205:    learn: 0.6465448        total: 6.02s    remaining: 23.2s
206:    learn: 0.6465445        total: 6.04s    remaining: 23.1s
207:    learn: 0.6464899        total: 6.07s    remaining: 23.1s
208:    learn: 0.6464814        total: 6.09s    remaining: 23s
209:    learn: 0.6464069        total: 6.12s    remaining: 23s
210:    learn: 0.6463863        total: 6.14s    remaining: 23s
211:    learn: 0.6463863        total: 6.16s    remaining: 22.9s
212:    learn: 0.6463741        total: 6.18s    remaining: 22.9s
213:    learn: 0.6462920        total: 6.22s    remaining: 22.8s
214:    learn: 0.6461956        total: 6.25s    remaining: 22.8s
215:    learn: 0.6460970        total: 6.28s    remaining: 22.8s
216:    learn: 0.6460462        total: 6.31s    remaining: 22.8s
217:    learn: 0.6460053        total: 6.34s    remaining: 22.8s
218:    learn: 0.6459955        total: 6.37s    remaining: 22.7s
219:    learn: 0.6459100        total: 6.4s     remaining: 22.7s
220:    learn: 0.6458382        total: 6.43s    remaining: 22.7s
221:    learn: 0.6458311        total: 6.46s    remaining: 22.6s
222:    learn: 0.6457933        total: 6.49s    remaining: 22.6s
223:    learn: 0.6457731        total: 6.51s    remaining: 22.6s
224:    learn: 0.6457158        total: 6.54s    remaining: 22.5s
225:    learn: 0.6457067        total: 6.57s    remaining: 22.5s
226:    learn: 0.6456260        total: 6.6s     remaining: 22.5s
227:    learn: 0.6456256        total: 6.61s    remaining: 22.4s
228:    learn: 0.6455065        total: 6.65s    remaining: 22.4s
229:    learn: 0.6453840        total: 6.68s    remaining: 22.4s
230:    learn: 0.6452540        total: 6.71s    remaining: 22.3s
231:    learn: 0.6452129        total: 6.74s    remaining: 22.3s
232:    learn: 0.6451640        total: 6.77s    remaining: 22.3s
233:    learn: 0.6450659        total: 6.81s    remaining: 22.3s
234:    learn: 0.6450044        total: 6.84s    remaining: 22.3s
235:    learn: 0.6449619        total: 6.87s    remaining: 22.2s
236:    learn: 0.6449417        total: 6.9s     remaining: 22.2s
237:    learn: 0.6448978        total: 6.93s    remaining: 22.2s
238:    learn: 0.6448567        total: 6.96s    remaining: 22.2s
239:    learn: 0.6447540        total: 6.99s    remaining: 22.1s
240:    learn: 0.6447109        total: 7.02s    remaining: 22.1s
241:    learn: 0.6446585        total: 7.06s    remaining: 22.1s
242:    learn: 0.6446170        total: 7.09s    remaining: 22.1s
243:    learn: 0.6445318        total: 7.12s    remaining: 22.1s
244:    learn: 0.6444192        total: 7.15s    remaining: 22s
245:    learn: 0.6443640        total: 7.18s    remaining: 22s
246:    learn: 0.6443047        total: 7.21s    remaining: 22s
247:    learn: 0.6442440        total: 7.24s    remaining: 22s
248:    learn: 0.6442439        total: 7.26s    remaining: 21.9s
249:    learn: 0.6441445        total: 7.29s    remaining: 21.9s
250:    learn: 0.6440838        total: 7.33s    remaining: 21.9s
251:    learn: 0.6439750        total: 7.36s    remaining: 21.9s
252:    learn: 0.6439448        total: 7.38s    remaining: 21.8s
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253:    learn: 0.6438766        total: 7.41s    remaining: 21.8s
254:    learn: 0.6438501        total: 7.44s    remaining: 21.7s
255:    learn: 0.6437738        total: 7.47s    remaining: 21.7s
256:    learn: 0.6437665        total: 7.49s    remaining: 21.7s
257:    learn: 0.6436835        total: 7.52s    remaining: 21.6s
258:    learn: 0.6436699        total: 7.55s    remaining: 21.6s
259:    learn: 0.6435756        total: 7.58s    remaining: 21.6s
260:    learn: 0.6435692        total: 7.6s     remaining: 21.5s
261:    learn: 0.6435640        total: 7.62s    remaining: 21.5s
262:    learn: 0.6434770        total: 7.65s    remaining: 21.4s
263:    learn: 0.6434039        total: 7.68s    remaining: 21.4s
264:    learn: 0.6433986        total: 7.7s     remaining: 21.4s
265:    learn: 0.6433708        total: 7.73s    remaining: 21.3s
266:    learn: 0.6433534        total: 7.76s    remaining: 21.3s
267:    learn: 0.6432393        total: 7.79s    remaining: 21.3s
268:    learn: 0.6432367        total: 7.81s    remaining: 21.2s
269:    learn: 0.6431665        total: 7.84s    remaining: 21.2s
270:    learn: 0.6431251        total: 7.87s    remaining: 21.2s
271:    learn: 0.6430515        total: 7.91s    remaining: 21.2s
272:    learn: 0.6429732        total: 7.94s    remaining: 21.1s
273:    learn: 0.6429120        total: 7.97s    remaining: 21.1s
274:    learn: 0.6428475        total: 8s       remaining: 21.1s
275:    learn: 0.6427893        total: 8.03s    remaining: 21.1s
276:    learn: 0.6427528        total: 8.07s    remaining: 21.1s
277:    learn: 0.6426320        total: 8.1s     remaining: 21s
278:    learn: 0.6426299        total: 8.12s    remaining: 21s
279:    learn: 0.6425578        total: 8.15s    remaining: 21s
280:    learn: 0.6425175        total: 8.18s    remaining: 20.9s
281:    learn: 0.6425090        total: 8.21s    remaining: 20.9s
282:    learn: 0.6424464        total: 8.24s    remaining: 20.9s
283:    learn: 0.6423219        total: 8.28s    remaining: 20.9s
284:    learn: 0.6422467        total: 8.32s    remaining: 20.9s
285:    learn: 0.6421692        total: 8.35s    remaining: 20.8s
286:    learn: 0.6420794        total: 8.38s    remaining: 20.8s
287:    learn: 0.6419609        total: 8.42s    remaining: 20.8s
288:    learn: 0.6418859        total: 8.45s    remaining: 20.8s
289:    learn: 0.6417834        total: 8.48s    remaining: 20.8s
290:    learn: 0.6417752        total: 8.51s    remaining: 20.7s
291:    learn: 0.6416822        total: 8.54s    remaining: 20.7s
292:    learn: 0.6415938        total: 8.57s    remaining: 20.7s
293:    learn: 0.6415411        total: 8.61s    remaining: 20.7s
294:    learn: 0.6414791        total: 8.64s    remaining: 20.6s
295:    learn: 0.6413914        total: 8.67s    remaining: 20.6s
296:    learn: 0.6413457        total: 8.71s    remaining: 20.6s
297:    learn: 0.6413409        total: 8.72s    remaining: 20.6s
298:    learn: 0.6412521        total: 8.76s    remaining: 20.5s
299:    learn: 0.6411722        total: 8.79s    remaining: 20.5s
300:    learn: 0.6411120        total: 8.82s    remaining: 20.5s
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301:    learn: 0.6410192        total: 8.86s    remaining: 20.5s
302:    learn: 0.6409691        total: 8.89s    remaining: 20.5s
303:    learn: 0.6409298        total: 8.92s    remaining: 20.4s
304:    learn: 0.6408231        total: 8.95s    remaining: 20.4s
305:    learn: 0.6408144        total: 8.97s    remaining: 20.4s
306:    learn: 0.6407679        total: 9.01s    remaining: 20.3s
307:    learn: 0.6406237        total: 9.04s    remaining: 20.3s
308:    learn: 0.6406071        total: 9.07s    remaining: 20.3s
309:    learn: 0.6405480        total: 9.1s     remaining: 20.3s
310:    learn: 0.6405476        total: 9.12s    remaining: 20.2s
311:    learn: 0.6405127        total: 9.14s    remaining: 20.2s
312:    learn: 0.6404554        total: 9.17s    remaining: 20.1s
313:    learn: 0.6404542        total: 9.19s    remaining: 20.1s
314:    learn: 0.6403880        total: 9.22s    remaining: 20.1s
315:    learn: 0.6403245        total: 9.25s    remaining: 20s
316:    learn: 0.6402503        total: 9.28s    remaining: 20s
317:    learn: 0.6401433        total: 9.32s    remaining: 20s
318:    learn: 0.6401323        total: 9.34s    remaining: 19.9s
319:    learn: 0.6400503        total: 9.37s    remaining: 19.9s
320:    learn: 0.6400049        total: 9.4s     remaining: 19.9s
321:    learn: 0.6399724        total: 9.43s    remaining: 19.9s
322:    learn: 0.6399042        total: 9.46s    remaining: 19.8s
323:    learn: 0.6398129        total: 9.49s    remaining: 19.8s
324:    learn: 0.6397287        total: 9.53s    remaining: 19.8s
325:    learn: 0.6396477        total: 9.56s    remaining: 19.8s
326:    learn: 0.6395828        total: 9.6s     remaining: 19.7s
327:    learn: 0.6394478        total: 9.63s    remaining: 19.7s
328:    learn: 0.6393568        total: 9.66s    remaining: 19.7s
329:    learn: 0.6392779        total: 9.69s    remaining: 19.7s
330:    learn: 0.6391993        total: 9.72s    remaining: 19.6s
331:    learn: 0.6390289        total: 9.75s    remaining: 19.6s
332:    learn: 0.6389372        total: 9.78s    remaining: 19.6s
333:    learn: 0.6388383        total: 9.81s    remaining: 19.6s
334:    learn: 0.6387865        total: 9.84s    remaining: 19.5s
335:    learn: 0.6387039        total: 9.88s    remaining: 19.5s
336:    learn: 0.6385942        total: 9.91s    remaining: 19.5s
337:    learn: 0.6385081        total: 9.94s    remaining: 19.5s
338:    learn: 0.6384447        total: 9.97s    remaining: 19.4s
339:    learn: 0.6383619        total: 10s      remaining: 19.4s
340:    learn: 0.6382283        total: 10s      remaining: 19.4s
341:    learn: 0.6381712        total: 10.1s    remaining: 19.4s
342:    learn: 0.6380292        total: 10.1s    remaining: 19.4s
343:    learn: 0.6379768        total: 10.1s    remaining: 19.3s
344:    learn: 0.6378444        total: 10.2s    remaining: 19.3s
345:    learn: 0.6377317        total: 10.2s    remaining: 19.3s
346:    learn: 0.6376563        total: 10.2s    remaining: 19.3s
347:    learn: 0.6375627        total: 10.3s    remaining: 19.2s
348:    learn: 0.6374721        total: 10.3s    remaining: 19.2s
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349:    learn: 0.6374045        total: 10.3s    remaining: 19.2s
350:    learn: 0.6373117        total: 10.4s    remaining: 19.2s
351:    learn: 0.6372196        total: 10.4s    remaining: 19.1s
352:    learn: 0.6370591        total: 10.4s    remaining: 19.1s
353:    learn: 0.6370038        total: 10.5s    remaining: 19.1s
354:    learn: 0.6369057        total: 10.5s    remaining: 19s
355:    learn: 0.6368108        total: 10.5s    remaining: 19s
356:    learn: 0.6367609        total: 10.5s    remaining: 19s
357:    learn: 0.6367104        total: 10.6s    remaining: 19s
358:    learn: 0.6366315        total: 10.6s    remaining: 18.9s
359:    learn: 0.6365038        total: 10.6s    remaining: 18.9s
360:    learn: 0.6364302        total: 10.7s    remaining: 18.9s
361:    learn: 0.6362493        total: 10.7s    remaining: 18.9s
362:    learn: 0.6360973        total: 10.7s    remaining: 18.8s
363:    learn: 0.6359749        total: 10.8s    remaining: 18.8s
364:    learn: 0.6359112        total: 10.8s    remaining: 18.8s
365:    learn: 0.6358155        total: 10.8s    remaining: 18.8s
366:    learn: 0.6357522        total: 10.9s    remaining: 18.8s
367:    learn: 0.6356724        total: 10.9s    remaining: 18.7s
368:    learn: 0.6355787        total: 10.9s    remaining: 18.7s
369:    learn: 0.6354798        total: 11s      remaining: 18.7s
370:    learn: 0.6353889        total: 11s      remaining: 18.7s
371:    learn: 0.6352995        total: 11s      remaining: 18.6s
372:    learn: 0.6351841        total: 11.1s    remaining: 18.6s
373:    learn: 0.6350580        total: 11.1s    remaining: 18.6s
374:    learn: 0.6348849        total: 11.1s    remaining: 18.6s
375:    learn: 0.6346756        total: 11.2s    remaining: 18.5s
376:    learn: 0.6345555        total: 11.2s    remaining: 18.5s
377:    learn: 0.6344279        total: 11.2s    remaining: 18.5s
378:    learn: 0.6342898        total: 11.3s    remaining: 18.5s
379:    learn: 0.6341558        total: 11.3s    remaining: 18.4s
380:    learn: 0.6340723        total: 11.3s    remaining: 18.4s
381:    learn: 0.6339713        total: 11.4s    remaining: 18.4s
382:    learn: 0.6338297        total: 11.4s    remaining: 18.4s
383:    learn: 0.6337062        total: 11.4s    remaining: 18.3s
384:    learn: 0.6336123        total: 11.5s    remaining: 18.3s
385:    learn: 0.6335156        total: 11.5s    remaining: 18.3s
386:    learn: 0.6334602        total: 11.5s    remaining: 18.3s
387:    learn: 0.6333623        total: 11.6s    remaining: 18.2s
388:    learn: 0.6332145        total: 11.6s    remaining: 18.2s
389:    learn: 0.6331005        total: 11.6s    remaining: 18.2s
390:    learn: 0.6330259        total: 11.7s    remaining: 18.2s
391:    learn: 0.6328832        total: 11.7s    remaining: 18.1s
392:    learn: 0.6328208        total: 11.7s    remaining: 18.1s
393:    learn: 0.6326984        total: 11.8s    remaining: 18.1s
394:    learn: 0.6325760        total: 11.8s    remaining: 18s
395:    learn: 0.6324760        total: 11.8s    remaining: 18s
396:    learn: 0.6323037        total: 11.8s    remaining: 18s
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397:    learn: 0.6322106        total: 11.9s    remaining: 18s
398:    learn: 0.6321124        total: 11.9s    remaining: 17.9s
399:    learn: 0.6320414        total: 11.9s    remaining: 17.9s
400:    learn: 0.6319417        total: 12s      remaining: 17.9s
401:    learn: 0.6318741        total: 12s      remaining: 17.9s
402:    learn: 0.6317351        total: 12s      remaining: 17.8s
403:    learn: 0.6316214        total: 12.1s    remaining: 17.8s
404:    learn: 0.6314853        total: 12.1s    remaining: 17.8s
405:    learn: 0.6314000        total: 12.1s    remaining: 17.8s
406:    learn: 0.6313038        total: 12.2s    remaining: 17.7s
407:    learn: 0.6312445        total: 12.2s    remaining: 17.7s
408:    learn: 0.6311476        total: 12.2s    remaining: 17.7s
409:    learn: 0.6310452        total: 12.3s    remaining: 17.6s
410:    learn: 0.6309389        total: 12.3s    remaining: 17.6s
411:    learn: 0.6308372        total: 12.3s    remaining: 17.6s
412:    learn: 0.6307443        total: 12.4s    remaining: 17.6s
413:    learn: 0.6306559        total: 12.4s    remaining: 17.5s
414:    learn: 0.6305479        total: 12.4s    remaining: 17.5s
415:    learn: 0.6304418        total: 12.5s    remaining: 17.5s
416:    learn: 0.6303395        total: 12.5s    remaining: 17.5s
417:    learn: 0.6302436        total: 12.5s    remaining: 17.4s
418:    learn: 0.6301721        total: 12.6s    remaining: 17.4s
419:    learn: 0.6300685        total: 12.6s    remaining: 17.4s
420:    learn: 0.6299809        total: 12.6s    remaining: 17.4s
421:    learn: 0.6298526        total: 12.7s    remaining: 17.3s
422:    learn: 0.6297760        total: 12.7s    remaining: 17.3s
423:    learn: 0.6296981        total: 12.7s    remaining: 17.3s
424:    learn: 0.6296115        total: 12.7s    remaining: 17.2s
425:    learn: 0.6295166        total: 12.8s    remaining: 17.2s
426:    learn: 0.6294036        total: 12.8s    remaining: 17.2s
427:    learn: 0.6293060        total: 12.8s    remaining: 17.2s
428:    learn: 0.6291422        total: 12.9s    remaining: 17.1s
429:    learn: 0.6290356        total: 12.9s    remaining: 17.1s
430:    learn: 0.6289782        total: 12.9s    remaining: 17.1s
431:    learn: 0.6288056        total: 13s      remaining: 17.1s
432:    learn: 0.6287426        total: 13s      remaining: 17s
433:    learn: 0.6286841        total: 13s      remaining: 17s
434:    learn: 0.6285631        total: 13.1s    remaining: 17s
435:    learn: 0.6284908        total: 13.1s    remaining: 16.9s
436:    learn: 0.6283325        total: 13.1s    remaining: 16.9s
437:    learn: 0.6282359        total: 13.2s    remaining: 16.9s
438:    learn: 0.6281488        total: 13.2s    remaining: 16.9s
439:    learn: 0.6280669        total: 13.2s    remaining: 16.8s
440:    learn: 0.6279270        total: 13.3s    remaining: 16.8s
441:    learn: 0.6278375        total: 13.3s    remaining: 16.8s
442:    learn: 0.6277096        total: 13.3s    remaining: 16.7s
443:    learn: 0.6276439        total: 13.4s    remaining: 16.7s
444:    learn: 0.6275252        total: 13.4s    remaining: 16.7s
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445:    learn: 0.6274199        total: 13.4s    remaining: 16.7s
446:    learn: 0.6273583        total: 13.4s    remaining: 16.6s
447:    learn: 0.6272619        total: 13.5s    remaining: 16.6s
448:    learn: 0.6271893        total: 13.5s    remaining: 16.6s
449:    learn: 0.6271057        total: 13.5s    remaining: 16.5s
450:    learn: 0.6270572        total: 13.6s    remaining: 16.5s
451:    learn: 0.6269464        total: 13.6s    remaining: 16.5s
452:    learn: 0.6268629        total: 13.6s    remaining: 16.5s
453:    learn: 0.6267204        total: 13.7s    remaining: 16.4s
454:    learn: 0.6265969        total: 13.7s    remaining: 16.4s
455:    learn: 0.6264391        total: 13.7s    remaining: 16.4s
456:    learn: 0.6263035        total: 13.8s    remaining: 16.4s
457:    learn: 0.6262364        total: 13.8s    remaining: 16.3s
458:    learn: 0.6261581        total: 13.8s    remaining: 16.3s
459:    learn: 0.6260927        total: 13.9s    remaining: 16.3s
460:    learn: 0.6260236        total: 13.9s    remaining: 16.2s
461:    learn: 0.6259077        total: 13.9s    remaining: 16.2s
462:    learn: 0.6258339        total: 14s      remaining: 16.2s
463:    learn: 0.6257366        total: 14s      remaining: 16.2s
464:    learn: 0.6256636        total: 14s      remaining: 16.1s
465:    learn: 0.6255569        total: 14.1s    remaining: 16.1s
466:    learn: 0.6254944        total: 14.1s    remaining: 16.1s
467:    learn: 0.6254420        total: 14.1s    remaining: 16s
468:    learn: 0.6253412        total: 14.2s    remaining: 16s
469:    learn: 0.6252440        total: 14.2s    remaining: 16s
470:    learn: 0.6251342        total: 14.2s    remaining: 16s
