In [7]:

```
import pandas as pd
import seaborn as sns1
import numpy as np
import matplotlib.pyplot as plt
import scipy.stats as stats
import pylab as pl
import random
from sklearn import preprocessing
from sklearn.decomposition import PCA
import math
import statistics
%matplotlib inline
print("---------dataset 2-----------")
df1_1=pd.read_csv('dist1_500_1.txt',sep=" ",header=None);
df1_1.dropna(how="all", inplace=True)
df1_2=pd.read_csv('dist1_500_2.txt',sep=" ",header=None);
df1_2.dropna(how="all", inplace=True)
df1=pd.concat([df1_1,df1_2])
pca = PCA(n_components=3)
pca.fit(df1)
print(pca.components_)
print(pca.explained_variance_)
ratio_arr = pca.explained_variance_ratio_
list=[]
print("---------dataset 2-----------")
plt.plot(np.cumsum(pca.explained_variance_ratio_))
plt.xlabel('number of components')
plt.ylabel('cumulative explained variance');
for i in ratio_arr:
    list.append(i*100)
list
df2_1=pd.read_csv('dist2_500_1.txt',sep=" ",header=None);
df2_1.dropna(how="all", inplace=True)
df2_2=pd.read_csv('dist2_500_2.txt',sep=" ",header=None);
df2_2.dropna(how="all", inplace=True)
df2=pd.concat([df2_1,df2_2])
pca = PCA(n_components=3)
pca.fit(df2)
print(pca.components_)
print(pca.explained_variance_)
ratio_arr = pca.explained_variance_ratio_
list=[]

plt.plot(np.cumsum(pca.explained_variance_ratio_))
plt.xlabel('number of components')
plt.ylabel('cumulative explained variance');
for i in ratio_arr:
    list.append(i*100)
list
```

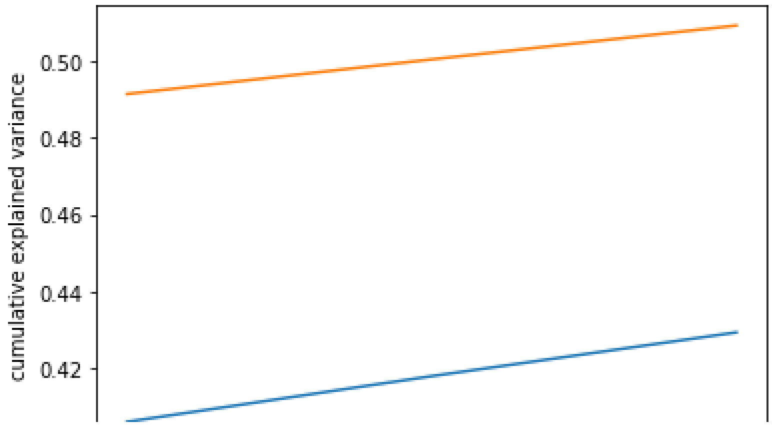
```
---------dataset 2-----------
[[-0.10416282 -0.10385417 -0.10065525 -0.09497416 -0.10889559 -0.0925407
5
  -0.09782877 -0.09891933 -0.10123439 -0.10490911 -0.10758328 -0.0944912
9
  -0.09475672 -0.09568107 -0.09433805 -0.10092958 -0.09852246 -0.1020829
```

```
3
 -0.09072236 -0.09446863 -0.10010197 -0.09716835 -0.09783511 -0.0998539
1
 -0.10252807 -0.1006186  -0.09525831 -0.09694633 -0.10942994 -0.1006809
5
 -0.10361362 -0.10695543 -0.10015786 -0.10160415 -0.10148048 -0.0915984
9
 -0.0964593  -0.10049542 -0.09895829 -0.10000045 -0.09571827 -0.0969179
8
 -0.09881569 -0.09905419 -0.10081724 -0.09933673 -0.10384122 -0.0986565
9
 -0.10341088 -0.10303236 -0.09777897 -0.10381266 -0.09277577 -0.0991019
9
 -0.09721603 -0.10342099 -0.09491655 -0.09851772 -0.10220389 -0.1002370
8
 -0.09748887 -0.09554182 -0.09617315 -0.10414511 -0.10042779 -0.0944029
6
 -0.09833723 -0.10254708 -0.10567763 -0.10204179 -0.10645483 -0.1092610
