In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

executed in 4.47s, finished 21:13:35 2019-01-29

In [2]:

```
train = pd.read_csv('train (1).csv')
```

executed in 258ms, finished 21:13:35 2019-01-29

In [3]:

```
joint=train
```

executed in 44ms, finished 21:13:35 2019-01-29

In [4]:

```
col_need=[]
for col in joint.columns:
    if joint[col].count()>int(0.7*len(joint)):
        col_need.append(col)
```

executed in 312ms, finished 21:13:35 2019-01-29

In [5]:

```
joint=joint[col_need]
```

executed in 180ms, finished 21:13:35 2019-01-29

In [6]:

```
col_un=['asset_niceroof','med_vacc_newborns','med_child_check',
        'wage_expenditures','ent_wagelabor',
        'fs_enoughtom','labor_primary',
        'early_survey','day_of_week']

joint.drop(col_un,axis=1,inplace=True)
```

executed in 280ms, finished 21:13:36 2019-01-29

```
C:\Users\ADEBAYO\Anaconda3\lib\site-packages\pandas\core\frame.py:3697: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/s
table/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pand
as-docs/stable/indexing.html#indexing-view-versus-copy)
  errors=errors)
```

In [7]:

```
from sklearn.preprocessing import Binarizer
```

executed in 519ms, finished 21:13:36 2019-01-29

In [8]:

```
transformer = Binarizer(threshold=1.5).fit(joint['ent_employees'].values.reshape(-1,1)) #
joint['ent_employees_x']=transformer.transform(joint['ent_employees'].values.reshape(-1,1
```

executed in 193ms, finished 21:13:36 2019-01-29

```
C:\Users\ADEBAYO\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: Settin
gWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/s
table/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pand
as-docs/stable/indexing.html#indexing-view-versus-copy)
```

In [9]:

```
transformer = Binarizer(threshold=5).fit(joint['children'].values.reshape(-1,1)) # fit do
joint['children_bins']=transformer.transform(joint['children'].values.reshape(-1,1))
joint['children_bins'].value_counts()
```

executed in 330ms, finished 21:13:37 2019-01-29

```
C:\Users\ADEBAYO\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: Settin
gWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/s
table/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pand
as-docs/stable/indexing.html#indexing-view-versus-copy)
```

Out[9]:

```
0    1041
1     102
Name: children_bins, dtype: int64
```

In [10]:

```
joint['fs_sleephun'].fillna(0,inplace=True)
joint['age'].fillna(joint['age'].mean(),inplace=True)
joint.fillna(0,inplace=True)
```

executed in 496ms, finished 21:13:37 2019-01-29

```
C:\Users\ADEBAYO\Anaconda3\lib\site-packages\pandas\core\generic.py:5434: Se
ttingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/s
table/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pand
as-docs/stable/indexing.html#indexing-view-versus-copy)
  self._update_inplace(new_data)
C:\Users\ADEBAYO\Anaconda3\lib\site-packages\pandas\core\frame.py:3790: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/s
table/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pand
as-docs/stable/indexing.html#indexing-view-versus-copy)
  downcast=downcast, **kwargs)
```

In [11]:

```
joint=joint.drop(['depressed','village','surveyid','survey_date'],axis=1)
```

executed in 150ms, finished 21:13:37 2019-01-29

In [12]:

```
import sklearn.feature_selection as fs

print(joint.shape)

## Define the variance threhold and fit the threshold to the feature array.
sel = fs.VarianceThreshold(threshold=(.8 * (1 - .8)))
features_reduced = sel.fit_transform(joint)

## Print the support and shape for the transformed features
print('Reduced shape:')
print(features_reduced.shape)
```

executed in 276ms, finished 21:13:38 2019-01-29

```
(1143, 49)
Reduced shape:
(1143, 40)
```

In [13]:

```
print(joint.columns[sel.get_support()])
```

executed in 68ms, finished 21:13:38 2019-01-29

```
Index(['age', 'married', 'children', 'hhsize', 'edu', 'hh_children',
       'hh_totalmembers', 'cons_nondurable', 'asset_livestock',
       'asset_durable', 'asset_phone', 'asset_savings',
       'asset_land_owned_total', 'cons_allfood', 'cons_ownfood',
       'cons_alcohol', 'cons_tobacco', 'cons_med_total', 'cons_ed',
       'cons_social', 'cons_other', 'ent_ownfarm', 'ent_nonagbusiness',
       'ent_nonag_revenue', 'ent_nonag_flowcost', 'ent_farmrevenue',
       'ent_farmexpenses', 'ent_animalstockrev', 'ent_total_cost',
       'fs_adskipm_often', 'fs_adwholed_often', 'fs_meat', 'fs_sleephun',
       'med_sickdays_hhave', 'durable_investment', 'nondurable_investment',
       'amount_given_mpesa', 'amount_received_mpesa', 'net_mpesa',
       'amount_saved_mpesa'],
      dtype='object')
```

In [14]:

```
print(features_reduced.shape)

# Create correlation matrix
corr_matrix = pd.DataFrame(features_reduced,columns=joint.columns[sel.get_support()]).cor

# Select upper triangle of correlation matrix
upper = corr_matrix.where(np.triu(np.ones(corr_matrix.shape), k=1).astype(np.bool))

# Find index of feature columns with correlation greater than 0.90
to_drop = [column for column in upper.columns if any(upper[column] > 0.90)]

feature_mat=pd.DataFrame(features_reduced,columns=joint.columns[sel.get_support()]).drop(

print(to_drop)
print(feature_mat.shape)
```

executed in 340ms, finished 21:13:38 2019-01-29

```
(1143, 40)
['hhsize', 'hh_totalmembers', 'cons_allfood', 'ent_total_cost', 'net_mpesa']
(1143, 35)
```

Applying PCA to reduce dimensionality. Note that the features have to be scaled first.

In [15]:

```
from sklearn.preprocessing import StandardScaler
```

executed in 12ms, finished 21:13:38 2019-01-29

In [16]:

```
scaler=StandardScaler()
scaler.fit_transform(feature_mat)
```

executed in 186ms, finished 21:13:38 2019-01-29

Out[16]:

```
array([[-0.47591917,  0.54263315,  0.61749574, ..., -0.08532784,
        -0.14292614, -0.11537196],
       [-0.83992367,  0.54263315,  0.0758245 , ..., -0.08532784,
         0.04972078, -0.11537196],
       [-0.91272457,  0.54263315,  0.0758245 , ..., -0.08532784,
         0.17815203, -0.11537196],
       ...,
       [-0.47591917,  0.54263315,  1.15916698, ..., -0.08532784,
        -0.14292614, -0.11537196],
       [-0.11191467, -1.84286566,  0.61749574, ..., -0.08532784,
        -0.14292614, -0.11537196],
       [ 0.32489074,  0.54263315, -1.54918924, ..., -0.08532784,
        -0.14292614, -0.11537196]])
```

In [17]:

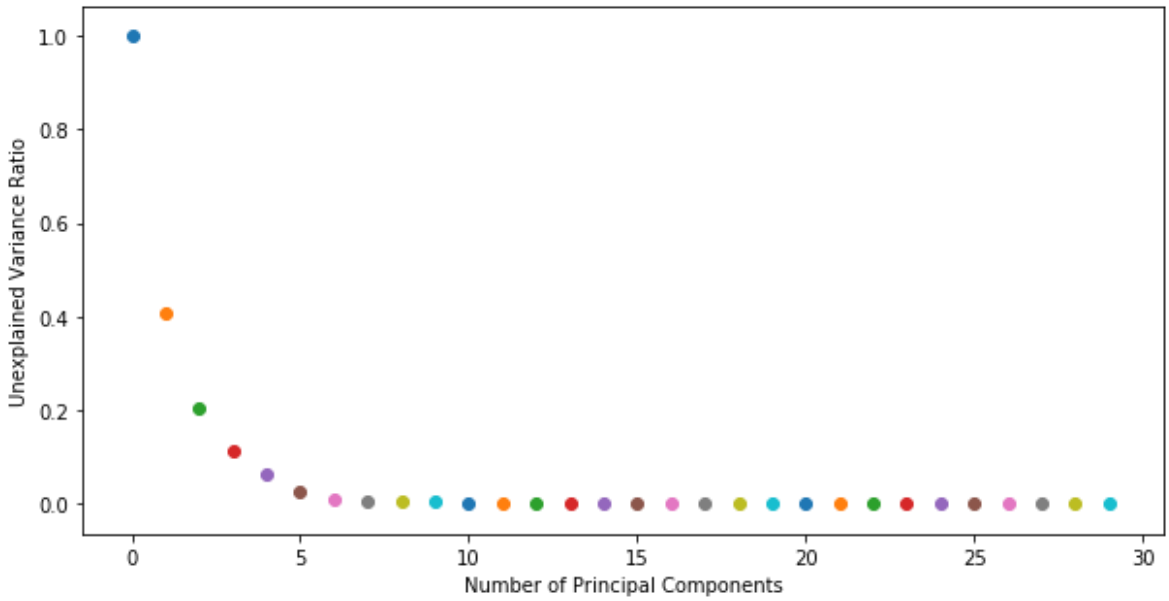
```
from sklearn.decomposition import PCA
```

executed in 252ms, finished 21:13:39 2019-01-29

In [18]:

```
pca=PCA(30).fit(feature_mat)
plt.figure(figsize=(10,5))
for i in range(0,len(pca.explained_variance_ratio_)):
    plt.scatter(y=pca.explained_variance_ratio_[i:].sum(),x=i)
    plt.xlabel('Number of Principal Components')
    plt.ylabel('Unexplained Variance Ratio')
```

executed in 1.04s, finished 21:13:40 2019-01-29



In [19]:

```
join=PCA(5).fit_transform(feature_mat)
join.shape
```

executed in 136ms, finished 21:13:40 2019-01-29

Out[19]:

```
(1143, 5)
```

In [20]:

```
X=feature_mat[:]
Y=train['depressed'].ravel()


split_test_size=.4

from sklearn.model_selection import train_test_split
Xtrain, Xtest, Ytrain, Ytest= train_test_split(X,Y, test_size=split_test_size, random_sta
```

executed in 60ms, finished 21:13:40 2019-01-29

Using SMOTE to balanced out the dataset

In [21]:

```
from imblearn.over_sampling import SMOTE
```

executed in 511ms, finished 21:13:40 2019-01-29

In [22]:

```
sm = SMOTE(random_state=12,sampling_strategy=.5)
Xtrain, Ytrain = sm.fit_sample(Xtrain, Ytrain)
```

executed in 48ms, finished 21:13:40 2019-01-29

In [23]:

```
from sklearn.preprocessing import StandardScaler
```

executed in 220ms, finished 21:13:41 2019-01-29

In [24]:

```
scaler=StandardScaler().fit(Xtrain)
Xtrain=scaler.transform(Xtrain)
Xtest=scaler.transform(Xtest)
```

executed in 220ms, finished 21:13:41 2019-01-29

In [25]:

```
from catboost import CatBoostClassifier
```

executed in 2.15s, finished 21:13:43 2019-01-29

In [26]:

```
cb=CatBoostClassifier(iterations=1000,depth=4,eval_metric='Accuracy',
                      random_seed=10,learning_rate=.05).fit(Xtrain,Ytrain,eval_set=(Xtest,Y
                                                            early_stopping_rounds=100,use_b
```

executed in 27.6s, finished 21:14:11 2019-01-29

```
0:      learn: 0.7010551        test: 0.8209607 best: 0.8209607 (0)     tota
l: 190ms        remaining: 3m 9s
50:     learn: 0.8182884        test: 0.8275109 best: 0.8318777 (22)    tota
l: 4.57s        remaining: 1m 25s
100:    learn: 0.8581477        test: 0.8318777 best: 0.8340611 (57)    tota
l: 8.8s remaining: 1m 18s
150:    learn: 0.8722157        test: 0.8384279 best: 0.8384279 (143)   tota
l: 13.4s        remaining: 1m 15s
200:    learn: 0.8874560        test: 0.8362445 best: 0.8384279 (143)   tota
l: 18s  remaining: 1m 11s
Stopped by overfitting detector  (100 iterations wait)

bestTest = 0.8384279476
bestIteration = 143

Shrink model to first 144 iterations.
```

In [27]:

```
print('Base accuracy for training set is:', 1-Ytrain.mean())
print('Base accuracy for validation set is:',1 - Ytest.mean())
```

executed in 38ms, finished 21:14:11 2019-01-29

```
Base accuracy for training set is: 0.6670574443141852
Base accuracy for validation set is: 0.8318777292576419
```

In [28]:

```
from sklearn.metrics import confusion_matrix,balanced_accuracy_score
```

executed in 686ms, finished 21:14:11 2019-01-29

In [29]:

```
cb.score(Xtest,Ytest)
```

executed in 554ms, finished 21:14:12 2019-01-29

Out[29]:

```
0.8384279475982532
```

In [30]:

```
confusion_matrix(Ytest,cb.predict(Xtest))
```

executed in 446ms, finished 21:14:12 2019-01-29

Out[30]:

```
array([[380,   1],
       [ 73,   4]], dtype=int64)
```

In [31]:

```
print(balanced_accuracy_score(Ytest,cb.predict(Xtest)))
```

executed in 348ms, finished 21:14:13 2019-01-29

```
0.5246616900160207
```

Classifier is better than random guessing but not by too much. The data is not only imbalanced, it is very noisy too. Furthermore, accuracy isnt the best metric to optimize for in problems like this. In real life, we might want to be biased a little towards the minority set as this usually our focus.