471:    learn: 0.6249902        total: 14.3s    remaining: 15.9s
472:    learn: 0.6248482        total: 14.3s    remaining: 15.9s
473:    learn: 0.6247225        total: 14.3s    remaining: 15.9s
474:    learn: 0.6245758        total: 14.3s    remaining: 15.9s
475:    learn: 0.6243739        total: 14.4s    remaining: 15.8s
476:    learn: 0.6242825        total: 14.4s    remaining: 15.8s
477:    learn: 0.6241925        total: 14.4s    remaining: 15.8s
478:    learn: 0.6241355        total: 14.5s    remaining: 15.7s
479:    learn: 0.6240673        total: 14.5s    remaining: 15.7s
480:    learn: 0.6240101        total: 14.5s    remaining: 15.7s
481:    learn: 0.6239208        total: 14.6s    remaining: 15.6s
482:    learn: 0.6238820        total: 14.6s    remaining: 15.6s
483:    learn: 0.6238220        total: 14.6s    remaining: 15.6s
484:    learn: 0.6237161        total: 14.7s    remaining: 15.6s
485:    learn: 0.6236452        total: 14.7s    remaining: 15.5s
486:    learn: 0.6235194        total: 14.7s    remaining: 15.5s
487:    learn: 0.6234517        total: 14.7s    remaining: 15.5s
488:    learn: 0.6233786        total: 14.8s    remaining: 15.4s
489:    learn: 0.6232696        total: 14.8s    remaining: 15.4s
490:    learn: 0.6231979        total: 14.8s    remaining: 15.4s
491:    learn: 0.6231358        total: 14.9s    remaining: 15.3s
492:    learn: 0.6230749        total: 14.9s    remaining: 15.3s
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493:    learn: 0.6229954        total: 14.9s    remaining: 15.3s
494:    learn: 0.6229101        total: 15s      remaining: 15.3s
495:    learn: 0.6228111        total: 15s      remaining: 15.2s
496:    learn: 0.6227366        total: 15s      remaining: 15.2s
497:    learn: 0.6226716        total: 15.1s    remaining: 15.2s
498:    learn: 0.6225618        total: 15.1s    remaining: 15.1s
499:    learn: 0.6224551        total: 15.1s    remaining: 15.1s
500:    learn: 0.6224038        total: 15.2s    remaining: 15.1s
501:    learn: 0.6222823        total: 15.2s    remaining: 15.1s
502:    learn: 0.6221854        total: 15.2s    remaining: 15s
503:    learn: 0.6221250        total: 15.2s    remaining: 15s
504:    learn: 0.6219307        total: 15.3s    remaining: 15s
505:    learn: 0.6217790        total: 15.3s    remaining: 14.9s
506:    learn: 0.6216915        total: 15.3s    remaining: 14.9s
507:    learn: 0.6216077        total: 15.4s    remaining: 14.9s
508:    learn: 0.6215526        total: 15.4s    remaining: 14.9s
509:    learn: 0.6214005        total: 15.4s    remaining: 14.8s
510:    learn: 0.6213197        total: 15.5s    remaining: 14.8s
511:    learn: 0.6212384        total: 15.5s    remaining: 14.8s
512:    learn: 0.6211791        total: 15.5s    remaining: 14.7s
513:    learn: 0.6211235        total: 15.6s    remaining: 14.7s
514:    learn: 0.6209831        total: 15.6s    remaining: 14.7s
515:    learn: 0.6209005        total: 15.6s    remaining: 14.7s
516:    learn: 0.6208477        total: 15.7s    remaining: 14.6s
517:    learn: 0.6207981        total: 15.7s    remaining: 14.6s
518:    learn: 0.6207227        total: 15.7s    remaining: 14.6s
519:    learn: 0.6206264        total: 15.7s    remaining: 14.5s
520:    learn: 0.6205593        total: 15.8s    remaining: 14.5s
521:    learn: 0.6204299        total: 15.8s    remaining: 14.5s
522:    learn: 0.6203987        total: 15.8s    remaining: 14.4s
523:    learn: 0.6203648        total: 15.9s    remaining: 14.4s
524:    learn: 0.6202640        total: 15.9s    remaining: 14.4s
525:    learn: 0.6201952        total: 15.9s    remaining: 14.4s
526:    learn: 0.6201051        total: 16s      remaining: 14.3s
527:    learn: 0.6200026        total: 16s      remaining: 14.3s
528:    learn: 0.6199492        total: 16s      remaining: 14.3s
529:    learn: 0.6198513        total: 16.1s    remaining: 14.2s
530:    learn: 0.6197789        total: 16.1s    remaining: 14.2s
531:    learn: 0.6196845        total: 16.1s    remaining: 14.2s
532:    learn: 0.6195985        total: 16.1s    remaining: 14.1s
533:    learn: 0.6194301        total: 16.2s    remaining: 14.1s
534:    learn: 0.6193078        total: 16.2s    remaining: 14.1s
535:    learn: 0.6192500        total: 16.2s    remaining: 14.1s
536:    learn: 0.6191376        total: 16.3s    remaining: 14s
537:    learn: 0.6190575        total: 16.3s    remaining: 14s
538:    learn: 0.6189801        total: 16.3s    remaining: 14s
539:    learn: 0.6189515        total: 16.4s    remaining: 13.9s
540:    learn: 0.6189090        total: 16.4s    remaining: 13.9s
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541:    learn: 0.6188244        total: 16.4s    remaining: 13.9s
542:    learn: 0.6187194        total: 16.5s    remaining: 13.9s
543:    learn: 0.6186011        total: 16.5s    remaining: 13.8s
544:    learn: 0.6185086        total: 16.5s    remaining: 13.8s
545:    learn: 0.6184214        total: 16.6s    remaining: 13.8s
546:    learn: 0.6183232        total: 16.6s    remaining: 13.7s
547:    learn: 0.6182777        total: 16.6s    remaining: 13.7s
548:    learn: 0.6181911        total: 16.6s    remaining: 13.7s
549:    learn: 0.6181278        total: 16.7s    remaining: 13.7s
550:    learn: 0.6180802        total: 16.7s    remaining: 13.6s
551:    learn: 0.6179838        total: 16.7s    remaining: 13.6s
552:    learn: 0.6178775        total: 16.8s    remaining: 13.6s
553:    learn: 0.6177852        total: 16.8s    remaining: 13.5s
554:    learn: 0.6176441        total: 16.8s    remaining: 13.5s
555:    learn: 0.6175694        total: 16.9s    remaining: 13.5s
556:    learn: 0.6175242        total: 16.9s    remaining: 13.4s
557:    learn: 0.6174392        total: 16.9s    remaining: 13.4s
558:    learn: 0.6173372        total: 17s      remaining: 13.4s
559:    learn: 0.6171855        total: 17s      remaining: 13.4s
560:    learn: 0.6171246        total: 17s      remaining: 13.3s
561:    learn: 0.6170974        total: 17.1s    remaining: 13.3s
562:    learn: 0.6170537        total: 17.1s    remaining: 13.3s
563:    learn: 0.6169564        total: 17.1s    remaining: 13.2s
564:    learn: 0.6169107        total: 17.1s    remaining: 13.2s
565:    learn: 0.6167858        total: 17.2s    remaining: 13.2s
566:    learn: 0.6167438        total: 17.2s    remaining: 13.1s
567:    learn: 0.6166690        total: 17.2s    remaining: 13.1s
568:    learn: 0.6166421        total: 17.3s    remaining: 13.1s
569:    learn: 0.6165942        total: 17.3s    remaining: 13.1s
570:    learn: 0.6164504        total: 17.3s    remaining: 13s
571:    learn: 0.6163492        total: 17.4s    remaining: 13s
572:    learn: 0.6162654        total: 17.4s    remaining: 13s
573:    learn: 0.6161953        total: 17.4s    remaining: 12.9s
574:    learn: 0.6160963        total: 17.5s    remaining: 12.9s
575:    learn: 0.6160003        total: 17.5s    remaining: 12.9s
576:    learn: 0.6159339        total: 17.5s    remaining: 12.8s
577:    learn: 0.6158084        total: 17.6s    remaining: 12.8s
578:    learn: 0.6157230        total: 17.6s    remaining: 12.8s
579:    learn: 0.6156729        total: 17.6s    remaining: 12.8s
580:    learn: 0.6155710        total: 17.6s    remaining: 12.7s
581:    learn: 0.6155396        total: 17.7s    remaining: 12.7s
582:    learn: 0.6154497        total: 17.7s    remaining: 12.7s
583:    learn: 0.6154005        total: 17.7s    remaining: 12.6s
584:    learn: 0.6152866        total: 17.8s    remaining: 12.6s
585:    learn: 0.6152091        total: 17.8s    remaining: 12.6s
586:    learn: 0.6151620        total: 17.8s    remaining: 12.5s
587:    learn: 0.6151038        total: 17.9s    remaining: 12.5s
588:    learn: 0.6150015        total: 17.9s    remaining: 12.5s
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589:    learn: 0.6149196        total: 17.9s    remaining: 12.5s
590:    learn: 0.6147721        total: 18s      remaining: 12.4s
591:    learn: 0.6147037        total: 18s      remaining: 12.4s
592:    learn: 0.6146074        total: 18s      remaining: 12.4s
593:    learn: 0.6144763        total: 18s      remaining: 12.3s
594:    learn: 0.6143772        total: 18.1s    remaining: 12.3s
595:    learn: 0.6142640        total: 18.1s    remaining: 12.3s
596:    learn: 0.6142061        total: 18.1s    remaining: 12.2s
597:    learn: 0.6141654        total: 18.2s    remaining: 12.2s
598:    learn: 0.6140996        total: 18.2s    remaining: 12.2s
599:    learn: 0.6140529        total: 18.2s    remaining: 12.2s
600:    learn: 0.6139516        total: 18.3s    remaining: 12.1s
601:    learn: 0.6139077        total: 18.3s    remaining: 12.1s
602:    learn: 0.6138044        total: 18.3s    remaining: 12.1s
603:    learn: 0.6137311        total: 18.4s    remaining: 12s
604:    learn: 0.6136375        total: 18.4s    remaining: 12s
605:    learn: 0.6135589        total: 18.4s    remaining: 12s
606:    learn: 0.6135270        total: 18.5s    remaining: 11.9s
607:    learn: 0.6133950        total: 18.5s    remaining: 11.9s
608:    learn: 0.6132601        total: 18.5s    remaining: 11.9s
609:    learn: 0.6131586        total: 18.6s    remaining: 11.9s
610:    learn: 0.6130852        total: 18.6s    remaining: 11.8s
611:    learn: 0.6130201        total: 18.6s    remaining: 11.8s
612:    learn: 0.6129278        total: 18.6s    remaining: 11.8s
613:    learn: 0.6128295        total: 18.7s    remaining: 11.7s
614:    learn: 0.6127839        total: 18.7s    remaining: 11.7s
615:    learn: 0.6127255        total: 18.7s    remaining: 11.7s
616:    learn: 0.6125975        total: 18.8s    remaining: 11.7s
617:    learn: 0.6125556        total: 18.8s    remaining: 11.6s
618:    learn: 0.6124476        total: 18.8s    remaining: 11.6s
619:    learn: 0.6123927        total: 18.9s    remaining: 11.6s
620:    learn: 0.6123342        total: 18.9s    remaining: 11.5s
621:    learn: 0.6122545        total: 18.9s    remaining: 11.5s
622:    learn: 0.6121503        total: 19s      remaining: 11.5s
623:    learn: 0.6120988        total: 19s      remaining: 11.5s
624:    learn: 0.6120584        total: 19s      remaining: 11.4s
625:    learn: 0.6119948        total: 19.1s    remaining: 11.4s
626:    learn: 0.6118237        total: 19.1s    remaining: 11.4s
627:    learn: 0.6117616        total: 19.1s    remaining: 11.3s
628:    learn: 0.6116925        total: 19.2s    remaining: 11.3s
629:    learn: 0.6116324        total: 19.2s    remaining: 11.3s
630:    learn: 0.6115076        total: 19.2s    remaining: 11.2s
631:    learn: 0.6113843        total: 19.3s    remaining: 11.2s
632:    learn: 0.6113315        total: 19.3s    remaining: 11.2s
633:    learn: 0.6112215        total: 19.3s    remaining: 11.2s
634:    learn: 0.6111361        total: 19.4s    remaining: 11.1s
635:    learn: 0.6110872        total: 19.4s    remaining: 11.1s
636:    learn: 0.6110231        total: 19.4s    remaining: 11.1s
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637:    learn: 0.6109496        total: 19.5s    remaining: 11s
638:    learn: 0.6109203        total: 19.5s    remaining: 11s
639:    learn: 0.6108959        total: 19.5s    remaining: 11s
640:    learn: 0.6108072        total: 19.5s    remaining: 10.9s
641:    learn: 0.6106779        total: 19.6s    remaining: 10.9s
642:    learn: 0.6105771        total: 19.6s    remaining: 10.9s
643:    learn: 0.6105278        total: 19.6s    remaining: 10.9s
644:    learn: 0.6105094        total: 19.7s    remaining: 10.8s
645:    learn: 0.6104549        total: 19.7s    remaining: 10.8s
646:    learn: 0.6104128        total: 19.7s    remaining: 10.8s
647:    learn: 0.6103128        total: 19.8s    remaining: 10.7s
648:    learn: 0.6102292        total: 19.8s    remaining: 10.7s
649:    learn: 0.6101742        total: 19.8s    remaining: 10.7s
650:    learn: 0.6101202        total: 19.9s    remaining: 10.6s
651:    learn: 0.6099976        total: 19.9s    remaining: 10.6s
652:    learn: 0.6099176        total: 19.9s    remaining: 10.6s
653:    learn: 0.6098800        total: 20s      remaining: 10.6s
654:    learn: 0.6097960        total: 20s      remaining: 10.5s
655:    learn: 0.6097481        total: 20s      remaining: 10.5s
656:    learn: 0.6096912        total: 20s      remaining: 10.5s
657:    learn: 0.6095942        total: 20.1s    remaining: 10.4s
658:    learn: 0.6094985        total: 20.1s    remaining: 10.4s
659:    learn: 0.6094581        total: 20.1s    remaining: 10.4s
660:    learn: 0.6093867        total: 20.2s    remaining: 10.3s
661:    learn: 0.6093084        total: 20.2s    remaining: 10.3s
662:    learn: 0.6092022        total: 20.2s    remaining: 10.3s
663:    learn: 0.6091438        total: 20.3s    remaining: 10.3s
664:    learn: 0.6090401        total: 20.3s    remaining: 10.2s
665:    learn: 0.6089326        total: 20.3s    remaining: 10.2s
666:    learn: 0.6088724        total: 20.4s    remaining: 10.2s
667:    learn: 0.6087834        total: 20.4s    remaining: 10.1s
668:    learn: 0.6087410        total: 20.4s    remaining: 10.1s
669:    learn: 0.6086948        total: 20.5s    remaining: 10.1s
670:    learn: 0.6086218        total: 20.5s    remaining: 10s
671:    learn: 0.6085973        total: 20.5s    remaining: 10s
672:    learn: 0.6085231        total: 20.5s    remaining: 9.98s
673:    learn: 0.6084674        total: 20.6s    remaining: 9.95s
674:    learn: 0.6084120        total: 20.6s    remaining: 9.92s
675:    learn: 0.6083667        total: 20.6s    remaining: 9.89s
676:    learn: 0.6082685        total: 20.7s    remaining: 9.86s
677:    learn: 0.6082148        total: 20.7s    remaining: 9.83s
678:    learn: 0.6081464        total: 20.7s    remaining: 9.8s
679:    learn: 0.6080929        total: 20.8s    remaining: 9.77s
680:    learn: 0.6080388        total: 20.8s    remaining: 9.74s
681:    learn: 0.6079950        total: 20.8s    remaining: 9.71s
682:    learn: 0.6079309        total: 20.8s    remaining: 9.68s
683:    learn: 0.6078537        total: 20.9s    remaining: 9.65s
684:    learn: 0.6078151        total: 20.9s    remaining: 9.62s
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685:    learn: 0.6077414        total: 20.9s    remaining: 9.59s
686:    learn: 0.6076839        total: 21s      remaining: 9.56s
687:    learn: 0.6075910        total: 21s      remaining: 9.53s
688:    learn: 0.6075509        total: 21s      remaining: 9.5s
689:    learn: 0.6074688        total: 21.1s    remaining: 9.47s
690:    learn: 0.6074008        total: 21.1s    remaining: 9.44s
691:    learn: 0.6073843        total: 21.1s    remaining: 9.4s
692:    learn: 0.6072935        total: 21.2s    remaining: 9.38s
693:    learn: 0.6072516        total: 21.2s    remaining: 9.35s
694:    learn: 0.6071017        total: 21.2s    remaining: 9.31s
695:    learn: 0.6070244        total: 21.3s    remaining: 9.29s
696:    learn: 0.6070031        total: 21.3s    remaining: 9.25s
697:    learn: 0.6069225        total: 21.3s    remaining: 9.22s
698:    learn: 0.6068655        total: 21.4s    remaining: 9.19s
699:    learn: 0.6068164        total: 21.4s    remaining: 9.16s
700:    learn: 0.6067609        total: 21.4s    remaining: 9.13s
701:    learn: 0.6067184        total: 21.4s    remaining: 9.1s
702:    learn: 0.6066791        total: 21.5s    remaining: 9.07s
703:    learn: 0.6066171        total: 21.5s    remaining: 9.04s
704:    learn: 0.6065680        total: 21.5s    remaining: 9.01s
705:    learn: 0.6065248        total: 21.6s    remaining: 8.98s
706:    learn: 0.6064425        total: 21.6s    remaining: 8.95s
707:    learn: 0.6063952        total: 21.6s    remaining: 8.92s
708:    learn: 0.6063670        total: 21.6s    remaining: 8.88s
709:    learn: 0.6062929        total: 21.7s    remaining: 8.85s
710:    learn: 0.6061854        total: 21.7s    remaining: 8.82s
711:    learn: 0.6060849        total: 21.7s    remaining: 8.8s
712:    learn: 0.6060270        total: 21.8s    remaining: 8.77s
713:    learn: 0.6059797        total: 21.8s    remaining: 8.73s
714:    learn: 0.6059157        total: 21.8s    remaining: 8.7s
715:    learn: 0.6058108        total: 21.9s    remaining: 8.67s
716:    learn: 0.6057312        total: 21.9s    remaining: 8.64s
717:    learn: 0.6056672        total: 21.9s    remaining: 8.61s
718:    learn: 0.6056008        total: 22s      remaining: 8.58s
719:    learn: 0.6055459        total: 22s      remaining: 8.55s
720:    learn: 0.6055117        total: 22s      remaining: 8.52s
721:    learn: 0.6054900        total: 22.1s    remaining: 8.49s
722:    learn: 0.6054314        total: 22.1s    remaining: 8.46s
723:    learn: 0.6053570        total: 22.1s    remaining: 8.43s
724:    learn: 0.6052662        total: 22.1s    remaining: 8.4s
725:    learn: 0.6051649        total: 22.2s    remaining: 8.37s
726:    learn: 0.6050942        total: 22.2s    remaining: 8.34s
727:    learn: 0.6050445        total: 22.2s    remaining: 8.31s
728:    learn: 0.6049681        total: 22.3s    remaining: 8.28s
729:    learn: 0.6049169        total: 22.3s    remaining: 8.25s
730:    learn: 0.6048716        total: 22.3s    remaining: 8.22s
731:    learn: 0.6048356        total: 22.4s    remaining: 8.19s
732:    learn: 0.6047794        total: 22.4s    remaining: 8.15s
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733:    learn: 0.6047556        total: 22.4s    remaining: 8.12s
734:    learn: 0.6047028        total: 22.4s    remaining: 8.09s
