```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

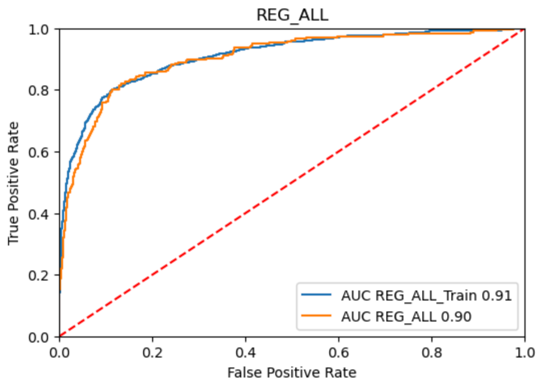
Assignment 3

All Variables

In [29]:
```python
def getCoefLogit( MODEL, TRAIN_DATA ) :
    varNames = list( TRAIN_DATA.columns.values )
    coef_dict = {}
    coef_dict["INTERCEPT"] = MODEL.intercept_[0]
    for coef, feat in zip(MODEL.coef_[0],varNames):
        coef_dict[feat] = coef
    print("\nFLAG")
    print("---------")
    print("Total Variables: ", len( coef_dict ) )
    for i in coef_dict :
        print( i, " = ", coef_dict[i]  )


WHO = "REG_ALL"

CLM = LogisticRegression( solver='newton-cg', max_iter=1000 )
CLM = CLM.fit( X_train, Y_train[ FLAG ] )

TRAIN_CLM = getProbAccuracyScores( WHO + "_Train", CLM, X_train, Y_train[ FLAG ] )
TEST_CLM = getProbAccuracyScores( WHO, CLM, X_test, Y_test[ FLAG ] )

print_Accuracy( WHO + " RMSE ACCURACY", [ TRAIN_CLM, TEST_CLM ] )

print_ROC_Curve( WHO, [ TRAIN_CLM, TEST_CLM ] )
print_Accuracy( WHO + " CLASSIFICATION ACCURACY", [ TRAIN_CLM, TEST_CLM ] )

#LOSS Regression

def getCoefLinear( MODEL, TRAIN_DATA ) :
    varNames = list( TRAIN_DATA.columns.values )
    coef_dict = {}
    coef_dict["INTERCEPT"] = MODEL.intercept_
    for coef, feat in zip(MODEL.coef_,varNames):
        coef_dict[feat] = coef
    print("\nLOSS")
    print("---------")
    print("Total Variables: ", len( coef_dict ) )
    for i in coef_dict :
        print( i, " = ", coef_dict[i]  )

AMT = LinearRegression()
AMT = AMT.fit( W_train, Z_train[LOSS] )

TRAIN_AMT = getAmtAccuracyScores( WHO + "_Train", AMT, W_train, Z_train[LOSS] )
TEST_AMT = getAmtAccuracyScores( WHO, AMT, W_test, Z_test[LOSS] )
print_Accuracy( WHO + " RMSE ACCURACY", [ TRAIN_AMT, TEST_AMT ] )


varNames = list( X_train.columns.values )

REG_ALL_CLM_COEF = getCoefLogit( CLM, X_train )
REG_ALL_AMT_COEF = getCoefLinear( AMT, X_train )

REG_ALL_CLM = TEST_CLM.copy()
REG_ALL_AMT = TEST_AMT.copy()
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
REG_ALL RMSE ACCURACY
======
REG_ALL_Train  =  0.8930369127516778
REG_ALL  =  0.8808724832214765
------
```

```
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```



```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

