Felix_prototype_V0

October 27, 2018

1 Felix prototype

Version 0
Date 21/10/2018
Model used : **Random Forest** Classifier on features selected through **lasso**
Clustering method used : **Hierarchical clustering** using **ward metric** based on 6 **NOT variable**

```
In [1]: from pathlib import Path
        import pandas as pd
        import numpy as np
        from datetime import datetime
        import time
        import matplotlib.pyplot as plt
        %matplotlib inline
        import itertools
        import pickle
        from sklearn.model_selection import train_test_split
        from sklearn.preprocessing import StandardScaler
        from sklearn.model_selection import cross_val_score, GridSearchCV
        from sklearn.ensemble import RandomForestClassifier
        from sklearn.metrics import confusion_matrix, f1_score, precision_score, recall_score
        from sklearn.model_selection import StratifiedKFold
        from sklearn.utils import resample
```

```
In [2]: path_project = Path.home() / Path('Google Drive/Felix')
        path_data = path_project / Path("data")
        path_dump = path_project / Path("dump")
```

```
In [3]: # loading data
        file = path_data / Path("dataset.csv")
        with Path.open(file, 'rb') as fp:
            dataset = pd.read_csv(fp,  encoding='utf-8',low_memory=False, index_col = 0)
```

1.0.1 Features scope and selection strategy

Features are selected using lasso on the full scope of feature. The 50 more important features (logistic regression coef ranking) are kept regardless of their activability

In [4]:
```
# load feature sets
filename = path_dump / Path("dict_features_sets.sav")
with open(filename, 'rb') as fp:
     dict_features_sets = pickle.load(fp)

usual_common_scope_features = dict_features_sets['usual_common_scope_features']

cdv_actionable_individual_1_features = dict_features_sets.get('cdv_actionable_individual
cdv_actionable_individual_2_features = dict_features_sets.get('cdv_actionable_individual
cdv_actionable_admin_1_features = dict_features_sets.get('cdv_actionable_admin_1_feature
cdv_actionable_admin_2_features = dict_features_sets.get('cdv_actionable_admin_2_feature
insee_recreation_actionable_admin_1_features = dict_features_sets.get('insee_recreation_
insee_recreation_actionable_admin_2_features = dict_features_sets.get('insee_recreation_
insee_environment_actionable_admin_1_features = dict_features_sets.get('insee_environmen
insee_environment_actionable_admin_2_features = dict_features_sets.get('insee_environmen
insee_demographics_actionable_admin_1_features = dict_features_sets.get('insee_demograph
insee_demographics_actionable_admin_2_features = dict_features_sets.get('insee_demograph

actionable_individual_1_features = cdv_actionable_individual_1_features
actionable_individual_2_features = cdv_actionable_individual_2_features
actionable_admin_1_features = cdv_actionable_admin_1_features | insee_recreation_actiona
actionable_admin_2_features = cdv_actionable_admin_2_features | insee_recreation_actiona

RFE_LogisticRegression_10_features = dict_features_sets['RFE_LogisticRegression_10_featu
RFE_LogisticRegression_20_features = dict_features_sets['RFE_LogisticRegression_20_featu
RFE_LogisticRegression_50_features = dict_features_sets['RFE_LogisticRegression_50_featu
RFE_LogisticRegression_100_features = dict_features_sets['RFE_LogisticRegression_100_fea

RFE_LinearSVC_100_features = dict_features_sets['RFE_LinearSVC_100_features'],
RFE_LinearSVC_50_features =  dict_features_sets['RFE_LinearSVC_50_features'],
RFE_LinearSVC_20_features =  dict_features_sets['RFE_LinearSVC_20_features'],
RFE_LinearSVC_10_features =  dict_features_sets['RFE_LinearSVC_10_features'],

SelectFromModel_LinearSCV_features = dict_features_sets['SelectFromModel_LinearSCV_featu
SelectFromModel_LogisticRegression_features = dict_features_sets['SelectFromModel_Logist

RFE_LinearSVC_10_features = RFE_LinearSVC_10_features[0]
RFE_LinearSVC_20_features = RFE_LinearSVC_20_features[0]
RFE_LinearSVC_50_features = RFE_LinearSVC_50_features[0]
RFE_LinearSVC_100_features = RFE_LinearSVC_100_features[0]
SelectFromModel_LinearSCV_features = SelectFromModel_LinearSCV_features[0]
```

In [5]:
```
print(f"The {len(SelectFromModel_LogisticRegression_features)} features obtained using l
print(f"{len(SelectFromModel_LogisticRegression_features & dict_features_sets.get('cdv_f
print(list(SelectFromModel_LogisticRegression_features))
```

```
The 56 features obtained using lasso:
56 issues de l'étude CDV, 0 de l'insee, 0 calculées à partir des données insee
```

```
['SOUFFINS_Oui', 'INQALIM', 'CADVIE', 'CLASSESO_La classe populaire', 'OPIIMMIG_[Nsp]', 'RE_VOIT
```

1.0.2 Clustering method - feature used

Hierarchical clustering is used using 6 common "NOT_" variable

```
In [6]: # loading clustering
        file = path_data / Path("clustTest3.csv")
        with Path.open(file, 'rb') as fp:
            clustTest1 = pd.read_csv(fp,  encoding='utf-8',low_memory=False, sep=";", index_col
```