735:    learn: 0.6046300        total: 22.5s    remaining: 8.06s
736:    learn: 0.6045870        total: 22.5s    remaining: 8.03s
737:    learn: 0.6044434        total: 22.5s    remaining: 8s
738:    learn: 0.6043921        total: 22.6s    remaining: 7.97s
739:    learn: 0.6043326        total: 22.6s    remaining: 7.94s
740:    learn: 0.6042545        total: 22.6s    remaining: 7.91s
741:    learn: 0.6041867        total: 22.7s    remaining: 7.88s
742:    learn: 0.6041500        total: 22.7s    remaining: 7.85s
743:    learn: 0.6040808        total: 22.7s    remaining: 7.82s
744:    learn: 0.6040272        total: 22.8s    remaining: 7.79s
745:    learn: 0.6039625        total: 22.8s    remaining: 7.76s
746:    learn: 0.6038881        total: 22.8s    remaining: 7.73s
747:    learn: 0.6038320        total: 22.8s    remaining: 7.7s
748:    learn: 0.6037677        total: 22.9s    remaining: 7.67s
749:    learn: 0.6036873        total: 22.9s    remaining: 7.64s
750:    learn: 0.6035926        total: 22.9s    remaining: 7.61s
751:    learn: 0.6035201        total: 23s      remaining: 7.58s
752:    learn: 0.6034076        total: 23s      remaining: 7.55s
753:    learn: 0.6032675        total: 23s      remaining: 7.52s
754:    learn: 0.6032134        total: 23.1s    remaining: 7.49s
755:    learn: 0.6031283        total: 23.1s    remaining: 7.46s
756:    learn: 0.6030766        total: 23.1s    remaining: 7.42s
757:    learn: 0.6030350        total: 23.2s    remaining: 7.39s
758:    learn: 0.6029751        total: 23.2s    remaining: 7.36s
759:    learn: 0.6028682        total: 23.2s    remaining: 7.33s
760:    learn: 0.6028006        total: 23.3s    remaining: 7.3s
761:    learn: 0.6027265        total: 23.3s    remaining: 7.27s
762:    learn: 0.6026258        total: 23.3s    remaining: 7.24s
763:    learn: 0.6025480        total: 23.3s    remaining: 7.21s
764:    learn: 0.6025104        total: 23.4s    remaining: 7.18s
765:    learn: 0.6024740        total: 23.4s    remaining: 7.15s
766:    learn: 0.6024100        total: 23.4s    remaining: 7.12s
767:    learn: 0.6023552        total: 23.5s    remaining: 7.09s
768:    learn: 0.6022946        total: 23.5s    remaining: 7.06s
769:    learn: 0.6022029        total: 23.5s    remaining: 7.03s
770:    learn: 0.6021523        total: 23.6s    remaining: 7s
771:    learn: 0.6020900        total: 23.6s    remaining: 6.97s
772:    learn: 0.6019806        total: 23.6s    remaining: 6.94s
773:    learn: 0.6019403        total: 23.7s    remaining: 6.91s
774:    learn: 0.6018337        total: 23.7s    remaining: 6.88s
775:    learn: 0.6017722        total: 23.7s    remaining: 6.85s
776:    learn: 0.6017145        total: 23.7s    remaining: 6.81s
777:    learn: 0.6016462        total: 23.8s    remaining: 6.79s
778:    learn: 0.6016098        total: 23.8s    remaining: 6.75s
779:    learn: 0.6015448        total: 23.8s    remaining: 6.72s
780:    learn: 0.6014814        total: 23.9s    remaining: 6.69s
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781:    learn: 0.6014295        total: 23.9s    remaining: 6.66s
782:    learn: 0.6013618        total: 23.9s    remaining: 6.63s
783:    learn: 0.6013420        total: 24s      remaining: 6.6s
784:    learn: 0.6012950        total: 24s      remaining: 6.57s
785:    learn: 0.6012608        total: 24s      remaining: 6.54s
786:    learn: 0.6011789        total: 24s      remaining: 6.51s
787:    learn: 0.6010980        total: 24.1s    remaining: 6.48s
788:    learn: 0.6010484        total: 24.1s    remaining: 6.45s
789:    learn: 0.6009814        total: 24.1s    remaining: 6.42s
790:    learn: 0.6009191        total: 24.2s    remaining: 6.38s
791:    learn: 0.6008577        total: 24.2s    remaining: 6.36s
792:    learn: 0.6007644        total: 24.2s    remaining: 6.32s
793:    learn: 0.6007037        total: 24.3s    remaining: 6.29s
794:    learn: 0.6006607        total: 24.3s    remaining: 6.26s
795:    learn: 0.6005721        total: 24.3s    remaining: 6.23s
796:    learn: 0.6005010        total: 24.4s    remaining: 6.2s
797:    learn: 0.6004748        total: 24.4s    remaining: 6.17s
798:    learn: 0.6003887        total: 24.4s    remaining: 6.14s
799:    learn: 0.6003201        total: 24.4s    remaining: 6.11s
800:    learn: 0.6002639        total: 24.5s    remaining: 6.08s
801:    learn: 0.6001969        total: 24.5s    remaining: 6.05s
802:    learn: 0.6001360        total: 24.5s    remaining: 6.02s
803:    learn: 0.6000078        total: 24.6s    remaining: 5.99s
804:    learn: 0.5999216        total: 24.6s    remaining: 5.96s
805:    learn: 0.5998524        total: 24.6s    remaining: 5.93s
806:    learn: 0.5998206        total: 24.7s    remaining: 5.9s
807:    learn: 0.5997685        total: 24.7s    remaining: 5.87s
808:    learn: 0.5996679        total: 24.7s    remaining: 5.84s
809:    learn: 0.5995164        total: 24.8s    remaining: 5.81s
810:    learn: 0.5994407        total: 24.8s    remaining: 5.78s
811:    learn: 0.5994133        total: 24.8s    remaining: 5.75s
812:    learn: 0.5993162        total: 24.9s    remaining: 5.72s
813:    learn: 0.5992368        total: 24.9s    remaining: 5.69s
814:    learn: 0.5991820        total: 24.9s    remaining: 5.66s
815:    learn: 0.5991243        total: 24.9s    remaining: 5.63s
816:    learn: 0.5990354        total: 25s      remaining: 5.59s
817:    learn: 0.5989380        total: 25s      remaining: 5.56s
818:    learn: 0.5988798        total: 25s      remaining: 5.54s
819:    learn: 0.5988323        total: 25.1s    remaining: 5.5s
820:    learn: 0.5987512        total: 25.1s    remaining: 5.47s
821:    learn: 0.5987026        total: 25.1s    remaining: 5.44s
822:    learn: 0.5986712        total: 25.2s    remaining: 5.41s
823:    learn: 0.5985798        total: 25.2s    remaining: 5.38s
824:    learn: 0.5985052        total: 25.2s    remaining: 5.35s
825:    learn: 0.5983995        total: 25.3s    remaining: 5.32s
826:    learn: 0.5983384        total: 25.3s    remaining: 5.29s
827:    learn: 0.5982952        total: 25.3s    remaining: 5.26s
828:    learn: 0.5982218        total: 25.4s    remaining: 5.23s
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829:    learn: 0.5981684        total: 25.4s    remaining: 5.2s
830:    learn: 0.5980844        total: 25.4s    remaining: 5.17s
831:    learn: 0.5980036        total: 25.4s    remaining: 5.14s
832:    learn: 0.5979374        total: 25.5s    remaining: 5.11s
833:    learn: 0.5978888        total: 25.5s    remaining: 5.08s
834:    learn: 0.5978600        total: 25.5s    remaining: 5.04s
835:    learn: 0.5978213        total: 25.6s    remaining: 5.01s
836:    learn: 0.5977016        total: 25.6s    remaining: 4.98s
837:    learn: 0.5976480        total: 25.6s    remaining: 4.95s
838:    learn: 0.5975796        total: 25.7s    remaining: 4.92s
839:    learn: 0.5974823        total: 25.7s    remaining: 4.89s
840:    learn: 0.5974630        total: 25.7s    remaining: 4.86s
841:    learn: 0.5974033        total: 25.7s    remaining: 4.83s
842:    learn: 0.5973602        total: 25.8s    remaining: 4.8s
843:    learn: 0.5973070        total: 25.8s    remaining: 4.77s
844:    learn: 0.5972360        total: 25.8s    remaining: 4.74s
845:    learn: 0.5971976        total: 25.9s    remaining: 4.71s
846:    learn: 0.5971058        total: 25.9s    remaining: 4.68s
847:    learn: 0.5970347        total: 25.9s    remaining: 4.65s
848:    learn: 0.5969566        total: 26s      remaining: 4.62s
849:    learn: 0.5968416        total: 26s      remaining: 4.59s
850:    learn: 0.5967832        total: 26s      remaining: 4.56s
851:    learn: 0.5966968        total: 26.1s    remaining: 4.53s
852:    learn: 0.5966298        total: 26.1s    remaining: 4.5s
853:    learn: 0.5965591        total: 26.1s    remaining: 4.47s
854:    learn: 0.5964779        total: 26.2s    remaining: 4.44s
855:    learn: 0.5964271        total: 26.2s    remaining: 4.41s
856:    learn: 0.5963765        total: 26.2s    remaining: 4.37s
857:    learn: 0.5963150        total: 26.2s    remaining: 4.34s
858:    learn: 0.5962626        total: 26.3s    remaining: 4.31s
859:    learn: 0.5962431        total: 26.3s    remaining: 4.28s
860:    learn: 0.5962070        total: 26.3s    remaining: 4.25s
861:    learn: 0.5961647        total: 26.4s    remaining: 4.22s
862:    learn: 0.5960881        total: 26.4s    remaining: 4.19s
863:    learn: 0.5960443        total: 26.4s    remaining: 4.16s
864:    learn: 0.5959634        total: 26.5s    remaining: 4.13s
865:    learn: 0.5958937        total: 26.5s    remaining: 4.1s
866:    learn: 0.5957953        total: 26.5s    remaining: 4.07s
867:    learn: 0.5957235        total: 26.6s    remaining: 4.04s
868:    learn: 0.5956682        total: 26.6s    remaining: 4.01s
869:    learn: 0.5956036        total: 26.6s    remaining: 3.98s
870:    learn: 0.5955038        total: 26.6s    remaining: 3.95s
871:    learn: 0.5954357        total: 26.7s    remaining: 3.92s
872:    learn: 0.5954163        total: 26.7s    remaining: 3.88s
873:    learn: 0.5953290        total: 26.7s    remaining: 3.85s
874:    learn: 0.5952637        total: 26.8s    remaining: 3.82s
875:    learn: 0.5951678        total: 26.8s    remaining: 3.79s
876:    learn: 0.5951336        total: 26.8s    remaining: 3.76s
```

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877:    learn: 0.5950854        total: 26.9s    remaining: 3.73s
878:    learn: 0.5950399        total: 26.9s    remaining: 3.7s
879:    learn: 0.5949908        total: 26.9s    remaining: 3.67s
880:    learn: 0.5949470        total: 27s      remaining: 3.64s
881:    learn: 0.5949286        total: 27s      remaining: 3.61s
882:    learn: 0.5948712        total: 27s      remaining: 3.58s
883:    learn: 0.5947991        total: 27s      remaining: 3.55s
884:    learn: 0.5947395        total: 27.1s    remaining: 3.52s
885:    learn: 0.5946334        total: 27.1s    remaining: 3.49s
886:    learn: 0.5945664        total: 27.1s    remaining: 3.46s
887:    learn: 0.5945241        total: 27.2s    remaining: 3.43s
888:    learn: 0.5944894        total: 27.2s    remaining: 3.4s
889:    learn: 0.5944158        total: 27.2s    remaining: 3.37s
890:    learn: 0.5943194        total: 27.3s    remaining: 3.33s
891:    learn: 0.5942554        total: 27.3s    remaining: 3.3s
892:    learn: 0.5941612        total: 27.3s    remaining: 3.27s
893:    learn: 0.5940964        total: 27.4s    remaining: 3.24s
894:    learn: 0.5940388        total: 27.4s    remaining: 3.21s
895:    learn: 0.5939708        total: 27.4s    remaining: 3.18s
896:    learn: 0.5939346        total: 27.4s    remaining: 3.15s
897:    learn: 0.5938766        total: 27.5s    remaining: 3.12s
898:    learn: 0.5938217        total: 27.5s    remaining: 3.09s
899:    learn: 0.5937790        total: 27.5s    remaining: 3.06s
900:    learn: 0.5937027        total: 27.6s    remaining: 3.03s
901:    learn: 0.5936132        total: 27.6s    remaining: 3s
902:    learn: 0.5935649        total: 27.6s    remaining: 2.97s
903:    learn: 0.5934853        total: 27.7s    remaining: 2.94s
904:    learn: 0.5933972        total: 27.7s    remaining: 2.91s
905:    learn: 0.5932786        total: 27.7s    remaining: 2.88s
906:    learn: 0.5932503        total: 27.8s    remaining: 2.85s
907:    learn: 0.5931843        total: 27.8s    remaining: 2.81s
908:    learn: 0.5931676        total: 27.8s    remaining: 2.78s
909:    learn: 0.5931104        total: 27.8s    remaining: 2.75s
910:    learn: 0.5930157        total: 27.9s    remaining: 2.72s
911:    learn: 0.5929496        total: 27.9s    remaining: 2.69s
912:    learn: 0.5928945        total: 27.9s    remaining: 2.66s
913:    learn: 0.5928447        total: 28s      remaining: 2.63s
914:    learn: 0.5928103        total: 28s      remaining: 2.6s
915:    learn: 0.5927665        total: 28s      remaining: 2.57s
916:    learn: 0.5926907        total: 28.1s    remaining: 2.54s
917:    learn: 0.5926346        total: 28.1s    remaining: 2.51s
918:    learn: 0.5925834        total: 28.1s    remaining: 2.48s
919:    learn: 0.5924968        total: 28.2s    remaining: 2.45s
920:    learn: 0.5924164        total: 28.2s    remaining: 2.42s
921:    learn: 0.5923659        total: 28.2s    remaining: 2.39s
922:    learn: 0.5923163        total: 28.2s    remaining: 2.36s
923:    learn: 0.5922678        total: 28.3s    remaining: 2.33s
924:    learn: 0.5922070        total: 28.3s    remaining: 2.29s
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925:    learn: 0.5921025        total: 28.3s    remaining: 2.27s
926:    learn: 0.5920145        total: 28.4s    remaining: 2.23s
927:    learn: 0.5919481        total: 28.4s    remaining: 2.2s
928:    learn: 0.5919034        total: 28.4s    remaining: 2.17s
929:    learn: 0.5918513        total: 28.5s    remaining: 2.14s
930:    learn: 0.5918036        total: 28.5s    remaining: 2.11s
931:    learn: 0.5917328        total: 28.5s    remaining: 2.08s
932:    learn: 0.5916112        total: 28.6s    remaining: 2.05s
933:    learn: 0.5915547        total: 28.6s    remaining: 2.02s
934:    learn: 0.5915001        total: 28.6s    remaining: 1.99s
935:    learn: 0.5914545        total: 28.7s    remaining: 1.96s
936:    learn: 0.5914066        total: 28.7s    remaining: 1.93s
937:    learn: 0.5913760        total: 28.7s    remaining: 1.9s
938:    learn: 0.5913255        total: 28.7s    remaining: 1.87s
939:    learn: 0.5912682        total: 28.8s    remaining: 1.84s
940:    learn: 0.5912249        total: 28.8s    remaining: 1.81s
941:    learn: 0.5911556        total: 28.8s    remaining: 1.77s
942:    learn: 0.5910945        total: 28.9s    remaining: 1.75s
943:    learn: 0.5910391        total: 28.9s    remaining: 1.71s
944:    learn: 0.5909918        total: 28.9s    remaining: 1.68s
945:    learn: 0.5909223        total: 29s      remaining: 1.65s
946:    learn: 0.5908694        total: 29s      remaining: 1.62s
947:    learn: 0.5908121        total: 29s      remaining: 1.59s
948:    learn: 0.5907709        total: 29.1s    remaining: 1.56s
949:    learn: 0.5907070        total: 29.1s    remaining: 1.53s
950:    learn: 0.5906675        total: 29.1s    remaining: 1.5s
951:    learn: 0.5905714        total: 29.2s    remaining: 1.47s
952:    learn: 0.5905240        total: 29.2s    remaining: 1.44s
953:    learn: 0.5904560        total: 29.2s    remaining: 1.41s
954:    learn: 0.5903648        total: 29.2s    remaining: 1.38s
955:    learn: 0.5903036        total: 29.3s    remaining: 1.35s
956:    learn: 0.5902545        total: 29.3s    remaining: 1.32s
957:    learn: 0.5901874        total: 29.4s    remaining: 1.29s
958:    learn: 0.5900970        total: 29.4s    remaining: 1.26s
959:    learn: 0.5900669        total: 29.4s    remaining: 1.23s
960:    learn: 0.5900278        total: 29.4s    remaining: 1.19s
961:    learn: 0.5899509        total: 29.5s    remaining: 1.16s
962:    learn: 0.5898811        total: 29.5s    remaining: 1.13s
963:    learn: 0.5898066        total: 29.5s    remaining: 1.1s
964:    learn: 0.5897525        total: 29.6s    remaining: 1.07s
965:    learn: 0.5897020        total: 29.6s    remaining: 1.04s
966:    learn: 0.5896079        total: 29.6s    remaining: 1.01s
967:    learn: 0.5895326        total: 29.7s    remaining: 980ms
968:    learn: 0.5894570        total: 29.7s    remaining: 950ms
969:    learn: 0.5894065        total: 29.7s    remaining: 919ms
970:    learn: 0.5893528        total: 29.7s    remaining: 888ms
971:    learn: 0.5893098        total: 29.8s    remaining: 858ms
972:    learn: 0.5892376        total: 29.8s    remaining: 827ms
```
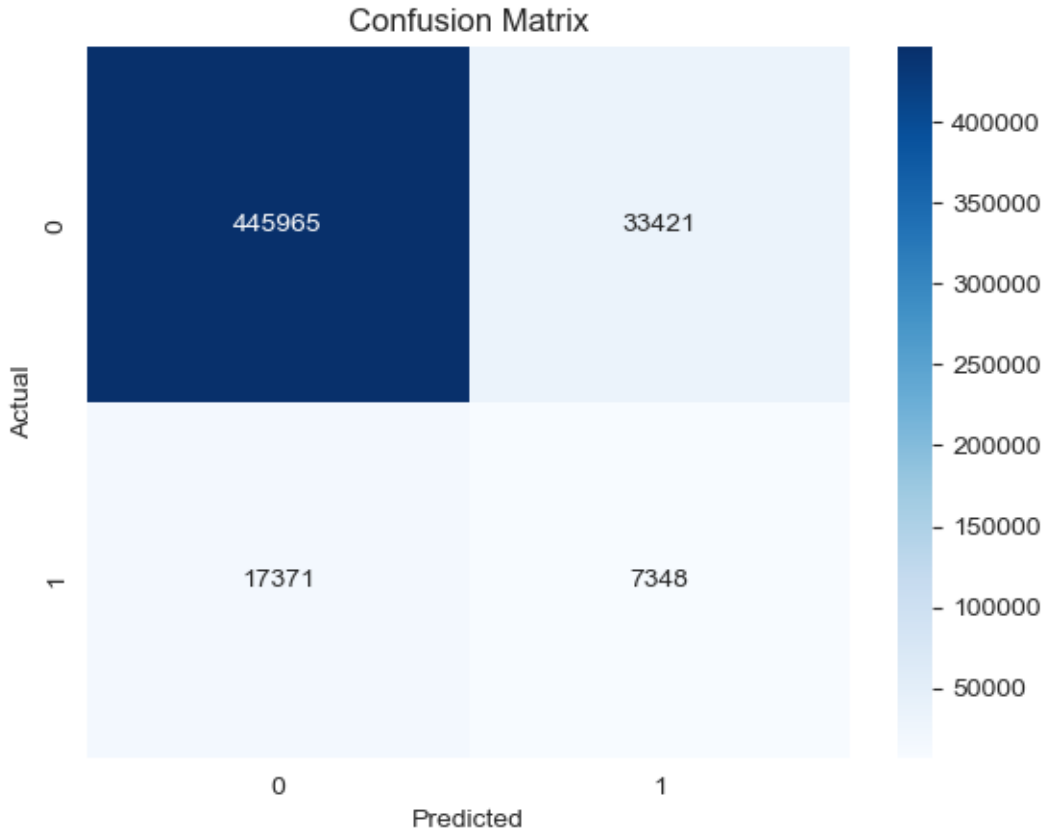

```
973:    learn: 0.5892119        total: 29.8s    remaining: 797ms
974:    learn: 0.5891623        total: 29.9s    remaining: 766ms
975:    learn: 0.5891034        total: 29.9s    remaining: 735ms
976:    learn: 0.5890436        total: 29.9s    remaining: 705ms
977:    learn: 0.5889916        total: 30s      remaining: 674ms
978:    learn: 0.5889560        total: 30s      remaining: 644ms
979:    learn: 0.5888986        total: 30s      remaining: 613ms
980:    learn: 0.5888374        total: 30.1s    remaining: 582ms
981:    learn: 0.5887568        total: 30.1s    remaining: 552ms
982:    learn: 0.5886779        total: 30.1s    remaining: 521ms
983:    learn: 0.5885821        total: 30.2s    remaining: 490ms
984:    learn: 0.5885324        total: 30.2s    remaining: 460ms
985:    learn: 0.5884489        total: 30.2s    remaining: 429ms
986:    learn: 0.5883843        total: 30.3s    remaining: 399ms
987:    learn: 0.5883166        total: 30.3s    remaining: 368ms
988:    learn: 0.5882726        total: 30.3s    remaining: 337ms
989:    learn: 0.5882271        total: 30.4s    remaining: 307ms
990:    learn: 0.5881442        total: 30.4s    remaining: 276ms
991:    learn: 0.5880463        total: 30.4s    remaining: 245ms
992:    learn: 0.5879915        total: 30.4s    remaining: 215ms
993:    learn: 0.5879675        total: 30.5s    remaining: 184ms
994:    learn: 0.5878865        total: 30.5s    remaining: 153ms
995:    learn: 0.5878343        total: 30.5s    remaining: 123ms
996:    learn: 0.5877114        total: 30.6s    remaining: 92ms
997:    learn: 0.5876330        total: 30.6s    remaining: 61.3ms
998:    learn: 0.5875737        total: 30.6s    remaining: 30.7ms
999:    learn: 0.5875060        total: 30.7s    remaining: 0us
```