```
REG_ALL CLASSIFICATION ACCURACY
======
REG_ALL_Train  =  0.8930369127516778
REG_ALL  =  0.8808724832214765
------


REG_ALL RMSE ACCURACY
======
REG_ALL_Train  =  3673.227061891806
REG_ALL  =  3754.7356551934763
------



FLAG
---------
Total Variables:  29
INTERCEPT  =  -5.435082439095795
Unnamed: 0  =  -6.934396183211991e-05
LOAN  =  -1.9839825794254507e-06
OHE_REASON_HOMEIMP  =  0.33292937091822955
OHE_REASON_DEBTCON  =  0.14893139057546884
OHE_REASON_MISSING  =  -0.5043834492795197
OHE_JOB_OFFICE  =  -0.4403793898454696
OHE_JOB_OTHER  =  0.2762334630907767
OHE_JOB_MGR  =  0.21155628136113833
OHE_JOB_PROFEXEC  =  0.0
OHE_JOB_SALES  =  1.344023654051649
M_MORTDUE  =  0.5024512734920682
IMP_MORTDUE  =  -3.5012147941512535e-06
M_VALUE  =  3.522712756317599
IMP_VALUE  =  4.317989578325467e-06
M_YOJ  =  -0.6265276813729354
IMP_YOJ  =  -0.01747638464527435
M_DEROG  =  -1.8996042047864978
IMP_DEROG  =  0.5007936717589831
M_DELINQ  =  -0.4685279468411719
IMP_DELINQ  =  0.8045444006431522
M_CLAGE  =  1.2623238375095556
IMP_CLAGE  =  -0.005588743043030741
M_NINQ  =  0.15837056498304586
IMP_NINQ  =  0.15533913876650177
M_CLNO  =  1.668387938668998
IMP_CLNO  =  -0.009406071096347472
M_DEBTINC  =  2.624415110141342
IMP_DEBTINC  =  0.0970698587362559

LOSS
---------
Total Variables:  29
INTERCEPT  =  -1209.768528457298
Unnamed: 0  =  0.6171536565904032
LOAN  =  -0.0009594887314227451
OHE_REASON_HOMEIMP  =  -214.01204012113615
OHE_REASON_DEBTCON  =  186.48144035296838
OHE_REASON_MISSING  =  27.530599832632085
OHE_JOB_OFFICE  =  -153.8318058506309
OHE_JOB_OTHER  =  45.34030341378558
OHE_JOB_MGR  =  -108.57772971283828
OHE_JOB_PROFEXEC  =  -2.61479726759716 87e-12
OHE_JOB_SALES  =  2717.1693534070973
M_MORTDUE  =  826.3961867277318
IMP_MORTDUE  =  -0.007713324099253575
M_VALUE  =  4290.232575456508
IMP_VALUE  =  0.008599099402534158
M_YOJ  =  -690.4502832153239
IMP_YOJ  =  -22.09012083528172
M_DEROG  =  -1381.5771658825563
IMP_DEROG  =  812.9588059202737
M_DELINQ  =  317.1857290953153
IMP_DELINQ  =  1164.4367148771412
M_CLAGE  =  -52.300400760190136
IMP_CLAGE  =  -6.877845376036764
M_NINQ  =  120.76829651830703
IMP_NINQ  =  191.96664438677308
M_CLNO  =  2037.8450168796653
IMP_CLNO  =  45.30765005782466
M_DEBTINC  =  4226.338509859905
IMP_DEBTINC  =  74.00335697515517
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

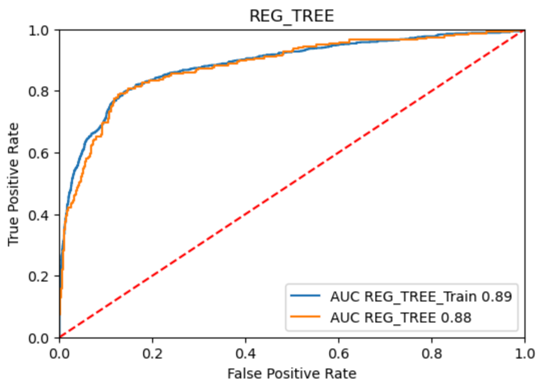
Decision Tree

```
In [30]: WHO = "REG_TREE"
         CLM = LogisticRegression( solver='newton-cg', max_iter=1000 )
         CLM = CLM.fit( X_train[vars_tree_flag], Y_train[ FLAG ] )

         TRAIN_CLM = getProbAccuracyScores( WHO + "_Train", CLM, X_train[vars_tree_flag], Y_train[ FLAG ] )
         TEST_CLM = getProbAccuracyScores( WHO, CLM, X_test[vars_tree_flag], Y_test[ FLAG ] )
```

```
print_ROC_Curve( WHO, [ TRAIN_CLM, TEST_CLM ] )
print_Accuracy( WHO + " CLASSIFICATION ACCURACY", [ TRAIN_CLM, TEST_CLM ] )
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` 
instead.
```

```
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```



```
REG_TREE CLASSIFICATION ACCURACY
======
REG_TREE_Train  =  0.8810822147651006
REG_TREE  =  0.8666107382550335
------
```

In [31]:
```python
def getCoefLinear( MODEL, TRAIN_DATA ) :
    varNames = list( TRAIN_DATA.columns.values )
    coef_dict = {}
    coef_dict["INTERCEPT"] = MODEL.intercept_
    for coef, feat in zip(MODEL.coef_,varNames):
        coef_dict[feat] = coef
    print("\nLOSS")
    print("---------")
    print("Total Variables: ", len( coef_dict ) )
    for i in coef_dict :
        print( i, " = ", coef_dict[i]  )

AMT = LinearRegression()
AMT = AMT.fit( W_train[vars_tree_amt], Z_train[LOSS] )

TRAIN_AMT = getAmtAccuracyScores( WHO + "_Train", AMT, W_train[vars_tree_amt], Z_train[LOSS] )
TEST_AMT = getAmtAccuracyScores( WHO, AMT, W_test[vars_tree_amt], Z_test[LOSS] )
print_Accuracy( WHO + " RMSE ACCURACY", [ TRAIN_AMT, TEST_AMT ] )


varNames = list( X_train.columns.values )

REG_TREE_CLM_COEF = getCoefLogit( CLM, X_train[vars_tree_flag] )
REG_TREE_AMT_COEF = getCoefLinear( AMT, X_train[vars_tree_amt] )

REG_TREE_CLM = TEST_CLM.copy()
REG_TREE_AMT = TEST_AMT.copy()
```

```
REG_TREE RMSE ACCURACY
======
REG_TREE_Train  =  3786.240357467525
REG_TREE  =  3850.540793930161
------



FLAG
---------
Total Variables:  8
INTERCEPT  =  -4.889917121878428
IMP_VALUE  =  9.94440257953066e-07
M_DEROG  =  -0.70941571448698
IMP_DEROG  =  0.5401551121471723
IMP_DELINQ  =  0.6867303723426624
IMP_CLAGE  =  -0.006498991436989625
M_DEBTINC  =  2.779816830618247
IMP_DEBTINC  =  0.08835364489046318

LOSS
---------
Total Variables:  10
INTERCEPT  =  -1047.2688586231825
Unnamed: 0  =  0.651552609634051
OHE_REASON_DEBTCON  =  258.41093862951607
IMP_MORTDUE  =  0.0017472255112593819
IMP_DEROG  =  968.0601775079234
IMP_DELINQ  =  1135.4770251933098
IMP_CLAGE  =  -7.397511908425877
IMP_CLNO  =  43.37993381691741
M_DEBTINC  =  4677.094409277137
IMP_DEBTINC  =  71.38674889287049
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

In [32]:
```python
#variales tree liked
def getTreeVars( TREE, varNames ) :
    tree_ = TREE.tree_
    varName = [ varNames[i] if i != _tree.TREE_UNDEFINED else "undefined!" for i in tree_.feature ]
    nameSet = set()
    for i in tree_.feature :
        if i != _tree.TREE_UNDEFINED :
            nameSet.add( i )
    nameList = list( nameSet )
    parameter_list = list()
    for i in nameList :
        parameter_list.append( varNames[i] )
    return parameter_list

theTree = tree.DecisionTreeRegressor( max_depth=4 )
theTree = theTree.fit( X, Y )
treeList = getTreeVars( theTree, varNames )
print( treeList )
```

```
['Unnamed: 0', 'LOAN', 'IMP_YOJ', 'IMP_DELINQ', 'IMP_CLNO', 'M_DEBTINC', 'IMP_DEBTINC']
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

Random Forest

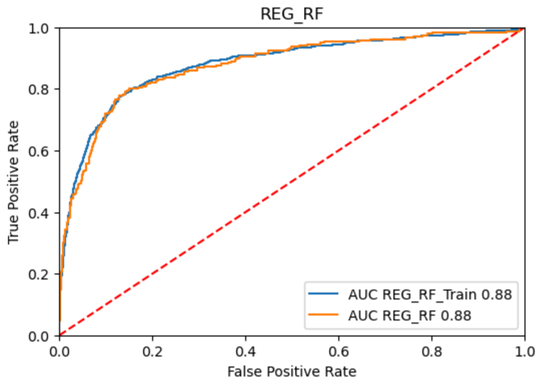
In [33]:
```python
WHO = "REG_RF"


print("\n\n")
RF_flag = []
for i in vars_RF_flag :
    print(i)
    theVar = i[0]
    RF_flag.append( theVar )

print("\n\n")
RF_amt = []
for i in vars_RF_amt :
    print(i)
    theVar = i[0]
    RF_amt.append( theVar )


CLM = LogisticRegression( solver='newton-cg', max_iter=1000 )
CLM = CLM.fit( X_train[RF_flag], Y_train[ FLAG ] )

TRAIN_CLM = getProbAccuracyScores( WHO + "_Train", CLM, X_train[RF_flag], Y_train[ FLAG ] )
TEST_CLM = getProbAccuracyScores( WHO, CLM, X_test[RF_flag], Y_test[ FLAG ] )

print_ROC_Curve( WHO, [ TRAIN_CLM, TEST_CLM ] )
```

```
print_Accuracy( WHO + " CLASSIFICATION ACCURACY", [ TRAIN_CLM, TEST_CLM ] )

#Regression RF LOSS

AMT = LinearRegression()
AMT = AMT.fit( W_train[RF_amt], Z_train[LOSS] )

TRAIN_AMT = getAmtAccuracyScores( WHO + "_Train", AMT, W_train[RF_amt], Z_train[LOSS] )
TEST_AMT = getAmtAccuracyScores( WHO, AMT, W_test[RF_amt], Z_test[LOSS] )
print_Accuracy( WHO + " RMSE ACCURACY", [ TRAIN_AMT, TEST_AMT ] )


REG_RF_CLM_COEF = getCoefLogit( CLM, X_train[RF_flag] )
REG_RF_AMT_COEF = getCoefLinear( AMT, X_train[RF_amt] )

REG_RF_CLM = TEST_CLM.copy()
REG_RF_AMT = TEST_AMT.copy()
```

```
('M_DEBTINC', 100)
('IMP_DEBTINC', 59)
('IMP_CLAGE', 37)
('IMP_DELINQ', 33)
('Unnamed: 0', 32)
('IMP_VALUE', 30)
('IMP_CLNO', 27)
('IMP_MORTDUE', 27)
('LOAN', 25)
('IMP_YOJ', 23)



('Unnamed: 0', 100)
('M_DEBTINC', 90)
('IMP_DEBTINC', 39)
('IMP_DELINQ', 36)
('IMP_CLAGE', 31)
('IMP_CLNO', 23)
('LOAN', 22)
('IMP_VALUE', 15)
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
```

```
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```



```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
REG_RF CLASSIFICATION ACCURACY
======
REG_RF_Train  =  0.8745805369127517
REG_RF  =  0.8657718120805369
------


REG_RF RMSE ACCURACY
======
REG_RF_Train  =  3859.486871231465
REG_RF  =  3845.8514817467126
------



FLAG
---------
Total Variables:  11
INTERCEPT  =  -4.424805758618589
M_DEBTINC  =  2.767422452997574
IMP_DEBTINC  =  0.08929834073884058
IMP_CLAGE  =  -0.006063300572911903
IMP_DELINQ  =  0.7319345819448747
Unnamed: 0  =  -9.276597190858906e-05
IMP_VALUE  =  3.1671116342963647e-06
IMP_CLNO  =  -0.007430708110113477
IMP_MORTDUE  =  -3.169478983925164e-06
LOAN  =  4.864688405827578e-06
IMP_YOJ  =  -0.02002740757298695

LOSS
---------
Total Variables:  9
INTERCEPT  =  -828.9433818804428
Unnamed: 0  =  0.6609921676553199
M_DEBTINC  =  4945.216367851677
IMP_DEBTINC  =  71.01238638641999
IMP_DELINQ  =  1238.026691409141
IMP_CLAGE  =  -8.467223272849122
IMP_CLNO  =  47.372886643776404
LOAN  =  0.000626654881804444
IMP_VALUE  =  0.0027837209280382686
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

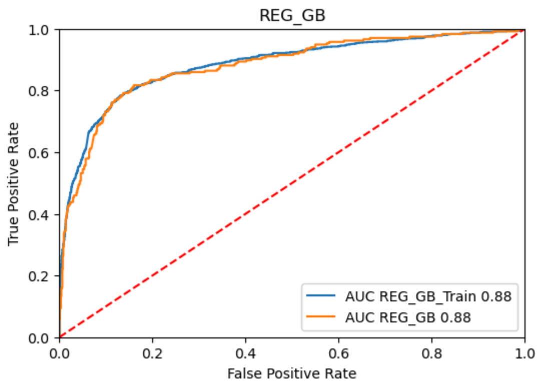
Gradient Boosting

In [34]:
```python
WHO = "REG_GB"


print("\n\n")
GB_flag = []
for i in vars_GB_flag :
    print(i)
    theVar = i[0]
    GB_flag.append( theVar )

print("\n\n")
GB_amt = []
for i in vars_GB_amt :
    print(i)
    theVar = i[0]
    GB_amt.append( theVar )


CLM = LogisticRegression( solver='newton-cg', max_iter=1000 )
CLM = CLM.fit( X_train[GB_flag], Y_train[ FLAG ] )

TRAIN_CLM = getProbAccuracyScores( WHO + "_Train", CLM, X_train[GB_flag], Y_train[ FLAG ] )
TEST_CLM = getProbAccuracyScores( WHO, CLM, X_test[GB_flag], Y_test[ FLAG ] )

print_ROC_Curve( WHO, [ TRAIN_CLM, TEST_CLM ] )
print_Accuracy( WHO + " CLASSIFICATION ACCURACY", [ TRAIN_CLM, TEST_CLM ] )

#Regression or GB LOSS


AMT = LinearRegression()
AMT = AMT.fit( W_train[GB_amt], Z_train[LOSS] )

TRAIN_AMT = getAmtAccuracyScores( WHO + "_Train", AMT, W_train[GB_amt], Z_train[LOSS] )
TEST_AMT = getAmtAccuracyScores( WHO, AMT, W_test[GB_amt], Z_test[LOSS] )
print_Accuracy( WHO + " RMSE ACCURACY", [ TRAIN_AMT, TEST_AMT ] )

REG_GB_CLM_COEF = getCoefLogit( CLM, X_train[GB_flag] )
REG_GB_AMT_COEF = getCoefLinear( AMT, X_train[GB_amt] )

REG_GB_CLM = TEST_CLM.copy()
REG_GB_AMT = TEST_AMT.copy()
```

```
('M_DEBTINC', 100)
('IMP_DEBTINC', 29)
('IMP_DELINQ', 19)
('IMP_CLAGE', 16)
('IMP_DEROG', 7)



('M_DEBTINC', 100)
('Unnamed: 0', 92)
('IMP_DELINQ', 44)
('IMP_DEBTINC', 36)
('IMP_CLAGE', 16)
('IMP_CLNO', 14)
('IMP_DEROG', 12)
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
```

```
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```



```
REG_GB CLASSIFICATION ACCURACY
======
REG_GB_Train  =  0.8766778523489933
REG_GB  =  0.8708053691275168
------


REG_GB RMSE ACCURACY
======
REG_GB_Train  =  3788.5348779902947
REG_GB  =  3850.885647456625
------



FLAG
---------
Total Variables:  6
INTERCEPT  =  -4.904836811894744
M_DEBTINC  =  2.760147831230137
IMP_DEBTINC  =  0.08940343127742956
IMP_DELINQ  =  0.66320967870209
IMP_CLAGE  =  -0.006427666524814138
IMP_DEROG  =  0.5706988321413794

LOSS
---------
Total Variables:  8
INTERCEPT  =  -918.3303690087341
M_DEBTINC  =  4673.878856557157
Unnamed: 0  =  0.6788285148069945
IMP_DELINQ  =  1132.1771879487108
IMP_DEBTINC  =  72.7061873797417
IMP_CLAGE  =  -7.536097089895807
IMP_CLNO  =  46.846302214793866
IMP_DEROG  =  959.3183391334528
```

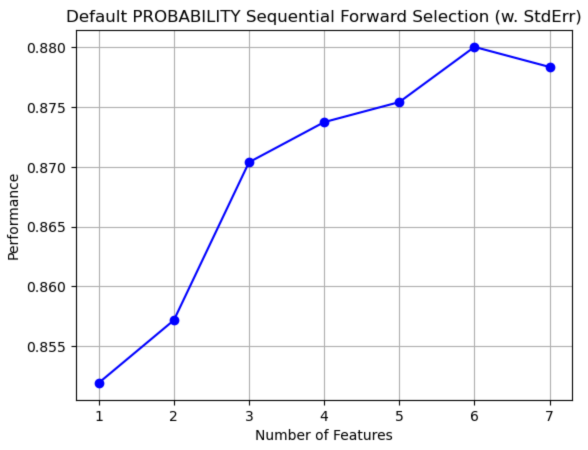
```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

Stepwise Selection

In [35]:
```
U_train = X_train[ vars_tree_flag ]
stepVarNames = list( U_train.columns.values )
maxCols = U_train.shape[1]

sfs = SFS( LogisticRegression( solver='newton-cg', max_iter=1000 ),
           k_features=( 1, maxCols ),
           forward=True,
           floating=False,
           cv=3
           )
sfs.fit(U_train.values, Y_train[ FLAG ].values)

theFigure = plot_sfs(sfs.get_metric_dict(), kind=None )
plt.title('Default PROBABILITY Sequential Forward Selection (w. StdErr)')
plt.grid()
plt.show()

#get metrics, what variables it liked and average error
dfm = pd.DataFrame.from_dict( sfs.get_metric_dict()).T
dfm_names = dfm.columns.values
print( dfm_names )
dfm = dfm[ ['feature_names', 'avg_score'] ]
```

```
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:466: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:314: LineSearchWarning: The line search algorithm did not converge
  warn('The line search algorithm did not converge', LineSearchWarning)
C:\Anaconda\Lib\site-packages\scipy\optimize\_linesearch.py:425: LineSearchWarning: Rounding errors prevent the line search from converging
  warn(msg, LineSearchWarning)
C:\Anaconda\Lib\site-packages\sklearn\utils\optimize.py:203: UserWarning: Line Search failed
  warnings.warn("Line Search failed")
```



```
['feature_idx' 'cv_scores' 'avg_score' 'feature_names' 'ci_bound'
 'std_dev' 'std_err']
```

In [36]:
```
dfm
```

Out[36]:

	feature_names	avg_score
1	(5,)	0.851927
2	(4, 5)	0.857171
3	(3, 4, 5)	0.870384
4	(3, 4, 5, 6)	0.87374
5	(2, 3, 4, 5, 6)	0.875417
6	(1, 2, 3, 4, 5, 6)	0.88003
7	(0, 1, 2, 3, 4, 5, 6)	0.878352

In [37]:
```
print(dfm.dtypes)
dfm.avg_score = dfm.avg_score.astype(float)
print(dfm.dtypes)
print(dfm)
```

```
feature_names    object
avg_score        object
dtype: object
feature_names     object
avg_score        float64
dtype: object
           feature_names  avg_score
1                   (5,)   0.851927
2                 (4, 5)   0.857171
3              (3, 4, 5)   0.870384
4           (3, 4, 5, 6)   0.873740
5        (2, 3, 4, 5, 6)   0.875417
6     (1, 2, 3, 4, 5, 6)   0.880030
7  (0, 1, 2, 3, 4, 5, 6)   0.878352
```

In [38]:
```python
def getVariables( DFM, INDEX, NAMES ) :
    theVars = DFM.iloc[ INDEX, ]
    theVars = theVars.feature_names
    print( INDEX,"=",theVars )
    theVarNames = []
    for i in theVars :
        index = int(i)
        try :
            theName = NAMES[ index ]
            theVarNames.append( theName )
        except :
            pass
    return theVarNames

print(" .................. ")

maxIndex = dfm.avg_score.argmax()
print( maxIndex )
regList = getVariables( dfm, maxIndex, varNames )
print( regList )
```

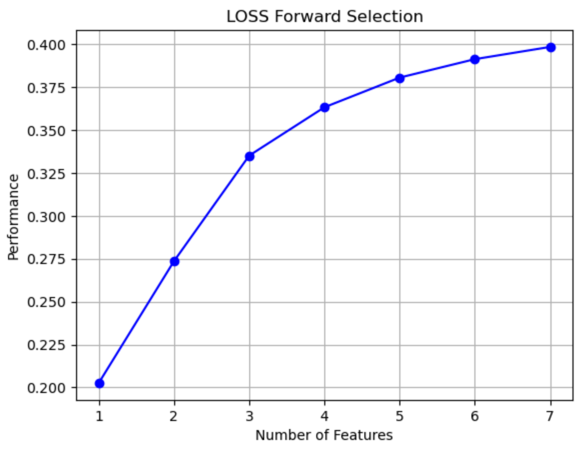
```
 ..................
5
5 = ('1', '2', '3', '4', '5', '6')
['LOAN', 'OHE_REASON_HOMEIMP', 'OHE_REASON_DEBTCON', 'OHE_REASON_MISSING', 'OHE_JOB_OFFICE', 'OHE_JOB_OTHER']
```

In [41]:
```python
stepVars = dfm.iloc[ maxIndex, ]
stepVars = stepVars.feature_names
print( stepVars )

finalStepVars = []
for i in stepVars :
    index = int(i)
    try :
        theName = stepVarNames[ index ]
        finalStepVars.append( theName )
    except :
        pass

for i in finalStepVars :
    print(i)