1.0.3 Training set and test set preparation

```
In [7]: df = dataset.loc[:,:]
        # reducing problem to a 2 class classification problem
        df["HEUREUX_CLF"] = 0
        df.loc[df["HEUREUX"]==4, "HEUREUX_CLF"] = 1
        df.loc[df["HEUREUX"]==3, "HEUREUX_CLF"] = 1
        df.loc[df["HEUREUX"]==5, "HEUREUX_CLF"] = None

        scope = ( SelectFromModel_LogisticRegression_features  )  & set(dataset.columns)
        n_max = 2000

        df = df.loc[:,scope | {"HEUREUX_CLF"} ].dropna()
        features = df.loc[:,scope ].columns

        X = df.loc[:,scope]
        y = df["HEUREUX_CLF"]


        Xs, ys = resample(X, y, random_state=42)

        Xs = Xs.iloc[0:n_max,:]
        ys = ys.iloc[0:n_max]

        X_train, X_test, y_train, y_test = train_test_split(Xs, ys,
                                                            test_size=0.2,
                                                            random_state=42
                                                           )

        scaler = StandardScaler().fit(X_train)
        X_train = scaler.transform(X_train)
        X_test = scaler.transform(X_test)

        print(f"Number exemple: {y.shape[0]}\n- training set: \
        {y_train.shape[0]}\n- test set: {y_test.shape[0]}")
        print(f"Number of features: p={X_train.shape[1]}")
```

```
        print(f"Number of class: {len(np.unique(y))}")
        for c in np.unique(y):
            print(f"class {c:0.0f} : {100*np.sum(y==c)/len(y):0.1f}%")
```

```
Number exemple: 10788
- training set: 1600
- test set: 400
Number of features: p=56
Number of class: 2
class 0 : 35.0%
class 1 : 65.0%
```

1.0.4 Learning and model performance evaluation on full dataset (before clustering)

In [8]:
```
startTime = time.time()
n_estimators_range = [32,64,128,256,512]
max_depth_range = [4,8,16,32,64]
param_grid = dict(n_estimators=n_estimators_range, max_depth = max_depth_range)

params = {'max_features' :'sqrt', 'random_state' : 32,
          'min_samples_split' : 2, 'class_weight' : 'balanced'}
clf = RandomForestClassifier(**params)

grid = GridSearchCV(clf, scoring='accuracy', param_grid=param_grid)
grid.fit(X_train, y_train)
print(f"Determination of optimal hyperparameters in {time.time() - startTime:0.1f} s")
print(f"Optimal values are {grid.best_params_} \n\
Accuracy Score of cross valdation {100*grid.best_score_:0.2f}%")

# Learning on full training set with optimals hyperparameters and score on test set
params = {'max_features' :'sqrt', 'random_state' : 32,
          'min_samples_split' : 2, 'class_weight' : 'balanced',
          'n_estimators' : grid.best_params_['n_estimators'],
          'max_depth' : grid.best_params_['max_depth']}
clf = RandomForestClassifier(**params).fit(X_train, y_train)
clf.fit(X_train, y_train)
y_test_pred = clf.predict(X_test)

print(f"Random Forest, p={X_train.shape[1]}")
accuracy = clf.score(X_test, y_test)
f1 = f1_score(y_test, y_test_pred)
p = precision_score(y_test, y_test_pred)
r = recall_score(y_test, y_test_pred)
print(f"Model score\n- Accuracy : {accuracy*100:0.1f} %")
print(f"- Precision : {p*100:0.1f} % (Happy # positive class)")
print(f"- Recall : {r*100:0.1f} %")
print(f"- F1 score : {f1*100:0.1f} %")
```

```
        res_full  = {
            'f1_score' : f1,
            'accuracy' : accuracy,
            'precision' : p,
            'recall' : r
            }
```

```
Determination of optimal hyperparameters in 39.1 s
Optimal values are {'max_depth': 16, 'n_estimators': 256}
Accuracy Score of cross valdation 75.56%
Random Forest, p=56
Model score
- Accuracy : 73.5 %
- Precision : 73.6 % (Happy # positive class)
- Recall : 90.5 %
- F1 score : 81.2 %
```