[44]:
```
<catboost.core.CatBoostClassifier at 0x1fa8242e320>
```

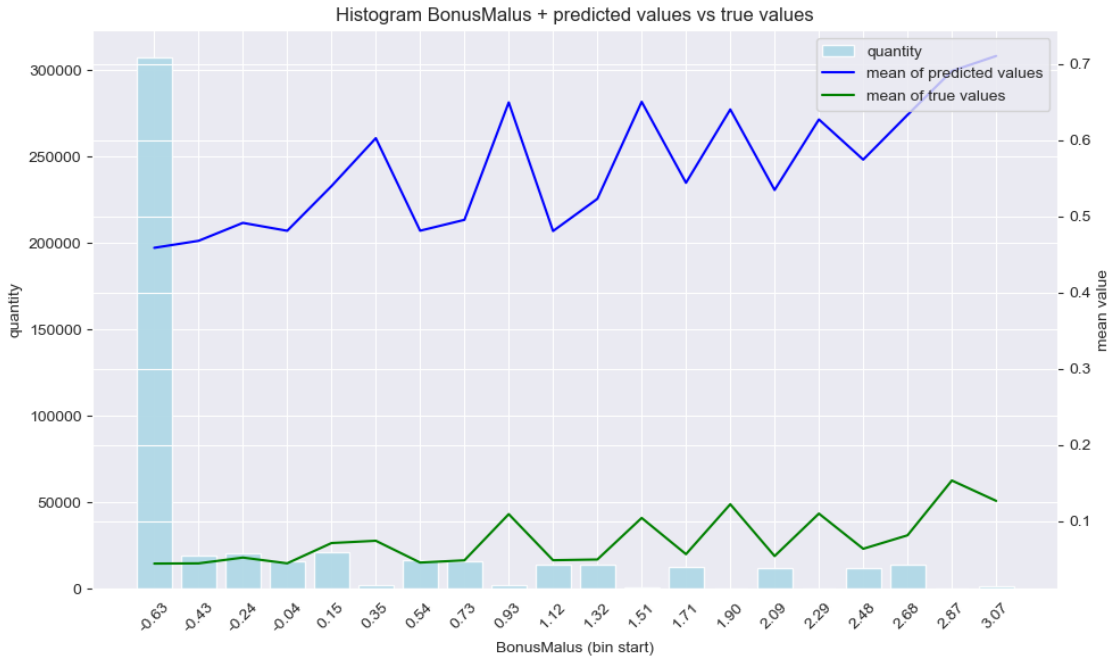
[45]:
```
print("TRAIN-SET SCORING")
y_pred = catboost.predict_proba(X_train_val)[:,1]
stats = score_binary_model(y_train_val,y_pred)
models_stats_train['catboost_tuned_weighted_train'] = stats

print("TRAIN-SET PLOTTING")
#plot_predict_with_feature(exposure_train_val_df,y_train_val,y_pred,'exposure')
for col in numeric_columns:
    plot_predict_with_feature(X_train_val,y_train_val,y_pred,col)

print("TEST-SET SCORING")
y_pred = catboost.predict_proba(X_test)[:,1]
stats =␣
 ↪score_binary_model(y_test,y_pred,models_stats_train['catboost_tuned_weighted_train']['best_
models_stats_test['catboost_tuned_weighted_test'] = stats

print("TEST-SET PLOTTING")
```