9
 -0.10207342 -0.09538272 -0.10032654 -0.09601277 -0.10687144 -0.1037770
1
 -0.10280366 -0.09525544 -0.10145447 -0.09546948 -0.10055034 -0.1006293
4
 -0.10207404 -0.09829762 -0.10030702 -0.10040381 -0.09887769 -0.0979199
6
 -0.09747595 -0.09801346 -0.10083288 -0.10169095 -0.1042297  -0.1046497
4
 -0.10093911 -0.09934273 -0.10025547 -0.10126546]
[ 0.09054808  0.01861019  0.05971139  0.18128602  0.00604904  0.0152048
3
 -0.14362587 -0.10461789 -0.03465931  0.02629723 -0.05762698  0.1138025
3
  0.18018496 -0.18585975 -0.15322475  0.02791241  0.04894245 -0.1329730
8
  0.06899594  0.06591983  0.04839692  0.04410212 -0.1121235   0.1033278
5
 -0.11865324 -0.00671726  0.0953137  -0.04896341 -0.15493518 -0.019518
 -0.06085894 -0.01689424  0.02664091  0.24881999 -0.00722471  0.0049113
6
 -0.11071621  0.14329884 -0.01809961  0.13199923  0.19196706 -0.0989212
4
  0.08418837 -0.02087035  0.04055638  0.15860518 -0.07268528 -0.0968092
9
  0.01782804  0.01619907  0.02339142 -0.09413646  0.15667052 -0.1560535
9
  0.13669147  0.07496942  0.03809409 -0.00251121 -0.01599632 -0.2430811
4
 -0.02758909 -0.2524742  -0.01796575 -0.01321531 -0.19228474 -0.0398782
4
 -0.18324346 -0.05744129  0.04973186  0.16551394 -0.03142739 -0.0190068
8
 -0.09255106  0.05945107 -0.06880389  0.05554263 -0.09259912  0.0347961
 -0.04970389  0.06787659  0.13783529 -0.02827062  0.0383797   0.0213456
9
  0.00670288 -0.02634238 -0.06896405 -0.08188155  0.06064285  0.0715070
1
 -0.09608421  0.08498539  0.00599124 -0.14777913  0.21067917  0.0529706
```

```
9
   0.03991062  0.10556288 -0.02456025 -0.01345482]
 [ 0.09843364  0.15259361 -0.01633016 -0.09781642  0.17404741 -0.0590234
6
  -0.06324053  0.08551586  0.0003353   0.03620277  0.11473376 -0.0228371
2
   0.01323858 -0.21030971 -0.21132323 -0.01237947 -0.16135038 -0.1373156
  -0.09835633  0.03211489  0.06274251 -0.00484564  0.01129458 -0.1689734
   0.15643266 -0.09642612  0.03681744  0.16632623  0.18375022 -0.0703581
7
  -0.04737657 -0.04580845  0.1541632  -0.13588861  0.00345758  0.1820174
6
  -0.01349492 -0.00290527 -0.0374535   0.05252719 -0.09322499 -0.1044411
2
  -0.0681333  -0.0237704  -0.01524989 -0.08910929  0.03093529 -0.0449184
2
   0.10551506  0.04093175 -0.01053461  0.03199764  0.02071162  0.0131625
9
  -0.10413665  0.13056628  0.09683734  0.07071657  0.08291163 -0.1056662
6
   0.10831625  0.07963907 -0.00308518 -0.04241856 -0.10250783  0.0351588
