1

$$E = \frac{1}{2}\sum_k (t_k - a_k)^2$$

$$\Delta W \propto -\frac{\partial E}{\partial W}$$

$$\Delta w_{kj} \propto -\frac{\partial E}{\partial w_{kj}}$$

$$\Delta w_{kj} = -\varepsilon \frac{\partial E}{\partial a_k}\frac{\partial a_k}{\partial net_k}\frac{\partial net_k}{\partial w_{kj}}$$

$$\frac{\partial E}{\partial a_k} = \frac{\partial(\frac{1}{2}(t_k - a_k)^2)}{\partial a_k} = -(t_k - a_k)$$

$$\frac{\partial a_k}{\partial net_k} = \frac{\partial(1 + e^{-net_k})^{-1}}{\partial net_k} = \frac{e^{-net_k}}{(1 + e^{-net_k})^2}$$

$$1 - \frac{1}{1 + e^{-net_k}} = \frac{e^{-net_k}}{1 + e^{-net_k}}$$

$$a_k(1 - a_k)$$

$$\frac{\partial net_k}{\partial w_{kj}} = \frac{\partial(w_{kj}a_j)}{\partial w_{kj}} = a_j$$

For output layer

$$\Delta w_{kj} = \varepsilon \overbrace{(t_k - a_k)a_k(1 - a_k)}^{\delta_k} a_j$$

$$\Delta w_{kj} = \varepsilon \delta_k a_j$$

For the input layer

$$\Delta w_{ji} \propto -[\sum_k \frac{\partial E}{\partial a_k}\frac{\partial a_k}{\partial net_k}\frac{\partial net_k}{\partial a_j}]\frac{\partial a_j}{\partial net_j}\frac{\partial net_j}{\partial w_{ji}}$$

$$= \varepsilon[\sum_k \overbrace{(t_k - a_k)a_k(1-a_k)}^{\delta_k} w_{kj}]a_j(1-a_j)a_i$$

$$= \varepsilon \overbrace{[\sum_k \delta_k w_{kj}]a_j(1-a_j)}^{\delta_j} a_i$$

$$\Delta w_{ji} = \varepsilon \delta_j a_i$$

2 1) the log-likelihood of the complete data

$$Z_{im} = \begin{cases} 1, & \text{if } (X_i, Y_i) \text{is in the } m\text{th group} \\ 0, & \text{otherwise.} \end{cases}$$

$$\sum_{i=1}^{n} \sum_{m=1}^{M} Z_{im} \left[\log p_m(X_i) + \log \lambda_m(X_i) - \lambda_m(X_i) Y_i\right].$$

2) E step

$$r_{im}^{(l+1)} = \frac{p_m^{(l)}(X_i)\lambda_m^{(l)}(X_i)\exp\{-\lambda_m^{(l)}(X_i)Y_i\}}{\sum_{m=1}^{M} p_m^{(l)}(X_i)\lambda_m^{(l)}(X_i)\exp\{-\lambda_m^{(l)}(X_i)Y_i\}}.$$

3) in the M step we need to maximize

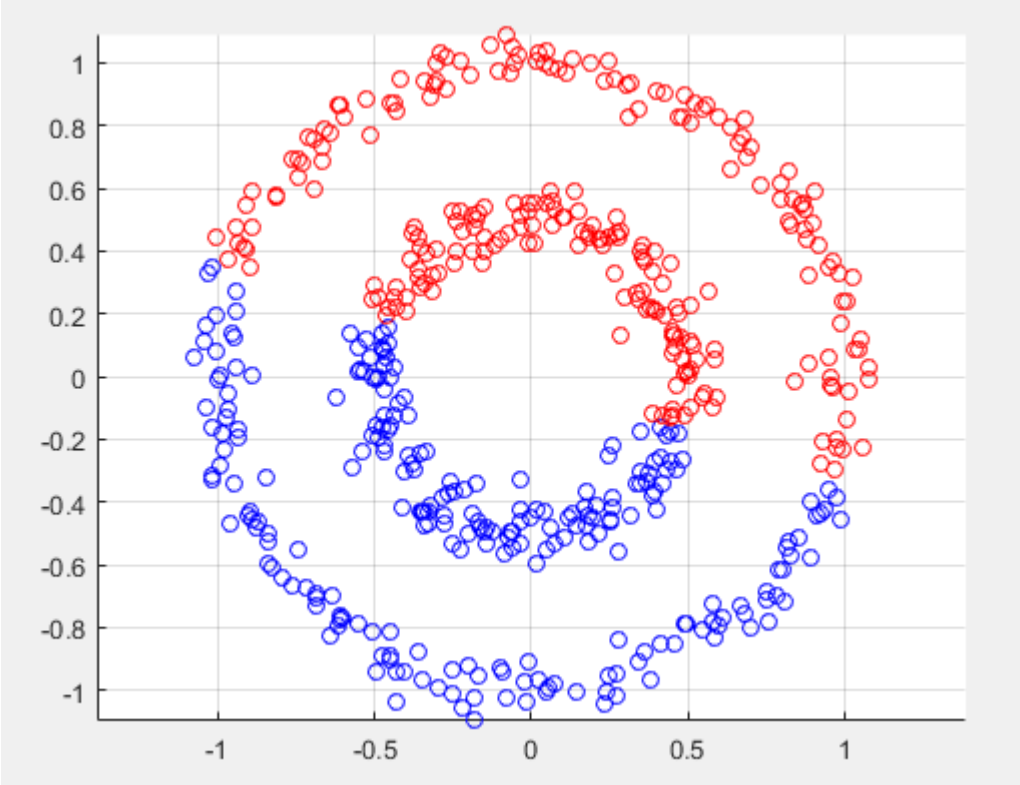
$$\sum_{i=1}^{n} \sum_{m=1}^{M} r_{im}^{(l+1)} \left[\log p_m + \log \lambda_m - \lambda_m Y_i\right]$$

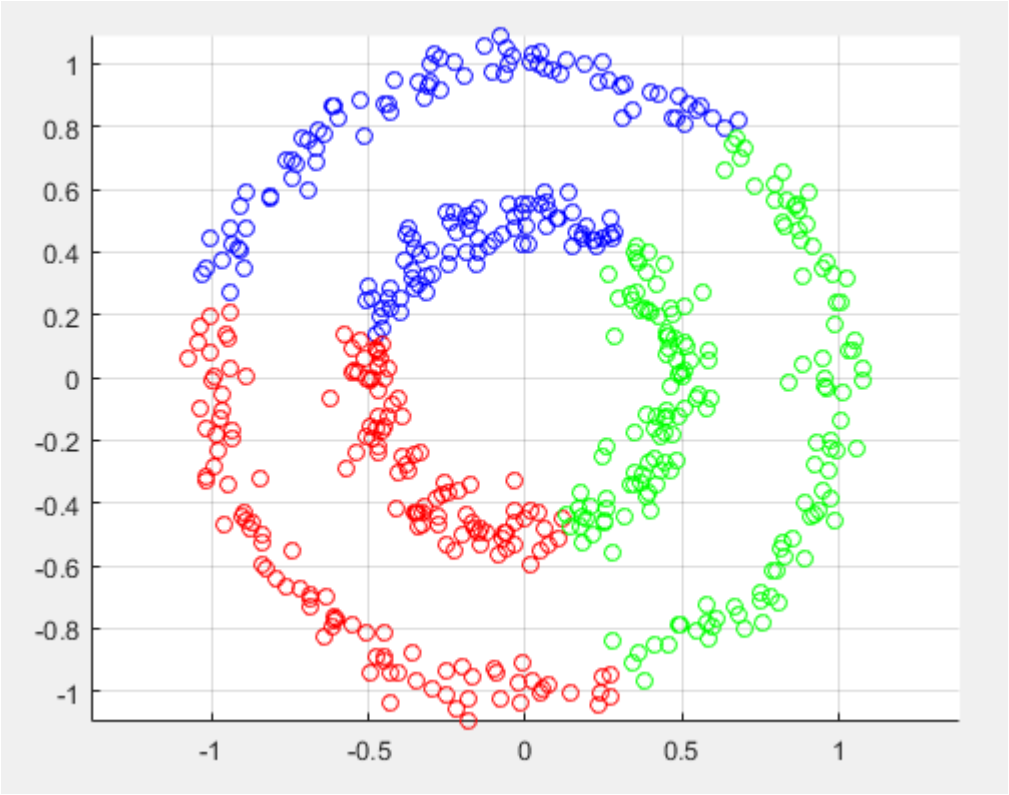
$$\lambda_m^{(l+1)}(x) = \frac{\sum_{i=1}^{n} r_{im}^{(l+1)} I}{\sum_{i=1}^{n} r_{im}^{(l+1)} Y_i}$$

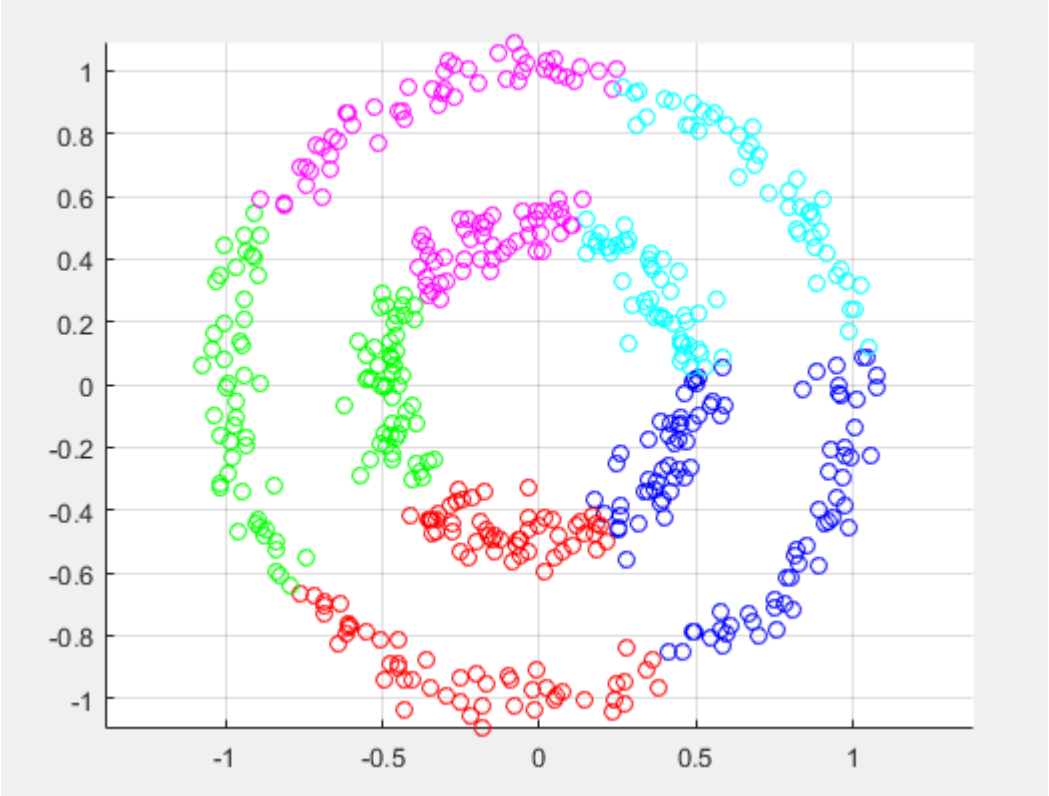
3

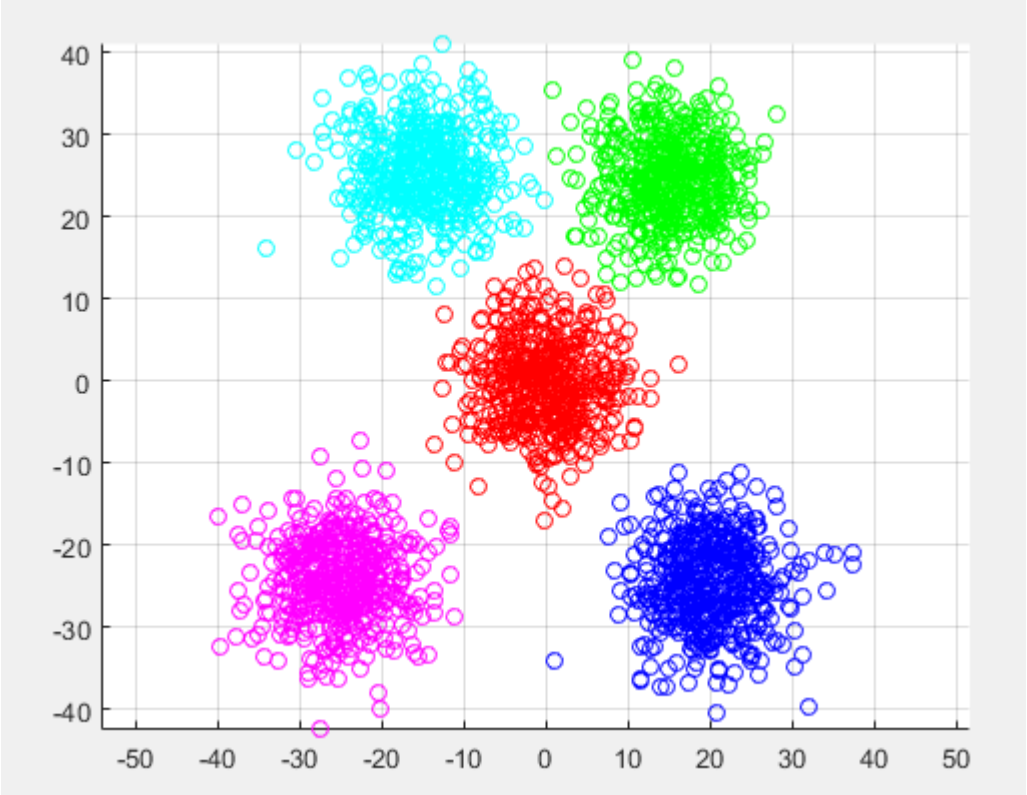
2) K-Means algorith is efficient for smaller data sets and K-Medoids algorithm seems to perform better for large data sets.