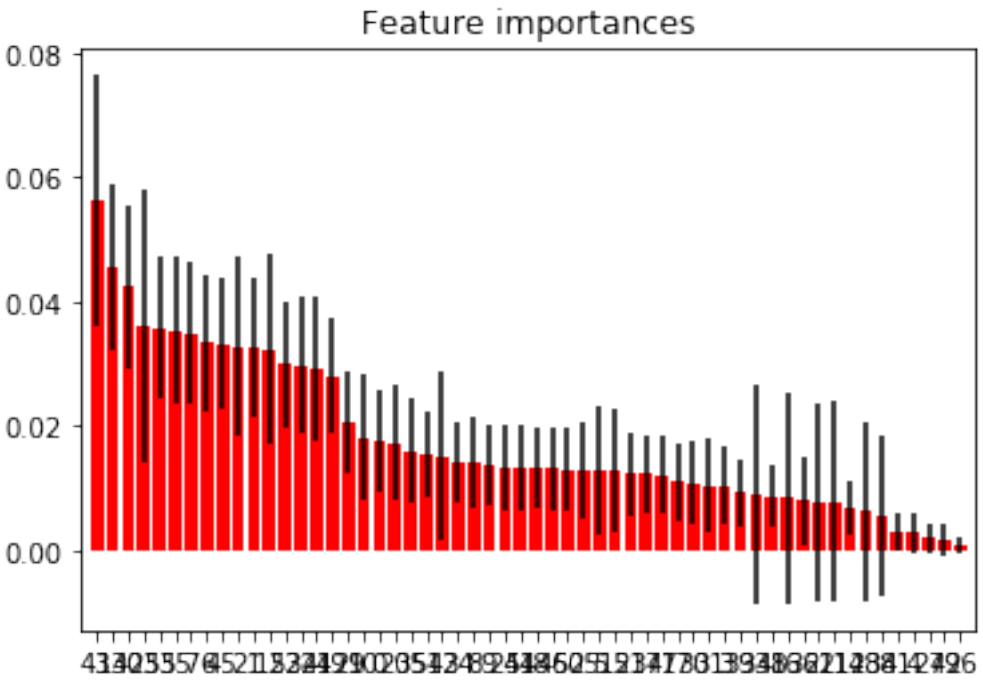
```
In [9]: importances = clf.feature_importances_
        std = np.std([tree.feature_importances_ for tree in clf.estimators_],
                     axis=0)
        indices = np.argsort(importances)[::-1]
        features_name = np.array(features)
        #features_name_sorted_rf = features_name[indices]
        # Print the feature ranking
        print("Feature ranking:")

        max_features = 15

        for f in range(min(X.shape[1],max_features)):
            print("%d. feature %d -%s- (%f)" % (f + 1, indices[f],features_name[indices[f]], imp
            if features_name[indices[f]] in actionable_individual_1_features:
                print("\tActionable at individual level (1)")
            if features_name[indices[f]] in actionable_individual_2_features:
                print("\tActionable at individual level (2)")
            if features_name[indices[f]] in actionable_admin_1_features:
                print("\tActionable at administrative level (1)")
            if features_name[indices[f]] in actionable_admin_2_features:
                print("\tActionable at administrative level (2)")

        # Plot the feature importances of the forest
        plt.figure()
        plt.title("Feature importances")
        plt.bar(range(X.shape[1]), importances[indices],
               color="r", yerr=std[indices], align="center")
        plt.xticks(range(X.shape[1]), indices)
        plt.xlim([-1, X.shape[1]])
        plt.show()
```

```
Feature ranking:
1. feature 43 -revtot7- (0.056071)
        Actionable at individual level (2)
        Actionable at administrative level (2)
2. feature 13 -NOT_PROF- (0.045418)
        Actionable at individual level (1)
        Actionable at administrative level (2)
3. feature 40 -NOT_AMIS- (0.042319)
        Actionable at individual level (1)
        Actionable at administrative level (2)
4. feature 23 -SOUFFDEP_Oui- (0.036069)
        Actionable at individual level (2)
        Actionable at administrative level (1)
5. feature 53 -NOT_LIBR- (0.035662)
        Actionable at individual level (1)
        Actionable at administrative level (1)
6. feature 55 -NOT_FAMI- (0.035329)
        Actionable at individual level (1)
        Actionable at administrative level (2)
7. feature 7 -NIVPERSO- (0.034845)
        Actionable at individual level (2)
        Actionable at administrative level (2)
8. feature 6 -NBENF6- (0.033256)
        Actionable at individual level (2)
        Actionable at administrative level (2)
9. feature 45 -CDV5- (0.033220)
        Actionable at individual level (2)
        Actionable at administrative level (1)
10. feature 2 -CADVIE- (0.032725)
        Actionable at individual level (1)
        Actionable at administrative level (1)
11. feature 1 -INQALIM- (0.032591)
        Actionable at individual level (1)
        Actionable at administrative level (1)
12. feature 12 -ETATSAN- (0.032364)
        Actionable at individual level (1)
        Actionable at administrative level (1)
13. feature 52 -INQCHOMA- (0.029876)
        Actionable at individual level (1)
        Actionable at administrative level (1)
14. feature 32 -CONFENTR- (0.029769)
        Actionable at individual level (1)
        Actionable at administrative level (1)
15. feature 44 -SECURITE- (0.029080)
        Actionable at individual level (2)
        Actionable at administrative level (1)
```