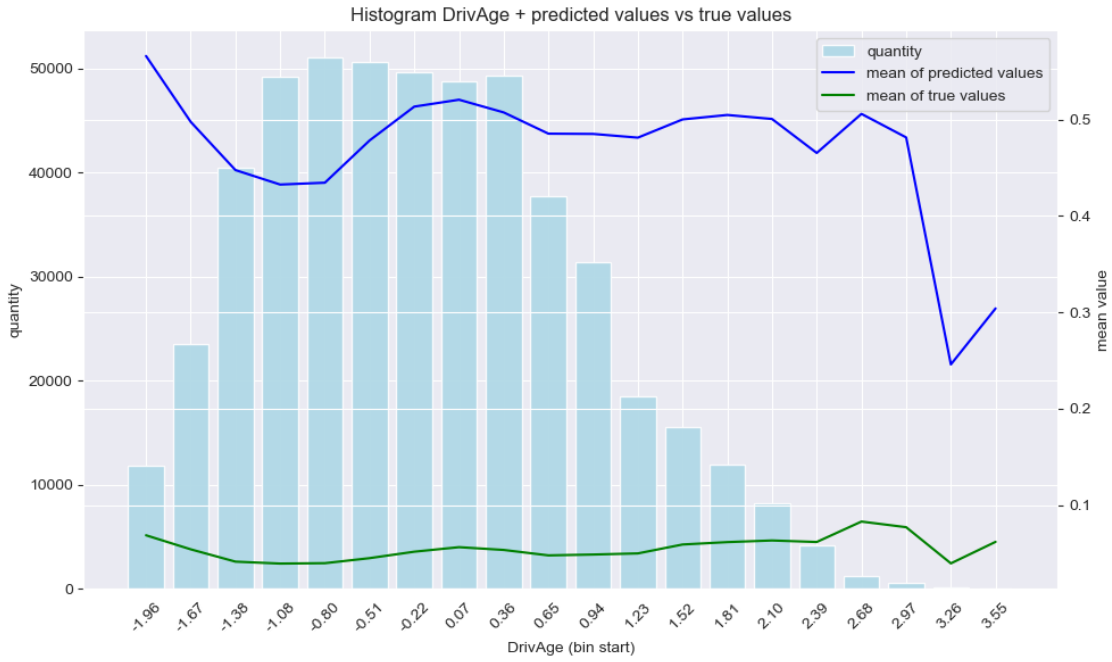
```
plot_predict_with_feature(exposure_test_df,y_test,y_pred,'exposure')
for col in numeric_columns:
    plot_predict_with_feature(X_test,y_test,y_pred,col)
```

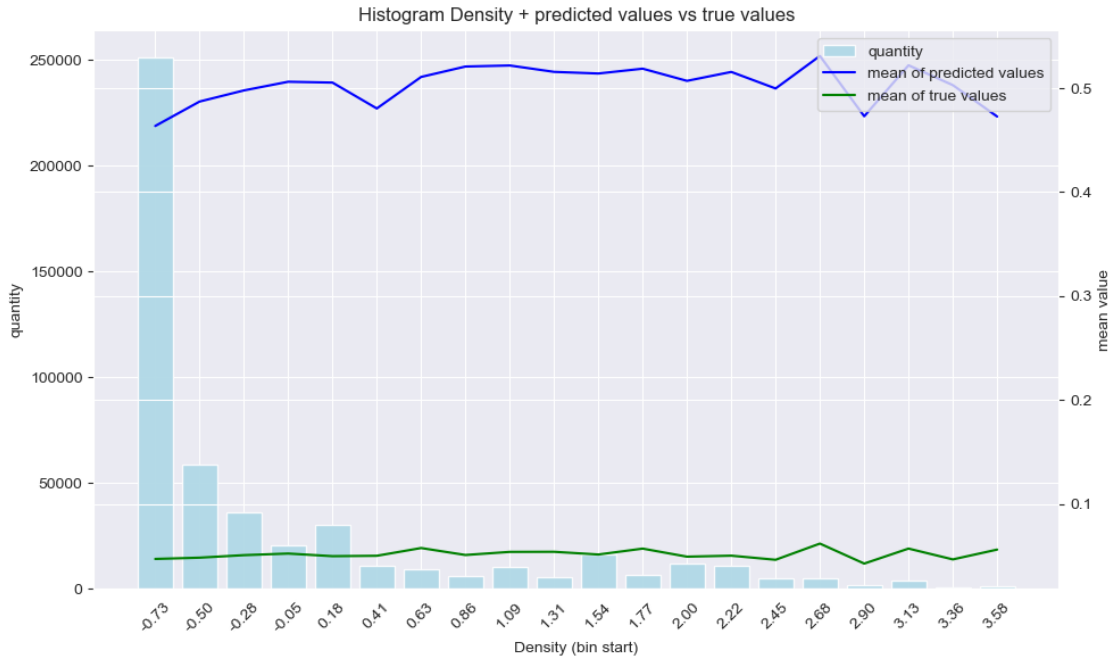
```
TRAIN-SET SCORING
ROC-AUC score: 0.7526426250937631
F1-score:  0.22440752504275593
Accuracy: 0.8992432132194682
Recall: 0.29726121606861117
Precision: 0.18023498246216488
```

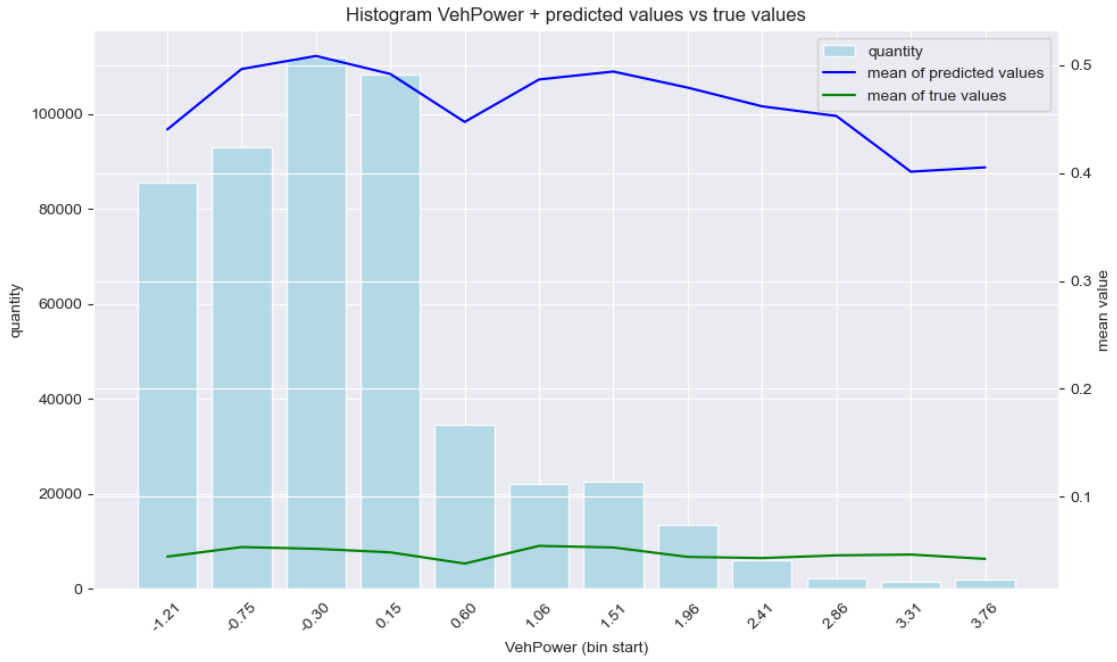


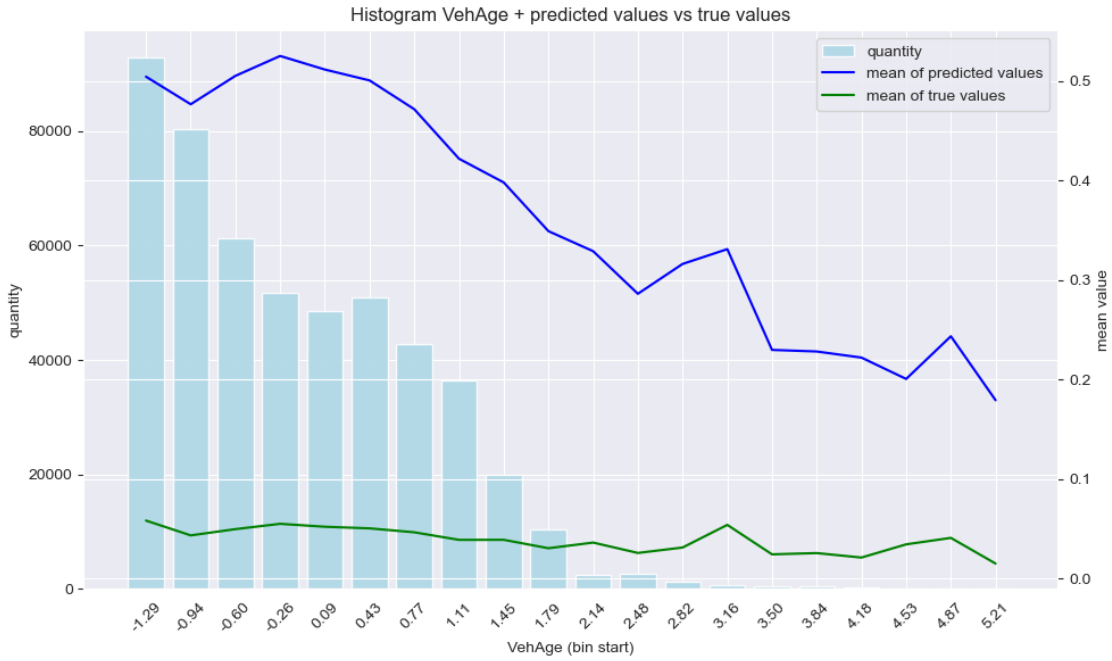

```
TRAIN-SET PLOTTING
```


Histogram BonusMalus + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
BonusMalus (bin start)
300000
250000
200000
150000
100000
50000
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-0.63
-0.43
-0.24
-0.04
0.15
0.35
0.54
0.73
0.93
1.12
1.32
1.51
1.71
1.90
2.09
2.29
2.48
2.68
2.87
3.07

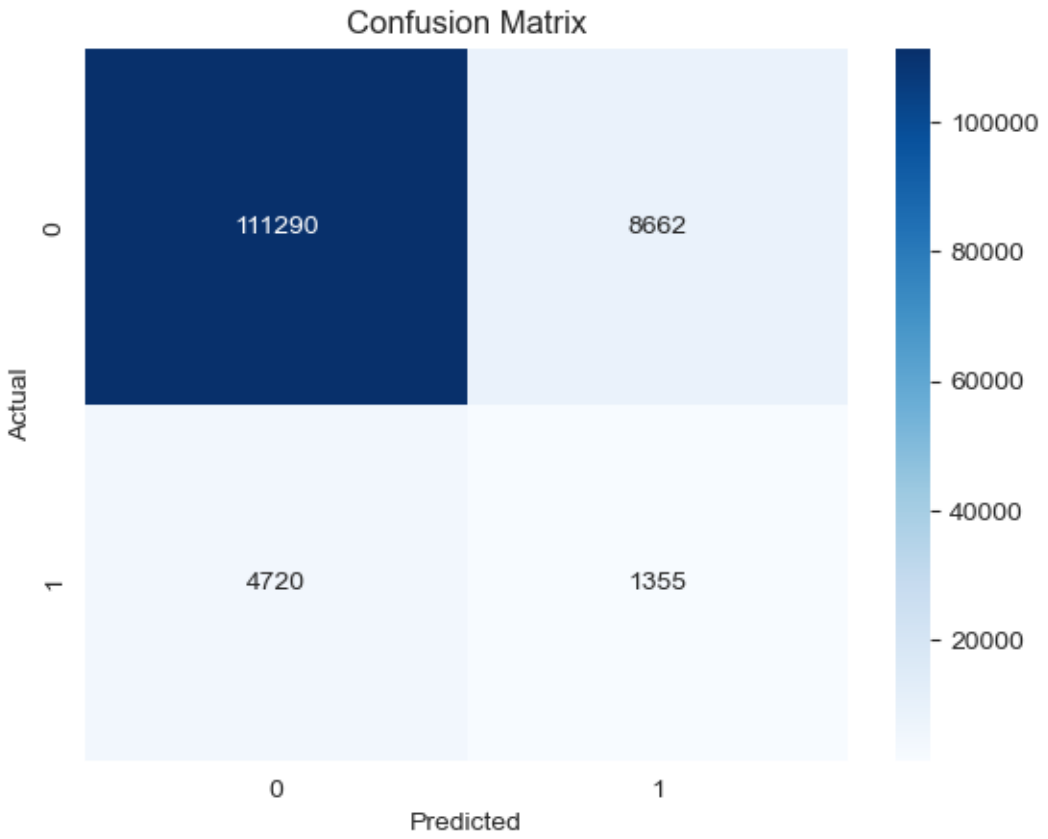

Histogram DrivAge + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
DrivAge (bin start)
50000
40000
30000
20000
10000
0
0.5
0.4
0.3
0.2
0.1
-1.96
-1.67
-1.38
-1.08
-0.80
-0.51
-0.22
0.07
0.36
0.65
0.94
1.23
1.52
1.81
2.10
2.39
2.68
2.97
3.26
3.55


Histogram Density + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
Density (bin start)
250000
200000
150000
100000
50000
0
0.5
0.4
0.3
0.2
0.1
-0.73
-0.50
-0.28
-0.05
0.18
0.41
0.63
0.86
1.09
1.31
1.54
1.77
2.00
2.22
2.45
2.68
2.90
3.13
3.36
3.58

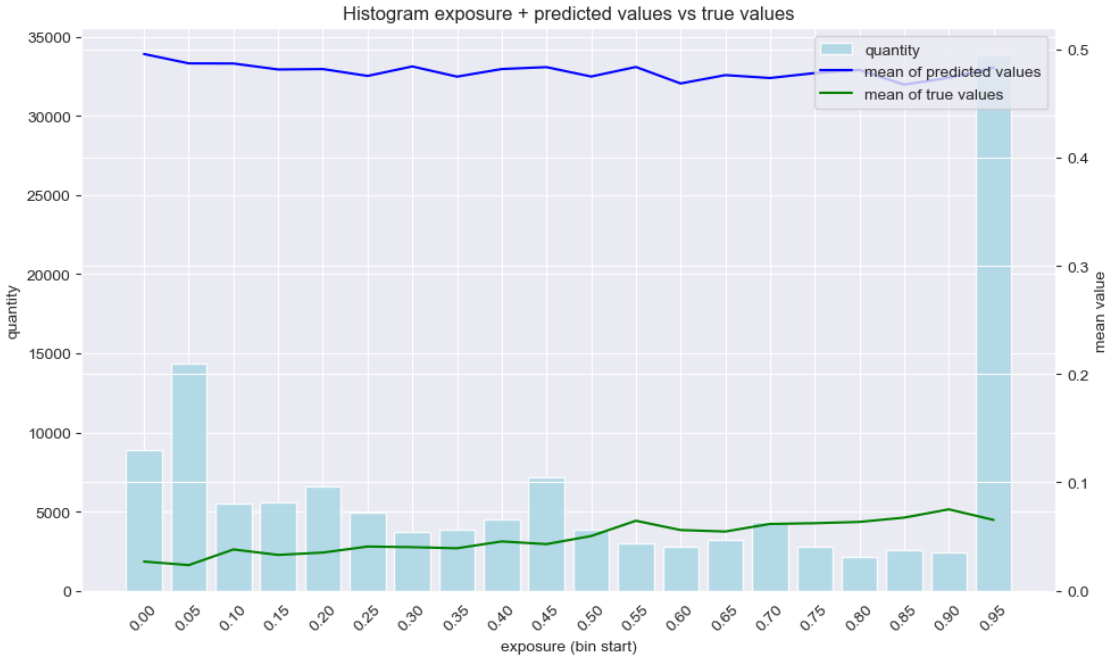

Histogram VehPower + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
VehPower (bin start)
100000
80000
60000
40000
20000
0
0.5
0.4
0.3
0.2
0.1
-1.21
-0.75
-0.30
0.15
0.60
1.06
1.51
1.96
2.41
2.86
3.31
3.76

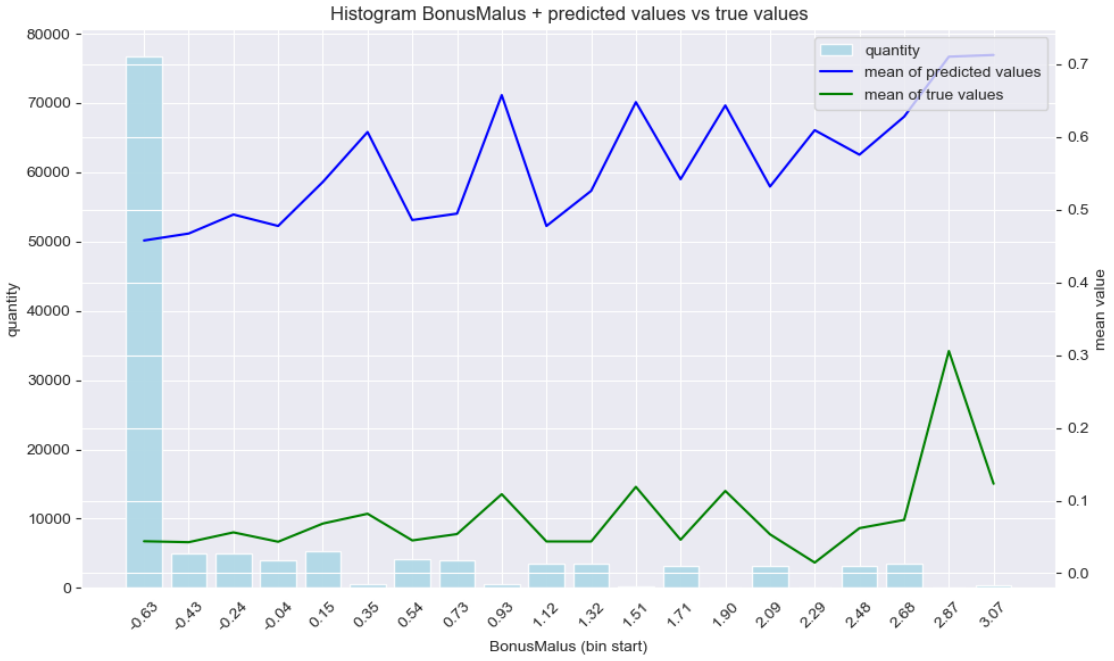


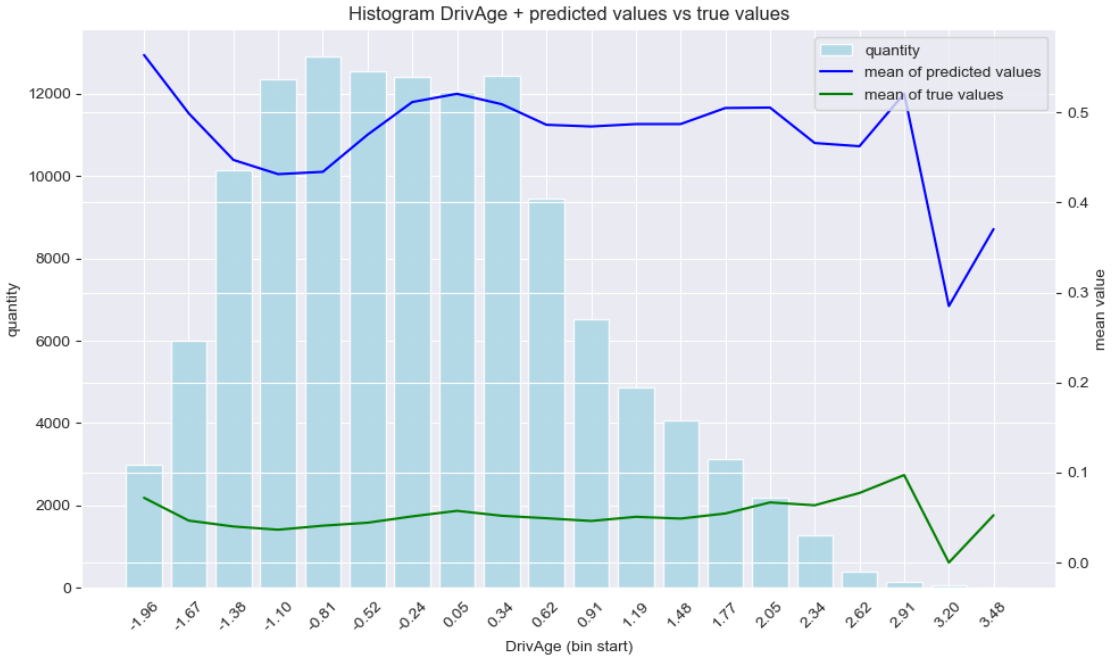

```
TEST-SET SCORING
ROC-AUC score: 0.6568305442890462
F1-score:  0.16840666169525229
Accuracy: 0.8938164044212749
Recall: 0.22304526748971193
Precision: 0.13527004093041828
```

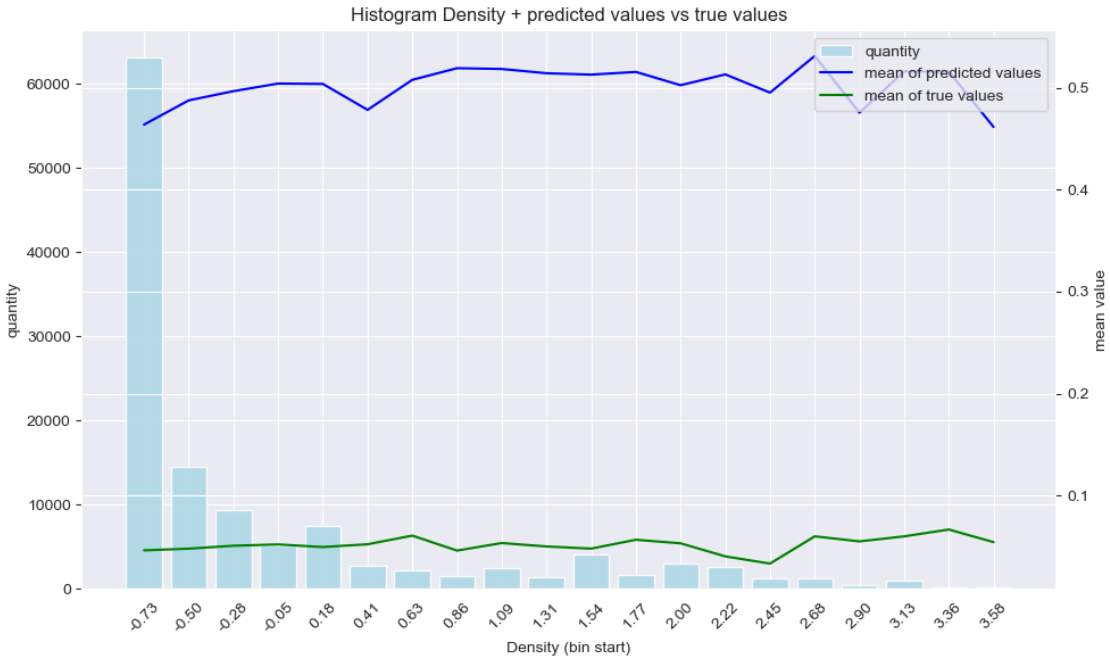


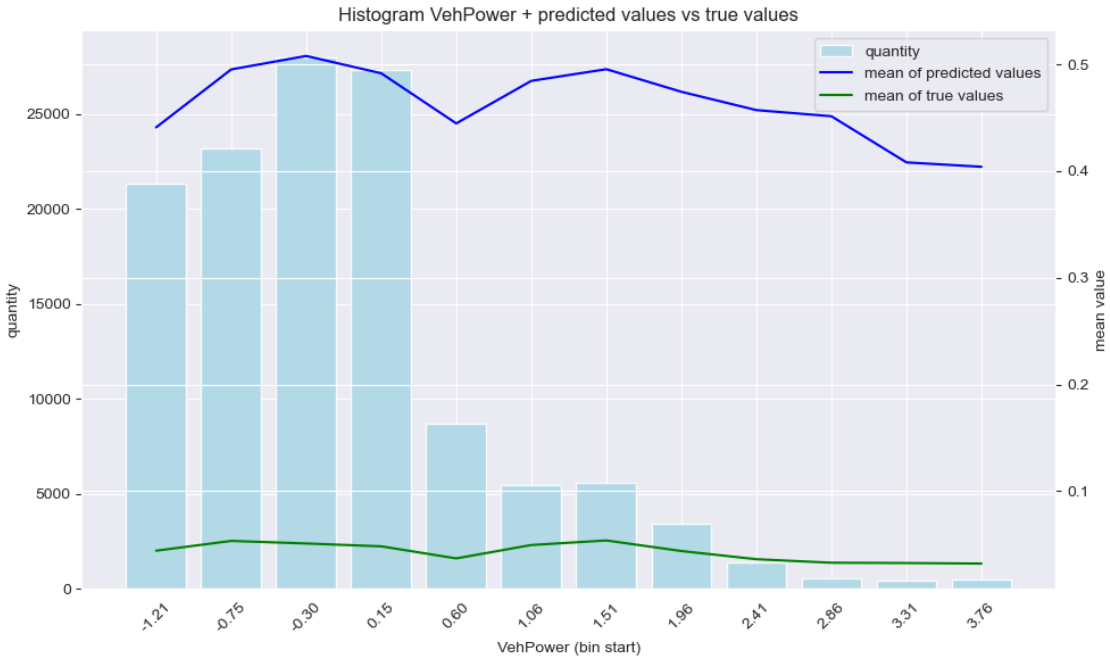
TEST-SET PLOTTING

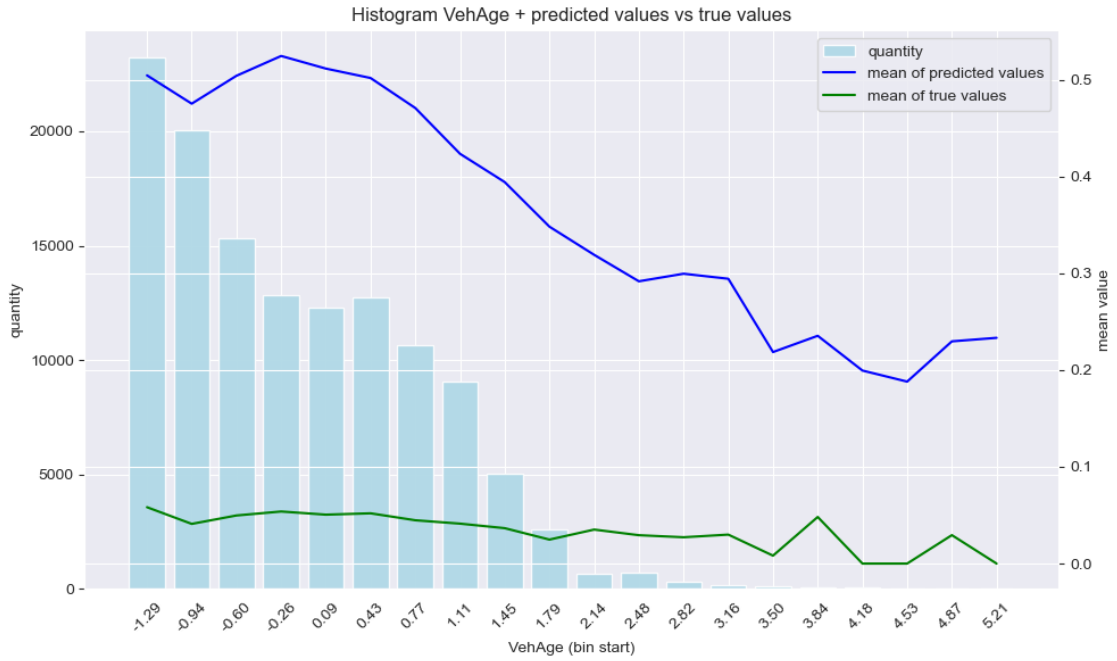



Histogram BonusMalus + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
BonusMalus (bin start)
0
10000
20000
30000
40000
50000
60000
70000
80000
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
-0.63
-0.43
-0.24
-0.04
0.15
0.35
0.54
0.73
0.93
1.12
1.32
1.51
1.71
1.90
2.09
2.29
2.48
2.68
2.87
3.07


Histogram DrivAge + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
DrivAge (bin start)
0
2000
4000
6000
8000
10000
12000
0.0
0.1
0.2
0.3
0.4
0.5
-1.96
-1.67
-1.38
-1.10
-0.81
-0.52
-0.24
0.05
0.34
0.62
0.91
1.19
1.48
1.77
2.05
2.34
2.62
2.91
3.20
3.48


Histogram Density + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
Density (bin start)
-0.73
-0.50
-0.28
-0.05
0.18
0.41
0.63
0.86
1.09
1.31
1.54
1.77
2.00
2.22
2.45
2.68
2.90
3.13
3.36
3.58


Histogram VehPower + predicted values vs true values
quantity
mean of predicted values
mean of true values
quantity
mean value
VehPower (bin start)
-1.21
-0.75
-0.30
0.15
0.60
1.06
1.51
1.96
2.41
2.86
3.31
3.76

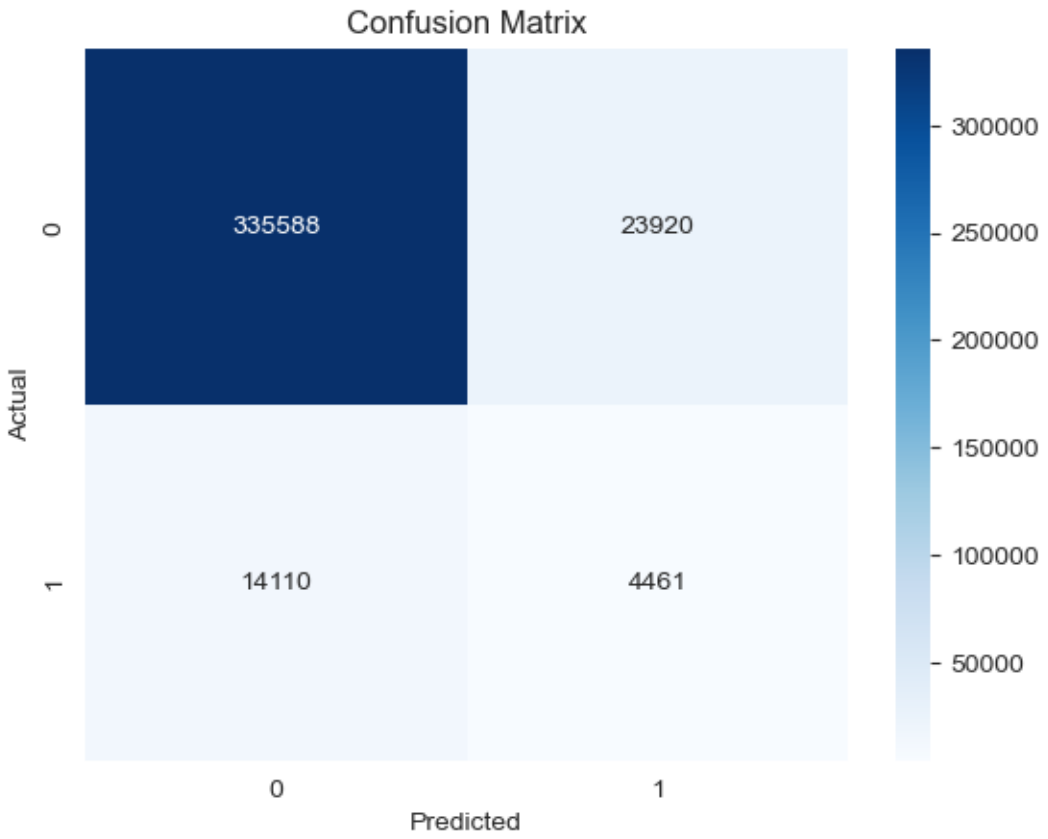


3.11 xgboost

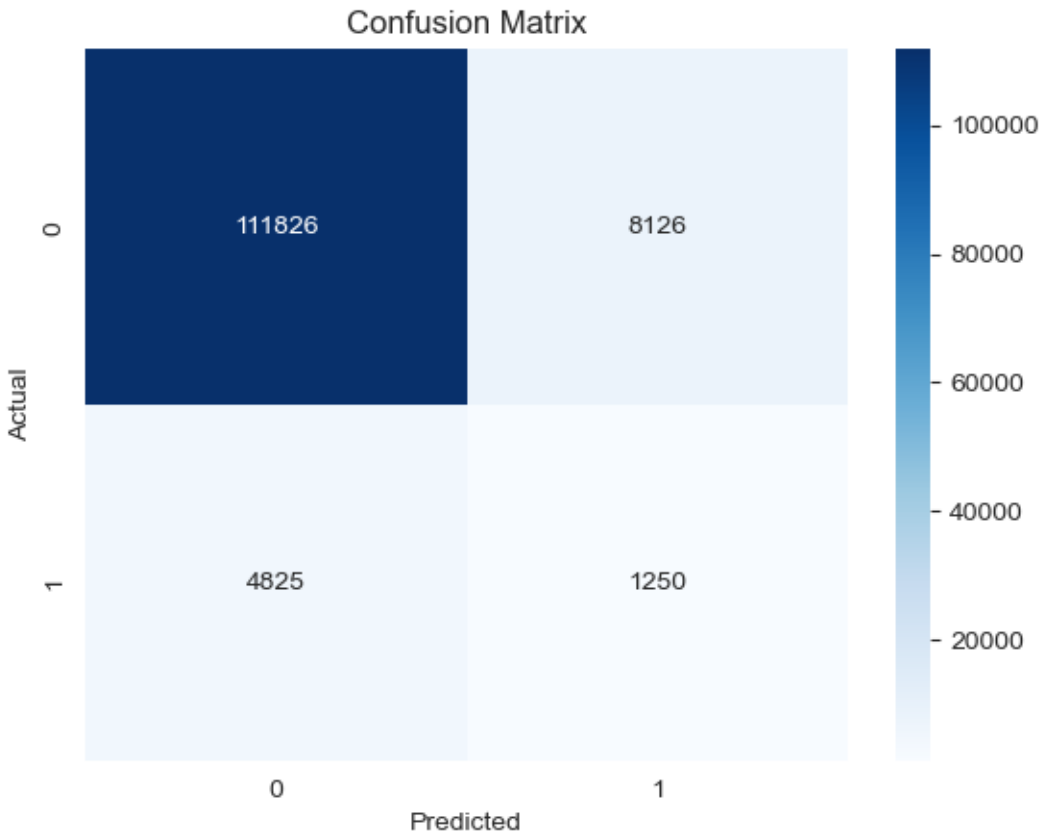
[46]:
```
dtrain_val = xgb.DMatrix(X_train_val,␣
 ↪label=y_train_val,weight=exposure_train_val)
dtrain = xgb.DMatrix(X_train, label=y_train,weight=exposure_train)
dval = xgb.DMatrix(X_val, label=y_val)
dtest = xgb.DMatrix(X_test, label=y_test)

params = {
    'objective': 'binary:logistic',
    'eval_metric': 'auc',
    'eta': 0.1,
    'max_depth': 6,
    'scale_pos_weight': sum(y_train == 0) / sum(y_train == 1),
    'verbosity': 1
}

evallist = [(dtrain, 'train'), (dval, 'eval')]
model = xgb.train(params, dtrain, num_boost_round=1000, evals=evallist,
                  early_stopping_rounds=20, verbose_eval=10)

print("TRAIN-SET SCORING")
y_pred =  model.predict(dtrain)
stats = score_binary_model(y_train,y_pred)
models_stats_train['xgboost_es_train'] = stats
```

```
print("TEST-SET SCORING")
y_pred =  model.predict(dtest)
stats =␣
 ↪score_binary_model(y_test,y_pred,models_stats_train['xgboost_es_train']['best_threshold'])
models_stats_test['xgboost_es_test'] = stats

# Training on bigger dataset, without earlystopping

model = xgb.train(params, dtrain_val, num_boost_round=1000,verbose_eval=10)

print("TRAIN-SET SCORING")
y_pred =  model.predict(dtrain_val)
stats = score_binary_model(y_train_val,y_pred)
models_stats_train['xgboost_train'] = stats

print("TEST-SET SCORING")
y_pred =  model.predict(dtest)
stats =␣
 ↪score_binary_model(y_test,y_pred,models_stats_train['xgboost_train']['best_threshold'])
models_stats_test['xgboost_test'] = stats
```

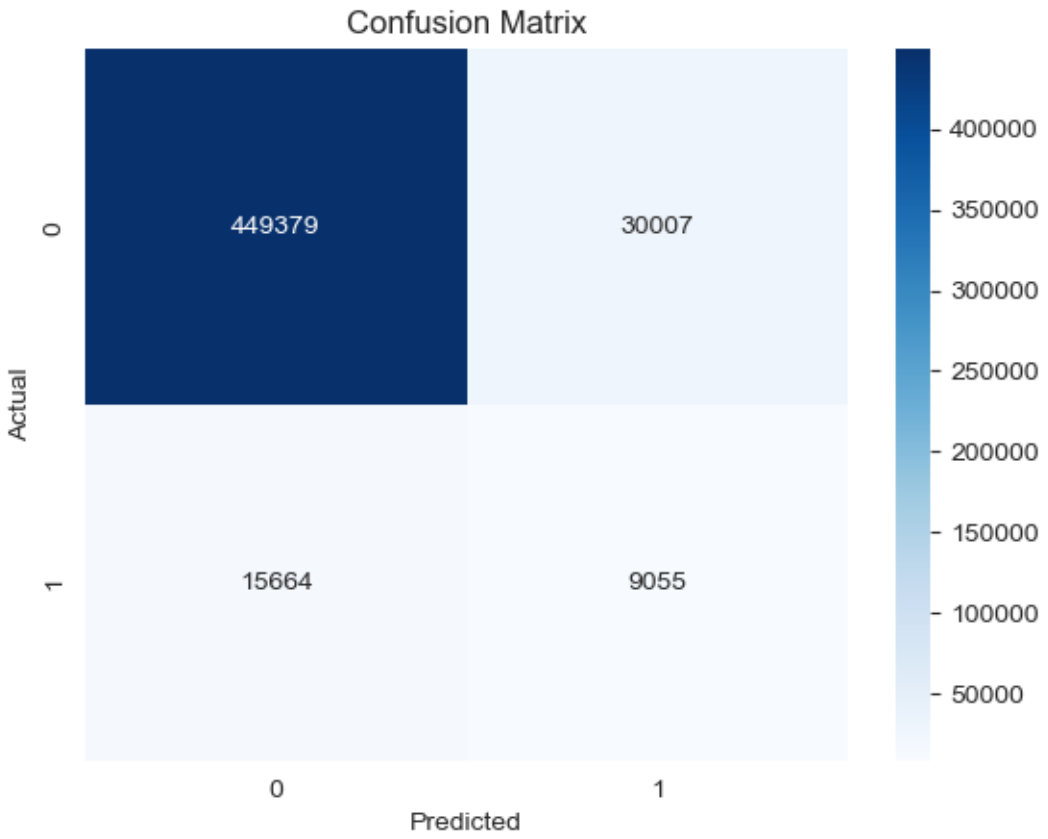
```
[0]     train-auc:0.62782       eval-auc:0.61691
[10]    train-auc:0.65102       eval-auc:0.63124
[20]    train-auc:0.66420       eval-auc:0.63811
[30]    train-auc:0.67427       eval-auc:0.64182
[40]    train-auc:0.68169       eval-auc:0.64441
[50]    train-auc:0.68770       eval-auc:0.64467
[60]    train-auc:0.69312       eval-auc:0.64587
[70]    train-auc:0.69764       eval-auc:0.64629
[80]    train-auc:0.70128       eval-auc:0.64625
[90]    train-auc:0.70502       eval-auc:0.64581
[97]    train-auc:0.70690       eval-auc:0.64578
TRAIN-SET SCORING
ROC-AUC score: 0.6985649867447855
F1-score:  0.19002385414891804
Accuracy: 0.899412556634989
Recall: 0.2402132356900544
Precision: 0.15718262217680842
```



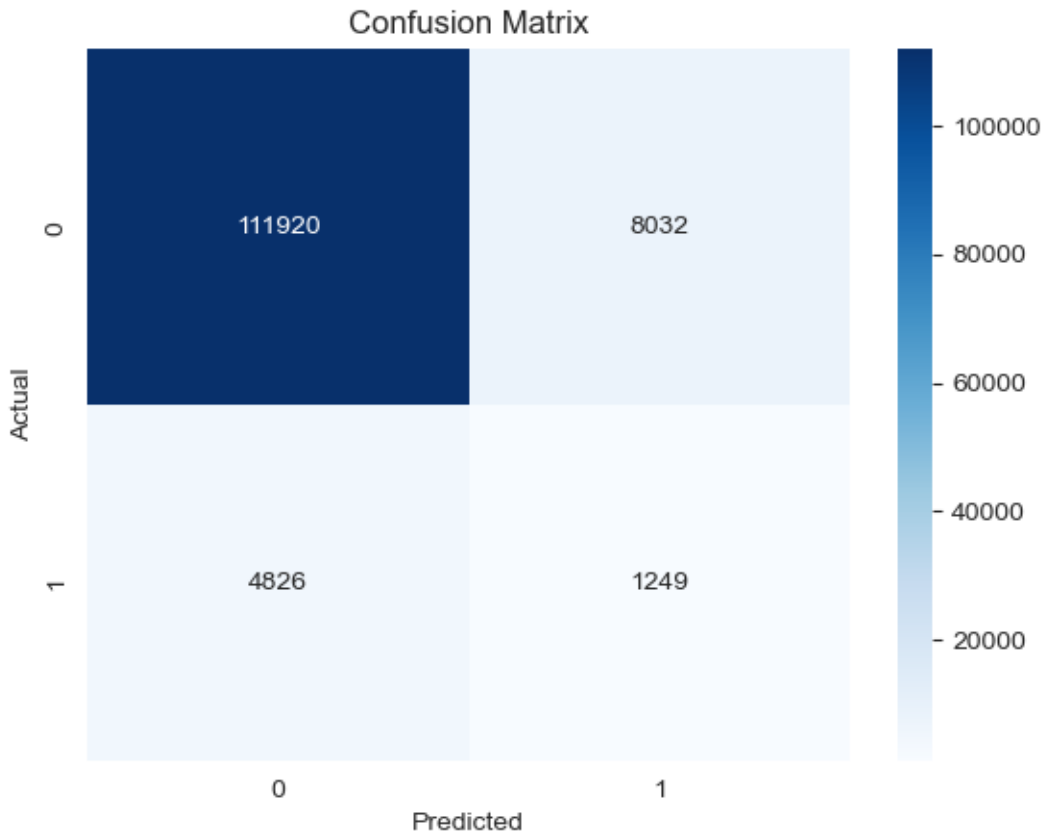

```
TEST-SET SCORING
ROC-AUC score: 0.6533876856641148
F1-score:  0.1618018251245874
Accuracy: 0.8972363065057488
Recall: 0.205761316872428
Precision: 0.13331911262798635
```




```
TRAIN-SET SCORING
ROC-AUC score: 0.8117111396027299
F1-score:  0.2839403584139477
Accuracy: 0.9094018111306176
Recall: 0.36631740766212223
Precision: 0.2318109671803799
```




```
TEST-SET SCORING
ROC-AUC score: 0.6446998072205562
F1-score:  0.16267257098202656
Accuracy: 0.8979742436144635
Recall: 0.20559670781893005
Precision: 0.13457601551556944
```



3.12 RandomForest

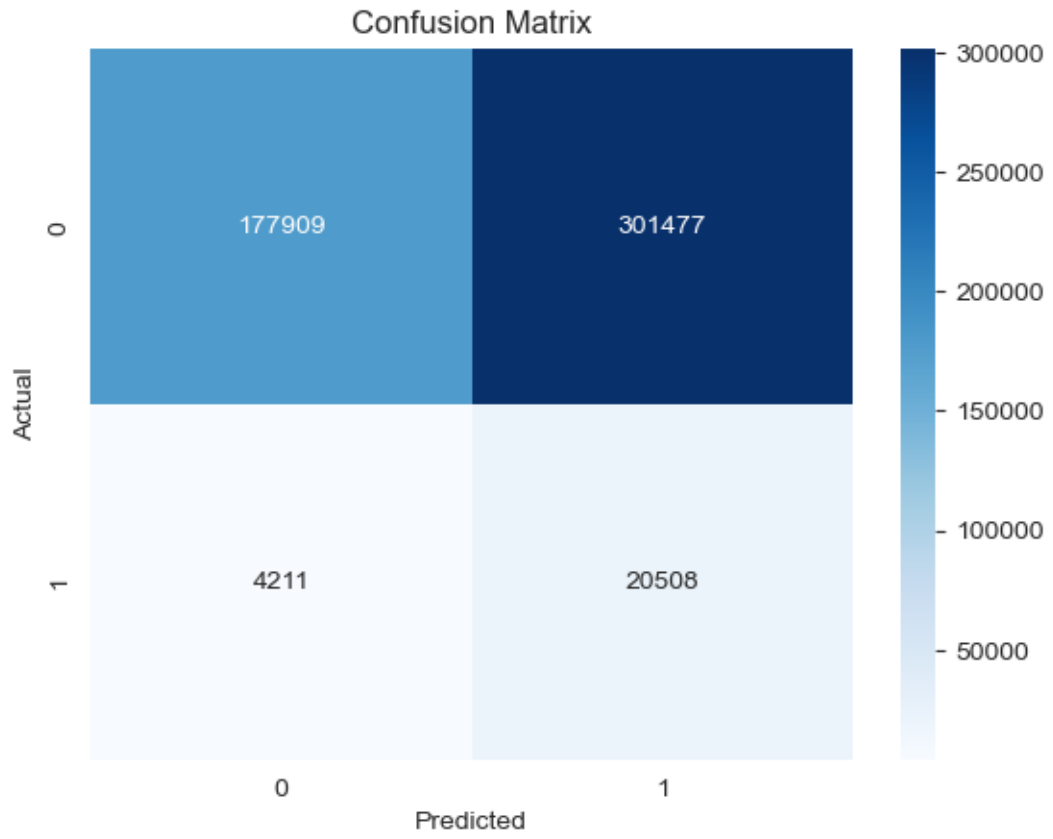
[47]:
```
model = RandomForestClassifier(
    n_estimators=200,
    max_depth=10,
    class_weight='balanced',
    random_state=42,
    n_jobs=-1
)

model.fit(X_train_val, y_train_val,sample_weight=exposure_train_val)
```

[47]:
```
RandomForestClassifier(class_weight='balanced', max_depth=10, n_estimators=200,
                       n_jobs=-1, random_state=42)
```

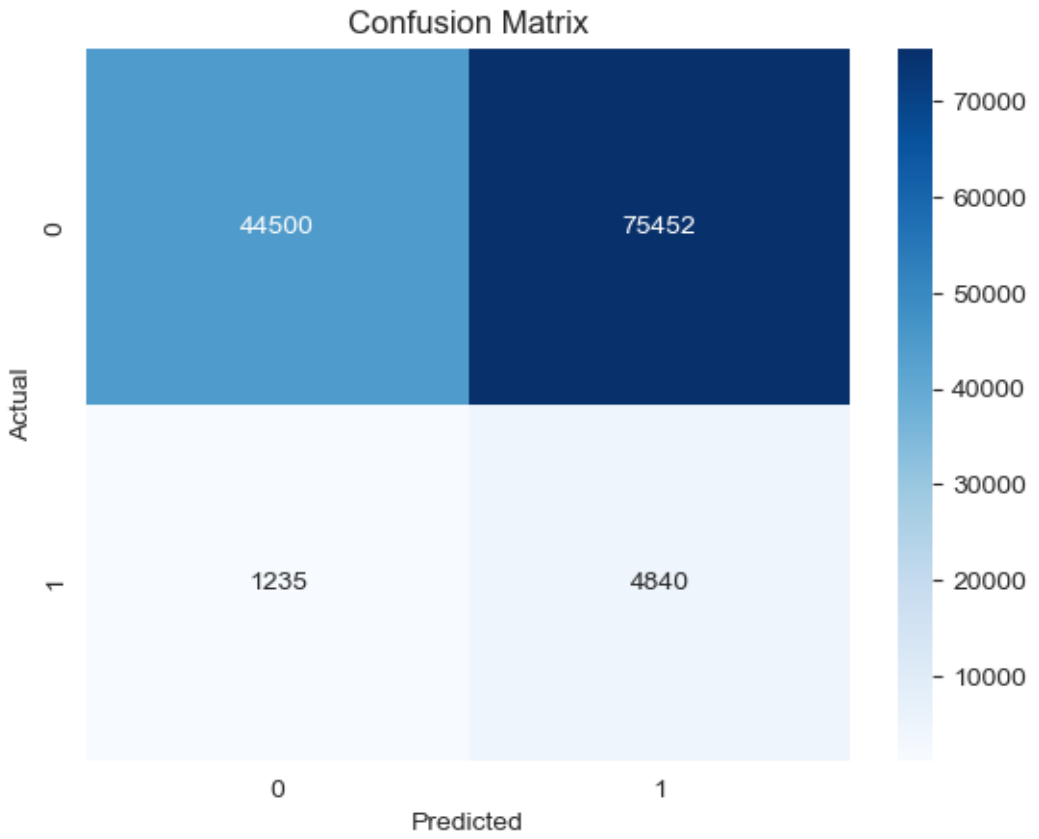
[48]:
```
print("TRAIN-SET SCORING")
y_pred =  model.predict(X_train_val)
stats = score_binary_model(y_train_val,y_pred)
models_stats_train['randomforest_train'] = stats
```

```
print("TEST-SET SCORING")
y_pred =  model.predict(X_test)
stats =␣
 ↪score_binary_model(y_test,y_pred,models_stats_train['randomforest_train']['best_threshold']
models_stats_test['randomforest_test'] = stats
```

```
TRAIN-SET SCORING
ROC-AUC score: 0.6003818422821053
F1-score:  0.11830264433061055
Accuracy: 0.39360252328383966
Recall: 0.8296452121849589
Precision: 0.06369240803143003
```



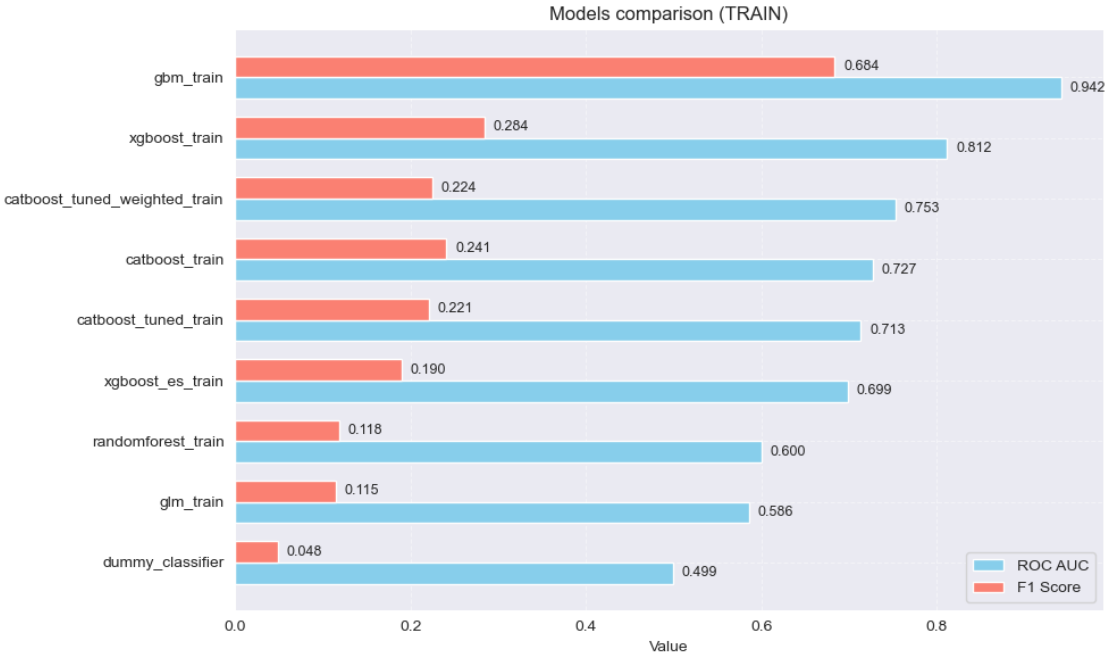

```
TEST-SET SCORING
ROC-AUC score: 0.583844772476892
F1-score:  0.11207984531128788
Accuracy: 0.39150340799987304
Recall: 0.7967078189300412
Precision: 0.06027997808000797
```



3.12.1 Comparison of models (binary prediction)

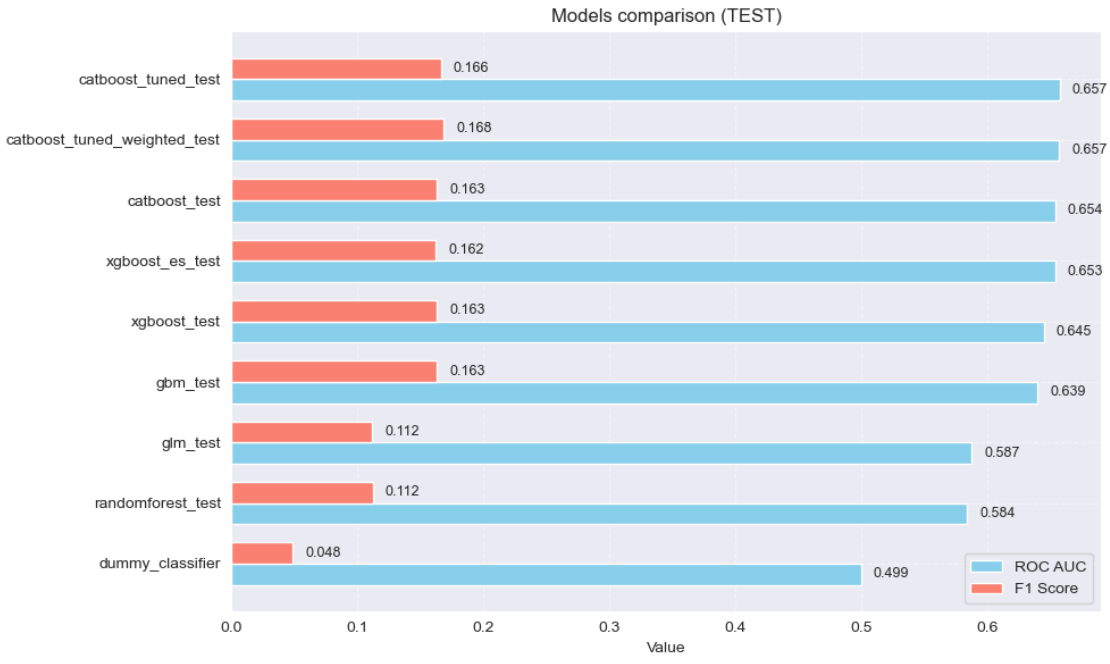
[49]:
```
sorted_items = sorted(models_stats_train.items(), key=lambda x:␣
 ↪x[1]['roc_auc_score'], reverse=False)

labels = [k for k, _ in sorted_items]
roc_aucs = [v['roc_auc_score'] for _, v in sorted_items]
f1_scores = [v['f1-score'] for _, v in sorted_items]

fig, ax = plt.subplots(figsize=(10, 6))
bar_height = 0.35
index = range(len(labels))

bars_roc = ax.barh(index, roc_aucs, bar_height, label='ROC AUC',␣
 ↪color='skyblue')
bars_f1 = ax.barh([i + bar_height for i in index], f1_scores, bar_height,␣
 ↪label='F1 Score', color='salmon')

for bar in bars_roc:
    ax.text(bar.get_width() + 0.01, bar.get_y() + bar.get_height() / 2,
```

```
            f'{bar.get_width():.3f}', va='center', fontsize=9)

for bar in bars_f1:
    ax.text(bar.get_width() + 0.01, bar.get_y() + bar.get_height() / 2,
            f'{bar.get_width():.3f}', va='center', fontsize=9)

ax.set_yticks([i + bar_height / 2 for i in index])
ax.set_yticklabels(labels)
ax.set_xlabel('Value')
ax.set_title('Models comparison (TRAIN)')
ax.legend(loc='lower right')

plt.tight_layout()
plt.grid(True, linestyle='--', alpha=0.5)
plt.show()
```



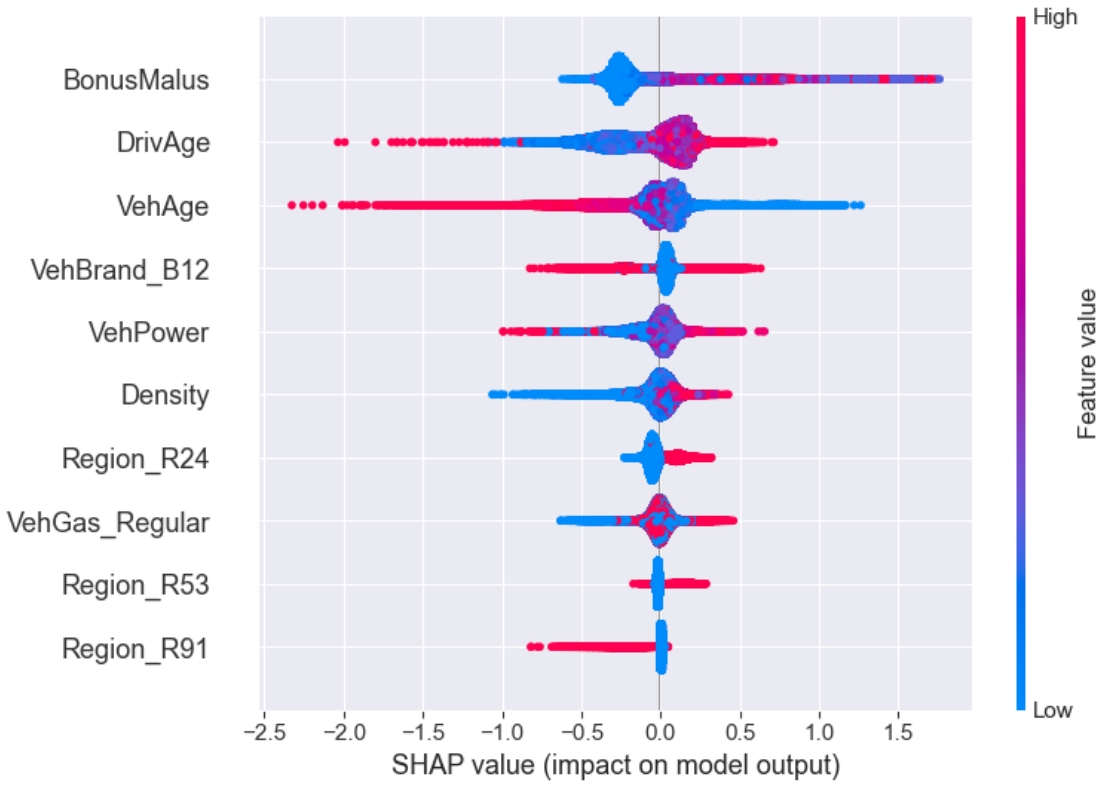
[50]:
```
sorted_items = sorted(models_stats_test.items(), key=lambda x:␣
 ↪x[1]['roc_auc_score'], reverse=False)

labels = [k for k, _ in sorted_items]
roc_aucs = [v['roc_auc_score'] for _, v in sorted_items]
f1_scores = [v['f1-score'] for _, v in sorted_items]

fig, ax = plt.subplots(figsize=(10, 6))
bar_height = 0.35
```

```
index = range(len(labels))

bars_roc = ax.barh(index, roc_aucs, bar_height, label='ROC AUC',␣
 ↪color='skyblue')
bars_f1 = ax.barh([i + bar_height for i in index], f1_scores, bar_height,␣
 ↪label='F1 Score', color='salmon')

for bar in bars_roc:
    ax.text(bar.get_width() + 0.01, bar.get_y() + bar.get_height() / 2,
            f'{bar.get_width():.3f}', va='center', fontsize=9)

for bar in bars_f1:
    ax.text(bar.get_width() + 0.01, bar.get_y() + bar.get_height() / 2,
            f'{bar.get_width():.3f}', va='center', fontsize=9)

ax.set_yticks([i + bar_height / 2 for i in index])
ax.set_yticklabels(labels)
ax.set_xlabel('Value')
ax.set_title('Models comparison (TEST)')
ax.legend(loc='lower right')

plt.tight_layout()
plt.grid(True, linestyle='--', alpha=0.5)
plt.show()
```



4 Explain the best model

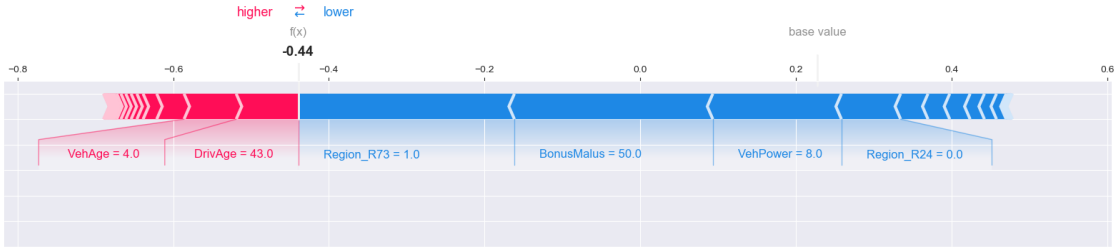
[51]:
```
import shap

explainer = shap.TreeExplainer(catboost)
shap_values1 = explainer.shap_values(X_test)
shap.summary_plot(shap_values1, X_test, max_display=10)
```



logit(p)=log(p/(1-p)), models operates on logits because it's optimal for log-loss, logits are also symmetrical

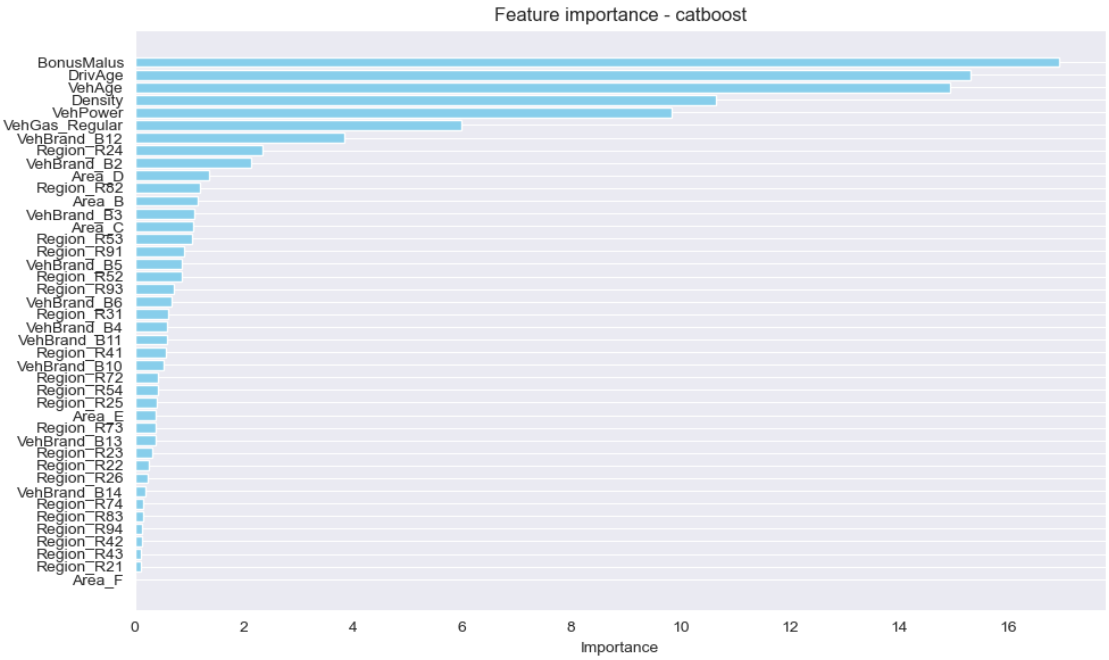
[52]:
```
# revert the scaling
first_row_og = X_test.iloc[0:1]
first_row_og[numeric_columns] =  ss.inverse_transform(X_test.iloc[0:
  ↪1][numeric_columns])

shap.force_plot(
    explainer.expected_value,
    shap_values1[0],
    first_row_og,
    matplotlib=True
)
```

```
C:\Users\Aycon\AppData\Local\Temp\ipykernel_1256\210979638.py:3:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  first_row_og[numeric_columns] =
ss.inverse_transform(X_test.iloc[0:1][numeric_columns])
```



In CatBoost, when you use .feature_importances_, the feature importance is typically computed using the "PredictionValuesChange" method by default.

[53]:
```
importances = catboost.feature_importances_
feature_names = X_train.columns

feat_imp = pd.DataFrame({
    'feature': feature_names,
    'importance': importances
}).sort_values(by='importance', ascending=False)

plt.figure(figsize=(10, 6))
plt.barh(feat_imp['feature'], feat_imp['importance'], color='skyblue')
plt.gca().invert_yaxis()
plt.xlabel('Importance')
plt.title('Feature importance - catboost')
plt.grid(axis='x')
plt.tight_layout()
plt.show()
```



5 What to improve

- pipeline (model + scaler in 1 go)
- more data from other sources could potentially help with overfitting.