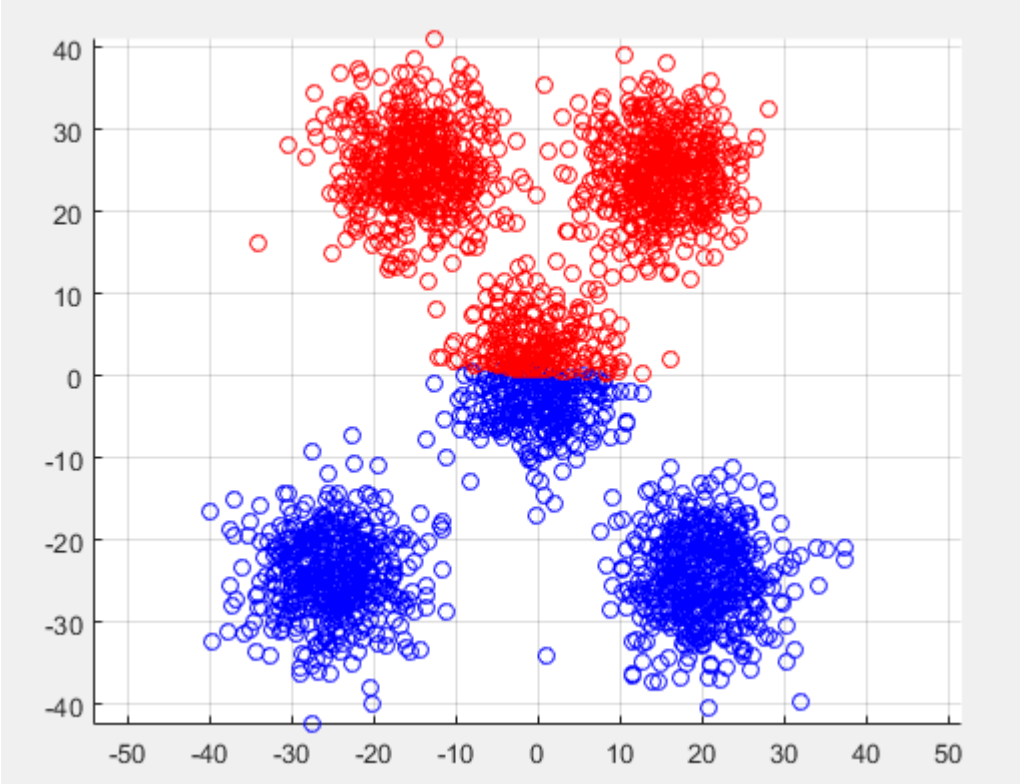
k means sensitive to outlier and objective function.

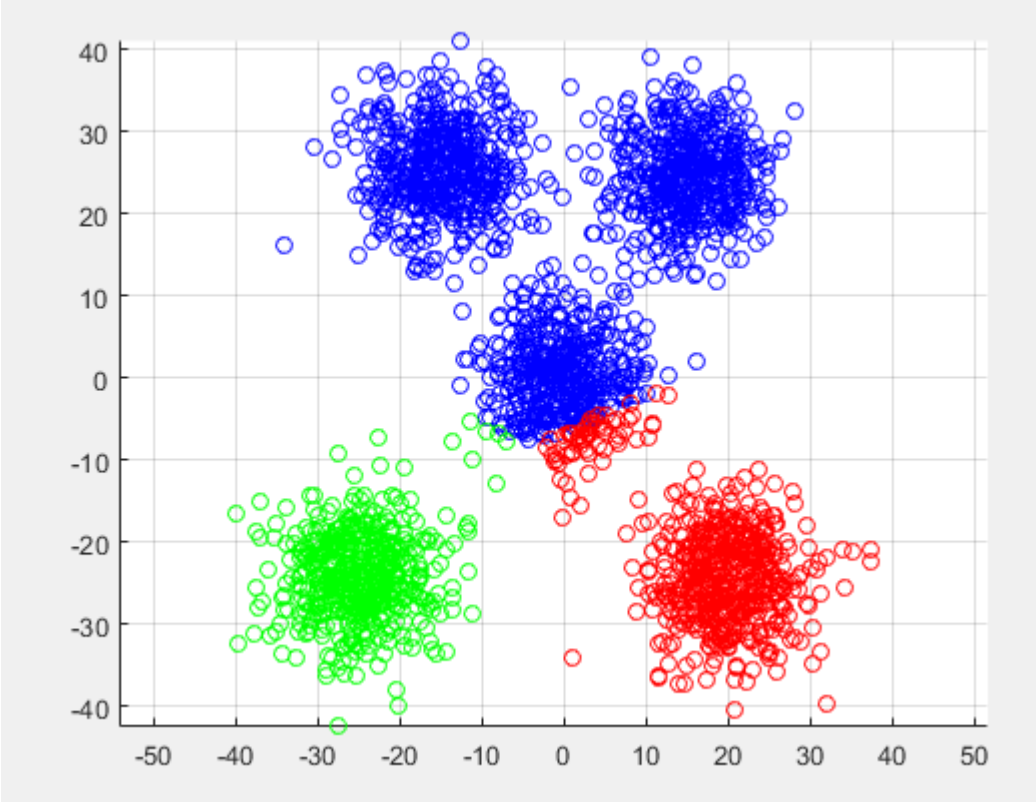



1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.5
0
0.5
1


1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.5
0
0.5
1


40
30
20
10
0
-10
-20
-30
-40
-50
-40
-30
-20
-10
0
10
20
30
40
50


40
30
20
10
0
-10
-20
-30
-40
-50
-40
-30
-20
-10
0
10
20
30
40
50



For the circle it is failed to separate it since the distance to the center is the same.

the NO. 1 model.
initial mu
2.8791 -0.4866
-0.0374 1.2096
5.4871 0.7125

initial sigma (:,:,1)= 0.5309 0
0 0.0915
(:,:,2) = 0.5309 0
0 0.0915
(:,:,3) = 0.5309 0
0 0.0915
inital prior probs
0.3333 0.3333 0.3333

initial log likelihood is:
-1.7388e+04

final iteration is
112

```
final likelihood is:
   -1.7381e+03

difference
     1.6629e-05
my gmm:
my mu
      2.3399       0.8565
      2.3950       3.4136
      5.7088       4.1591
my Sigma
(:,:,1) =
      2.0459       0.3604
      0.3604       0.4099
(:,:,2) =
      1.0018       1.2935
      1.2935       2.7074
(:,:,3) =
      0.4280       0.0466
      0.0466       0.4718
my prop
      0.4268       0.3726       0.2007
the NO. 2    model.
initial mu
      2.1850       5.5090
     -0.4494       1.1877
     -0.3842       3.9230
initial sigma
(:,:,1) =0.9644            0
               0       0.4325
(:,:,2) =0.9644            0
               0       0.4325
(:,:,3) =0.9644            0
               0       0.4325
inital prior probs
      0.3333       0.3333       0.3333
initial log likelihood is:
   -3.8687e+03
final iteration is
     120
final likelihood is:
   -1.7293e+03
```

```
difference
    1.0683e-05
my gmm:
my mu 4.3903      4.4395
      3.6040      0.9653
      1.3894      1.2819
my Sigma (:,:,1) =2.2263     -0.2868
                  -0.2868      0.6176
(:,:,2) =0.2684      0.0864
      0.0864      0.3318
(:,:,3) =0.7881      0.6014
      0.6014      1.0386
my prop
      0.3974      0.2052      0.3974

the NO. 3   model.
initial mu 4.7227      4.3786
      5.2782     -0.4064
      2.4246      6.8183
initial sigma
(:,:,1) =0.1875           0
               0      0.2662
(:,:,2) =0.1875           0
               0      0.2662
(:,:,3) =0.1875           0
               0      0.2662
inital prior probs
      0.3333      0.3333      0.3333
initial log likelihood is:
   -1.1767e+04

final iteration is
    164
final likelihood is:
   -1.7381e+03
difference
    1.6050e-05
my gmm:
my mu 5.7089      4.1592
      2.3337      0.8560
      2.4026      3.4266
my Sigma
(:,:,1) =0.4279      0.0466
      0.0466      0.4718
```

(:,:,2) =2.0488 0.3614
0.3614 0.4108
(:,:,3) =0.9927 1.2777
1.2777 2.6824
my prop 0.2006 0.4286 0.3708
the NO. 4 model.
initial mu 5.6265 2.1034
2.9065 1.0244
5.3734 -1.0422
initial sigma (:,:,1) = 0.6733 0
0 0.4296
(:,:,2) =0.6733 0
0 0.4296
(:,:,3) =0.6733 0
0 0.4296
inital prior probs
0.3333 0.3333 0.3333
initial log likelihood is:
-3.8414e+03
final iteration is
41
final likelihood is:
-1.7293e+03
difference
1.5497e-05
my gmm:
my mu 4.3901 4.4395
1.3897 1.2816
3.6046 0.9653
my Sigma
(:,:,1) = 2.2264 -0.2866
-0.2866 0.6176
(:,:,2) =0.7883 0.6010
0.6010 1.0380
(:,:,3) =0.2679 0.0864
0.0864 0.3317
my prop
0.3975 0.3975 0.2050
the NO. 5 model.
initial mu 2.5921 1.4003
3.9784 5.4064
-0.8479 4.7375
initial sigma (:,:,1) =0.1253 0
0 0.1302

(:,:,2) =0.1253 0
0 0.1302
(:,:,3) =0.1253 0
0 0.1302
inital prior probs 0.3333 0.3333 0.3333
initial log likelihood is: -6.6951e+03
final iteration is 153
final likelihood is: -1.7381e+03
difference 1.7286e-05
my gmm:
my mu 2.3336 0.8560
5.7089 4.1592
2.4027 3.4268
my Sigma (:,:,1) =2.0488 0.3614
0.3614 0.4108
(:,:,2) = 0.4279 0.0466
0.0466 0.4718
(:,:,3) = 0.9925 1.2774
1.2774 2.6819
my prop 0.4286 0.2006 0.3708

the NO. 1 model for holdout data.
initial mu
2.3399 0.8565
2.3950 3.4136
5.7088 4.1591
initial sigma
(:,:,1) =2.0459 0.3604
0.3604 0.4099
(:,:,2) =1.0018 1.2935
1.2935 2.7074
(:,:,3) =0.4280 0.0466
0.0466 0.4718
inital prior probs 0.4268 0.3726 0.2007
initial log likelihood is: -4.6437e+03
final iteration is 62
final likelihood is: -4.4798e+03
difference 4.3214e-05
my gmm: 2.2692 0.9090
2.4711 3.6114
5.7262 4.1480
(:,:,1) =2.1199 0.2742
0.2742 0.3626
(:,:,2) =

0.7666 0.9497
0.9497 2.3070
(:,:,3) = 0.3804 0.0370
0.0370 0.3942
0.3409 0.2497 0.4094
the NO. 2 model for holdout data.
initial mu 4.3903 4.4395
3.6040 0.9653
1.3894 1.2819
initial sigma
(:,:,1) = 2.2263 -0.2868
-0.2868 0.6176
(:,:,2) = 0.2684 0.0864
0.0864 0.3318
(:,:,3) =0.7881 0.6014
0.6014 1.0386
inital prior probs 0.3974 0.2052 0.3974
initial log likelihood is: -4.7798e+03
final iterat 35
final likelihood is: -4.6074e+03
differenc 4.0285e-05
my gmm:
5.0506 4.3018
3.5109 0.9705
1.3605 1.3854
(:,:,1) =1.7368 -0.2836
-0.2836 0.5095
(:,:,2) =0.5404 0.0810
0.0810 0.2898
(:,:,3) =0.7403 0.5667
0.5667 1.0368
0.5464 0.1665 0.2871
the NO. 3 model for holdout data.
initial mu
5.7089 4.1592
2.3337 0.8560
2.4026 3.4266

initial sigma

(:,:,1) =

0.4279 0.0466
0.0466 0.4718

(:,:,2) =2.0488 0.3614
0.3614 0.4108
(:,:,3) =0.9927 1.2777
1.2777 2.6824
inital prior probs 0.2006 0.4286 0.3708
initial log likelihood is: -4.6436e+03
final iteration is 61
final likelihood is: -4.4798e+03
difference 4.4752e-05
my gmm: 5.7262 4.1480
2.2692 0.9089
2.4710 3.6113
(:,:,1) =0.3804 0.0370
0.0370 0.3942
(:,:,2) =2.1199 0.2742
0.2742 0.3626
(:,:,3) =0.7666 0.9498
0.9498 2.3072
0.4094 0.3409 0.2497
the NO. 4 model for holdout data.
Initial mu 4.3901 4.4395
1.3897 1.2816
3.6046 0.9653
initial sigma(:,:,1) =2.2264 -0.2866
-0.2866 0.6176
(:,:,2) =0.7883 0.6010
0.6010 1.0380
(:,:,3) =0.2679 0.0864
0.0864 0.3317
inital prior probs
0.3975 0.3975 0.2050
initial log likelihood is: -4.7799e+03
final iteration is 35
final likelihood is: -4.6074e+03
difference 4.0657e-05
my gmm:
5.0506 4.3018
1.3605 1.3854
3.5109 0.9705
(:,:,1) =1.7368 -0.2836
-0.2836 0.5095
(:,:,2) =0.7403 0.5667

0.5667 1.0368
(:,:,3) =0.5403 0.0810
0.0810 0.2898
0.5464 0.2871 0.1665
the NO. 5 model for holdout data.
initial mu 2.3336 0.8560
5 .7089 4.1592
2.4027 3.4268
initial sigma(:,:,1) =2.0488 0.3614
0.3614 0.4108
(:,:,2) =0.4279 0.0466
0.0466 0.4718
(:,:,3) =0.9925 1.2774
1.2774 2.6819
inital prior probs 0.4286 0.2006 0.3708
initial log likelihood is: -4.6436e+03
final iteration is 61
final likelihood is: -4.4798e+03
difference 4.4683e-05
my gmm: 2.2692 0.9089
5.7262 4.1480
2.4710 3.6113
(:,:,1) =2.1199 0.2742
0.2742 0.3626
(:,:,2) =0.3804 0.0370
0.0370 0.3942
(:,:,3) =0.7666 0.9498
0.9498 2.3072
0.3409 0.4094 0.2497

So we can see that the best likelihood of holdout data is the one with high log
The iteration is 61 likelyhood is -4.4798e+03
The likelihood of the training data is -1.7381e+03

K=5
the NO. 1 model.
initial mu 5.2182 7.0422
0.8679 3.4292
3.0674 -0.1533
4.7607 -0.0597
6.4426 0.8891
initial sigma
(:,:,1) =3.9726 0
0 3.5544

```
(:,:,2) =3.9726         0
              0    3.5544
(:,:,3) =3.9726         0
              0    3.5544
(:,:,4) =3.9726         0
              0    3.5544
(:,:,5) =3.9726         0
              0    3.5544
                   inital prior probs
         0.2000    0.2000    0.2000    0.2000    0.2000
initial log likelihood is   -2.3548e+03
final iteration is 174
final likelihood is: -1.6764e+03
difference   1.3680e-05
my gmm:
my mu   3.7502    5.2922
         2.9310    4.5226
         1.3475    1.1861
         3.6098    0.9643
         5.7450    4.1179
my Sigma
(:,:,1) =0.8827    0.0338
         0.0338    0.0066
(:,:,2) =0.4563    0.2301
         0.2301    0.7889
(:,:,3) =0.7736    0.5374
         0.5374    0.8824
(:,:,4) =0.2653    0.0896
         0.0896    0.3340
(:,:,5) =0.3990    0.0814
         0.0814    0.4506
my prop   0.0253    0.1972    0.3791    0.2042    0.1942
the NO. 2   model.   initial mu
         5.7708    0.8328
         0.7665    4.0326
         6.7789    2.7810
         1.6999    1.7146
         0.3550    5.9158
initial sigma   (:,:,1) =3.7172         0
                        0    3.8498
(:,:,2) = 3.7172         0
              0    3.8498
(:,:,3) = 3.7172         0
              0    3.8498
```

```
(:,:,4) =3.7172         0
              0    3.8498
(:,:,5) = 3.7172         0
              0    3.8498
inital prior probs  0.2000    0.2000    0.2000    0.2000    0.2000

initial log likelihood is: -2.3125e+03
final iteration is 269
final likelihood is:   -1.6764e+03
difference   1.6680e-05
my gmm:   my mu
         3.7029    1.0112
         1.3879    1.3957
         5.7264    4.1436
         2.0216    0.8306
         2.9957    4.6978
my Sigma (:,:,1) = 0.1715    0.0738
                   0.0738    0.3096
(:,:,2) =0.8170    0.7705
         0.7705    1.0892
(:,:,3) =0.4093    0.0588
         0.0588    0.4720
(:,:,4) =1.4790    0.1807
         0.1807    0.4694
(:,:,5) =0.5347    0.2379
         0.2379    0.6326
my prop  0.1595    0.2947    0.1983    0.1435    0.2040
the NO. 3   model. initial mu
         6.6731    3.6098
         1.1375   -0.7036
         5.2703   -0.8957
         5.2398    3.2852
         1.9670    5.4629
initial sigma
(:,:,1) =4.0659         0
              0    3.4300
(:,:,2) =4.0659         0
              0    3.4300
(:,:,3) =4.0659         0
              0    3.4300
(:,:,4) =4.0659         0
              0    3.4300
(:,:,5) =4.0659         0
              0    3.4300
```

```
inital prior probs    0.2000        0.2000        0.2000        0.2000        0.2000
initial log likelihood is    -2.3066e+03
final iteration is    263
final likelihood is    -1.6764e+03
difference    1.6564e-05

my gmm: my mu 5.7264        4.1436
                1.3878        1.3956
                3.7029        1.0112
                2.0218        0.8306
                2.9957        4.6977
my Sigma (:,:,1) = 0.4093        0.0588
            0.0588        0.4720
(:,:,2) =0.8170        0.7704
            0.7704        1.0891
(:,:,3) =0.1715        0.0738
            0.0738        0.3096
(:,:,4) =1.4791        0.1806
            0.1806        0.4694
(:,:,5) =0.5347        0.2379
            0.2379        0.6326
my prop 0.1983        0.2947        0.1595        0.1435        0.2040
the NO. 4    model. initial mu
            3.6186        5.5954
            2.7468        1.3600
           -1.2643        3.2654
            1.5871        0.0837
            0.0533        3.9093
initial sigma(:,:,1) =3.3949                0
                            0        3.9542
(:,:,2) =3.3949                0
                    0        3.9542
(:,:,3) =3.3949                0
                    0        3.9542
(:,:,4) =3.3949                0
                    0        3.9542
(:,:,5) =3.3949                0
                    0        3.9542
inital prior probs    0.2000        0.2000        0.2000        0.2000        0.2000
initial log likelihood is: -2.2490e+03
final iteration is    212
final likelihood is:    -1.6764e+03
difference    1.6514e-05
my gmm    my mu    5.7263        4.1437
```

3.7046 1.0096
1.3832 1.3912
2.0256 0.8508
2.9949 4.6963
my Sigma(:,:,1) =0.4093 0.0588
0.0588 0.4719
(:,:,2) =0.1702 0.0743
0.0743 0.3087
(:,:,3) =0.8182 0.7770
0.7770 1.0947
(:,:,4) =1.4657 0.1748
0.1748 0.4809
(:,:,5) =0.5351 0.2388
0.2388 0.6344
my prop 0.1983 0.1586 0.2916 0.1473 0.2042

the NO. 5 model. initial mu
4.6742 6.6392
5.1909 -0.0327
2.5816 5.8719
-0.6338 3.3514
0.6389 7.3652
initial sigma (:,:,1) =3.2101 0
0 3.7428
(:,:,2) = 3.2101 0
0 3.7428
(:,:,3) =3.2101 0
0 3.7428
(:,:,4) =3.2101 0
0 3.7428
(:,:,5) =3.2101 0
0 3.7428
inital prior probs 0.2000 0.2000 0.2000 0.2000 0.2000
initial log likelihood is -2.5780e+03
final iteration is 135
final likelihood is: -1.6734e+03
difference 1.6561e-05
my gmm: my mu
5.7278 4.1427
3.6300 0.9660
2.0401 2.4891
1.2415 0.9107
2.9876 4.6476

```
my Sigma (:,:,1) =0.4082        0.0595
                  0.0595        0.4717
(:,:,2) =0.2484        0.0865
          0.0865        0.3337
(:,:,3) =0.4741        0.2318
          0.2318        0.1553
(:,:,4) =0.7661        0.3921
          0.3921        0.5776
(:,:,5) =0.5466        0.2519
          0.2519        0.6689
my prop    0.1981        0.1996        0.0697        0.3185        0.2141
the NO. 1    model. initial mu
          5.2182        7.0422
          0.8679        3.4292
          3.0674       -0.1533
          4.7607       -0.0597
          6.4426        0.8891
initial sigma
(:,:,1) =3.9726              0
                0        3.5544
(:,:,2) =3.9726              0
                0        3.5544
(:,:,3) =3.9726              0
                0        3.5544
(:,:,4) =3.9726              0
                0        3.5544
(:,:,5) =3.9726              0
                0        3.5544
inital prior probs 0.2000        0.2000        0.2000        0.2000        0.2000
initial log likelihood is: -2.3548e+03
final iteration is    174
final likelihood is: -1.6764e+03
difference 1.3680e-05
my gmm: my mu
          3.7502        5.2922
          2.9310        4.5226
          1.3475        1.1861
          3.6098        0.9643
          5.7450        4.1179
my Sigma (:,:,1) =0.8827        0.0338
                  0.0338        0.0066
(:,:,2) =0.4563        0.2301
          0.2301        0.7889
(:,:,3) =0.7736        0.5374
```

0.5374 0.8824
(:,:,4) =0.2653 0.0896
0.0896 0.3340
(:,:,5) =0.3990 0.0814
0.0814 0.4506
my prop 0.0253 0.1972 0.3791 0.2042 0.1942
the NO. 2 model.initial mu
5.7708 0.8328
0.7665 4.0326
6.7789 2.7810
1.6999 1.7146
0.3550 5.9158
initial sigma(:,:,1) =3.7172 0
0 3.8498
(:,:,2) =3.7172 0
0 3.8498
(:,:,3) =3.7172 0
0 3.8498
(:,:,4) =3.7172 0
0 3.8498
(:,:,5) =3.7172 0
0 3.8498
inital prior probs 0.2000 0.2000 0.2000 0.2000 0.2000
initial log likelihood is: -2.3125e+03
final iteration is 269
final likelihood is: -1.6764e+03
difference 1.6680e-05
my gmm: my mu
3.7029 1.0112
1.3879 1.3957
5.7264 4.1436
2.0216 0.8306
2.9957 4.6978
my Sigma(:,:,1) =0.1715 0.0738
0.0738 0.3096
(:,:,2) =0.8170 0.7705
0.7705 1.0892
(:,:,3) =0.4093 0.0588
0.588 0.4720
(:,:,4) =1.4790 0.1807
0.1807 0.4694
(:,:,5) =0.5347 0.2379
0.2379 0.6326
my prop 0.1595 0.2947 0.1983 0.1435 0.2040

```
the NO. 3    model. initial mu
            6.6731       3.6098
            1.1375      -0.7036
            5.2703      -0.8957
            5.2398       3.2852
            1.9670       5.4629
initial sigma (:,:,1) =4.0659                0
                       0       3.4300
(:,:,2) =4.0659              0
                       0       3.4300
(:,:,3) =4.0659              0
                       0       3.4300
(:,:,4) =4.0659              0
                       0       3.4300
(:,:,5) =4.0659              0
                       0       3.4300
inital prior probs 0.2000       0.2000       0.2000       0.2000       0.2000
initial log likelihood is: -2.3066e+03
final iteration is    263
final likelihood is: -1.6764e+03
difference    1.6564e-05
my gmm: my mu
            5.7264       4.1436
            1.3878       1.3956
            3.7029       1.0112
            2.0218       0.8306
            2.9957       4.6977
my Sigma(:,:,1) =0.4093       0.0588
                       0.0588       0.4720
(:,:,2) =0.8170       0.7704
            0.7704       1.0891
(:,:,3) =0.1715       0.0738
            0.0738       0.3096
(:,:,4) =1.4791       0.1806
            0.1806       0.4694
(:,:,5) =0.5347       0.2379
            0.2379       0.6326
my prop 0.1983       0.2947       0.1595       0.1435       0.2040
the NO. 4    model. initial mu
            3.6186       5.5954
            2.7468       1.3600
           -1.2643       3.2654
            1.5871       0.0837
            0.0533       3.9093
```

```
initial sigma (:,:,1) =3.3949                0
                            0       3.9542
(:,:,2) =3.3949                0
                      0       3.9542
(:,:,3) =3.3949                0
                      0       3.9542
(:,:,4) =3.3949                0
                      0       3.9542
(:,:,5) =3.3949                0
                      0       3.9542
inital prior probs 0.2000       0.2000       0.2000       0.2000       0.2000
initial log likelihood is: -2.2490e+03
final iteration is 212
final likelihood is: -1.6764e+03
difference    1.6514e-05
my gmm: my mu
            5.7263       4.1437
            3.7046       1.0096
            1.3832       1.3912
            2.0256       0.8508
            2.9949       4.6963
my Sigma(:,:,1) =0.4093       0.0588
                      0.0588       0.4719
(:,:,2) =0.1702       0.0743
            0.0743       0.3087
(:,:,3) =0.8182       0.7770
            0.7770       1.0947
(:,:,4) =1.4657       0.1748
            0.1748       0.4809
(:,:,5) =0.5351       0.2388
            0.2388       0.6344
my prop 0.1983       0.1586       0.2916       0.1473       0.2042
the NO. 5    model initial mu
            4.6742       6.6392
            5.1909      -0.0327
            2.5816       5.8719
           -0.6338       3.3514
            0.6389       7.3652
initial sigma(:,:,1) =3.2101                0
                      0       3.7428
(:,:,2) =3.2101                0
                      0       3.7428
(:,:,3) =3.2101                0
                      0       3.7428
```

(:,:,4) =3.2101 0
0 3.7428
(:,:,5) =3.2101 0
0 3.7428
inital prior probs 0.2000 0.2000 0.2000 0.2000 0.2000
initial log likelihood is: -2.5780e+03
final iteration is 135
final likelihood is: -1.6734e+03
difference 1.6561e-05
my gmm: my mu
5.7278 4.1427
3.6300 0.9660
2.0401 2.4891
1.2415 0.9107
2.9876 4.6476
my Sigma(:,:,1) =0.4082 0.0595
0.0595 0.4717
(:,:,2) =0.2484 0.0865
0.0865 0.3337
(:,:,3) =0.4741 0.2318
0.2318 0.1553
(:,:,4) =0.7661 0.3921
0.3921 0.5776
(:,:,5) =0.5466 0.2519
0.2519 0.6689
my prop 0.1981 0.1996 0.0697 0.3185 0.2141

the NO. 1 model for holdout data. initial mu
3.7502 5.2922
2.9310 4.5226
1.3475 1.1861
3.6098 0.9643
5.7450 4.1179
initial sigma(:,:,1) =0.8827 0.0338
0.0338 0.0066
(:,:,2) =0.4563 0.2301
0.2301 0.7889
(:,:,3) =0.7736 0.5374
0.5374 0.8824
(:,:,4) =0.2653 0.0896
0.0896 0.3340
(:,:,5) =0.3990 0.0814
0.0814 0.4506
inital prior probs 0.0253 0.1972 0.3791 0.2042 0.1942

initial log likelihood is: -4.5966e+03
final iteration is 60
final likelihood is: -4.3929e+03
difference 4.0136e-05
my gmm:4.8229 5.4811
2.9591 4.6370
1.3236 1.2822
3.5364 0.9659
5.7322 4.1409
(:,:,1) =0.4330 0.1081
0.1081 0.0271
(:,:,2) =0.3382 0.0722
0.0722 0.6726
(:,:,3) =0.7182 0.4759
0.4759 0.8494
(:,:,4) =0.5150 0.0825
0.0825 0.2871
(:,:,5) =0.3727 0.0391
0.0391 0.3935
0.0030 0.1496 0.2773 0.1627 0.4074
the NO. 2 model for holdout data.
initial mu
3.7029 1.0112
1.3879 1.3957
5.7264 4.1436
2.0216 0.8306
2.9957 4.6978
initial sigma(:,:,1) =0.1715 0.0738
0.0738 0.3096
(:,:,2) =0.8170 0.7705
0.7705 1.0892
(:,:,3) =0.4093 0.0588
0.0588 0.4720
(:,:,4) =1.4790 0.1807
0.1807 0.4694
(:,:,5) =0.5347 0.2379
0.2379 0.6326
inital prior probs 0.1595 0.2947 0.1983 0.1435 0.2040
initial log likelihood is: -4.5942e+03
final iteration is 141
final likelihood is: -4.3799e+03
difference 4.1152e-05
my gmm:3.6227 0.9938
1.7994 1.6964

5.7288 4.1483
0.6287 0.6027
3.0187 4.6903
(:,:,1) =0.4330 0.0497
0.0497 0.2644
(:,:,2) =0.4182 0.1368
0.1368 0.8853
(:,:,3) =0.3739 0.0347
0.0347 0.4032
(:,:,4) =0.3942 0.1353
0.1353 0.2654
(:,:,5) =0.2915 0.0140
0.0140 0.6241
0.1508 0.1881 0.4097 0.1071 0.1443
the NO. 3 model for holdout data.
initial mu 5.7264 4.1436
1.3878 1.3956
3.7029 1.0112
2.0218 0.8306
2.9957 4.6977
initial sigma (:,:,1) =0.4093 0.0588
0.0588 0.4720
(:,:,2) =0.8170 0.7704
0.7704 1.0891
(:,:,3) =0.1715 0.0738
0.0738 0.3096
(:,:,4) =1.4791 0.1806
0.1806 0.4694
(:,:,5) =0.5347 0.2379
0.2379 0.6326
inital prior probs 0.1983 0.2947 0.1595 0.1435 0.2040
initial log likelihood is: -4.5942e+03
final iteration is 141
final likelihood is: -4.3799e+03
difference 4.1212e-05
my gmm:5.7288 4.1483
1.7994 1.6964
3.6227 0.9938
0.6287 0.6027
3.0187 4.6903
(:,:,1) =0.3739 0.0347
0.0347 0.4032
(:,:,2) =0.4182 0.1368
0.1368 0.8853

(:,:,3) =0.4330 0.0497
0.0497 0.2644
(:,:,4) =0.3942 0.1353
0.1353 0.2654
(:,:,5) =0.2915 0.0140
0.0140 0.6241
0.4097 0.1881 0.1508 0.1071 0.1443
the NO. 4 model for holdout data. initial mu
5.7263 4.1437
3.7046 1.0096
1.3832 1.3912
2.0256 0.8508
2.9949 4.6963
initial sigma(:,:,1) =0.4093 0.0588
0.0588 0.4719
(:,:,2) =0.1702 0.0743
0.0743 0.3087
(:,:,3) =0.8182 0.7770
0.7770 1.0947
(:,:,4) =1.4657 0.1748
0.1748 0.4809
(:,:,5) =0.5351 0.2388
0.2388 0.6344
inital prior probs
0.1983 0.1586 0.2916 0.1473 0.2042
initial log likelihood is:-4.5948e+03
final iteration is 150
final likelihood is: -4.3799e+03
difference 4.2264e-05
my gmm:
5.7288 4.1483
3.6248 0.9939
1.8050 1.6998
0.6339 0.6057
3.0188 4.6902
(:,:,1) =0.3739 0.0347
0.0347 0.4032
(:,:,2) =0.4315 0.0494
0.0494 0.2636
(:,:,3) =0.4174 0.1324
0.1324 0.8849
(:,:,4) =0.3957 0.1361
0.1361 0.2678
(:,:,5) =0.2913 0.0139

0.0139 0.6242
0.4097 0.1504 0.1873 0.1082 0.1443
the NO. 5 model for holdout data.
initial mu5.7278 4.1427
3.6300 0.9660
2.0401 2.4891
1.2415 0.9107
2.9876 4.6476

initial sigma
(:,:,1) =0.4082 0.0595
0.0595 0.4717
(:,:,2) =0.2484 0.0865
0.0865 0.3337
(:,:,3) =0.4741 0.2318
0.2318 0.1553
(:,:,4) =0.7661 0.3921
0.3921 0.5776
(:,:,5) =0.5466 0.2519
0.2519 0.6689
inital prior probs 0.1981 0.1996 0.0697 0.3185 0.2141
initial log likelihood is -4.5858e+03
final iteration is 347
final likelihood is: -4.3799e+03
difference 4.3540e-05
my gmm:
5.7288 4.1482
3.6263 0.9939
1.8071 1.7000
0.6350 0.6063
3.0189 4.6903
(:,:,1) =0.3739 0.0347
0.0347 0.4032
(:,:,2) =0.4305 0.0493
0.0493 0.2631
(:,:,3) =0.4179 0.1309
0.1309 0.8849
(:,:,4) =0.3959 0.1362
0.1362 0.2683
(:,:,5) =0.2912 0.0139
0.0139 0.6241
0.4097 0.1502 0.1874 0.1085 0.1443

The best log for the holdout data is -4.3799e+03 iteration is 141 the log of the training data is -1.6764e+03

K=7

the NO. 1 model.

initial mu

4.6528	5.4326
0.2403	2.8994
1.8621	2.4528
4.1166	2.5486
5.4722	1.3173
-0.6574	3.0898
6.7800	3.1096

initial sigma (:,:,1) =3.9495 0

0 4.0950

(:,:,2) =3.9495 0

0 4.0950

(:,:,3) =3.9495 0

0 4.0950

(:,:,4) =3.9495 0

0 4.0950

(:,:,5) =3.9495 0

0 4.0950

(:,:,6) =3.9495 0

0 4.0950

(:,:,7) =3.9495 0

0 4.0950

inital prior probs 0.1429 0.1429 0.1429 0.1429 0.1429 0.1429 0.1429

initial log likelihood is: -2.2069e+03

final iteration is 411

final likelihood is: -1.6629e+03

difference 1.6351e-05

my gmm: my mu

2.9712	4.6530
1.9171	1.8283
1.8589	0.3343
3.4058	4.6263
3.6813	1.0276
0.6519	0.4775
5.7191	4.1512

my Sigma(:,:,1) =0.4926 0.1475

0.1475 0.5928

(:,:,2) =0.4226 0.0966
0.0966 0.5506
(:,:,3) =2.0794 -0.1032
-0.1032 0.2545
(:,:,4) =0.0846 0.3151
0.3151 1.2351
(:,:,5) =0.1854 0.0833
0.0833 0.2944
(:,:,6) =0.2778 0.1631
0.1631 0.2969
(:,:,7) = 0.4151 0.0507
0.0507 0.4781
my prop
0.1807 0.2183 0.0522 0.0294 0.1760 0.1436 0.1997

the NO. 2 model.
initial mu
4.2805 3.4550
1.9509 4.0890
5.7471 3.7784
3.3030 0.4527
1.7064 1.2726
6.8643 2.7603
6.3114 0.6522
initial sigma(:,:,1) = 3.9762 0
0 3.4949
(:,:,2) =3.9762 0
0 3.4949
(:,:,3) =3.9762 0
0 3.4949
(:,:,4) =3.9762 0
0 3.4949
(:,:,5) =3.9762 0
0 3.4949
(:,:,6) =3.9762 0
0 3.4949
(:,:,7) =3.9762 0
0 3.4949

inital prior probs
0.1429 0.1429 0.1429 0.1429 0.1429 0.1429 0.1429
initial log likelihood is: -2.1583e+03
final iteration is 217
final likelihood is: -1.6567e+03

difference 6.6306e-06

my gmm: my mu

1.9325 2.4329

2.9929 4.6759

5.1591 5.0393

2.4258 1.2866

0.8006 0.5797

5.7237 4.1303

3.7764 1.0401

my Sigma (:,:,1) = 1.0626 0.5658

0.5658 0.3424

(:,:,2) =0.4999 0.2227

0.2227 0.6105

(:,:,3) =2.5019 -1.0183

-1.0183 0.4145

(:,:,4) =0.7207 -0.1799

-0.1799 0.6485

(:,:,5) =0.3785 0.2331

0.2331 0.3532

(:,:,6) =0.3695 0.0687

0.0687 0.4732

(:,:,7) =0.1430 0.0860

0.0860 0.2978

my prop

0.0738 0.2038 0.0091 0.1925 0.1916 0.1917 0.1375

the NO. 3 model.

initial mu

0.6121 0.2517

0.1280 6.5651

0.6274 7.2215

2.4514 2.4792

1.3590 -0.3944

6.7273 0.8940

2.4033 2.2149

initial sigma(:,:,1) = 3.7268 0

0 3.5623

(:,:,2) =3.7268 0

0 3.5623

(:,:,3) =.7268 0

0 3.5623

(:,:,4) = 3.7268 0

0 3.5623

(:,:,5) =3.7268 0

0 3.5623

(:,:,6) =3.7268 0
0 3.5623
(:,:,7) =3.7268 0
0 3.5623
inital prior probs 0.1429 0.1429 0.1429 0.1429 0.1429 0.1429 0.1429
initial log likelihood is: -2.3160e+03
final iteration is 371
final likelihood is: -1.6575e+03
difference 1.5138e-05
my gmm: my mu
0.7107 0.5197
3.3600 4.6263
2.9972 4.7567
1.9876 2.4971
3.6824 0.9945
5.7290 4.1469
2.0167 1.5761
my Sigma (:,:,1) = 0.3102 0.1800
0.1800 0.3116
(:,:,2) =0.0976 0.3559
0.3559 1.3090
(:,:,3) =0.5018 0.1676
0.1676 0.4908
(:,:,4) =1.4013 0.7742
0.7742 0.4670
(:,:,5) =0.2042 0.0630
0.0630 0.3236
(:,:,6) =0.4083 0.0549
0.0549 0.4772
(:,:,7) = 0.3201 -0.0111
-0.0111 0.7746
my prop 0.1758 0.0206 0.1775 0.0613 0.1896 0.1977 0.1776

the NO. 4 model.
initial mu
3.9169 3.0841
4.8671 -0.6189
0.5755 0.9327
-0.3392 5.6544
1.2325 -1.1125
1.4263 6.7753
2.3503 5.0347
initial sigm (:,:,1) =3.6205 0
0 3.8786

(:,:,2) = 3.6205 0
0 3.8786
(:,:,3) = 3.6205 0
0 3.8786
(:,:,4) = 3.6205 0
0 3.8786
(:,:,5) = 3.6205 0
0 3.8786
(:,:,6) = 3.6205 0
0 3.8786
(:,:,7) = 3.6205 0
0 3.8786
inital prior probs
0.1429 0.1429 0.1429 0.1429 0.1429 0.1429 0.1429
initial log likelihood is: -2.3174e+03
final iteration is 447
final likelihood is: -1.6630e+03
difference 1.5841e-05
my gmm: my mu
5.7162 4.1281
3.6887 0.9697
1.7462 1.8067
1.2176 2.1300
1.5208 0.8451
3.0338 4.8251
5.1630 5.0378
my Sigma (:,:,1) = 0.3752 0.0712
0.0712 0.4724
(:,:,2) =0.2045 0.0688
0.0688 0.3216
(:,:,3) =1.1791 1.2711
1.2711 1.4950
(:,:,4) = 0.3647 0.5433
0.5433 1.3543
(:,:,5) = 1.0281 0.3479
0.3479 0.4981
(:,:,6) = 0.4148 0.1736
0.1736 0.4984
(:,:,7) = 2.5010 -1.0179
-1.0179 0.4143

my prop
0.1930 0.1806 0.1613 0.0642 0.2171 0.1745 0.0091

the NO. 5 model.

initial mu

0.7118 4.1029

2.6544 4.5858

7.0755 2.0991

3.4256 1.8529

3.2005 7.2937

0.6619 -1.0378

2.9179 6.3923

initial sigma (:,:,1) = 4.0452 0

0 4.0963

(:,:,2) = 4.0452 0

0 4.0963

(:,:,3) =4.0452 0

0 4.0963

(:,:,4) =4.0452 0

0 4.0963

(:,:,5) = 4.0452 0

0 4.0963

(:,:,6) =4.0452 0

0 4.0963

(:,:,7) =4.0452 0

0 4.0963

nital prior probs

0.1429 0.1429 0.1429 0.1429 0.1429 0.1429 0.1429

initial log likelihood is -2.3047e+03

final iteration is 169

final likelihood is: -1.6664e+03

difference 1.4350e-05

my gmm: my mu

1.9265 1.7425

3.0064 4.6339

5.7461 3.9540

3.6716 0.9803

5.2111 5.0268

0.6352 0.4964

5.4826 4.5715

my Sigma (:,:,1) = 0.4035 0.0971

0.0971 0.8236

(:,:,2) =0.3844 0.1099

0.1099 0.6336

(:,:,3) = 0.3330 0.1070

0.1070 0.4696

(:,:,4) = 0.2123 0.0703

0.0703 0.3219
(:,:,5) = 1.3343 -0.5845
-0.5845 0.2887
(:,:,6) = 0.3492 0.1421
0.1421 0.3100
(:,:,7) =0.5673 0.2016
0.2016 0.0931
my prop
0.2415 0.1911 0.1452 0.1910 0.0367 0.1643 0.0302

the NO. 1 model for holdout data.
initial mu
2.9712 4.6530
1.9171 1.8283
1.8589 0.3343
3.4058 4.6263
3.6813 1.0276
0.6519 0.4775
5.7191 4.1512
initial sigma
(:,:,1) = 0.4926 0.1475
0.1475 0.5928
(:,:,2) = 0.4226 0.0966
0.0966 0.5506
(:,:,3) = 2.0794 -0.1032
-0.1032 0.2545
(:,:,4) =0.0846 0.3151
0.3151 1.2351
(:,:,5) =0.1854 0.0833
0.0833 0.2944
(:,:,6) = 0.2778 0.1631
0.1631 0.2969
(:,:,7) =0.4151 0.0507
0.0507 0.4781
inital prior probs
0.1807 0.2183 0.0522 0.0294 0.1760 0.1436 0.1997
initial log likelihood is -4.5919e+03
final iteration is 243
final likelihood is: -4.3721e+03
difference 4.3580e-05
my gmm:
3.0029 4.7038
1.7306 1.7829
1.7072 -0.1397

3.1470 3.4856
3.5775 1.0160
0.6493 0.6105
5.7281 4.1481
(:,:,1) = 0.2962 0.0109
0.0109 0.6073
(:,:,2) = 0.3916 0.1814
0.1814 0.7938
(:,:,3) = 0.5534 -0.1681
-0.1681 0.1080
(:,:,4) = 0.1901 0.6590
0.6590 2.2859
(:,:,5) =0.4641 0.0319
0.0319 0.2570
(:,:,6) =0.4261 0.1473
0.1473 0.2604
(:,:,7) = 0.3749 0.0348
0.0348 0.4034
0.1396 0.1705 0.0088 0.0070 0.1584 0.1058 0.4099
the NO. 2 model for holdout data.
initial mu
1.9325 2.4329
2.9929 4.6759
5.1591 5.0393
2.4258 1.2866
0.8006 0.5797
5.7237 4.1303
3.7764 1.0401
initial sigma(:,:,1) =1.0626 0.5658
0.5658 0.3424
(:,:,2) = 0.4999 0.2227
0.2227 0.6105
(:,:,3) =2.5019 -1.0183
-1.0183 0.4145
(:,:,4) = 0.7207 -0.1799
-0.1799 0.6485
(:,:,5) =0.3785 0.2331
0.2331 0.3532
(:,:,6) = 0.3695 0.0687
0.0687 0.4732
(:,:,7) = 0.1430 0.0860
0.0860 0.2978
inital prior probs
0.0738 0.2038 0.0091 0.1925 0.1916 0.1917 0.1375

initial log likelihood is: -4.6189e+03
final iteration is 166
final likelihood is: -4.3713e+03
difference 4.1926e-05
my gmm:
1.5299 2.0535
3.0267 4.6801
5.2091 5.0204
2.1971 1.8678
0.8969 0.7023
5.7334 4.1403
3.6888 1.0132
(:,:,1) =0.2911 0.0720
0.0720 0.1375
(:,:,2) =0.2814 0.0127
0.0127 0.6389
(:,:,3) =0.0246 -0.0089
-0.0089 0.0033
(:,:,4) = 0.3459 -0.1399
-0.1399 1.1252
(:,:,5) =0.5096 0.1726
0.1726 0.3186
(:,:,6) =0.3743 0.0394
0.0394 0.4004
(:,:,7) =0.3965 0.0322
0.0322 0.2427
0.0405 0.1446 0.0035 0.1053 0.1611 0.4062 0.1388
the NO. 3 model for holdout data.
initial mu
0.7107 0.5197
3.3600 4.6263
2.9972 4.7567
1.9876 2.4971
3.6824 0.9945
5.7290 4.1469
2.0167 1.5761
initial sigma(:,:,1) =0.3102 0.1800
0.1800 0.3116
(:,:,2) =0.0976 0.3559
0.3559 1.3090
(:,:,3) =0.5018 0.1676
0.1676 0.4908
(:,:,4) = 1.4013 0.7742
0.7742 0.4670

(:,:,5) =0.2042 0.0630
0.0630 0.3236
(:,:,6) = 0.4083 0.0549
0.0549 0.4772
(:,:,7) = 0.3201 -0.0111
-0.0111 0.7746
inital prior probs
0.1758 0.0206 0.1775 0.0613 0.1896 0.1977 0.1776
initial log likelihood is: -4.6004e+03
final iteration is 279
final likelihood is: -4.3716e+03
difference 4.3088e-05
my gmm:
0.9027 0.7046
3.1379 3.4542
3.0128 4.6912
1.5350 2.0597
3.6731 1.0195
5.7275 4.1483
2.1657 1.8930
(:,:,1) = 0.5132 0.1753
0.1753 0.3196
(:,:,2) = 0.2038 0.7059
0.7059 2.4476
(:,:,3) = 0.2782 0.0083
0.0083 0.6265
(:,:,4) = 0.2958 0.0804
0.0804 0.1462
(:,:,5) = 0.4017 0.0288
0.0288 0.2486
(:,:,6) = 0.3756 0.0345
0.0345 0.4037
(:,:,7) = 0.3212 -0.1487
-0.1487 1.1580
0.1620 0.0069 0.1397 0.0423 0.1423 0.4101 0.0967
the NO. 4 model for holdout data.
initial mu
5.7162 4.1281
3.6887 0.9697
1.7462 1.8067
1.2176 2.1300
1.5208 0.8451
3.0338 4.8251
5.1630 5.0378

initial sigma (:,:,1) = 0.3752 0.0712
0.0712 0.4724
(:,:,2) = 0.2045 0.0688
0.0688 0.3216
(:,:,3) = 1.1791 1.2711
1.2711 1.4950
(:,:,4) = 0.3647 0.5433
0.5433 1.3543
(:,:,5) = 1.0281 0.3479
0.3479 0.4981
(:,:,6) = 0.4148 0.1736
0.1736 0.4984
(:,:,7) = 2.5010 -1.0179
-1.0179 0.4143

inital prior probs
0.1930 0.1806 0.1613 0.0642 0.2171 0.1745 0.0091
initial log likelihood is: -4.6027e+03
final iteration is 724
final likelihood is: -4.3705e+03
difference 4.2298e-05
my gmm:
5.7341 4.1407
3.5449 0.9693
1.8647 2.0846
1.9777 3.1676
0.9870 0.7445
3.0015 4.6488
5.2091 5.0204
(:,:,1) = 0.3737 0.0393
0.0393 0.3992
(:,:,2) = 0.5041 0.0799
0.0799 0.2893
(:,:,3) = 0.3438 0.0187
0.0187 0.1784
(:,:,4) = 0.3502 -0.1581
-0.1581 0.1010
(:,:,5) = 0.5738 0.1877
0.1877 0.3402
(:,:,6) = 0.3027 0.0300
0.0300 0.6552
(:,:,7) = 0.0246 -0.0089
-0.0089 0.0033
0.4059 0.1619 0.0862 0.0137 0.1786 0.1503 0.0035

the NO. 5 model for holdout data. initial mu

1.9265 1.7425

3.0064 4.6339

5.7461 3.9540

3.6716 0.9803

5.2111 5.0268

0.6352 0.4964

5.4826 4.5715

initial sigma (:,:,1) = 0.4035 0.0971

0.0971 0.8236

(:,:,2) = 0.3844 0.1099

0.1099 0.6336

(:,:,3) = 0.3330 0.1070

0.1070 0.4696

(:,:,4) = 0.2123 0.0703

0.0703 0.3219

(:,:,5) = 1.3343 -0.5845

-0.5845 0.2887

(:,:,6) = 0.3492 0.1421

0.1421 0.3100

(:,:,7) = 0.5673 0.2016

0.2016 0.0931

inital prior probs

0.2415 0.1911 0.1452 0.1910 0.0367 0.1643 0.0302

initial log likelihood is: -4.5925e+03

final iteration is 995

final likelihood is: -4.3682e+03

difference 4.3230e-05

my gmm:

1.8017 1.6978

3.0236 4.6879

5.5166 3.7719

3.6242 0.9939

5.8993 4.5024

0.6301 0.6036

6.9322 4.9705

(:,:,1) = 0.4183 0.1358

0.1358 0.8858

(:,:,2) = 0.2948 0.0099

0.0099 0.6219

(:,:,3) = 0.2972 -0.0081

-0.0081 0.2862

(:,:,4) = 0.4326 0.0501

0.0501 0.2642

(:,:,5) = 0.3115 -0.1085
-0.1085 0.2386
(:,:,6) = 0.3945 0.1355
0.1355 0.2661
(:,:,7) = 0.1568 -0.0332
-0.0332 0.0292
0.1881 0.1448 0.2038 0.1506 0.1961 0.1074 0.0091

The high log is -4.3713e+03 with iteration 166 the log of training data is -1.6567e+03

K=9

the NO. 1 model.

initial mu

-0.5032 5.4619
0.9273 4.9006
1.5716 6.5549
4.5910 6.4427
-0.1714 1.5612
4.9549 4.7578
-0.4326 0.3657
4.3633 -1.1009
2.9641 5.1552

initial sigma

(:,:,1) =3.6319 0
0 3.7800
(:,:,2) =3.6319 0
0 3.7800
(:,:,3) =3.6319 0
0 3.7800
(:,:,4) =3.6319 0
0 3.7800
(:,:,5) =3.6319 0
0 3.7800
(:,:,6) =3.6319 0
0 3.7800
(:,:,7) =3.6319 0
0 3.7800
(:,:,8) =3.6319 0
0 3.7800
(:,:,9) =3.6319 0
0 3.7800

inital prior probs

0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111
0.1111 0.1111

initial log likelihood is: -2.3895e+03
final iteration is 176
final likelihood is: -1.6497e+03
difference 1.5074e-05
my gmm:
my mu
3.4406 5.6017
2.1381 2.5273
3.0362 4.6241
4.9587 5.1235
1.4989 1.0662
5.7127 4.0696
0.4471 0.3736
3.6779 0.9728
1.6977 3.6612
my Sigma
(:,:,1) =0.1077 0.2487
0.2487 0.5830
(:,:,2) =0.4264 0.2259
0.2259 0.1586
(:,:,3) =0.2741 0.0045
0.0045 0.4394
(:,:,4) =1.4091 -0.6039
-0.6039 0.2910
(:,:,5) =0.7789 0.2773
0.2773 0.5892
(:,:,6) =0.3785 0.0913
0.0913 0.4658
(:,:,7) = 0.2017 0.2235
0.2235 0.2898
(:,:,8) =0.2104 0.0719
0.0719 0.3215
(:,:,9) =0.0582 -0.0331
-0.0331 0.5054
my prop
0.0126 0.0638 0.1562 0.0409 0.2756 0.1766 0.0625
0.1870 0.0248
the NO. 2 model.
initial mu
6.5637 -1.1173
3.9785 2.9267
4.0469 0.1036
6.1667 7.2122
5.6937 4.8801

3.6879 3.0193
0.2351 2.7617
0.7350 -0.8460
6.4040 4.6107

initial sigma

(:,:,1) =3.1743 0
0 3.3716

(:,:,2) =3.1743 0
0 3.3716

(:,:,3) =3.1743 0
0 3.371

(:,:,4) = 3.1743 0
0 3.3716

(:,:,5) =3.1743 0
0 3.3716

(:,:,6) =3.1743 0
0 3.3716

(:,:,7) = 3.1743 0
0 3.3716

(:,:,8) = 3.1743 0
0 3.3716

(:,:,9) = 3.1743 0
0 3.3716

inital prior probs

0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111

initial log likelihood is: -2.2363e+03

final iteration is 324

final likelihood is: -1.6458e+03

Difference 1.6390e-05

my gmm:

my mu

3.9165 1.1828
1.8343 1.9623
3.1945 1.0762
3.9363 5.5601
2.9316 4.5980
3.4819 4.9295
1.8819 2.4190
0.8134 0.6027
5.7437 4.1220

my Sigma
(:,:,1) =0.0909 0.1309
0.1309 0.2860
(:,:,2) =0.0684 -0.1394
-0.1394 1.9205
(:,:,3) =0.4591 -0.1575
-0.1575 0.3945
(:,:,4) =0.5321 -0.1471
-0.1471 0.0656
(:,:,5) =0.2570 -0.0241
-0.0241 0.3877
(:,:,6) =0.0638 0.2275
0.2275 0.8633
(:,:,7) =1.0674 0.5410
0.5410 0.3387
(:,:,8) =0.3678 0.2299
0.2299 0.3598
(:,:,9) =0.4022 0.0755
0.0755 0.4505
my prop 0.0695 0.0810 0.1802 0.0314 0.1300 0.0287 0.0834 0.2018 0.1940
the NO. 3 model.initial mu
3.2050 4.3215
-0.5206 5.6484
5.8047 2.6101
5.7994 2.4224
4.9655 5.8675
-0.0547 -0.6369
4.4146 -0.2011
3.1782 0.1515
7.1621 2.0590
initial sigma(:,:,1) =3.9633 0
0 4.1035
(:,:,2) =3.9633 0
0 4.1035
(:,:,3) =3.9633 0
0 4.1035
(:,:,4) =3.9633 0
0 4.1035
(:,:,5) =3.9633 0
0 4.1035
(:,:,6) =3.9633 0
0 4.1035
(:,:,7) =3.9633 0

0 4.1035
(:,:,8) =3.9633 0
0 4.1035
(:,:,9) =3.9633 0
0 4.1035
inital prior probs
0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111
0.1111 0.1111
initial log likelihood is:-2.3014e+03
final iteration is 325
final likelihood is: -1.6494e+03
difference 1.4906e-05
my gmm:my mu 3.4246 4.7506
2.7561 4.6564
1.6841 2.3344
2.0227 2.1315
4.5706 5.2760
0.7497 0.4910
3.7826 1.0475
2.4321 1.2601
5.7225 4.1090
my Sigma(:,:,1) =0.0685 0.2345
0.2345 0.8460
(:,:,2) =0.4348 0.2282
0.2282 0.5064
(:,:,3) =1.0796 0.5632
0.5632 0.3299
(:,:,4) =1.5943 1.6934
1.6934 1.8463
(:,:,5) =1.5731 -0.6426
-0.6426 0.2685
(:,:,6) =0.3233 0.1451
0.1451 0.2833
(:,:,7) =0.1397 0.0871
0.0871 0.2982
(:,:,8) =0.7455 -0.1869
-0.1869 0.5973
(:,:,9) =0.3892 0.0755
0.0755 0.4668
my prop
0.0324 0.1455 0.0501 0.0712 0.0250 0.1563 0.1340
0.1970 0.1885
the NO. 4 model initial mu
-0.8385 7.2594

```
    2.1319    0.0970
    3.2508   -0.4374
    2.2857    1.8965
    4.3905    0.3684
    4.1372    2.9248
    1.1914    1.6079
    2.4159    6.9750
   -1.2329    6.7006
initial sigma(:,:,1) =3.1846         0
                      0    4.0380
(:,:,2) =3.1846         0
              0    4.0380
(:,:,3) =3.1846         0
              0    4.0380
(:,:,4) =3.1846         0
              0    4.0380
(:,:,5) =3.1846         0
              0    4.0380
(:,:,6) =3.1846         0
              0    4.0380
(:,:,7) =3.1846         0
              0    4.0380
(:,:,8) =3.1846         0
              0    4.0380
(:,:,9) =3.1846         0
              0    4.0380
inital prior probs
    0.1111    0.1111    0.1111    0.1111    0.1111    0.1111    0.1111
0.1111    0.1111
initial log likelihood is -2.2697e+03
final iteration is 366
final likelihood is: -1.6491e+03
difference 1.5444e-05
my gmm:my mu
    3.6438    5.4206
    0.4814    0.0039
    3.2427    0.9529
    1.9552    2.4271
    3.9254    1.1821
    5.6810    4.1730
    1.0859    0.8338
    3.0178    4.3934
    2.1353    4.3088
my Sigma(:,:,1) =0.0897    0.0147
```

0.0147 0.0945
(:,:,2) =0.9896 -0.4058
-0.4058 0.1735
(:,:,3) =0.4591 -0.0205
-0.0205 0.3716
(:,:,4) =0.5363 0.2790
0.2790 0.1897
(:,:,5) =0.0769 0.1184
0.1184 0.2770
(:,:,6) =0.4534 0.0256
0.0256 0.4839
(:,:,7) =0.5576 0.3847
0.3847 0.4839
(:,:,8) =0.1673 -0.0783
-0.0783 0.3316
(:,:,9) =0.5493 0.6919
0.6919 1.4201
my prop
0.0447 0.0162 0.1794 0.0826 0.0629 0.2060 0.2427
0.1004 0.0652
the NO. 5 model.
initial mu
0.9909 3.3582
2.3386 4.7521
3.4349 4.4753
6.8970 0.1931
2.2940 -0.2463
7.2505 7.3910
1.2744 0.1317
4.7784 -1.0829
4.4736 3.5518
initial sigma(:,:,1) =4.0138 0
0 3.9693
(:,:,2) =4.0138 0
0 3.9693
(:,:,3) =4.0138 0
0 3.9693
(:,:,4) =4.0138 0
0 3.9693
(:,:,5) =4.0138 0
0 3.9693
(:,:,6) =4.0138 0
0 3.9693
(:,:,7) =4.0138 0

0 3.9693
(:,:,8) =4.0138 0
0 3.9693
(:,:,9) =4.0138 0
0 3.9693
inital prior probs
0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111 0.1111
initial log likelihood is: -2.2472e+03
final iteration is 218
final likelihood is -1.6473e+03
difference 1.6228e-05
my gmm: my mu
1.8637 2.3800
2.8958 4.6876
2.9424 4.6708
3.3428 0.9270
1.8237 1.2690
5.7441 4.1310
0.6252 0.3743
3.7076 0.8551
2.8911 2.6864
my Sigma(:,:,1) =0.3556 0.1679
0.1679 0.1339
(:,:,2) =0.5994 0.4093
0.4093 0.6762
(:,:,3) =0.1038 -0.1802
-0.1802 0.5791
(:,:,4) =0.7690 0.6918
0.6918 0.6892
(:,:,5) =1.0147 0.2047
0.2047 0.2438
(:,:,6) =0.3968 0.0783
0.0783 0.4490
(:,:,7) =0.2881 0.1612
0.1612 0.2576
(:,:,8) =0.1727 0.0282
0.0282 0.2767
(:,:,9) =1.4320 2.0041
2.0041 2.8105
my prop
0.0803 0.1629 0.0364 0.0520 0.1662 0.1943 0.1264 0.1363 0.0453
the NO. 1 model for holdout data.initial mu

3.4406 5.6017
2.1381 2.5273
3.0362 4.6241
4.9587 5.1235
1.4989 1.0662
5.7127 4.0696
0.4471 0.3736
3.6779 0.9728
1.6977 3.6612

initial sigma(:,:,1) =0.1077 0.2487
0.2487 0.5830

(:,:,2) =0.4264 0.2259
0.2259 0.1586

(:,:,3) =0.2741 0.0045
0.0045 0.4394

(:,:,4) =1.4091 -0.6039
-0.6039 0.2910

(:,:,5) =0.7789 0.2773
0.2773 0.5892

(:,:,6) =0.3785 0.0913
0.0913 0.4658

(:,:,7) = 0.2017 0.2235
0.2235 0.2898

(:,:,8) =0.2104 0.0719
0.0719 0.3215

(:,:,9) =0.0582 -0.0331
-0.0331 0.5054

inital prior probs
0.0126 0.0638 0.1562 0.0409 0.2756 0.1766 0.0625
0.1870 0.0248

initial log likelihood is: -4.6050e+03
final iteration is 284
final likelihood is: -4.3588e+03
difference 4.2308e-05
my gmm:
3.0231 4.4368
1.8596 2.0589
3.0077 4.6666
5.9271 4.5820
0.9813 0.6623
5.7102 4.1060
0.5408 1.1169
3.5551 0.9720
1.7004 3.3855

(:,:,1) = 0.0111 0.0318
0.0318 0.0908
(:,:,2) =0.3634 0.0690
0.0690 0.2548
(:,:,3) =0.3098 0.0206
0.0206 0.6645
(:,:,4) =0.3687 -0.1841
-0.1841 0.1324
(:,:,5) =0.6059 0.1833
0.1833 0.3029
(:,:,6) =0.3694 0.0468
0.0468 0.4099
(:,:,7) =0.0103 0.0373
0.0373 0.1646
(:,:,8) =0.4924 0.0763
0.0763 0.2900
(:,:,9) =0.1854 -0.0379
-0.0379 0.0291
0.0049 0.1047 0.1440 0.0364 0.1578 0.3731 0.0095 0.1605 0.0091
the NO. 2 model for holdout data.
initial mu
3.9165 1.1828
1.8343 1.9623
3.1945 1.0762
3.9363 5.5601
2.9316 4.5980
3.4819 4.9295
1.8819 2.4190
0.8134 0.6027
5.7437 4.1220
initial sigma(:,:,1) =0.0909 0.1309
0.1309 0.2860
(:,:,2) =0.0684 -0.1394
-0.1394 1.9205
(:,:,3) =0.4591 -0.1575
-0.1575 0.3945
(:,:,4) =0.5321 -0.1471
-0.1471 0.0656
(:,:,5) =0.2570 -0.0241
-0.0241 0.3877
(:,:,6) =0.0638 0.2275
0.2275 0.8633
(:,:,7) =1.0674 0.5410

0.5410 0.3387
(:,:,8) =0.3678 0.2299
0.2299 0.3598
(:,:,9) =0.4022 0.0755
0.0755 0.4505
inital prior probs
0.0695 0.0810 0.1802 0.0314 0.1300 0.0287 0.0834
0.2018 0.1940
initial log likelihood is: -4.6310e+03
final iteration is 470
final likelihood is: -4.3566e+03
difference 4.0722e-05
my gmm:
3.2690 0.9762
2.2242 1.8409
3.7750 1.0228
4.5320 5.6155
3.0154 4.6615
3.1404 3.4631
1.4869 2.0527
0.9102 0.7053
5.7228 4.1386
(:,:,1) =0.0093 -0.0039
-0.0039 0.0035
(:,:,2) =0.3373 -0.1761
-0.1761 1.1063
(:,:,3) =0.3716 0.0315
0.0315 0.2637

(:,:,4) =3.7667 -0.9643
-0.9643 0.2754
(:,:,5) =0.2608 0.0224
0.0224 0.5800
(:,:,6) =0.2074 0.7190
0.7190 2.4947
(:,:,7) =0.2748 0.0758
0.0758 0.1387
(:,:,8) =0.5186 0.1747
0.1747 0.3193
(:,:,9) =0.3676 0.0333
0.0333 0.3959
0.0111 0.1079 0.1222 0.0073 0.1358 0.0068 0.0390 0.1633
0.4065
the NO. 3 model for holdout data. initial mu

3.4246 4.7506
2.7561 4.6564
1.6841 2.3344
2.0227 2.1315
4.5706 5.2760
0.7497 0.4910
3.7826 1.0475
2.4321 1.2601
5.7225 4.1090
initial sigma(:,:,1) =0.0685 0.2345
0.2345 0.8460
(:,:,2) =0.4348 0.2282
0.2282 0.5064
(:,:,3) =1.0796 0.5632
0.5632 0.3299
(:,:,4) =1.5943 1.6934
1.6934 1.8463
(:,:,5) =1.5731 -0.6426
-0.6426 0.2685
(:,:,6) =0.3233 0.1451
0.1451 0.2833
(:,:,7) =0.1397 0.0871
0.0871 0.2982
(:,:,8) =0.7455 -0.1869
-0.1869 0.5973
(:,:,9) =0.3892 0.0755
0.0755 0.4668
inital prior probs
0.0324 0.1455 0.0501 0.0712 0.0250 0.1563 0.1340
0.1970 0.1885
initial log likelihood is -4.6218e+03
final iteration is 483
final likelihood is: -4.3604e+03
difference 4.3488e-05
my gmm:
3.3152 4.4391
2.9983 4.6657
1.4411 2.3619
1.7352 1.7534
3.2033 6.2065
0.7324 0.6548
3.6704 0.9996
1.9376 1.7229
5.7279 4.1451

(:,:,1) =0.0095 0.0719
0.0719 0.5748
(:,:,2) =0.2858 0.0227
0.0227 0.5251
(:,:,3) =0.2429 0.2044
0.2044 0.1726
(:,:,4) = 0.9956 1.1951
1.1951 1.4363
(:,:,5) =0.8594 -0.0825
-0.0825 0.0090
(:,:,6) =0.4346 0.1440
0.1440 0.3009
(:,:,7) =0.4043 0.0415
0.0415 0.2486
(:,:,8) =0.4238 0.0301
0.0301 0.8891
(:,:,9) =0.3762 0.0369
0.0369 0.3988
0.0063 0.1304 0.0067 0.0118 0.0058 0.1250 0.1424 0.1621
0.4096
the NO. 4 model for holdout data initial mu
3.6438 5.4206
0.4814 0.0039
3.2427 0.9529
1.9552 2.4271
3.9254 1.1821
5.6810 4.1730
1.0859 0.8338
3.0178 4.3934
2.1353 4.3088
initial sigma (:,:,1) =0.0897 0.0147
0.0147 0.0945
(:,:,2) =0.9896 -0.4058
-0.4058 0.1735
(:,:,3) =0.4591 -0.0205
-0.0205 0.3716
(:,:,4) =0.5363 0.2790
0.2790 0.1897
(:,:,5) =0.0769 0.1184
0.1184 0.2770
(:,:,6) = 0.4534 0.0256
0.0256 0.4839
(:,:,7) =0.5576 0.3847
0.3847 0.4839

(:,:,8) =0.1673 -0.0783
-0.0783 0.3316
(:,:,9) =0.5493 0.6919
0.6919 1.4201
inital prior probs
0.0447 0.0162 0.1794 0.0826 0.0629 0.2060 0.2427
0.1004 0.0652
initial log likelihood is: -4.6035e+03
final iteration is 435
final likelihood is: -4.3592e+03
difference 4.0478e-05
my gmm:
3.1150 4.9151
0.9772 -0.0842
3.6179 0.9725
1.5076 2.0605
4.5003 1.0311
5.7286 4.1484
0.9471 0.7467
2.8129 4.1969
2.3046 2.0585
(:,:,1) = 0.2586 -0.0244
-0.0244 0.5552
(:,:,2) = 0.8045 -0.3144
-0.3144 0.1241
(:,:,3) =0.3763 0.0540
0.0540 0.2109
(:,:,4) =0.2594 0.0553
0.0553 0.1212
(:,:,5) =0.0118 0.0122
0.122 0.3669
(:,:,6) =0.3740 0.0340
0.0340 0.4038
(:,:,7) =0.5368 0.1931
0.1931 0.3298
(:,:,8) =0.2531 -0.1552
-0.1552 0.1243
(:,:,9) =0.3965 -0.1226
-0.1226 1.1130
0.1065 0.0051 0.1224 0.0380 0.0119 0.4099 0.1651 0.0295
0.1115
the NO. 5 model for holdout data. initial mu
1.8637 2.3800
2.8958 4.6876

```
            2.9424       4.6708
            3.3428       0.9270
            1.8237       1.2690
            5.7441       4.1310
            0.6252       0.3743
            3.7076       0.8551
            2.8911       2.6864
initial sigma (:,:,1) =0.3556       0.1679
                       0.1679       0.1339
(:,:,2) =0.5994       0.4093
            0.4093       0.6762
(:,:,3) =0.1038      -0.1802
           -0.1802       0.5791
(:,:,4) =0.7690       0.6918
            0.6918       0.6892
(:,:,5) =1.0147       0.2047
            0.2047       0.2438
(:,:,6) =0.3968       0.0783
            0.0783       0.4490
(:,:,7) =0.2881       0.1612
            0.1612       0.2576
(:,:,8) =0.1727       0.0282
            0.0282       0.2767
(:,:,9) =1.4320       2.0041
            2.0041       2.8105
inital prior probs
  0.0803    0.1629    0.0364    0.0520    0.1662    0.1943    0.1264    0.1363
0.0453
initial log likelihood is:-4.6344e+03
final iteration is    880
final likelihood is: -4.3635e+03
difference 4.3505e-05
my gmm:
            1.7337       2.1309
            1.7013       3.3810
            3.0058       4.6724
            3.5486       0.8614
            2.4054       1.0871
            5.7308       4.1517
            0.8865       0.7457
            3.6288       0.9636
            2.0504       1.5080
(:,:,1) =0.3421       0.1091
            0.1091       0.2257
```

(:,:,2) =0.1808 -0.0369
-0.0369 0.0297
(:,:,3) =0.2978 0.0228
0.0228 0.6304
(:,:,4) =0.6046 0.4152
0.4152 0.4724
(:,:,5) =0.6110 0.6057
0.6057 0.7056
(:,:,6) =0.3725 0.0328
0.0328 0.3992
(:,:,7) =0.5365 0.2144
0.2144 0.2936
(:,:,8) =0.4326 -0.0341
-0.0341 0.1876
(:,:,9) =0.4233 0.6174
0.6174 0.9024
0.0869 0.0094 0.1476 0.0495 0.0333 0.4086 0.1516 0.1019
0.0112

The high log is -4.3588e+03 with iteration 284 the log of training data is -1.6497e+03.

K=11
the NO. 1 model. initial mu
0.3010 -0.3112
1.8659 3.8000
2.6708 0.6145
7.2381 2.0036
0.0026 3.7428
6.1323 0.8391
4.2845 1.1778
1.9304 4.0418
0.3053 0.9572
2.3861 5.8593
2.8576 7.2471
initial sigma(:,:,1) =3.8621 0
0 3.6440
(:,:,2) =3.8621 0
0 3.6440
(:,:,3) =3.8621 0
0 3.6440
(:,:,4) =3.8621 0
0 3.6440
(:,:,5) =3.8621 0

```
                    0       3.6440
(:,:,6) =3.8621             0
                    0       3.6440
(:,:,7) =3.8621             0
                    0       3.6440
(:,:,8) =3.8621             0
                    0       3.6440
(:,:,9) =3.8621             0
                    0       3.6440
(:,:,10) =3.8621            0
                    0       3.6440
(:,:,11) =3.8621            0
                    0       3.6440
inital prior probs
  0.0909        0.0909        0.0909        0.0909        0.0909        0.0909        0.0909        0.0909
0.0909        0.0909        0.0909
initial log likelihood is: -2.2577e+03
final iteration is 282
final likelihood is:    -1.6418e+03
difference 1.6068e-05
my gmm: my mu
            0.9107      0.4360
            1.7588      2.3449
            3.4718      0.9198
            5.7114      4.0743
            1.4210      2.8673
            3.9927      1.3230
            2.1253      1.4194
            3.4489      4.8362
            1.5620      1.5761
            2.8896      4.7078
            4.8966      5.1436

my Sigma
(:,:,1) =0.5497       0.0023
            0.0023      0.2499
(:,:,2) =0.3906       0.2021
            0.2021      0.1442
(:,:,3) =0.2709      -0.0214
           -0.0214      0.3103
(:,:,4) =0.3817       0.0889
            0.0889      0.4636
(:,:,5) =0.3593       0.6186
            0.6186      1.6533
```

(:,:,6) =0.0732 0.1127
0.1127 0.2530
(:,:,7) =0.1564 0.0776
0.0776 0.1240
(:,:,8) =0.0675 0.2364
0.2364 0.8742
(:,:,9) =1.3294 1.4094
1.4094 1.5554
(:,:,10) =0.3034 0.0634
0.0634 0.4037
(:,:,11) =1.4785 -0.6253
-0.6253 0.2940
my prop 0.1383 0.0532 0.1632 0.1781 0.0414 0.0477 0.0581
0.0307 0.1217 0.1278 0.0399
the NO. 2 model. initial mu
3.7523 0.1987
-0.4238 2.3391
6.5776 -0.5425
6.3439 3.8790
5.8013 2.7603
0.9173 4.7332
3.8425 4.7678
-1.1713 4.2298
2.3599 -1.0741
1.3732 -0.7654
0.0472 1.4335
initial sigma (:,:,1) = 3.6628 0
0 3.9546
(:,:,2) =3.6628 0
0 3.9546
(:,:,3) =3.6628 0
0 3.9546
(:,:,4) =3.6628 0
0 3.9546
(:,:,5) =3.6628 0
0 3.9546
(:,:,6) =3.6628 0
0 3.9546
(:,:,7) =3.6628 0
0 3.9546
(:,:,8) =3.6628 0
0 3.9546
(:,:,9) =3.6628 0
0 3.9546

(:,:,10) =3.6628 0
0 3.9546
(:,:,11) =3.6628 0
0 3.9546
inital prior probs 0.0909 0.0909 0.0909 0.0909 0.0909 0.0909 0.0909
0.0909 0.0909 0.0909 0.0909
initial log likelihood is -2.2936e+03
final iteration is 257
final likelihood is: -1.6397e+03
difference 1.6340e-05
my gmm: my mu
3.4865 0.9329
1.9612 2.4278
3.9950 1.3277
5.7125 4.1860
5.8055 3.8058
3.1252 4.6550
3.7471 5.2973
1.7815 3.9914
2.1104 1.4591
0.4695 0.0162
0.8296 0.6347
my Sigma (:,:,1) = 0.2542 -0.0361
-0.0361 0.3197
(:,:,2) =0.6432 0.3518
0.3518 0.2344
(:,:,3) =0.0775 0.1177
0.1177 0.2587
(:,:,4) =0.4998 0.0630
0.0630 0.3369
(:,:,5) =0.0564 0.1716
0.1716 0.8297
(:,:,6) =0.2683 0.1461
0.1461 0.6152
(:,:,7) =1.0408 0.0405
0.0405 0.0070
(:,:,8) =0.3947 0.6783
0.6783 1.5021
(:,:,9) =0.1413 -0.0132
-0.0132 0.6086
(:,:,10) =1.0778 -0.4455
-0.4455 0.1904
(:,:,11) =0.3553 0.2389
0.2389 0.3664

my prop 0.1600 0.0729 0.0487 0.1617 0.0342 0.1550 0.0253
0.0388 0.0967 0.0142 0.1925

the NO. 3 model. initial mu
2.2052 0.9677
5.8207 -0.0215
4.9297 1.0951
7.1242 2.4899
3.2899 3.2532
1.4821 2.6419
-0.4426 6.3064
3.9881 3.1735
5.4597 6.9048
2.3440 4.2226
-0.5724 7.0282
initial sigma (:,:,1) = 3.3726 0
0 3.9762
(:,:,2) =3.3726 0
0 3.9762
(:,:,3) =3.3726 0
0 3.9762
(:,:,4) =3.3726 0
0 3.9762
(:,:,5) =3.3726 0
0 3.9762
(:,:,6) =3.3726 0
0 3.9762
(:,:,7) =3.3726 0
0 3.9762
(:,:,8) =3.3726 0
0 3.9762
(:,:,9) =3.3726 0
0 3.9762
(:,:,10) =3.3726 0
0 3.9762
(:,:,11) =3.3726 0
0 3.9762
inital prior probs 0.0909 0.0909 0.0909 0.0909 0.0909 0.0909 0.0909
0.0909 0.0909 0.0909 0.0909
initial log likelihood is -2.2579e+03
final iteration is 755
final likelihood is: -1.6399e+03
difference 1.5018e-05
my gmm: my mu

0.4718 0.0098
3.7989 1.0811
2.5649 1.2083
5.7020 4.0797
2.0666 2.1153
0.7954 0.5696
2.6038 4.7578
1.9133 2.4142
5.1072 5.0422
1.7346 3.7776
3.3662 4.7936
my Sigma(:,:,1) = 1.1084 -0.4604
-0.4604 0.1971
(:,:,2) =0.1320 0.0953
0.0953 0.2990
(:,:,3) =0.7817 -0.2387
-0.2387 0.4905
(:,:,4) =0.3843 0.0848
0.0848 0.4678
(:,:,5) =1.9290 1.9960
1.9960 2.0792
(:,:,6) =0.3259 0.1772
0.1772 0.3125
(:,:,7) =0.0510 -0.0154
-0.0154 0.4053
(:,:,8) =0.5017 0.2575
0.2575 0.1730
(:,:,9) =1.4097 -0.6099
-0.6099 0.2880
(:,:,10) =0.0650 -0.0204
-0.0204 0.4979
(:,:,11) =0.1137 0.1502
0.1502 0.5980
my prop 0.0140 0.1219 0.1931 0.1790 0.0405 0.1657 0.0625
0.0633 0.0343 0.0287 0.0969
the NO. 4 model. initial mu
1.1658 -1.3098
4.5216 3.9110
4.7261 2.0224
-0.7726 6.6625
0.8652 -1.3586
0.5956 2.6860
4.4867 2.3519
6.0348 2.6725

1.6515 5.3839
5.4747 1.4587
4.5525 5.5117
initial sigma(:,:,1) = 3.6033 0
0 3.3359
(:,:,2) =3.6033 0
0 3.3359
(:,:,3) =3.6033 0
0 3.3359
(:,:,4) =3.6033 0
0 3.3359
(:,:,5) =3.6033 0
0 3.3359
(:,:,6) =3.6033 0
0 3.3359
(:,:,7) =3.6033 0
0 3.3359
(:,:,8) =3.6033 0
0 3.3359
(:,:,9) =3.6033 0
0 3.3359
(:,:,10) =3.6033 0
0 3.3359
(:,:,11) = 3.6033 0
0 3.3359
inital prior probs
0.0909 0.0909 0.0909 0.0909 0.0909 0.0909 0.0909
0.0909 0.0909 0.0909 0.0909
nitial log likelihood is: -2.2398e+03
final iteration is 286
final likelihood is -1.6356e+03
difference 1.5523e-05

my gmm:
my mu
1.4625 0.7652
3.1597 4.0583
2.7204 1.2723
2.4861 4.3075
1.0213 0.4509
0.6539 0.6041
2.0065 2.4586
5.6926 3.6308
3.2022 5.3064

3.7919 1.0940
5.7104 4.2480
my Sigma(:,:,1) =0.1945 0.2902
0.2902 0.4484
(:,:,2) =0.1337 -0.0207
-0.0207 0.1205
(:,:,3) =0.7261 -0.3290
-0.3290 0.4439
(:,:,4) =0.5214 0.4123
0.4123 0.4505
(:,:,5) =0.8383 -0.1101
-0.1101 0.2596
(:,:,6) =0.2869 0.3119
0.3119 0.4026
(:,:,7) =0.5906 0.3183
0.3183 0.2203
(:,:,8) =0.0086 0.0148
0.0148 0.4091
(:,:,9) =0.5378 0.0821
0.0821 0.2545
(:,:,10) =0.1388 0.1047
0.1047 0.3137
(:,:,11) =0.5179 0.0564
0.0564 0.4160
my prop
0.0430 0.0509 0.1588 0.0594 0.0794 0.1065 0.0841
0.0325 0.0943 0.1228 0.1682

the NO. 5 model. initial mu
0.1733 5.3430
4.9595 0.2854
2.7827 1.1520
-0.0297 -0.5698
1.6222 3.6834
3.9568 4.6229
0.3125 3.4237
5.1057 2.3640
0.7606 4.2816
6.6751 4.3095
0.9904 4.5848
initial sigma
(:,:,1) =3.7677 0
0 4.2453
(:,:,2) =3.7677 0

0 4.2453
(:,:,3) =3.7677 0
0 4.2453
(:,:,4) = 3.7677 0
0 4.2453
(:,:,5) = 3.7677 0
0 4.2453
(:,:,6) = 3.7677 0
0 4.2453
(:,:,7) = 3.7677 0
0 4.2453
(:,:,8) =3.7677 0
0 4.2453
(:,:,9) =3.7677 0
0 4.2453
(:,:,10) =3.7677 0
0 4.2453
(:,:,11) = 3.7677 0
0 4.2453
inital prior probs
0.0909 0.0909 0.0909 0.0909 0.0909 0.0909 0.0909
0.0909 0.0909 0.0909 0.0909
initial log likelihood is: -2.2398e+03
final iteration is 310
final likelihood is: -1.6382e+03
differenc 1.5696e-05
my gmm: my mu
3.0248 4.2165
3.7067 1.0340
1.8875 0.3216
0.7509 0.5870
1.7947 1.8965
3.3727 5.3497
2.0231 2.4747
5.7348 4.8759
2.3257 1.5368
5.7324 4.1084
2.1878 4.3014
my Sigma(:,:,1) = 0.1874 -0.0399
-0.0399 0.1603
(:,:,2) = 0.1720 0.0870
0.0870 0.2990
(:,:,3) =2.0462 -0.0948
-0.0948 0.2135

(:,:,4) =0.3073 0.2080
0.2080 0.3502
(:,:,5) =0.0025 -0.0041
-0.0041 1.3567
(:,:,6) =0.5599 -0.0058
-0.0058 0.1241
(:,:,7) =0.5978 0.3129
0.3129 0.2055
(:,:,8) =0.3410 0.7014
0.7014 1.4426
(:,:,9) =0.2734 -0.0192
-0.0192 0.1980
(:,:,10) =0.4123 0.0561
0.0561 0.4157
(:,:,11) =0.8117 0.9680
0.9680 1.3888
my prop
0.0832 0.1687 0.0566 0.1702 0.0296 0.0852 0.0817
0.0049 0.0898 0.1915 0.0386

the NO. 1 model for holdout data.
initial mu
0.9107 0.4360
1.7588 2.3449
3.4718 0.9198
5.7114 4.0743
1.4210 2.8673
3.9927 1.3230
2.1253 1.4194
3.4489 4.8362
1.5620 1.5761
2.8896 4.7078
4.8966 5.1436
initial sigma(:,:,1) =0.5497 0.0023
0.0023 0.2499
(:,:,2) =0.3906 0.2021
0.2021 0.1442
(:,:,3) =0.2709 -0.0214
-0.0214 0.3103
(:,:,4) =0.3817 0.0889
0.0889 0.4636
(:,:,5) =0.3593 0.6186
0.6186 1.6533
(:,:,6) =0.0732 0.1127

0.1127 0.2530
(:,:,7) =0.1564 0.0776
0.0776 0.1240
(:,:,8) =0.0675 0.2364
0.2364 0.8742
(:,:,9) =1.3294 1.4094
1.4094 1.5554
(:,:,10) = 0.3034 0.0634
0.0634 0.4037
(:,:,11) = 1.4785 -0.6253
-0.6253 0.2940
inital prior probs
0.1383 0.0532 0.1632 0.1781 0.0414 0.0477 0.0581
0.0307 0.1217 0.1278 0.0399
initial log likelihood is: -4.6104e+03
final iteration is 712
final likelihood is: -4.3519e+03
difference 4.2569e-05
my gmm:
0.9008 0.6888
1.6187 2.2433
3.5622 0.9707
5.7072 4.1056
1.9993 1.8794
4.5011 1.0495
2.7968 1.8413
3.6136 5.3847
1.7814 1.7409
2.9822 4.5978
5.9180 4.5827
(:,:,1) =0.5108 0.1670
0.1670 0.3064
(:,:,2) =0.4095 0.1632
0.1632 0.1364
(:,:,3) = 0.3885 0.0434
0.0434 0.2048
(:,:,4) =0.3730 0.0464
0.0464 0.4131
(:,:,5) =0.2186 -0.2149
-0.2149 1.3461
(:,:,6) =0.0116 0.0119
0.0119 0.3665
(:,:,7) =0.2377 0.0735
0.0735 0.0276

(:,:,8) =0.0499 0.0866
0.0866 0.2332
(:,:,9) =0.2806 0.1504
0.1504 0.0834
(:,:,10) =0.2636 -0.0147
-0.0147 0.6821
(:,:,11) =0.3755 -0.1854
-0.1854 0.1318
0.1609 0.0427 0.1335 0.3739 0.0647 0.0122 0.0145 0.0077
0.0128 0.1404 0.0368
the NO. 2 model for holdout data. initial mu
3.4865 0.9329
1.9612 2.4278
3.9950 1.3277
5.7125 4.1860
5.8055 3.8058
3.1252 4.6550
3.7471 5.2973
1.7815 3.9914
2.1104 1.4591
0.4695 0.0162
0.8296 0.6347
initial sigma (:,:,1) = 0.2542 -0.0361
-0.0361 0.3197
(:,:,2) = 0.6432 0.3518
0.3518 0.2344
(:,:,3) =0.0775 0.1177
0.1177 0.2587
(:,:,4) =0.4998 0.0630
0.0630 0.3369
(:,:,5) =0.0564 0.1716
0.1716 0.8297

(:,:,6) = 0.2683 0.1461
0.1461 0.6152
(:,:,7) =1.0408 0.0405
0.0405 0.0070
(:,:,8) =0.3947 0.6783
0.6783 1.5021
(:,:,9) =0.1413 -0.0132
-0.0132 0.6086
(:,:,10) =1.0778 -0.4455
-0.4455 0.1904
(:,:,11) =0.3553 0.2389

0.2389 0.3664

inital prior probs

0.1600 0.0729 0.0487 0.1617 0.0342 0.1550 0.0253 0.0388 0.0967 0.0142 0.1925

initial log likelihood is: -4.6433e+03

final iteration is 220

final likelihood is: -4.3518e+03

difference 4.2001e-05

my gmm:

3.6323 0.9766

1.5074 2.0613

4.5006 1.0320

5.7268 4.2061

5.7314 3.1765

3.0410 4.6643

4.8222 5.4809

2.0811 2.8765

2.3784 1.9399

0.6766 0.0375

0.9799 0.7511

(:,:,1) =0.3753 0.0576

0.0576 0.2116

(:,:,2) =0.2537 0.0602

0.0602 0.1330

(:,:,3) = 0.0118 0.0122

0.0122 0.3694

(:,:,4) = 0.3978 0.0386

0.0386 0.3436

(:,:,5) = 0.1062 0.0372

0.0372 0.1481

(:,:,6) =0.2272 0.0362

0.0362 0.6203

(:,:,7) = 0.4371 0.1092

0.1092 0.0273

(:,:,8) =0.0474 -0.4192

-0.4192 3.9969

(:,:,9) =0.4554 -0.2661

-0.2661 0.9591

(:,:,10) =0.6934 -0.2591

-0.2591 0.0973

(:,:,11) =0.5490 0.1929

0.1929 0.3343

0.1183 0.0408 0.0118 0.3830 0.0258 0.1389 0.0031 0.0128 0.0901 0.0045 0.1708

the NO. 3 model for holdout data.

initial mu

0.4718 0.0098

3.7989 1.0811

2.5649 1.2083

5.7020 4.0797

2.0666 2.1153

0.7954 0.5696

2.6038 4.7578

1.9133 2.4142

5.1072 5.0422

1.7346 3.7776

3.3662 4.7936

initial sigma(:,:,1) = 1.1084 -0.4604

-0.4604 0.1971

(:,:,2) =0.1320 0.0953

0.0953 0.2990

(:,:,3) = 0.7817 -0.2387

-0.2387 0.4905

(:,:,4) =0.3843 0.0848

0.0848 0.4678

(:,:,5) =1.9290 1.9960

1.9960 2.0792

(:,:,6) =0.3259 0.1772

0.1772 0.3125

(:,:,7) = 0.0510 -0.0154

-0.0154 0.4053

(:,:,8) =0.5017 0.2575

0.2575 0.1730

(:,:,9) = 1.4097 -0.6099

-0.6099 0.2880

(:,:,10) =0.0650 -0.0204

-0.0204 0.4979

(:,:,11) =0.1137 0.1502

0.1502 0.5980

inital prior probs 0.0140 0.1219 0.1931 0.1790 0.0405 0.1657 0.0625 0.0633 0.0343 0.0287 0.0969

initial log likelihood is: -4.6298e+03

final iteration is 407

final likelihood is: -4.3449e+03

difference 4.2210e-05

my gmm:

1.0632 -0.1141

3.7108 0.9984
2.2529 1.7136
5.7859 3.9965
5.1864 4.8442
0.8577 0.7038
1.9685 2.8455
1.5122 2.0610
5.6032 4.7433
1.3580 2.9617
3.0602 4.6583

(:,:,1) = 0.6135 -0.2414
-0.2414 0.0969

(:,:,2) = 0.3928 0.0423
0.0423 0.2351

(:,:,3) = 0.4010 -0.1124
-0.1124 0.8733

(:,:,4) = 0.3977 0.0968
0.0968 0.3415

(:,:,5) = 0.1693 0.1287
0.1287 0.1092

(:,:,6) = 0.5096 0.1818
0.1818 0.2780

(:,:,7) = 0.1835 0.8325
0.8325 3.7788

(:,:,8) = 0.3436 0.1236
0.1236 0.1623

(:,:,9) =0.1604 -0.0686
-0.0686 0.2054

(:,:,10) =0.1065 0.6004
0.6004 4.5566

(:,:,11) = 0.2573 0.0414
0.0414 0.5929

0.0056 0.1332 0.1064 0.3302 0.0198 0.1434 0.0113 0.0414 0.0594 0.0093 0.1399

the NO. 4 model for holdout data.initial mu

1.4625 0.7652
3.1597 4.0583
2.7204 1.2723
2.4861 4.3075
1.0213 0.4509
0.6539 0.6041
2.0065 2.4586
5.6926 3.6308
3.2022 5.3064

3.7919 1.0940
5.7104 4.2480
initial sigma(:,:,1) = 0.1945 0.2902
0.2902 0.4484
(:,:,2) =0.1337 -0.0207
-0.0207 0.1205
(:,:,3) =0.7261 -0.3290
-0.3290 0.4439
(:,:,4) =0.5214 0.4123
0.4123 0.4505
(:,:,5) = 0.8383 -0.1101
-0.1101 0.2596
(:,:,6) =0.2869 0.3119
0.3119 0.4026
(:,:,7) =0.5906 0.3183
0.3183 0.2203
(:,:,8) =0.0086 0.0148
0.0148 0.4091
(:,:,9) =0.5378 0.0821
0.0821 0.2545
(:,:,10) =0.1388 0.1047
0.1047 0.3137
(:,:,11) =0.5179 0.0564
0.0564 0.4160
inital prior probs
0.0430 0.0509 0.1588 0.0594 0.0794 0.1065 0.0841
0.0325 0.0943 0.1228 0.1682
initial log likelihood is: -4.6396e+03
final iteration 824
final likelihood is: -4.3454e+03
difference 4.2701e-05
my gmm:
1.8016 1.5490
2.8451 4.1708
3.0547 0.9948
1.9903 3.4180
0.5899 0.4873
0.5335 1.0633
1.5690 2.3177
5.6723 4.1006
3.0744 4.8966
3.8772 0.9862
5.7307 4.1506
(:,:,1) =0.3773 0.1699

0.1699 0.7415
(:,:,2) = 0.2607 -0.1590
-0.1590 0.1261
(:,:,3) = 0.0769 0.1137
0.1137 0.4821
(:,:,4) = 0.4179 -0.0562
-0.0562 0.0180
(:,:,5) =0.4369 0.1263
0.1263 0.2126
(:,:,6) = 0.0143 0.0315
0.0315 0.1375
(:,:,7) =0.5678 0.2711
0.2711 0.1628
(:,:,8) =0.0028 0.0363
0.0363 0.7606
(:,:,9) = 0.2928 0.0012
0.0012 0.5485
(:,:,10) =0.3046 0.0459
0.0459 0.2249
(:,:,11) =0.3918 0.0339
0.0339 0.3862
0.1750 0.0290 0.0397 0.0093 0.0865 0.0138 0.0164 0.0176
0.1110 0.1094 0.3922
the NO. 5 model for holdout data.
initial mu
3.0248 4.2165
3.7067 1.0340
1.8875 0.3216
0.7509 0.5870
1.7947 1.8965
3.3727 5.3497
2.0231 2.4747
5.7348 4.8759
2.3257 1.5368
5.7324 4.1084
2.1878 4.3014

initial sigma(:,:,1) = 0.1874 -0.0399
-0.0399 0.1603
(:,:,2) =0.1720 0.0870
0.0870 0.2990
(:,:,3) =2.0462 -0.0948
-0.0948 0.2135
(:,:,4) =0.3073 0.2080

0.2080 0.3502

(:,:,5) =0.0025 -0.0041

-0.0041 1.3567

(:,:,6) =0.5599 -0.0058

-0.0058 0.1241

(:,:,7) = 0.5978 0.3129

0.3129 0.2055

(:,:,8) =0.3410 0.7014

0.7014 1.4426

(:,:,9) =0.2734 -0.0192

-0.0192 0.1980

(:,:,10) =0.4123 0.0561

0.0561 0.4157

(:,:,11) =0.8117 0.9680

0.9680 1.3888

inital prior probs

0.0832 0.1687 0.0566 0.1702 0.0296 0.0852 0.0817 0.0049 0.0898 0.1915 0.0386

initial log likelihood is:

-4.6415e+03

The high log is -4.3518e+03 with iteration 220 the log of training is -1.6397e+03

So form the log we can see that it is better to choose k=3 with similar log but less iteration.