Results from Original File

Logistic Regression with SMOTE

logistic regression model - SMOTE RFM
training set

	precision	recall	f1-score	support
0	0.60	0.62	0.61	3073
1	0.60	0.59	0.60	3073
accuracy			0.60	6146
macro avg	0.60	0.60	0.60	6146
weighted avg	0.60	0.60	0.60	6146

test set

	precision	recall	f1-score	support
0	0.93	0.60	0.73	1330
1	0.17	0.65	0.27	170
accuracy			0.61	1500
macro avg	0.55	0.63	0.50	1500
weighted avg	0.85	0.61	0.68	1500

logistic regression model - SMOTE CLV
training set

	precision	recall	f1-score	support
0	0.59	0.62	0.61	3073
1	0.60	0.58	0.59	3073
accuracy			0.60	6146
macro avg	0.60	0.60	0.60	6146
weighted avg	0.60	0.60	0.60	6146

test set

	precision	recall	f1-score	support
0	0.93	0.61	0.74	1330
1	0.17	0.62	0.27	170
accuracy			0.61	1500
macro avg	0.55	0.62	0.50	1500
weighted avg	0.84	0.61	0.69	1500

XGBoost with SMOTE

XGBoost model - SMOTE RFM
[0] validation_0-auc:0.577145
Will train until validation_0-auc hasn't improved in 5 rounds.
[1] validation_0-auc:0.666252
[2] validation_0-auc:0.64722
[3] validation_0-auc:0.643182
[4] validation_0-auc:0.651329
[5] validation_0-auc:0.666252
[6] validation_0-auc:0.664854
Stopping. Best iteration:
[1] validation_0-auc:0.666252

training set

	precision	recall	f1-score	support
0	0.64	0.57	0.61	3073
1	0.61	0.68	0.65	3073
accuracy			0.63	6146
macro avg	0.63	0.63	0.63	6146
weighted avg	0.63	0.63	0.63	6146

test set

	precision	recall	f1-score	support
0	0.93	0.57	0.71	1330
1	0.17	0.66	0.27	170
accuracy			0.58	1500
macro avg	0.55	0.62	0.49	1500
weighted avg	0.84	0.58	0.66	1500

XGBoost model - SMOTE CLV
[0] validation_0-auc:0.638452
Will train until validation_0-auc hasn't improved in 5 rounds.
[1] validation_0-auc:0.670705
[2] validation_0-auc:0.68444
[3] validation_0-auc:0.684042
[4] validation_0-auc:0.687351
[5] validation_0-auc:0.690741
[6] validation_0-auc:0.692315
[7] validation_0-auc:0.69236
[8] validation_0-auc:0.686809
[9] validation_0-auc:0.68937
[10] validation_0-auc:0.690741
[11] validation_0-auc:0.69335
[12] validation_0-auc:0.693412
[13] validation_0-auc:0.693538
[14] validation_0-auc:0.694135
[15] validation_0-auc:0.694847
[16] validation_0-auc:0.69479
[17] validation_0-auc:0.694034
[18] validation_0-auc:0.693919
[19] validation_0-auc:0.694715
[20] validation_0-auc:0.694622
Stopping. Best iteration:
[15] validation_0-auc:0.694847

training set

	precision	recall	f1-score	support
0	0.68	0.56	0.62	3073
1	0.63	0.74	0.68	3073
accuracy			0.65	6146
macro avg	0.65	0.65	0.65	6146
weighted avg	0.65	0.65	0.65	6146

test set

	precision	recall	f1-score	support
0	0.94	0.57	0.71	1330
1	0.18	0.72	0.28	170
accuracy			0.58	1500
macro avg	0.56	0.64	0.49	1500
weighted avg	0.85	0.58	0.66	1500

Tuning CLV

Best AUC Score: 0.671839531581116
Accuracy: 0.48733333333333334
[[594 736]
[33 137]]
test set

	precision	recall	f1-score	support
0	0.95	0.45	0.61	1330
1	0.16	0.81	0.26	170
accuracy			0.49	1500
macro avg	0.55	0.63	0.43	1500
weighted avg	0.86	0.49	0.57	1500

What to do

1. **Drop March 2013 - March 2015**
2. **Fix imbalanced data with undersampling and oversampling**
3. **Calculate AUC**
4. **Compare !**

Let's start...

Results from My File

Logistic Regression SMOTE - RFM

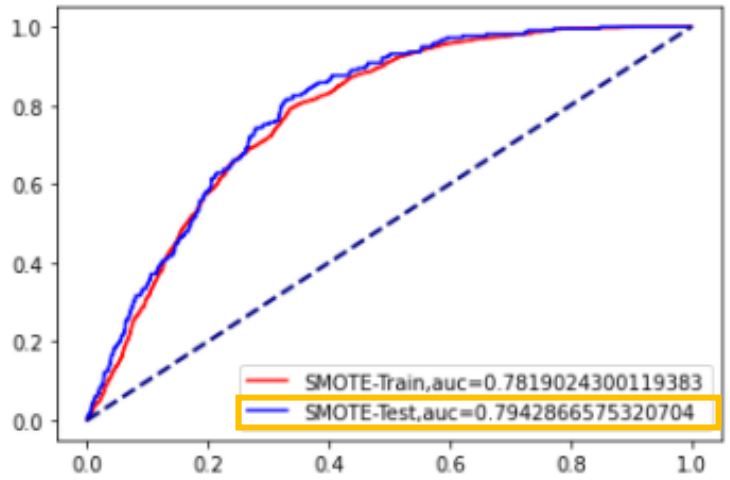
logistic regression model - SMOTE RFM
training set

	precision	recall	f1-score	support
0	0.72	0.69	0.71	4389
1	0.70	0.72	0.71	4389
accuracy			0.71	8778
macro avg	0.71	0.71	0.71	8778
weighted avg	0.71	0.71	0.71	8778

test set

	precision	recall	f1-score	support
0	0.96	0.68	0.80	1848
1	0.22	0.77	0.35	218
accuracy			0.69	2066
macro avg	0.59	0.73	0.57	2066
weighted avg	0.88	0.69	0.75	2066

Logistic regression model - SMOTE RFM - AUC



Logistic Regression Undersampling - RFM

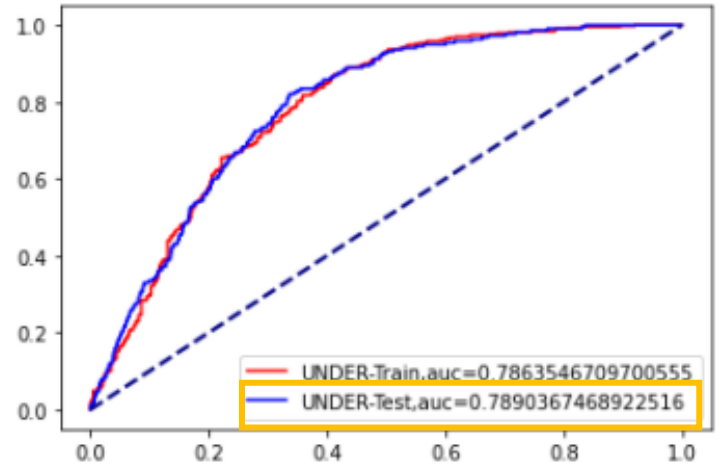
logistic regression model - Undersampling RFM
training set

	precision	recall	f1-score	support
0	0.74	0.68	0.71	429
1	0.70	0.76	0.73	429
accuracy			0.72	858
macro avg	0.72	0.72	0.72	858
weighted avg	0.72	0.72	0.72	858

test set

	precision	recall	f1-score	support
0	0.96	0.67	0.79	1848
1	0.22	0.79	0.34	218
accuracy			0.68	2066
macro avg	0.59	0.73	0.57	2066
weighted avg	0.89	0.68	0.74	2066