   0.05834943  0.06584422 -0.00219711 -0.0214559  -0.02746326  0.0819634
7
   0.00935067 -0.09632349  0.1528906   0.10845223 -0.04423377 -0.0057595
  -0.15882931  0.06397666  0.17212361 -0.17335909  0.14220277 -0.0447992
4
   0.10893679  0.02538572  0.09114    -0.08371478 -0.00923348 -0.1155410
9
   0.16791971 -0.2353445  -0.03093815 -0.14684408  0.1471568   0.0699974
3
  -0.13842872 -0.05977211 -0.11996425 -0.08485022]]
[242165.66814866   7119.12908863   6804.72317256]
---------dataset 2-----------
[[-9.98177049e-02 -1.03176242e-01 -9.93441289e-02 -1.01774648e-01
  -9.55820788e-02 -1.03232146e-01 -1.01978193e-01 -1.04465645e-01
  -1.05100279e-01 -9.57022235e-02 -9.54126205e-02 -9.87211636e-02
  -1.01001058e-01 -9.76934140e-02 -9.43913613e-02 -9.99668557e-02
  -1.04376779e-01 -9.94414194e-02 -9.67351551e-02 -1.02716612e-01
  -9.51199259e-02 -9.88147996e-02 -1.01609804e-01 -9.84602302e-02
  -1.02488196e-01 -9.86099364e-02 -9.76380690e-02 -1.01862912e-01
  -9.89098771e-02 -1.00283985e-01 -9.42556078e-02 -9.99484324e-02
  -1.05328054e-01 -9.79220718e-02 -1.01875692e-01 -1.00775361e-01
  -9.66226963e-02 -1.05097766e-01 -9.94741600e-02 -9.79730766e-02
  -9.35159696e-02 -1.05575123e-01 -1.02840155e-01 -9.53235978e-02
  -9.91481336e-02 -1.00015544e-01 -9.37785110e-02 -1.09768798e-01
  -1.03041490e-01 -9.74995198e-02 -9.87965458e-02 -1.02586782e-01
  -1.00261183e-01 -9.52778152e-02 -9.72672810e-02 -9.79814748e-02
  -9.96577614e-02 -9.71385653e-02 -9.64671911e-02 -1.00320560e-01
  -1.03512667e-01 -1.00915013e-01 -1.05540260e-01 -1.03142727e-01
  -9.94791096e-02 -1.05879154e-01 -9.73840121e-02 -1.01224797e-01
  -1.03145811e-01 -9.84994073e-02 -9.77891297e-02 -1.02073055e-01
  -9.81738338e-02 -9.79457199e-02 -9.82884765e-02 -1.04898222e-01
  -9.87709228e-02 -9.65100520e-02 -9.77529962e-02 -1.00758952e-01
  -1.01379679e-01 -9.34374579e-02 -9.85894384e-02 -9.86268030e-02
  -1.00405825e-01 -9.70032692e-02 -1.03331185e-01 -9.89896561e-02
  -1.01703379e-01 -9.95953345e-02 -1.00895978e-01 -9.75477175e-02
  -1.01927857e-01 -9.75490271e-02 -9.94337101e-02 -1.03302748e-01
```

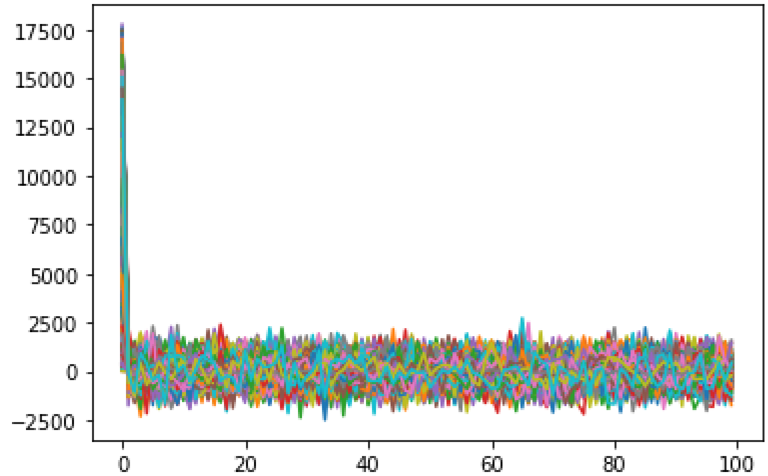
```
 -1.00853841e-01 -1.06080679e-01 -9.87747318e-02 -1.03856789e-01]
[-6.13859604e-02 -1.29374501e-03  5.67938804e-03 -4.68780635e-02
 -9.67608579e-03  9.86014205e-02 -1.43099528e-01  1.50356954e-03
 -3.68712172e-02  1.44405038e-01  5.38450504e-02  9.71964035e-02