U_train = X_train[ finalStepVars ]
U_test = X_test[ finalStepVars ]
```

```
('1', '2', '3', '4', '5', '6')
M_DEROG
IMP_DEROG
IMP_DELINQ
IMP_CLAGE
M_DEBTINC
IMP_DEBTINC
```

In [44]:
```python
V_train = W_train[ GB_amt ]
stepVarNames = list( V_train.columns.values )
maxCols = V_train.shape[1]

sfs = SFS( LinearRegression(),
           k_features=( 1, maxCols ),
           forward=True,
           floating=False,
           scoring = 'r2',
           cv=5
           )
sfs.fit(V_train.values, Z_train[ LOSS ].values)

theFigure = plot_sfs(sfs.get_metric_dict(), kind=None )
plt.title('LOSS Forward Selection')
plt.grid()
plt.show()

dfm = pd.DataFrame.from_dict( sfs.get_metric_dict()).T
dfm = dfm[ ['feature_names', 'avg_score'] ]
dfm.avg_score = dfm.avg_score.astype(float)

print(" .................. ")
maxIndex = dfm.avg_score.argmax()
print("argmax")
print( dfm.iloc[ maxIndex, ] )
print(" .................. ")

stepVars = dfm.iloc[ maxIndex, ]
stepVars = stepVars.feature_names
print( stepVars )

finalStepVars = []
for i in stepVars :
    index = int(i)
    try :
        theName = stepVarNames[ index ]
        finalStepVars.append( theName )
    except :
        pass

for i in finalStepVars :
    print(i)
```

```
V_train = W_train[ finalStepVars ]
V_test = W_test[ finalStepVars ]
```

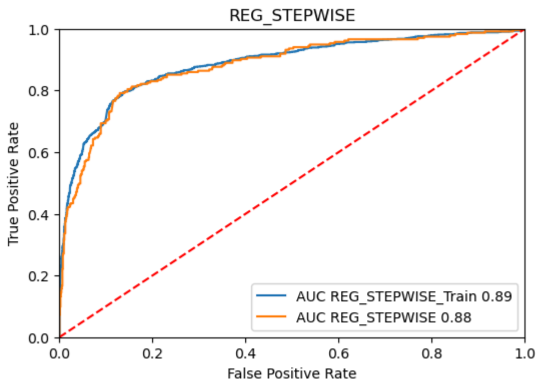


```
 ..................
argmax
feature_names    (0, 1, 2, 3, 4, 5, 6)
avg_score                      0.398375
Name: 7, dtype: object
 ..................
('0', '1', '2', '3', '4', '5', '6')
M_DEBTINC
Unnamed: 0
IMP_DELINQ
IMP_DEBTINC
IMP_CLAGE
IMP_CLNO
IMP_DEROG
```

In [46]:
```
WHO = "REG_STEPWISE"

CLM = LogisticRegression( solver='newton-cg', max_iter=1000 )
CLM = CLM.fit( U_train, Y_train[ FLAG ] )

TRAIN_CLM = getProbAccuracyScores( WHO + "_Train", CLM, U_train, Y_train[ FLAG ] )
TEST_CLM = getProbAccuracyScores( WHO, CLM, U_test, Y_test[ FLAG ] )

print_ROC_Curve( WHO, [ TRAIN_CLM, TEST_CLM ] )
print_Accuracy( WHO + " CLASSIFICATION ACCURACY", [ TRAIN_CLM, TEST_CLM ] )


# DAMAGES

AMT = LinearRegression()
AMT = AMT.fit( V_train, Z_train[FLAG] )

TRAIN_AMT = getAmtAccuracyScores( WHO + "_Train", AMT, V_train, Z_train[LOSS] )
TEST_AMT = getAmtAccuracyScores( WHO, AMT, V_test, Z_test[FLAG] )
print_Accuracy( WHO + " RMSE ACCURACY", [ TRAIN_AMT, TEST_AMT ] )

REG_STEP_CLM_COEF = getCoefLogit( CLM, U_train )
REG_STEP_AMT_COEF = getCoefLinear( AMT, V_train )

REG_STEP_CLM = TEST_CLM.copy()
REG_STEP_AMT = TEST_AMT.copy()
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)`
```

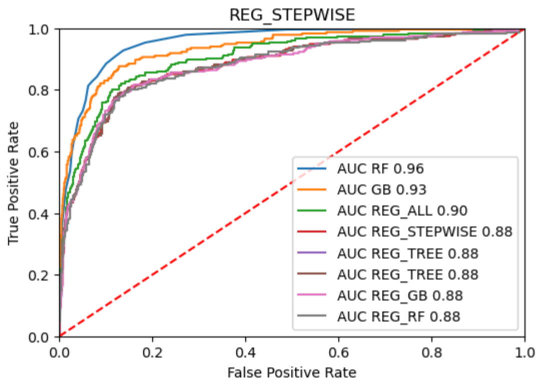
```
instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```



```
REG_STEPWISE CLASSIFICATION ACCURACY
======
REG_STEPWISE_Train  =  0.8802432885906041
REG_STEPWISE  =  0.8666107382550335
------


REG_STEPWISE RMSE ACCURACY
======
REG_STEPWISE_Train  =  6926.149285430292
REG_STEPWISE  =  0.31089901163192085
------



FLAG
---------
Total Variables:  7
INTERCEPT  =  -4.855706069405142
M_DEROG  =  -0.7136124293178427
IMP_DEROG  =  0.5359661653690089
IMP_DELINQ  =  0.6841654129272896
IMP_CLAGE  =  -0.006326639479117751
M_DEBTINC  =  2.773981174414131
IMP_DEBTINC  =  0.08953090425878735

LOSS
---------
Total Variables:  8
INTERCEPT  =  -0.023145071413099322
M_DEBTINC  =  0.4409632154020521
Unnamed: 0  =  -8.000769509228112e-06
IMP_DELINQ  =  0.08121939721255265
IMP_DEBTINC  =  0.0065440419659819815
IMP_CLAGE  =  -0.00046950884511877205
IMP_CLNO  =  -0.0015854317038726576
IMP_DEROG  =  0.0746411235248708
```

```
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:767: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if not hasattr(array, "sparse") and array.dtypes.apply(is_sparse).any():
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:605: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype):
C:\Anaconda\Lib\site-packages\sklearn\utils\validation.py:614: FutureWarning: is_sparse is deprecated and will be removed in a future version. Check `isinstance(dtype, pd.SparseDtype)` instead.
  if is_sparse(pd_dtype) or not is_extension_array_dtype(pd_dtype):
```

In [48]:
```
ALL_CLM = [ REG_TREE_CLM, RF_CLM, GB_CLM, REG_ALL_CLM, REG_TREE_CLM, REG_RF_CLM, REG_GB_CLM, REG_STEP_CLM ]

ALL_CLM = sorted( ALL_CLM, key = lambda x: x[4], reverse=True )
print_ROC_Curve( WHO, ALL_CLM )

ALL_CLM = sorted( ALL_CLM, key = lambda x: x[1], reverse=True )
print_Accuracy( "ALL FLAG ACCURACY", ALL_CLM )


ALL_AMT = [ TREE_AMT, RF_AMT, GB_AMT, REG_ALL_AMT, REG_TREE_AMT, REG_RF_AMT, REG_GB_AMT, REG_STEP_AMT ]
ALL_AMT = sorted( ALL_AMT, key = lambda x: x[1] )
print_Accuracy( "ALL LOSS ACCURACY", ALL_AMT )
```



```
ALL FLAG ACCURACY
======
RF  =  0.9093959731543624
GB  =  0.8993288590604027
REG_ALL  =  0.8808724832214765
REG_GB  =  0.8708053691275168
REG_STEPWISE  =  0.8666107382550335
REG_TREE  =  0.8666107382550335
REG_TREE  =  0.8666107382550335
REG_RF  =  0.8657718120805369
------


ALL LOSS ACCURACY
======
REG_STEPWISE  =  0.31089901163192085
RF  =  2730.1689152417407
GB  =  2767.579215901141
TREE  =  3301.3240853093553
REG_ALL  =  3754.7356551934763
REG_RF  =  3845.8514817467126
REG_TREE  =  3850.540793930161
REG_GB  =  3850.885647456625
------
```