1.0.5 Learning and model performance evaluation on each clusters

```
In [10]: n_estimators_range = [16,32,64,128]
         max_depth_range = [2,4,8,16,32,64]
         param_grid = dict(n_estimators=n_estimators_range, max_depth = max_depth_range)
         params = {'max_features' :'sqrt',
                   'random_state' : 32,
                   'min_samples_split' : 2,
                   'class_weight' : 'balanced'
                  }
         scope = ( SelectFromModel_LogisticRegression_features )  & set(dataset.columns)
         features = df.loc[:,scope].columns

In [11]: score_clustering_methods = []
         clustering_methods = clustTest1.columns[2:3]

         for method in clustering_methods:
             print("-----------------------------------------")
             print(f"\nAnalysis cluster method {method}")
             cluster_list = clustTest1[method].unique()
             print(f"liste of clusters : {cluster_list}")
             score_cluster = []
             for cluster in cluster_list:
                 index_scope = clustTest1.loc[clustTest1[method]==cluster,:].index
                 print(f"cluster {cluster} : {len(index_scope)} elements")
```

```
        Xc = X.loc[index_scope.intersection(X.index),:]
        yc = y[index_scope.intersection(X.index)]

        Xs, ys = resample(Xc, yc, random_state=42)

        Xs = Xs.iloc[0:n_max,:]
        ys = ys.iloc[0:n_max]

        X_train, X_test, y_train, y_test = train_test_split(Xs, ys,
                                                            test_size=0.2,
                                                            random_state=42)

        scaler = StandardScaler().fit(X_train)
        X_train = scaler.transform(X_train)
        X_test = scaler.transform(X_test)

        print(f"Number exemple: {ys.shape[0]}\n\
        - training set: {y_train.shape[0]}\n\
        - test set: {y_test.shape[0]}")
        print(f"Number of features: p={X_train.shape[1]}")
        print(f"Number of class: {len(np.unique(y))}")
        for c in np.unique(y):
            print(f"class {c:0.0f} : {100*np.sum(y==c)/len(y):0.1f}%")


        startTime = time.time()
        clf = RandomForestClassifier(**params)
        grid = GridSearchCV(clf,
                            scoring='accuracy',
                            param_grid=param_grid)

        grid.fit(X_train, y_train)
        print(f"Optimal values are {grid.best_params_} \n\
cross validation score {100*grid.best_score_:0.2f}%")
        print()

        # Learning on full training set with optimals hyperparameters and score on test
        params_opt = {'max_features' :'sqrt', 'random_state' : 32,
                      'min_samples_split' : 2, 'class_weight' : 'balanced',
                      'n_estimators' : grid.best_params_['n_estimators'],
                      'max_depth' : grid.best_params_['max_depth']}
        clf = RandomForestClassifier(**params_opt).fit(X_train, y_train)


        y_test_pred = clf.predict(X_test)
        accuracy = clf.score(X_test, y_test)
        f1 = f1_score(y_test, y_test_pred)
```

```
                p = precision_score(y_test, y_test_pred)
                r = recall_score(y_test, y_test_pred)

                res  = {'f1_score' : f1,
                        'accuracy' : accuracy,
                        'precision' : p,
                        'recall' : r}


                importances = clf.feature_importances_
                std = np.std([tree.feature_importances_ for tree in clf.estimators_],
                             axis=0)
                indices = np.argsort(importances)[::-1]
                features_name = np.array(features)

                cl = {'cluster' : cluster,
                      'size' : len(index_scope),
                      'model' : 'RandomForestClassifier',
                      'params' : params_opt,
                      'metrics' : res,
                      'importances' : importances,
                      'sdt' : std,
                      'indices' : indices,
                      'features_name' : features_name
                     }

                score_cluster.append(cl)







            d = {'clustering_method' : method,
                 'cluster_scores' : score_cluster
                }
            score_clustering_methods.append(d)
```

```
-------------------------------------------

Analysis cluster method clust3
liste of clusters : [2 4 6 1 3 5]
cluster 2 : 3053 elements
Number exemple: 2000
        - training set: 1600
        - test set: 400
```

```
Number of features: p=56
Number of class: 2
class 0 : 35.0%
class 1 : 65.0%
Optimal values are {'max_depth': 16, 'n_estimators': 128}
cross validation score 80.00%

cluster 4 : 2359 elements
Number exemple: 2000
        - training set: 1600
        - test set: 400
Number of features: p=56
Number of class: 2
class 0 : 35.0%
class 1 : 65.0%
Optimal values are {'max_depth': 16, 'n_estimators': 32}
cross validation score 84.31%

cluster 6 : 2313 elements
Number exemple: 2000
        - training set: 1600
        - test set: 400
Number of features: p=56
Number of class: 2
class 0 : 35.0%
class 1 : 65.0%
Optimal values are {'max_depth': 16, 'n_estimators': 128}
cross validation score 82.88%

cluster 1 : 528 elements
Number exemple: 505
        - training set: 404
        - test set: 101
Number of features: p=56
Number of class: 2
class 0 : 35.0%
class 1 : 65.0%
Optimal values are {'max_depth': 8, 'n_estimators': 16}
cross validation score 83.66%

cluster 3 : 1384 elements
Number exemple: 1367
        - training set: 1093
        - test set: 274
Number of features: p=56
Number of class: 2
class 0 : 35.0%
class 1 : 65.0%
```

```
Optimal values are {'max_depth': 16, 'n_estimators': 64}
cross validation score 86.64%

cluster 5 : 1494 elements
Number exemple: 1472
        - training set: 1177
        - test set: 295
Number of features: p=56
Number of class: 2
class 0 : 35.0%
class 1 : 65.0%
Optimal values are {'max_depth': 16, 'n_estimators': 128}
cross validation score 84.03%
```

1.0.6 Performance gain obtained using clustering

In [12]:
```
# F1 score
for score_method in score_clustering_methods:
    print(f"method {score_method['clustering_method']}:")
    average_score = 0
    total_size = 0
    for i, score_cluster in enumerate(score_method['cluster_scores']):
        print(f"cluster {score_cluster['cluster']} ({score_cluster['size']}), f1 macro
        average_score += score_cluster['metrics']['f1_score']*score_cluster['size']
        total_size += score_cluster['size']

    average_score = average_score / total_size
    print(f"average f1 on clusters {100*average_score:0.1f}% gain {100*(average_score-r
```

```
method clust3:
cluster 2 (3053), f1 macro 90.2%
cluster 4 (2359), f1 macro 92.3%
cluster 6 (2313), f1 macro 92.2%
cluster 1 (528), f1 macro 89.6%
cluster 3 (1384), f1 macro 92.7%
cluster 5 (1494), f1 macro 88.7%
average f1 on clusters 91.1% gain 9.9
```

In [13]:
```
# accuracy
for score_method in score_clustering_methods:
    print(f"method {score_method['clustering_method']}:")
    average_score = 0
    total_size = 0
    for i, score_cluster in enumerate(score_method['cluster_scores']):
```

```
            print(f"cluster {score_cluster['cluster']} ({score_cluster['size']}) , accuracy
            average_score = average_score + score_cluster['metrics']['accuracy']*score_clus
            total_size += score_cluster['size']
        average_score = average_score / total_size
        print(f"average accuracy on clusters {100*average_score:0.1f}% gain {100*(average_s
```

```
method clust3:
cluster 2 (3053) , accuracy 86.2%
cluster 4 (2359) , accuracy 88.5%
cluster 6 (2313) , accuracy 88.5%
cluster 1 (528) , accuracy 90.1%
cluster 3 (1384) , accuracy 89.4%
cluster 5 (1494) , accuracy 86.4%
average accuracy on clusters 87.8% gain 14.3
```