 -5.53406762e-03 -1.29040997e-01 -1.01552092e-01  1.18096864e-01
 -1.26999791e-01 -9.67763168e-03 -1.78958744e-03 -1.34475913e-01
  1.84404621e-04  8.39892148e-02  8.97771802e-02 -1.49136699e-01
 -1.62855176e-01 -1.26603991e-01 -5.99373213e-02 -1.40911101e-01
  3.58735982e-02  1.97899013e-01 -2.99801458e-02  1.51091417e-02
 -2.89860844e-02  2.38067162e-02  5.89085902e-02  6.31565232e-02
 -3.68060485e-02  4.56699749e-02  6.29801296e-02  1.79934976e-01
 -3.79391732e-02 -7.06527184e-02  3.37001129e-02  1.74866015e-02
  8.18701284e-02 -1.06915646e-01 -2.10375474e-02 -1.86272894e-01
  2.00939665e-01  1.34956346e-01 -1.79264886e-01  1.66922439e-01
  4.39787714e-02 -5.51925556e-02  2.05180497e-01 -2.06421500e-01
  1.78888817e-01  2.12821473e-01 -8.09340346e-02 -2.42017654e-02
  5.82455804e-02  1.48711090e-01  3.89854272e-03  9.42697094e-02
  4.87875815e-02 -6.66962677e-02 -1.54745246e-02  1.22735967e-01
  5.50198923e-02  4.96159638e-04 -1.48417083e-01 -1.18546455e-01
 -2.12857997e-02 -6.51502999e-03 -1.85510465e-01  8.00780687e-02
  7.43008097e-02 -1.53586155e-02 -1.48421197e-01 -3.80684426e-02
 -7.86724364e-02  2.06472782e-02 -1.55092471e-01 -1.28854390e-01
  1.24268806e-01  5.68289540e-02  7.39054818e-02 -2.99642513e-02
 -6.93918011e-02 -8.37769590e-02  8.70917377e-02  1.32816522e-01
  4.67222571e-02 -2.38563465e-02 -8.34410976e-02  1.32163438e-01
 -6.34626363e-03 -2.61829577e-02  6.93379755e-03 -5.41393909e-02]
[-1.17346388e-01 -1.51095620e-01 -4.74800852e-02  1.10259788e-01
 -8.67778546e-02 -1.07439252e-01 -1.17434430e-01 -6.58631894e-03
 -4.15246095e-02  1.30349133e-01 -1.32095806e-01 -6.25604392e-03
  1.67224596e-01  2.80422590e-01 -7.14169156e-02 -5.26402719e-02
  8.79007911e-02  1.49644384e-01  8.22573369e-03  5.52771434e-02
 -3.27925187e-02  7.71760477e-02  2.18813811e-02 -2.10901159e-02
 -3.86372188e-02  8.35254138e-02 -1.36536330e-02 -1.67137066e-02
  1.24016212e-02  7.30336782e-03  4.44782073e-02 -9.97482952e-02
 -5.37372978e-02  1.55219944e-01  4.32374413e-02 -1.40324793e-01
 -5.71562229e-02 -1.28854578e-01 -2.47885941e-02 -2.46783808e-01
 -1.36181297e-01 -6.18438954e-02  1.16315747e-01 -7.61804134e-02
  1.12897170e-01 -7.99790453e-02  3.24214699e-02  8.90780476e-02
  1.51204049e-02  3.30643914e-02  9.31926322e-02 -2.58920043e-02
  2.48629643e-01 -9.95447780e-03  2.36915743e-01 -4.41946286e-02
  1.85736617e-01 -4.97570342e-02 -1.90278344e-01  5.49142571e-02