Logistic regression model - Undersampling RFM - AUC



Logistic Regression Oversampling - RFM

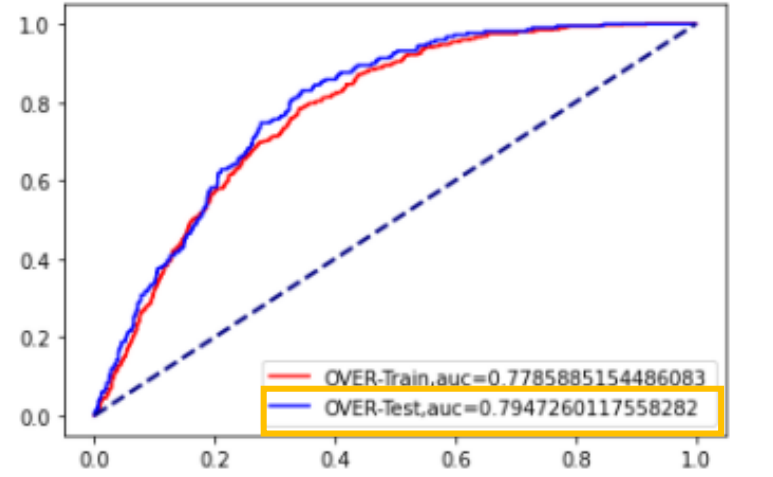
logistic regression model - Oversampling RFM
training set

	precision	recall	f1-score	support
0	0.71	0.69	0.70	4389
1	0.70	0.72	0.71	4389
accuracy			0.71	8778
macro avg	0.71	0.71	0.71	8778
weighted avg	0.71	0.71	0.71	8778

test set

	precision	recall	f1-score	support
0	0.96	0.68	0.80	1848
1	0.22	0.78	0.35	218
accuracy			0.69	2066
macro avg	0.59	0.73	0.57	2066
weighted avg	0.88	0.69	0.75	2066

Logistic regression model - Oversampling RFM - AUC



Results from My File

Logistic Regression SMOTE - CLV

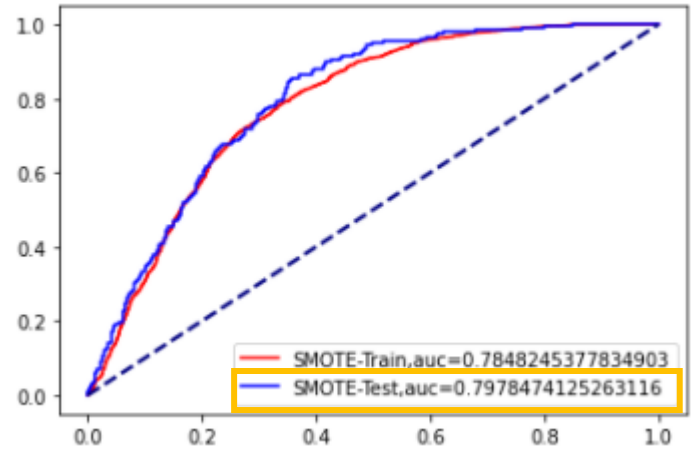
logistic regression model - SMOTE CLV
training set

	precision	recall	f1-score	support
0	0.73	0.69	0.71	4389
1	0.71	0.75	0.73	4389
accuracy			0.72	8778
macro avg	0.72	0.72	0.72	8778
weighted avg	0.72	0.72	0.72	8778

test set

	precision	recall	f1-score	support
0	0.96	0.68	0.80	1848
1	0.22	0.78	0.35	218
accuracy			0.69	2066
macro avg	0.59	0.73	0.57	2066
weighted avg	0.88	0.69	0.75	2066

Logistic regression model - SMOTE clv - AUC



Logistic Regression Undersampling - CLV

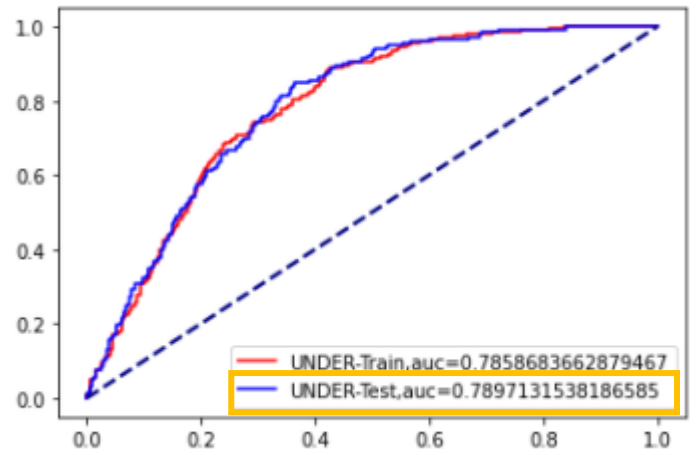
logistic regression model - Undersampling CLV
training set

	precision	recall	f1-score	support
0	0.73	0.70	0.71	429
1	0.71	0.74	0.73	429
accuracy			0.72	858
macro avg	0.72	0.72	0.72	858
weighted avg	0.72	0.72	0.72	858

test set

	precision	recall	f1-score	support
0	0.96	0.69	0.80	1848
1	0.22	0.76	0.34	218
accuracy			0.70	2066
macro avg	0.59	0.72	0.57	2066
weighted avg	0.88	0.70	0.75	2066

Logistic regression model - Undersampling CLV - AUC



Logistic Regression Oversampling - CLV

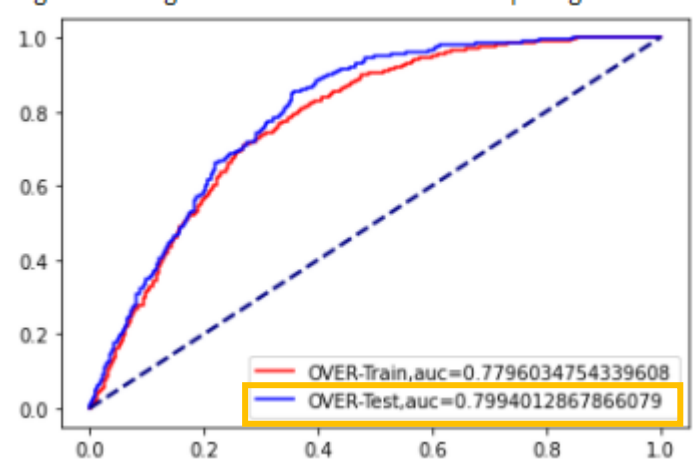
logistic regression model - Oversampling CLV
training set

	precision	recall	f1-score	support
0	0.73	0.69	0.71	4389
1	0.70	0.74	0.72	4389
accuracy			0.71	8778
macro avg	0.71	0.71	0.71	8778
weighted avg	0.71	0.71	0.71	8778

test set

	precision	recall	f1-score	support
0	0.96	0.68	0.80	1848
1	0.22	0.78	0.35	218
accuracy			0.69	2066
macro avg	0.59	0.73	0.57	2066
weighted avg	0.88	0.69	0.75	2066

Logistic regression model - Oversampling CLV - AUC



Results from My File

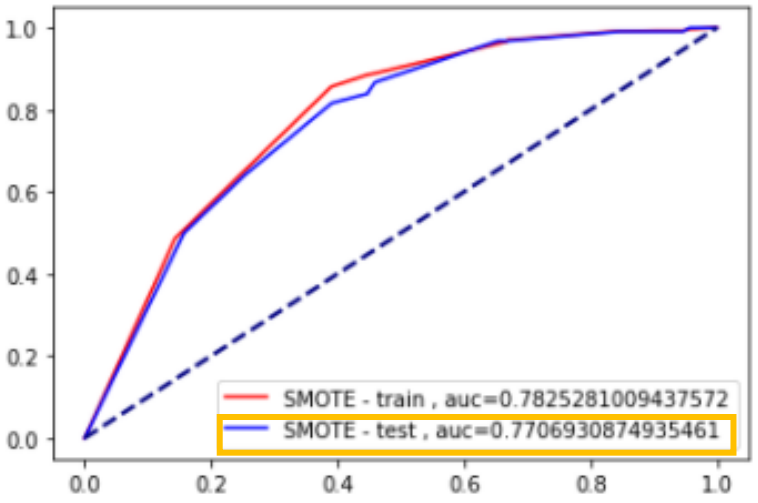
XGBoost SMOTE - RFM

training set

	precision	recall	f1-score	support
0	0.81	0.61	0.70	4389
1	0.69	0.86	0.76	4389
accuracy			0.73	8778
macro avg	0.75	0.73	0.73	8778
weighted avg	0.75	0.73	0.73	8778

test set

	precision	recall	f1-score	support
0	0.97	0.61	0.75	1848
1	0.20	0.82	0.32	218
accuracy			0.63	2066
macro avg	0.58	0.71	0.53	2066
weighted avg	0.88	0.63	0.70	2066



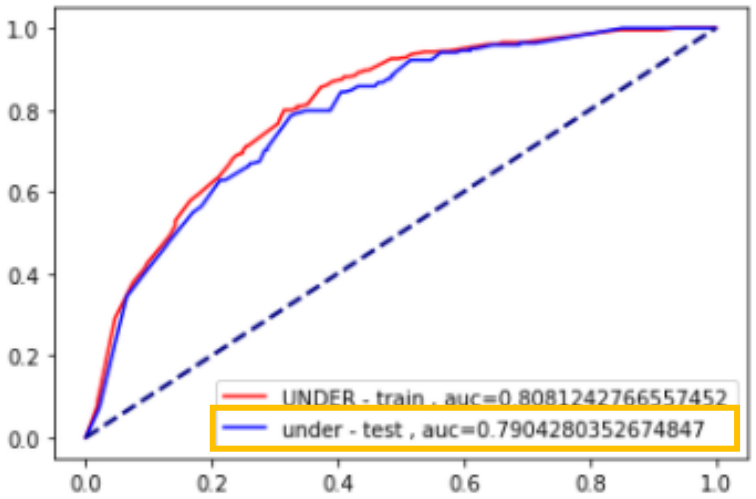
XGBoost Undersampling - RFM

training set

	precision	recall	f1-score	support
0	0.78	0.65	0.71	429
1	0.70	0.81	0.75	429
accuracy			0.73	858
macro avg	0.74	0.73	0.73	858
weighted avg	0.74	0.73	0.73	858

test set

	precision	recall	f1-score	support
0	0.96	0.61	0.75	1848
1	0.20	0.80	0.31	218
accuracy			0.63	2066
macro avg	0.58	0.71	0.53	2066
weighted avg	0.88	0.63	0.70	2066



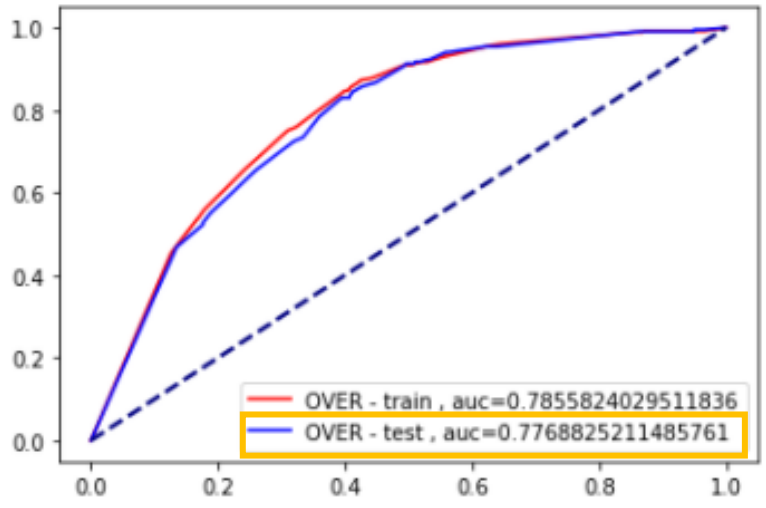
XGBoost Oversampling - RFM

training set

	precision	recall	f1-score	support
0	0.79	0.60	0.69	4389
1	0.68	0.84	0.75	4389
accuracy			0.72	8778
macro avg	0.74	0.72	0.72	8778
weighted avg	0.74	0.72	0.72	8778

test set

	precision	recall	f1-score	support
0	0.97	0.60	0.74	1848
1	0.20	0.83	0.32	218
accuracy			0.63	2066
macro avg	0.58	0.72	0.53	2066
weighted avg	0.89	0.63	0.70	2066



Results from My File

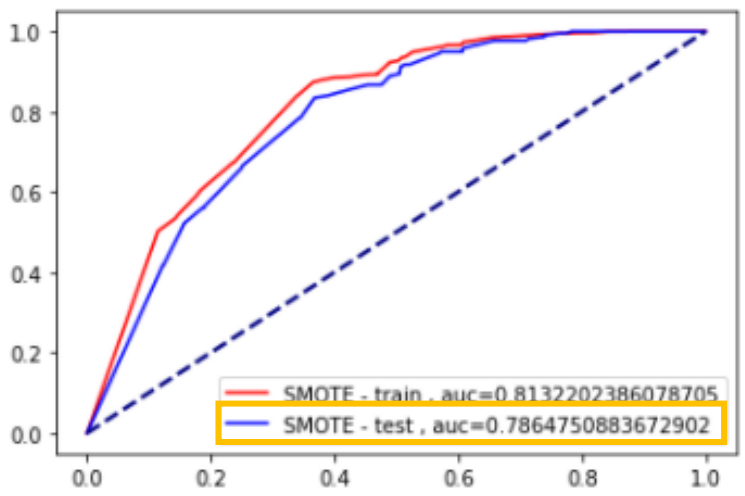
Logistic Regression SMOTE - CLV

training set

	precision	recall	f1-score	support
0	0.84	0.60	0.70	4389
1	0.69	0.89	0.77	4389
accuracy			0.74	8778
macro avg	0.76	0.74	0.74	8778
weighted avg	0.76	0.74	0.74	8778

test set

	precision	recall	f1-score	support
0	0.97	0.59	0.73	1848
1	0.20	0.85	0.32	218
accuracy			0.62	2066
macro avg	0.58	0.72	0.53	2066
weighted avg	0.89	0.62	0.69	2066



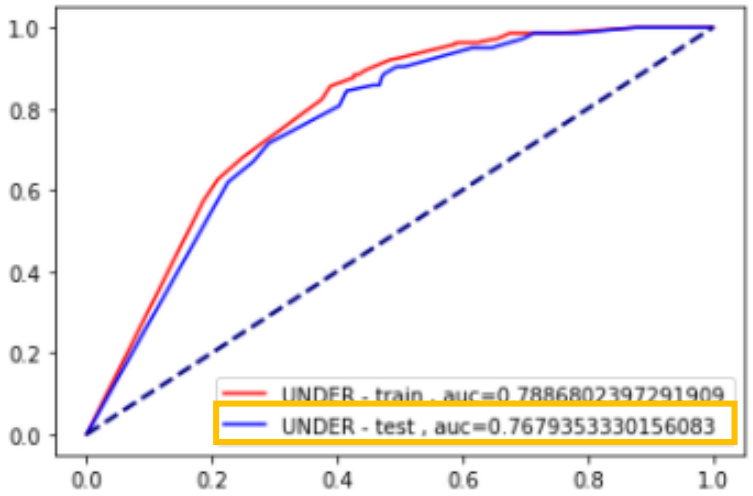
Logistic Regression Undersampling - CLV

training set

	precision	recall	f1-score	support
0	0.81	0.61	0.70	429
1	0.69	0.86	0.76	429
accuracy			0.73	858
macro avg	0.75	0.73	0.73	858
weighted avg	0.75	0.73	0.73	858

test set

	precision	recall	f1-score	support
0	0.97	0.58	0.73	1848
1	0.19	0.84	0.31	218
accuracy			0.61	2066
macro avg	0.58	0.71	0.52	2066
weighted avg	0.89	0.61	0.69	2066



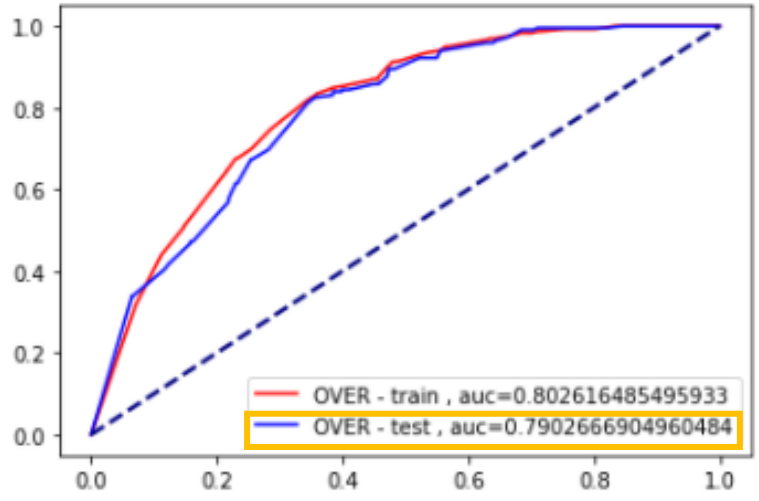
Logistic Regression Oversampling - CLV

training set

	precision	recall	f1-score	support
0	0.81	0.56	0.66	4389
1	0.66	0.87	0.75	4389
accuracy			0.71	8778
macro avg	0.73	0.71	0.70	8778
weighted avg	0.73	0.71	0.70	8778

test set

	precision	recall	f1-score	support
0	0.97	0.55	0.70	1848
1	0.18	0.86	0.30	218
accuracy			0.58	2066
macro avg	0.58	0.70	0.50	2066
weighted avg	0.89	0.58	0.66	2066



Results from My File

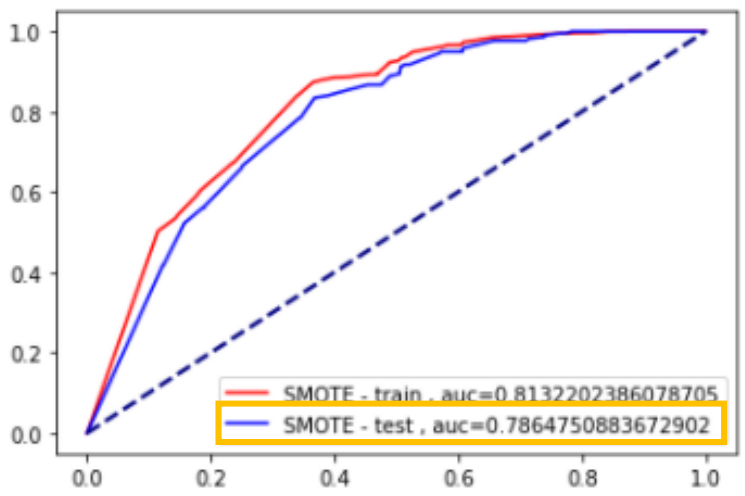
Logistic Regression SMOTE - CLV

training set

	precision	recall	f1-score	support
0	0.84	0.60	0.70	4389
1	0.69	0.89	0.77	4389
accuracy			0.74	8778
macro avg	0.76	0.74	0.74	8778
weighted avg	0.76	0.74	0.74	8778

test set

	precision	recall	f1-score	support
0	0.97	0.59	0.73	1848
1	0.20	0.85	0.32	218
accuracy			0.62	2066
macro avg	0.58	0.72	0.53	2066
weighted avg	0.89	0.62	0.69	2066



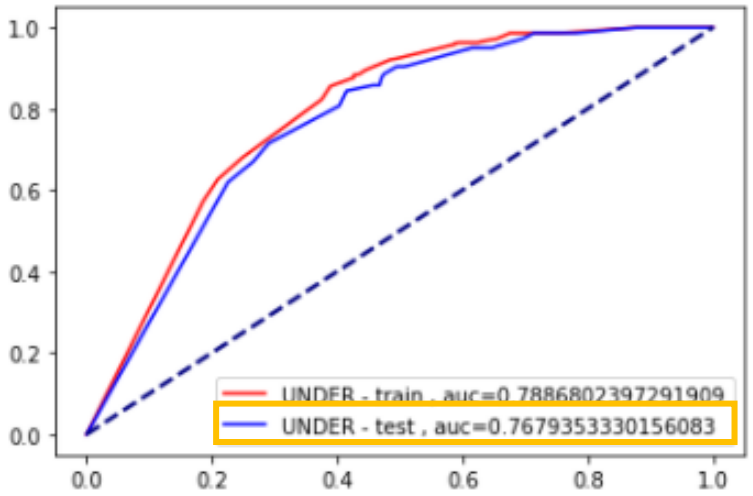
Logistic Regression Undersampling - CLV

training set

	precision	recall	f1-score	support
0	0.81	0.61	0.70	429
1	0.69	0.86	0.76	429
accuracy			0.73	858
macro avg	0.75	0.73	0.73	858
weighted avg	0.75	0.73	0.73	858

test set

	precision	recall	f1-score	support
0	0.97	0.58	0.73	1848
1	0.19	0.84	0.31	218
accuracy			0.61	2066
macro avg	0.58	0.71	0.52	2066
weighted avg	0.89	0.61	0.69	2066



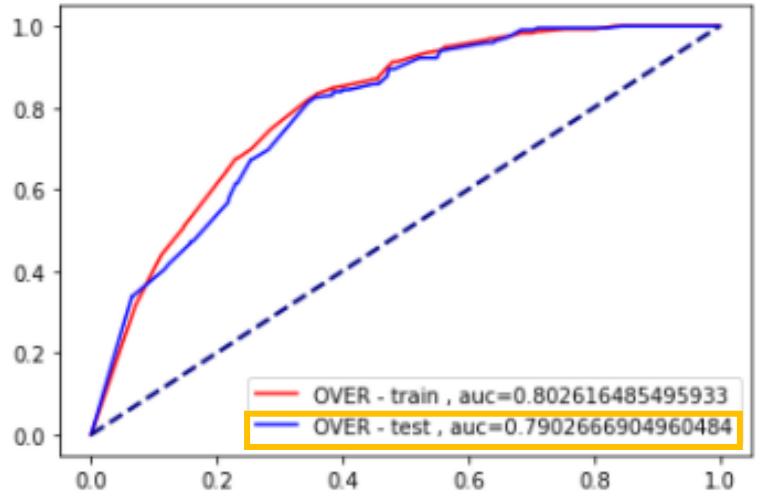
Logistic Regression Oversampling - CLV

training set

	precision	recall	f1-score	support
0	0.81	0.56	0.66	4389
1	0.66	0.87	0.75	4389
accuracy			0.71	8778
macro avg	0.73	0.71	0.70	8778
weighted avg	0.73	0.71	0.70	8778

test set

	precision	recall	f1-score	support
0	0.97	0.55	0.70	1848
1	0.18	0.86	0.30	218
accuracy			0.58	2066
macro avg	0.58	0.70	0.50	2066
weighted avg	0.89	0.58	0.66	2066



Results from My File

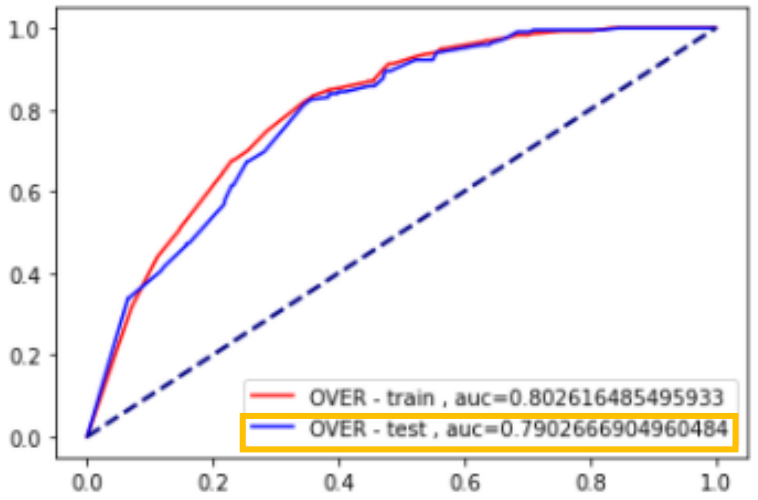
Logistic Regression Oversampling - CLV

training set

	precision	recall	f1-score	support
0	0.81	0.56	0.66	4389
1	0.66	0.87	0.75	4389
accuracy			0.71	8778
macro avg	0.73	0.71	0.70	8778
weighted avg	0.73	0.71	0.70	8778

test set

	precision	recall	f1-score	support
0	0.97	0.55	0.70	1848
1	0.18	0.86	0.30	218
accuracy			0.58	2066
macro avg	0.58	0.70	0.50	2066
weighted avg	0.89	0.58	0.66	2066



Summary

- **Dropped the timeframe before 2013-03-01 provided the better results so, we could imply that the effectiveness of models depended on appropriate timeframe.**
- **Evaluated with 'accuracy' was not enough, calculated ROC curve would be a good choice to figure out the exact best result.**
- **Based on the accuracy and AUC Score, the best model was presented by Logistic Regression Oversampling – CLV**
  at Accuracy = 0.69 (better than original model at 0.61)
  at AUC = 0.799 (better than original model at 0.666)

For Tuning - RFM

Best AUC Score: 0.7626080744558595
Accuracy: 0.6892545982575025
[[1265 583]
[59 159]]

test set

	precision	recall	f1-score	support
0	0.96	0.68	0.80	1848
1	0.21	0.73	0.33	218
accuracy			0.69	2066
macro avg	0.58	0.71	0.56	2066
weighted avg	0.88	0.69	0.75	2066

The result wasn't better than other models
So, I decided not to do other steps.