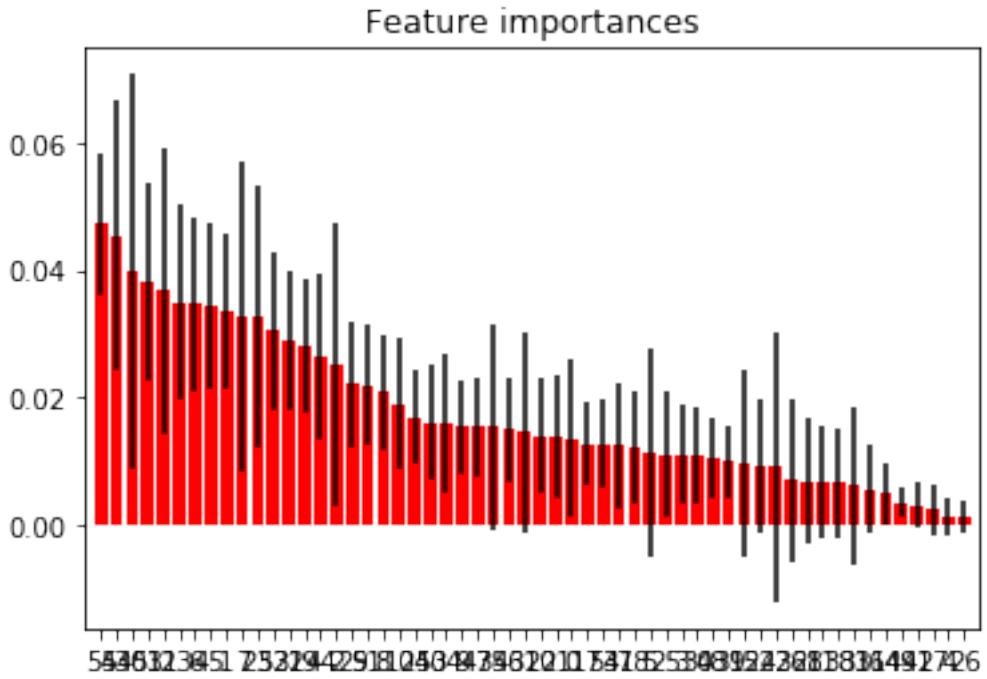
1.0.7 Feature importance of the models & actionable variables

```
In [14]: # Feature importance by cluster
         for score_method in score_clustering_methods:
             print(f"method {score_method['clustering_method']}:")
             for i, score_cluster in enumerate(score_method['cluster_scores']):
                 print(f"cluster {score_cluster['cluster']} ({score_cluster['size']}), f1 macro
                 print(f"top 15 features:")
                 indices = score_cluster['indices']
                 features_name = score_cluster['features_name']
                 importances = score_cluster['importances']
                 for f in range(15):
                     print("%d. feature %d -%s- (%f)" % (f + 1, indices[f],features_name[indices
                     if features_name[indices[f]] in actionable_individual_1_features:
                         print("\tActionable at individual level (1)")
                     if features_name[indices[f]] in actionable_individual_2_features:
                         print("\tActionable at individual level (2)")
                     if features_name[indices[f]] in actionable_admin_1_features:
                         print("\tActionable at administrative level (1)")
                     if features_name[indices[f]] in actionable_admin_2_features:
                         print("\tActionable at administrative level (2)")

                 # Plot the feature importances of the forest
                 plt.figure()
                 plt.title("Feature importances")
                 plt.bar(range(X.shape[1]), importances[indices],
                         color="r", yerr=std[indices], align="center")
                 plt.xticks(range(X.shape[1]), indices)
                 plt.xlim([-1, X.shape[1]])
                 plt.show()
```

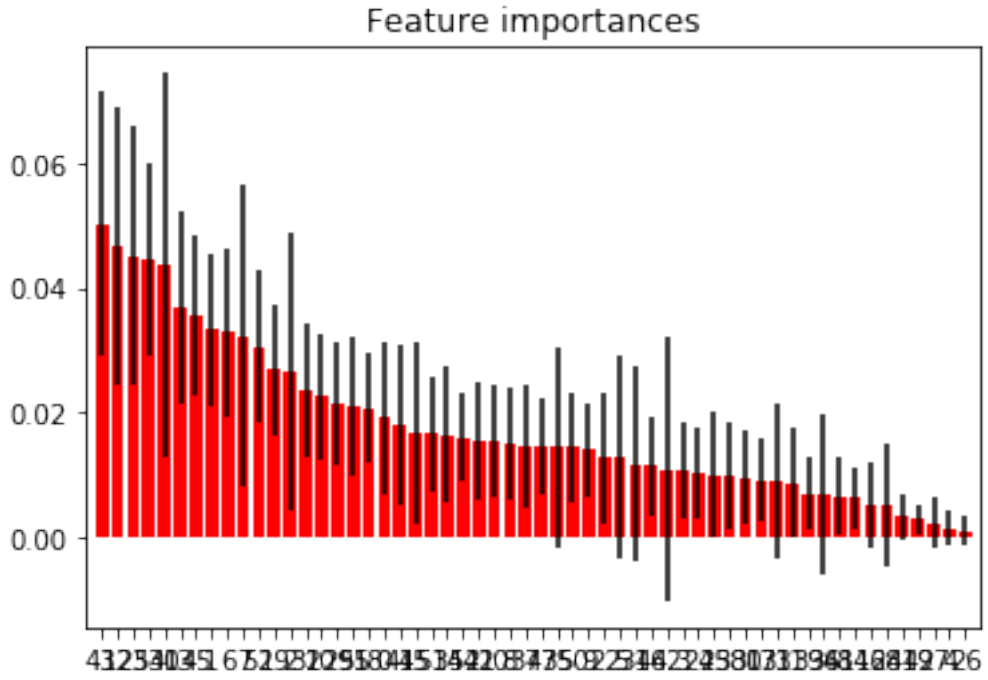
```
method clust3:
cluster 2 (3053), f1 macro 90.2%
top 15 features:
1. feature 55 -NOT_FAMI- (0.047229)
        Actionable at individual level (1)
        Actionable at administrative level (2)
2. feature 43 -revtot7- (0.045349)
        Actionable at individual level (2)
        Actionable at administrative level (2)
3. feature 40 -NOT_AMIS- (0.039835)
        Actionable at individual level (1)
        Actionable at administrative level (2)
4. feature 53 -NOT_LIBR- (0.038174)
        Actionable at individual level (1)
        Actionable at administrative level (1)
5. feature 12 -ETATSAN- (0.036699)
        Actionable at individual level (1)
        Actionable at administrative level (1)
6. feature 13 -NOT_PROF- (0.034915)
        Actionable at individual level (1)
        Actionable at administrative level (2)
7. feature 6 -NBENF6- (0.034645)
        Actionable at individual level (2)
        Actionable at administrative level (2)
8. feature 45 -CDV5- (0.034303)
        Actionable at individual level (2)
        Actionable at administrative level (1)
9. feature 1 -INQALIM- (0.033439)
        Actionable at individual level (1)
        Actionable at administrative level (1)
10. feature 7 -NIVPERSO- (0.032703)
        Actionable at individual level (2)
        Actionable at administrative level (2)
11. feature 23 -SOUFFDEP_Oui- (0.032618)
        Actionable at individual level (2)
        Actionable at administrative level (1)
12. feature 52 -INQCHOMA- (0.030446)
        Actionable at individual level (1)
        Actionable at administrative level (1)
13. feature 32 -CONFENTR- (0.028920)
        Actionable at individual level (1)
        Actionable at administrative level (1)
14. feature 19 -INQMALAD- (0.028291)
        Actionable at individual level (1)
        Actionable at administrative level (1)
15. feature 44 -SECURITE- (0.026523)
```

Actionable at individual level (2)
Actionable at administrative level (1)



cluster 4 (2359), f1 macro 92.3%
top 15 features:
1. feature 43 -revtot7- (0.050264)
Actionable at individual level (2)
Actionable at administrative level (2)
2. feature 12 -ETATSAN- (0.046572)
Actionable at individual level (1)
Actionable at administrative level (1)
3. feature 23 -SOUFFDEP_Oui- (0.045102)
Actionable at individual level (2)
Actionable at administrative level (1)
4. feature 53 -NOT_LIBR- (0.044613)
Actionable at individual level (1)
Actionable at administrative level (1)
5. feature 40 -NOT_AMIS- (0.043499)
Actionable at individual level (1)
Actionable at administrative level (2)
6. feature 13 -NOT_PROF- (0.036864)
Actionable at individual level (1)
Actionable at administrative level (2)
7. feature 45 -CDV5- (0.035426)

```
        Actionable at individual level (2)
        Actionable at administrative level (1)
8. feature 1 -INQALIM- (0.033184)
        Actionable at individual level (1)
        Actionable at administrative level (1)
9. feature 6 -NBENF6- (0.032871)
        Actionable at individual level (2)
        Actionable at administrative level (2)
10. feature 7 -NIVPERSO- (0.032304)
        Actionable at individual level (2)
        Actionable at administrative level (2)
11. feature 52 -INQCHOMA- (0.030538)
        Actionable at individual level (1)
        Actionable at administrative level (1)
12. feature 19 -INQMALAD- (0.026938)
        Actionable at individual level (1)
        Actionable at administrative level (1)
13. feature 2 -CADVIE- (0.026725)
        Actionable at individual level (1)
        Actionable at administrative level (1)
14. feature 32 -CONFENTR- (0.023535)
        Actionable at individual level (1)
        Actionable at administrative level (1)
15. feature 10 -SOUFFNER_Oui- (0.022568)
        Actionable at individual level (2)
        Actionable at administrative level (1)
```



```
cluster 6 (2313), f1 macro 92.2%
top 15 features:
1. feature 40 -NOT_AMIS- (0.054962)
        Actionable at individual level (1)
        Actionable at administrative level (2)
2. feature 43 -revtot7- (0.048263)
        Actionable at individual level (2)
        Actionable at administrative level (2)
3. feature 2 -CADVIE- (0.043735)
        Actionable at individual level (1)
        Actionable at administrative level (1)
4. feature 13 -NOT_PROF- (0.042258)
        Actionable at individual level (1)
        Actionable at administrative level (2)
5. feature 7 -NIVPERSO- (0.038694)
        Actionable at individual level (2)
        Actionable at administrative level (2)
6. feature 12 -ETATSAN- (0.036454)
        Actionable at individual level (1)
        Actionable at administrative level (1)
7. feature 23 -SOUFFDEP_Oui- (0.035865)
        Actionable at individual level (2)
        Actionable at administrative level (1)
8. feature 44 -SECURITE- (0.034124)
        Actionable at individual level (2)
        Actionable at administrative level (1)
9. feature 1 -INQALIM- (0.032326)
        Actionable at individual level (1)
        Actionable at administrative level (1)
10. feature 45 -CDV5- (0.031427)
        Actionable at individual level (2)
        Actionable at administrative level (1)
11. feature 6 -NBENF6- (0.030770)
        Actionable at individual level (2)
        Actionable at administrative level (2)
12. feature 53 -NOT_LIBR- (0.029735)
        Actionable at individual level (1)
        Actionable at administrative level (1)
13. feature 52 -INQCHOMA- (0.028376)
        Actionable at individual level (1)
        Actionable at administrative level (1)
14. feature 19 -INQMALAD- (0.025945)
        Actionable at individual level (1)
        Actionable at administrative level (1)
15. feature 32 -CONFENTR- (0.025728)
```

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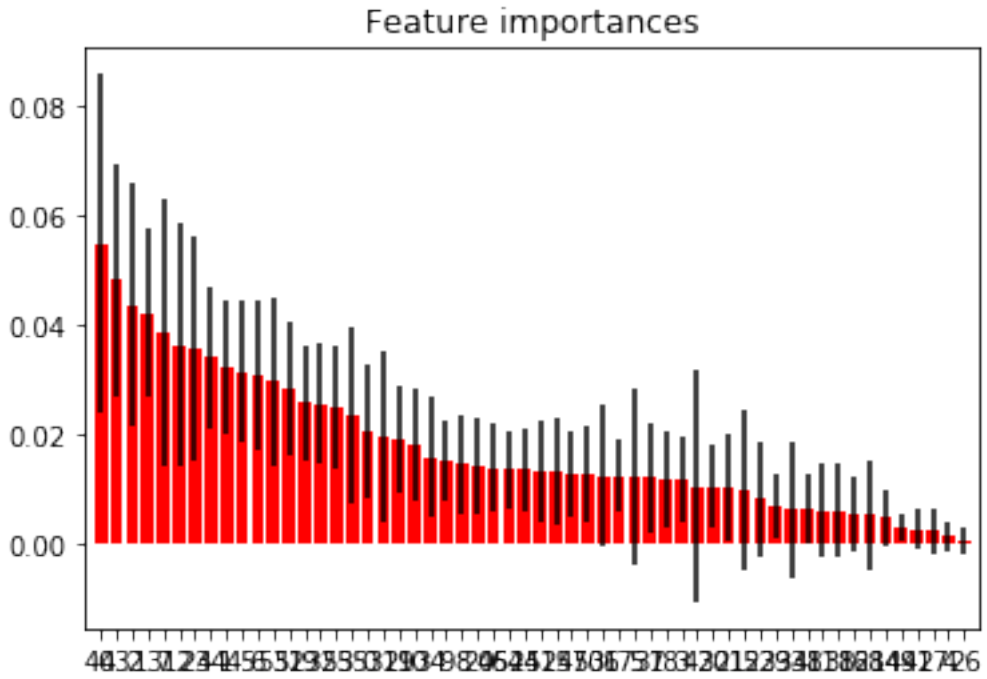
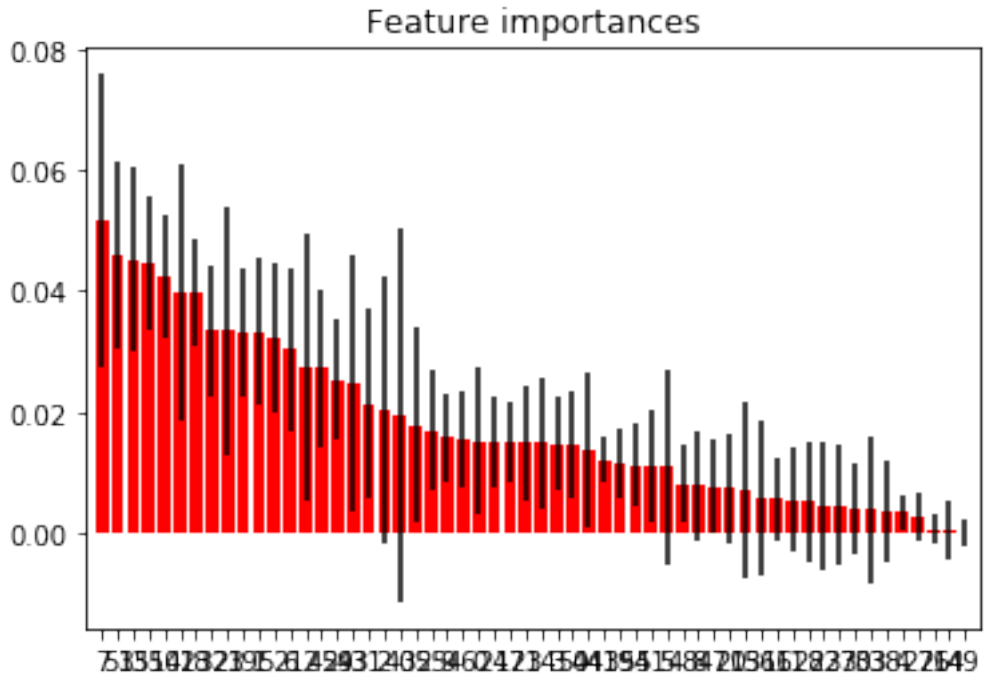
        Actionable at individual level (1)
        Actionable at administrative level (1)
```



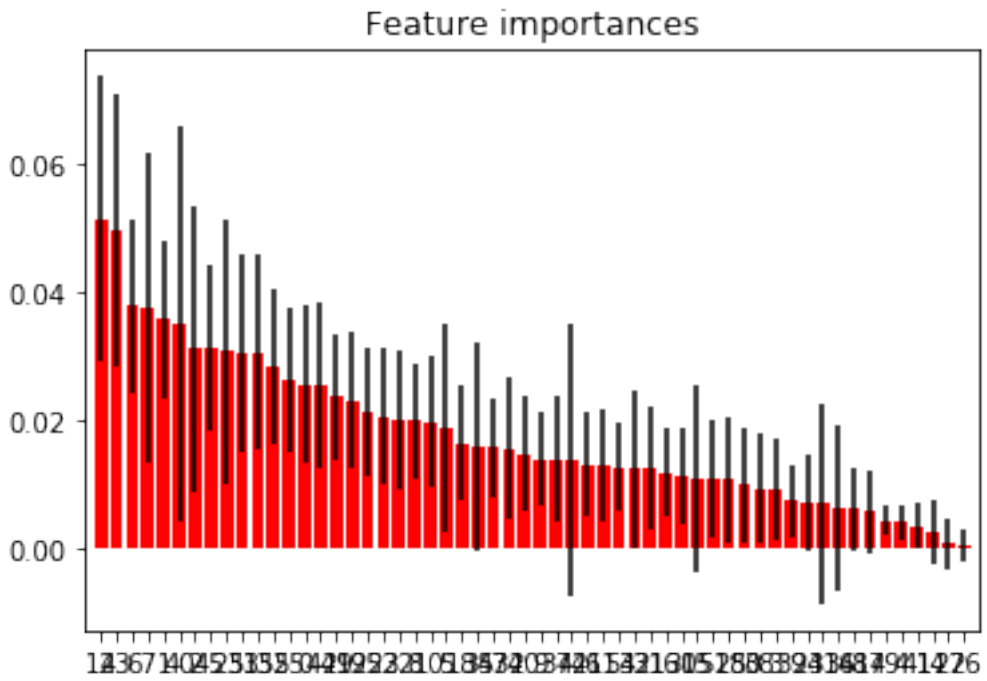

```
cluster 1 (528), f1 macro 89.6%
top 15 features:
1. feature 7 -NIVPERSO- (0.051644)
        Actionable at individual level (2)
        Actionable at administrative level (2)
2. feature 53 -NOT_LIBR- (0.045984)
        Actionable at individual level (1)
        Actionable at administrative level (1)
3. feature 13 -NOT_PROF- (0.045222)
        Actionable at individual level (1)
        Actionable at administrative level (2)
4. feature 55 -NOT_FAMI- (0.044613)
        Actionable at individual level (1)
        Actionable at administrative level (2)
5. feature 10 -SOUFFNER_Oui- (0.042431)
        Actionable at individual level (2)
        Actionable at administrative level (1)
6. feature 42 -RE_ALIM_Oui- (0.039831)
        Actionable at individual level (2)
        Actionable at administrative level (2)
7. feature 18 -HANDICAP_Oui- (0.039793)
```

```
        Actionable at administrative level (2)
8. feature 32 -CONFENTR- (0.033522)
        Actionable at individual level (1)
        Actionable at administrative level (1)
9. feature 23 -SOUFFDEP_Oui- (0.033482)
        Actionable at individual level (2)
        Actionable at administrative level (1)
10. feature 19 -INQMALAD- (0.033233)
        Actionable at individual level (1)
        Actionable at administrative level (1)
11. feature 1 -INQALIM- (0.033214)
        Actionable at individual level (1)
        Actionable at administrative level (1)
12. feature 52 -INQCHOMA- (0.032230)
        Actionable at individual level (1)
        Actionable at administrative level (1)
13. feature 6 -NBENF6- (0.030413)
        Actionable at individual level (2)
        Actionable at administrative level (2)
14. feature 12 -ETATSAN- (0.027272)
        Actionable at individual level (1)
        Actionable at administrative level (1)
15. feature 45 -CDV5- (0.027209)
        Actionable at individual level (2)
        Actionable at administrative level (1)
```



```
cluster 3 (1384), f1 macro 92.7%
top 15 features:
1. feature 12 -ETATSAN- (0.051474)
        Actionable at individual level (1)
        Actionable at administrative level (1)
2. feature 43 -revtot7- (0.049737)
        Actionable at individual level (2)
        Actionable at administrative level (2)
3. feature 6 -NBENF6- (0.037793)
        Actionable at individual level (2)
        Actionable at administrative level (2)
4. feature 7 -NIVPERSO- (0.037499)
        Actionable at individual level (2)
        Actionable at administrative level (2)
5. feature 1 -INQALIM- (0.035686)
        Actionable at individual level (1)
        Actionable at administrative level (1)
6. feature 40 -NOT_AMIS- (0.034994)
        Actionable at individual level (1)
        Actionable at administrative level (2)
7. feature 2 -CADVIE- (0.031286)
        Actionable at individual level (1)
        Actionable at administrative level (1)
8. feature 45 -CDV5- (0.031238)
        Actionable at individual level (2)
        Actionable at administrative level (1)
9. feature 23 -SOUFFDEP_Oui- (0.030694)
        Actionable at individual level (2)
        Actionable at administrative level (1)
10. feature 53 -NOT_LIBR- (0.030586)
        Actionable at individual level (1)
        Actionable at administrative level (1)
11. feature 13 -NOT_PROF- (0.030575)
        Actionable at individual level (1)
        Actionable at administrative level (2)
12. feature 52 -INQCHOMA- (0.028418)
        Actionable at individual level (1)
        Actionable at administrative level (1)
13. feature 55 -NOT_FAMI- (0.026436)
        Actionable at individual level (1)
        Actionable at administrative level (2)
14. feature 0 -SOUFFINS_Oui- (0.025608)
        Actionable at individual level (2)
        Actionable at administrative level (1)
15. feature 44 -SECURITE- (0.025453)
        Actionable at individual level (2)
```

Actionable at administrative level (1)




```
cluster 5 (1494), f1 macro 88.7%
top 15 features:
1. feature 40 -NOT_AMIS- (0.070359)
        Actionable at individual level (1)
        Actionable at administrative level (2)
2. feature 7 -NIVPERSO- (0.051790)
        Actionable at individual level (2)
        Actionable at administrative level (2)
3. feature 43 -revtot7- (0.044206)
        Actionable at individual level (2)
        Actionable at administrative level (2)
4. feature 12 -ETATSAN- (0.040595)
        Actionable at individual level (1)
        Actionable at administrative level (1)
5. feature 13 -NOT_PROF- (0.038788)
        Actionable at individual level (1)
        Actionable at administrative level (2)
6. feature 2 -CADVIE- (0.035547)
        Actionable at individual level (1)
        Actionable at administrative level (1)
7. feature 6 -NBENF6- (0.032935)
        Actionable at individual level (2)
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```
        Actionable at administrative level (2)
8. feature 45 -CDV5- (0.031032)
        Actionable at individual level (2)
        Actionable at administrative level (1)
9. feature 23 -SOUFFDEP_Oui- (0.030917)
        Actionable at individual level (2)
        Actionable at administrative level (1)
10. feature 53 -NOT_LIBR- (0.030499)
        Actionable at individual level (1)
        Actionable at administrative level (1)
11. feature 52 -INQCHOMA- (0.029194)
        Actionable at individual level (1)
        Actionable at administrative level (1)
12. feature 1 -INQALIM- (0.028913)
        Actionable at individual level (1)
        Actionable at administrative level (1)
13. feature 44 -SECURITE- (0.027863)
        Actionable at individual level (2)
        Actionable at administrative level (1)
14. feature 32 -CONFENTR- (0.023610)
        Actionable at individual level (1)
        Actionable at administrative level (1)
15. feature 35 -VACANCES_Oui- (0.023022)
        Actionable at individual level (1)
        Actionable at administrative level (1)
```