  1.05781855e-01 -1.14534935e-01 -9.14824199e-02  6.75779213e-02
  7.45850025e-02  1.13779982e-01 -5.35294544e-03  1.13657351e-01
 -5.18601761e-02 -2.05906747e-02  2.21499415e-02  4.24786543e-02
 -2.52390484e-01  1.73702725e-02 -5.54305453e-02 -6.51174358e-03
  3.24347147e-02  5.26918633e-02 -1.34973500e-01 -3.58995720e-02
 -1.07115843e-02 -9.13325762e-02  5.30688473e-02  2.07504763e-01
 -1.78773255e-03 -9.15395992e-02  5.75340661e-02 -8.74146825e-03
  7.97976254e-02 -7.09218202e-02  9.02243679e-02 -1.01949920e-01
  2.17867417e-02  2.25447365e-02  9.31269944e-02 -1.10716607e-01
 -7.73798677e-02 -8.35977446e-02 -3.13485022e-02 -6.37582621e-03]]
[240460.62688681   4426.20400544   4324.75657443]
```

Out[7]:
```
[49.145245826729, 0.9046257873596385, 0.8838920023744803]
```


cumulative explained variance
0.50
0.48
0.46
0.44
0.42

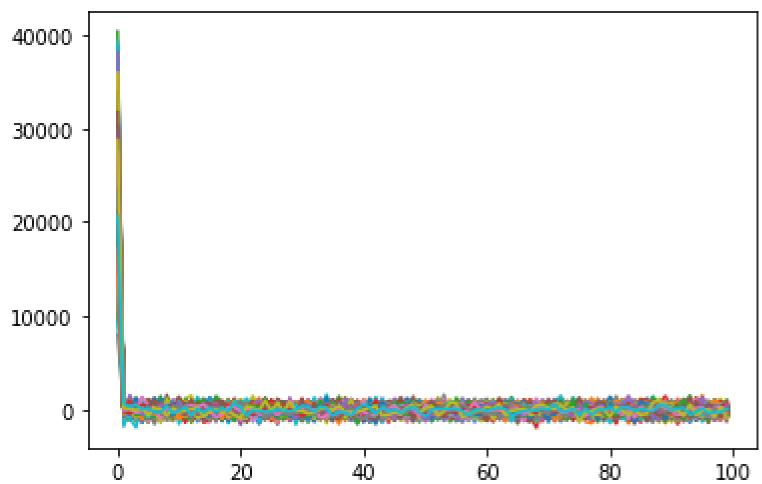
In [26]:

```
# df1_1=pd.read_csv('dist1_500_1.txt',sep=" ",header=None);
# df1_1.dropna(how="all", inplace=True)
# df1_2=pd.read_csv('dist1_500_2.txt',sep=" ",header=None);
# df1_2.dropna(how="all", inplace=True)
# df1=pd.concat([df1_1,df1_2])
# print(df1.iloc[0]);

# alpha0=math.sqrt(1/100)
# alpha1=math.sqrt(2/100)
# print(alpha1)
# for x in range(0,100):
#     print(x)
#     cosinetransform=math.cos(((2*x)+1)*x*math.pi/2*100)
# #     print(cosinetransform)
#     samation=df1.iloc[x]*cosinetransform
# #     print(samation)
# u = []
# for i in range(100):
#     u.append(0)
# for i in range(0,100):
#     if i==0:
#         u[i]=alpha0*samation
#     elif i>0:
#         u[i]=alpha1*samation
#     print(u[0])
def transform(vector):
    result = []
    factor = math.pi / len(vector)
    for i in range(len(vector)):
        sum = 0.0
        for (j, val) in enumerate(vector):
            sum += val * math.cos((j + 0.5) * i * factor)
        result.append(sum)
    return result
dfg1=[]
# list2=[]
for i in range(0,1000):
#     dfg1.append(transform(df1.iloc[i]))
    pl.plot(transform(df1.iloc[i]))
    dfg1.append(transform(df1.iloc[i]))
#     print(statistics.variance(dfg1[i]))

# list2.sort(reverse=True)
# dfg1
```



In [27]:

```
dfg2=[]
for i in range(0,1000):
#     dfg1.append(transform(df1.iloc[i]))
    pl.plot(transform(df2.iloc[i]))
    dfg2.append(transform(df2.iloc[i]))
#     print(statistics.variance(dfg2[i]))
#     list2.append(statistics.variance(dfg1[i]))

# list2.sort(reverse=True)
```



In [ ]: