CAPM and other Statistics for HSI Components Version 1.1

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Contents

*No funding received yet. Please donate urgently
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1 Introduction

CAPM Analysis on Hang Seng Index Components .
Hang Seng Index itself is used as the benchmark.

In finance, the capital asset pricing model (CAPM) is used to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio, given that asset's non-diversifiable risk. The model takes into account the asset's sensitivity to non-diversifiable risk (also known as systematic risk or market risk), often represented by the quantity beta in the financial industry, as well as the expected return of the market and the expected return of a theoretical risk-free asset.

The model was introduced by Jack Treynor (1961, 1962),[1] William Sharpe (1964), John Lintner (1965a,b) and Jan Mossin (1966) independently, building on the earlier work of Harry Markowitz on diversification and modern portfolio theory. Sharpe, Markowitz and Merton Miller jointly received the Nobel Memorial Prize in Economics for this contribution to the field of financial economics.[1]

We attempt to show the CAPM data for all HSI components with data from Yahoo starting with 2009-01-01 and generate some more charts and statistics on the way.

This document is generated on a daily basis to have snapshots of the data for further study , if one is so inclined.

[1] Wikipedia

2 CAPM Analysis

The general idea behind CAPM is that investors need to be compensated in two ways: time value of money and risk. The time value of money is represented by the risk-free (rf) rate in the formula and compensates the investors for placing money in any investment over a period of time. The other half of the formula represents risk and calculates the amount of compensation the investor needs for taking on additional risk. This is calculated by taking a risk measure (beta) that compares the returns of the asset to the market over a period of time and to the market premium (Rm-rf).[2]

2.1 HSI Components CAPM with HSI as benchmark

CAPM - Combined

```
## Warning message: missing values removed from data
##                      HSI Components to HSI
## Alpha                               -0.0005
## Beta                                 0.0085
## Beta+                               -0.3924
## Beta-                                0.2791
## R-squared                            0.0000
## Annualized Alpha                    -0.1173
## Correlation                          0.0055
## Correlation p-value                  0.9411
## Tracking Error                       0.4627
## Active Premium                      -0.0891
## Information Ratio                   -0.1925
## Treynor Ratio                      -21.3985
```

[2] http://www.investopedia.com/terms/c/capm.asp

CAPM - Distinct for each stock

```
## Error: 'names' attribute [49] must be the same length as the vector [48]
##                      X0001.HK to HSI X0002.HK to HSI X0003.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           1.040           0.234           0.314
## Beta+                          1.044           0.037          -0.076
## Beta-                          1.011           0.261           0.509
## R-squared                      0.745           0.140           0.186
## Annualized Alpha              -0.003           0.015           0.094
## Correlation                    0.863           0.375           0.432
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.160           0.252           0.249
## Active Premium                -0.021           0.172           0.225
## Information Ratio             -0.131           0.686           0.904
## Treynor Ratio                 -0.232          -0.203           0.015
##                      X0004.HK to HSI X0005.HK to HSI X0006.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           1.200           1.011           0.139
## Beta+                          1.210           0.915          -0.061
## Beta-                          1.157           1.103           0.204
## R-squared                      0.629           0.798           0.033
## Annualized Alpha              -0.005          -0.010           0.021
## Correlation                    0.793           0.893           0.182
## Correlation p-value            0.000           0.000           0.004
## Tracking Error                 0.247           0.133           0.299
## Active Premium                -0.068          -0.017           0.191
## Information Ratio             -0.276          -0.128           0.639
## Treynor Ratio                 -0.240          -0.235          -0.206
##                      X0011.HK to HSI X0012.HK to HSI X0013.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           0.656           1.004           1.032
## Beta+                          0.667           0.952           0.948
## Beta-                          0.740           0.976           1.105
## R-squared                      0.570           0.596           0.683
## Annualized Alpha              -0.054          -0.018          -0.030
## Correlation                    0.755           0.772           0.826
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.174           0.216           0.184
## Active Premium                 0.021          -0.033          -0.043
## Information Ratio              0.120          -0.152          -0.234
## Treynor Ratio                 -0.304          -0.252          -0.255
##                      X0016.HK to HSI X0017.HK to HSI X0019.HK to HSI
## Alpha                          0.000          -0.001          -0.001
## Beta                           0.912           1.103           0.700
## Beta+                          0.983           0.677           0.697
## Beta-                          0.716           1.285           0.643
## R-squared                      0.569           0.460           0.334
## Annualized Alpha              -0.068          -0.160          -0.143
## Correlation                    0.754           0.678           0.578
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.209           0.314           0.270
## Active Premium                -0.051          -0.176          -0.079
## Information Ratio             -0.244          -0.560          -0.293
## Treynor Ratio                 -0.297          -0.359          -0.428
##                      X0023.HK to HSI X0066.HK to HSI X0083.HK to HSI
## Alpha                          0.000           0.000           0.000
```

```
## Beta                          0.890           0.524           1.181
## Beta+                         1.058           0.476           1.283
## Beta-                         0.818           0.556           1.248
## R-squared                     0.534           0.444           0.571
## Annualized Alpha             -0.030          -0.012           0.108
## Correlation                   0.731           0.667           0.756
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.220           0.198           0.272
## Active Premium               -0.018           0.085           0.011
## Information Ratio            -0.080           0.430           0.040
## Treynor Ratio                -0.267          -0.258          -0.177
##                     X0101.HK to HSI X0144.HK to HSI X0151.HK to HSI
## Alpha                         0.000           0.000           0.002
## Beta                          1.068           1.176           0.661
## Beta+                         1.114           1.272           0.537
## Beta-                         1.136           1.224           0.816
## R-squared                     0.575           0.545           0.201
## Annualized Alpha             -0.004          -0.056           0.522
## Correlation                   0.758           0.738           0.449
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.241           0.285           0.356
## Active Premium               -0.039          -0.107           0.448
## Information Ratio            -0.164          -0.375           1.256
## Treynor Ratio                -0.243          -0.278           0.344
##                     X0267.HK to HSI X0291.HK to HSI X0293.HK to HSI
## Alpha                        -0.002           0.000          -0.001
## Beta                          1.167           0.760           0.736
## Beta+                         1.455           0.692           0.952
## Beta-                         1.015           0.917           0.610
## R-squared                     0.564           0.377           0.361
## Annualized Alpha             -0.316           0.012          -0.217
## Correlation                   0.751           0.614           0.601
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.272           0.264           0.265
## Active Premium               -0.290           0.036          -0.145
## Information Ratio            -1.067           0.135          -0.545
## Treynor Ratio                -0.437          -0.243          -0.496
##                     X0322.HK to HSI X0330.HK to HSI X0386.HK to HSI
## Alpha                         0.000          -0.001           0.000
## Beta                          0.470           1.125           0.790
## Beta+                         0.728           1.094           0.722
## Beta-                         0.503           1.273           0.587
## R-squared                     0.128           0.154           0.478
## Annualized Alpha             -0.067          -0.278           0.113
## Correlation                   0.358           0.392           0.692
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.350           0.691           0.223
## Active Premium                0.015          -0.353           0.119
## Information Ratio             0.044          -0.510           0.534
## Treynor Ratio                -0.436          -0.509          -0.128
##                     X0388.HK to HSI X0494.HK to HSI X0688.HK to HSI
## Alpha                        -0.001           0.001           0.002
## Beta                          1.080           1.228           1.577
## Beta+                         1.146           1.130           2.272
## Beta-                         1.037           1.073           1.374
## R-squared                     0.690           0.423           0.568
## Annualized Alpha             -0.172           0.218           0.658
```

```
## Correlation                   0.831           0.651           0.754
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.191           0.380           0.391
## Active Premium               -0.160           0.050           0.241
## Information Ratio            -0.838           0.131           0.616
## Treynor Ratio                -0.352          -0.139           0.013
##                      X0700.HK to HSI X0762.HK to HSI X0836.HK to HSI
## Alpha                          0.001          -0.001           0.000
## Beta                           1.048           0.963           0.472
## Beta+                          1.329           1.074           0.235
## Beta-                          0.965           1.018           0.589
## R-squared                      0.496           0.439           0.126
## Annualized Alpha               0.284          -0.182           0.056
## Correlation                    0.704           0.662           0.355
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.277           0.286           0.354
## Active Premium                 0.172          -0.161           0.119
## Information Ratio              0.620          -0.564           0.336
## Treynor Ratio                 -0.046          -0.396          -0.214
##                      X0857.HK to HSI X0883.HK to HSI X0939.HK to HSI
## Alpha                          0.001           0.000           0.000
## Beta                           0.934           1.393           1.098
## Beta+                          0.858           1.663           1.141
## Beta-                          0.920           1.413           1.037
## R-squared                      0.657           0.760           0.782
## Annualized Alpha               0.162           0.083          -0.058
## Correlation                    0.810           0.872           0.884
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.178           0.230           0.154
## Active Premium                 0.129          -0.044          -0.074
## Information Ratio              0.726          -0.190          -0.480
## Treynor Ratio                 -0.098          -0.189          -0.268
##                      X0941.HK to HSI X1044.HK to HSI X1088.HK to HSI
## Alpha                          0.001           0.001           0.000
## Beta                           0.528           0.640           1.202
## Beta+                          0.307           0.814           1.187
## Beta-                          0.504           0.696           1.239
## R-squared                      0.370           0.277           0.719
## Annualized Alpha               0.280           0.354          -0.018
## Correlation                    0.608           0.526           0.848
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.219           0.287           0.204
## Active Premium                 0.334           0.343          -0.071
## Information Ratio              1.528           1.196          -0.350
## Treynor Ratio                  0.216           0.192          -0.242
##                      X1109.HK to HSI X1199.HK to HSI X1299.HK to HSI
## Alpha                          0.002           0.000           0.000
## Beta                           1.552           1.416           0.867
## Beta+                          2.148           1.354           0.797
## Beta-                          1.243           1.567           1.126
## R-squared                      0.512           0.626           0.446
## Annualized Alpha               0.676          -0.105           0.147
## Correlation                    0.716           0.791           0.668
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.422           0.307           0.256
## Active Premium                 0.246          -0.188           0.119
## Information Ratio              0.582          -0.613           0.466
```

```
## Treynor Ratio                0.016          -0.288          -0.116
##                     X1398.HK to HSI X1880.HK to HSI X1898.HK to HSI
## Alpha                         0.000           0.000           0.000
## Beta                          1.382           1.079           1.473
## Beta+                         1.632           1.301           1.539
## Beta-                         1.220           0.931           1.378
## R-squared                     0.819           0.387           0.686
## Annualized Alpha              0.029           0.092           0.038
## Correlation                   0.905           0.622           0.828
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.198           0.356           0.289
## Active Premium               -0.073           0.002          -0.102
## Information Ratio            -0.369           0.006          -0.351
## Treynor Ratio                -0.212          -0.202          -0.218
##                     X2318.HK to HSI X2388.HK to HSI X2600.HK to HSI
## Alpha                         0.000           0.001          -0.001
## Beta                          1.643           0.991           1.483
## Beta+                         1.960           1.010           1.622
## Beta-                         1.335           1.081           1.285
## R-squared                     0.692           0.642           0.581
## Annualized Alpha              0.096           0.188          -0.282
## Correlation                   0.832           0.801           0.762
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.333           0.194           0.353
## Active Premium               -0.105           0.132          -0.321
## Information Ratio            -0.316           0.678          -0.908
## Treynor Ratio                -0.198          -0.089          -0.365
##                     X2628.HK to HSI X3328.HK to HSI X3988.HK to HSI
## Alpha                         0.000           0.000           0.000
## Beta                          1.358           1.363           1.167
## Beta+                         1.373           1.378           1.176
## Beta-                         1.257           1.347           1.102
## R-squared                     0.651           0.775           0.756
## Annualized Alpha             -0.038          -0.103          -0.086
## Correlation                   0.807           0.880           0.869
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.277           0.215           0.179
## Active Premium               -0.128          -0.163          -0.111
## Information Ratio            -0.461          -0.759          -0.619
## Treynor Ratio                -0.256          -0.281          -0.284
```

3 HSI Components Risk

3.1 Correlation

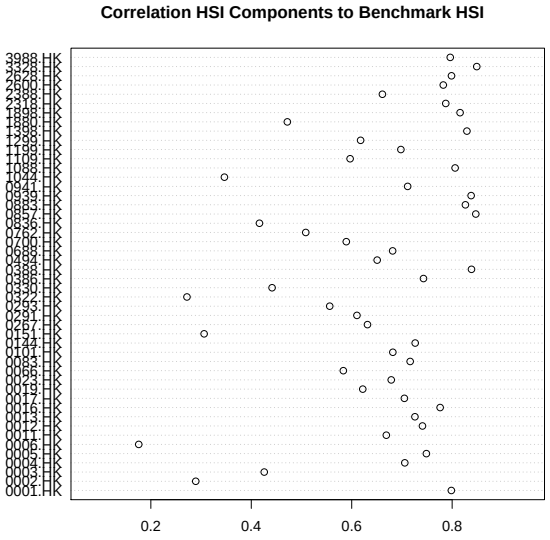
Correlation Combined

```
##                       Correlation p-value Lower CI Upper CI
## HSI Components to HSI      0.0055  0.9411  -0.1839   0.1944
```

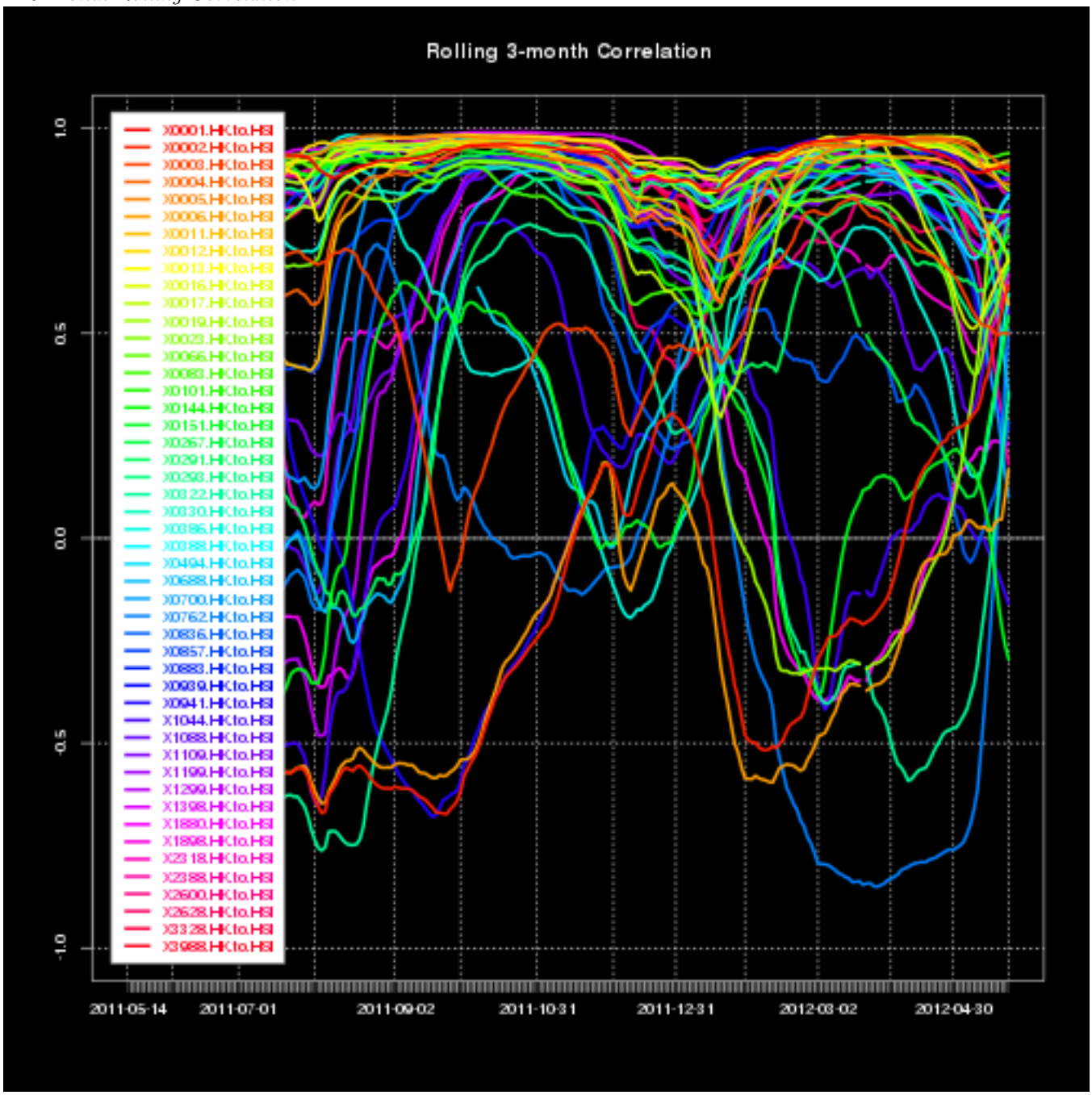
Correlation - Distinct

```
##         Correlation p-value Lower CI Upper CI
## 0001.HK      0.7984       0   0.7638   0.8284
## 0002.HK      0.2894       0   0.2060   0.3686
## 0003.HK      0.4258       0   0.3503   0.4957
## 0004.HK      0.7057       0   0.6581   0.7476
## 0005.HK      0.7487       0   0.7069   0.7852
## 0006.HK      0.1759       0   0.0885   0.2606
## 0011.HK      0.6689       0   0.6169   0.7152
## 0012.HK      0.7409       0   0.6981   0.7785
## 0013.HK      0.7259       0   0.6810   0.7653
## 0016.HK      0.7761       0   0.7382   0.8091
## 0017.HK      0.7049       0   0.6572   0.7469
## 0019.HK      0.6220       0   0.5644   0.6736
## 0023.HK      0.6787       0   0.6278   0.7238
## 0066.HK      0.5833       0   0.5216   0.6390
## 0083.HK      0.7164       0   0.6703   0.7570
## 0101.HK      0.6819       0   0.6314   0.7266
## 0144.HK      0.7264       0   0.6816   0.7658
## 0151.HK      0.3061       0   0.2235   0.3844
## 0267.HK      0.6314       0   0.5749   0.6819
## 0291.HK      0.6104       0   0.5515   0.6631
## 0293.HK      0.5562       0   0.4918   0.6146
## 0322.HK      0.2719       0   0.1876   0.3521
## 0330.HK      0.4414       0   0.3671   0.5102
## 0386.HK      0.7429       0   0.7003   0.7802
## 0388.HK      0.8385       0   0.8100   0.8630
## 0494.HK      0.6507       0   0.5440   0.7366
## 0688.HK      0.6815       0   0.6310   0.7263
## 0700.HK      0.5892       0   0.5282   0.6442
## 0762.HK      0.5085       0   0.4398   0.5714
## 0836.HK      0.4163       0   0.3402   0.4870
## 0857.HK      0.8471       0   0.8200   0.8704
## 0883.HK      0.8264       0   0.7960   0.8526
## 0939.HK      0.8378       0   0.8093   0.8624
## 0941.HK      0.7114       0   0.6646   0.7526
## 1044.HK      0.3465       0   0.2661   0.4221
## 1088.HK      0.8059       0   0.7724   0.8349
## 1109.HK      0.5968       0   0.5365   0.6511
## 1199.HK      0.6979       0   0.6494   0.7408
## 1299.HK      0.6177       0   0.5300   0.6924
## 1398.HK      0.8294       0   0.7995   0.8551
## 1880.HK      0.4718       0   0.3998   0.5380
## 1898.HK      0.8158       0   0.7838   0.8434
## 2318.HK      0.7873       0   0.7511   0.8189
## 2388.HK      0.6611       0   0.6080   0.7082
## 2600.HK      0.7823       0   0.7453   0.8145
## 2628.HK      0.7987       0   0.7641   0.8287
```

```
## 3328.HK      0.8490       0   0.8222   0.8720
## 3988.HK      0.7962       0   0.7613   0.8266
```



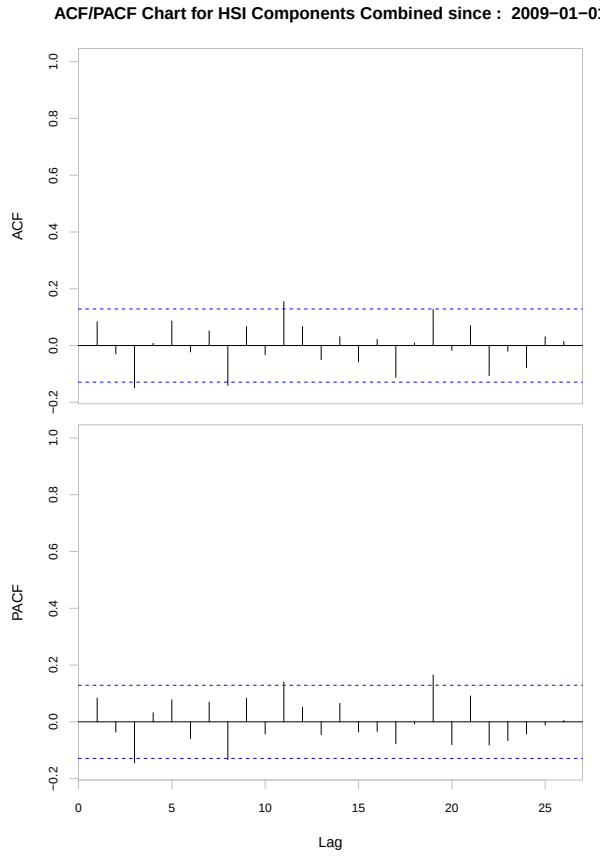
3 Month Rolling Correlation



3.2 Autocorrelation Coefficients - Combined

Autocorrelation Combined

```
##                  rho1   rho2    rho3   rho4   rho5    rho6 Q(6) p-value
## daily.returns 0.0838 -0.029 -0.1487 0.0078 0.0866 -0.0224       0.1542
```



3.3 Downside Risk - Combined

Downside Risk Combined

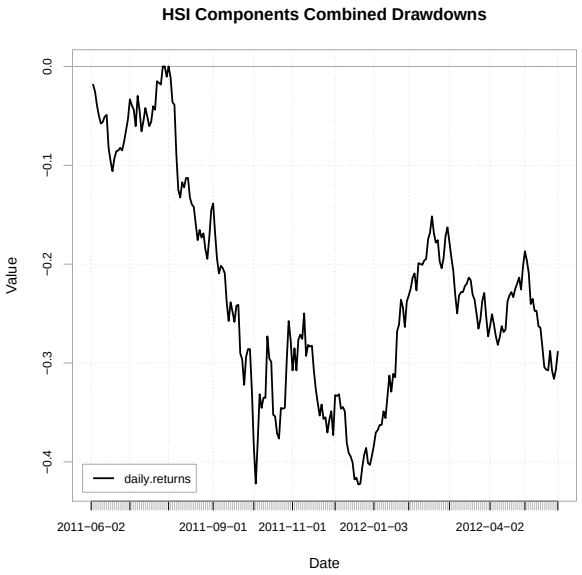
```
##                                HSI Components dailyReturn
## Semi Deviation                                      0.0238
## Gain Deviation                                      0.0179
## Loss Deviation                                      0.0157
## Downside Deviation (MAR=210%)                       0.0274
## Downside Deviation (Rf=0%)                          0.0246
## Downside Deviation (0%)                             0.0246
## Maximum Drawdown                                    0.4229
## Historical VaR (95%)                               -0.0370
## Historical ES (95%)                                -0.0538
## Modified VaR (95%)                                 -0.0392
## Modified ES (95%)                                  -0.0507
```

3.4 Drawdowns - Combined

Drawdowns Combined

```
## Warning message: Only 3 available in the data.
```

```
##         From     Trough         To   Depth Length To Trough Recovery
## 1 2011-08-02 2011-12-19       <NA> -0.4229    202        98       NA
## 2 2011-06-03 2011-06-20 2011-07-28 -0.1060     38        11       27
## 3 2011-07-29 2011-07-29 2011-08-01 -0.0104      2         1        1
```



3.5 Downside Deviation - Combined

Downside Deviation Combined

```
##                                 HSI Components
## Downside Deviation (MAR = 0%)          0.02462
```

3.6 Downside Deviation - Distinct

```
##                                0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## Downside Deviation (MAR = 0%)   0.019  0.0088  0.0152  0.0238  0.0247
##                                0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## Downside Deviation (MAR = 0%)   0.011  0.0147  0.0211  0.0188  0.0202
##                                0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## Downside Deviation (MAR = 0%)  0.0244  0.0206  0.0203   0.013  0.0252
##                                0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## Downside Deviation (MAR = 0%)  0.0248  0.0265  0.0218  0.0246  0.0227
##                                0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## Downside Deviation (MAR = 0%)  0.0213  0.0201  0.0351  0.0202  0.0194
##                                0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Downside Deviation (MAR = 0%)   0.032  0.0257  0.0242  0.0228  0.0202
##                                0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## Downside Deviation (MAR = 0%)  0.0205  0.0235  0.0205  0.0157  0.0203
##                                1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## Downside Deviation (MAR = 0%)  0.0238  0.0287  0.0288  0.0196   0.021
##                                1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## Downside Deviation (MAR = 0%)  0.0268  0.0289  0.0263  0.0195  0.0293
##                                2628.HK 3328.HK 3988.HK
## Downside Deviation (MAR = 0%)   0.022  0.0222  0.0212
```

4 General Statistics

Statistics Distinct

```
##                Observations NAs Minimum Quartile 1  Median Arithmetic Mean
## X0001.HK.Close          842  12   56.00      91.71  98.500          100.231
## X0002.HK.Close          842  12   51.10      52.70  59.975           59.782
## X0003.HK.Close          842  12   10.78      17.28  18.260           17.756
## X0004.HK.Close          841  13   15.20      37.60  42.150           41.984
## X0005.HK.Close          842  12   33.00      66.40  77.050           74.389
## X0006.HK.Close          841  13   41.10      43.70  47.800           49.662
## X0011.HK.Close          842  12   67.00     102.50 109.500          109.016
## X0012.HK.Close          842  12   23.75      42.76  48.000           46.719
## X0013.HK.Close          841  13   36.40      53.40  61.150           64.892
## X0016.HK.Close          842  12   55.80      98.51 110.950          107.726
## X0017.HK.Close          841  13    6.20       9.35  13.260           12.456
## X0019.HK.Close          841  13   42.90      84.90  91.500           92.160
## X0023.HK.Close          842  12   12.34      26.95  29.000           28.274
## X0066.HK.Close          842  12   16.14      25.25  26.900           26.108
## X0083.HK.Close          841  13    5.60      11.92  13.500           13.061
## X0101.HK.Close          842  12   13.66      25.75  28.800           28.552
## X0144.HK.Close          841  13   12.20      23.20  26.250           25.918
## X0151.HK.Close          842  12    2.77       4.94   6.300            6.056
## X0267.HK.Close          841  13    7.18      13.82  16.800           16.761
## X0291.HK.Close          842  12   10.66      24.85  27.925           26.227
## X0293.HK.Close          841  13    6.98      12.68  14.680           15.076
## X0322.HK.Close          841  13    8.27      17.30  19.460           18.454
## X0330.HK.Close          841  13    7.93      22.90  41.500           37.328
## X0386.HK.Close          842  12    3.65       6.23   6.880            6.939
## X0388.HK.Close          841  13   54.60     123.00 135.000          136.000
## X0494.HK.Close          242 612   11.60      14.04  15.200           15.385
## X0688.HK.Close          842  12    9.41      14.38  15.530           15.247
## X0700.HK.Close          850   4   41.80     130.32 158.350          153.229
## X0762.HK.Close          849   5    8.31       9.83  11.160           12.001
## X0836.HK.Close          842  12   11.10      14.16  15.210           15.350
## X0857.HK.Close          842  12    5.10       8.75   9.485            9.451
## X0883.HK.Close          841  13    6.08      11.78  13.520           13.769
## X0939.HK.Close          841  13    3.66       5.64   6.230            6.107
## X0941.HK.Close          842  12   63.00      73.65  76.325           76.301
## X1044.HK.Close          853   1   24.25      50.20  60.850           57.705
## X1088.HK.Close          842  12   13.90      30.36  33.325           31.767
## X1109.HK.Close          841  13    7.50      13.04  14.480           14.370
## X1199.HK.Close          841  13    5.40       9.48  11.080           11.120
## X1299.HK.Close          388 466   19.86      23.00  24.600           24.918
## X1398.HK.Close          842  12    3.03       4.98   5.675            5.437
## X1880.HK.Close          841  13    2.98       8.39  12.620           11.255
## X1898.HK.Close          841  13    4.43       9.13  10.400           10.320
## X2318.HK.Close          842  12   30.35      58.49  64.350           65.128
## X2388.HK.Close          842  12    6.30      16.86  18.780           18.997
## X2600.HK.Close          841  13    3.17       4.40   6.820            6.441
## X2628.HK.Close          841  13   17.24      23.05  29.750           28.958
## X3328.HK.Close          841  13    4.17       5.94   7.880            7.456
## X3988.HK.Close          841  13    1.84       3.08   3.860            3.624
##                Geometric Mean Quartile 3 Maximum SE Mean LCL Mean (0.95)
## X0001.HK.Close         98.956    112.000  135.70  0.5410          99.170
## X0002.HK.Close         59.423     65.150   75.00  0.2286          59.333
## X0003.HK.Close         17.622     19.095   21.00  0.0718          17.615
## X0004.HK.Close         40.378     50.000   62.00  0.3685          41.261
```

```
## X0005.HK.Close          73.418     82.700   98.00  0.3958          73.612
## X0006.HK.Close          49.282     55.950   64.80  0.2170          49.236
## X0011.HK.Close         108.300    116.800  134.00  0.4220         108.188
## X0012.HK.Close          45.957     52.775   60.50  0.2744          46.180
## X0013.HK.Close          63.008     77.750   95.90  0.5416          63.828
## X0016.HK.Close         106.073    118.500  146.30  0.6118         106.525
## X0017.HK.Close          12.006     15.240   18.54  0.1141          12.232
## X0019.HK.Close          89.908    107.000  136.40  0.6637          90.857
## X0023.HK.Close          27.774     31.950   35.90  0.1685          27.943
## X0066.HK.Close          25.898     28.100   31.15  0.1085          25.895
## X0083.HK.Close          12.815     14.720   18.56  0.0830          12.898
## X0101.HK.Close          28.000     31.900   40.30  0.1857          28.187
## X0144.HK.Close          25.416     28.700   37.55  0.1686          25.587
## X0151.HK.Close           5.874      7.138    9.70  0.0530           5.952
## X0267.HK.Close          16.274     20.450   24.40  0.1371          16.492
## X0291.HK.Close          25.280     30.600   35.25  0.2180          25.799
## X0293.HK.Close          14.585     18.120   24.05  0.1352          14.811
## X0322.HK.Close          17.828     21.450   25.95  0.1532          18.154
## X0330.HK.Close          33.117     49.300   64.30  0.5342          36.280
## X0386.HK.Close           6.851      7.730    9.64  0.0392           6.862
## X0388.HK.Close         132.378    152.800  197.50  1.0032         134.031
## X0494.HK.Close          15.286     16.900   19.86  0.1162          15.156
## X0688.HK.Close          15.128     16.600   19.44  0.0652          15.119
## X0700.HK.Close         142.605    187.675  247.00  1.6875         149.917
## X0762.HK.Close          11.782     14.000   17.40  0.0843          11.836
## X0836.HK.Close          15.269     16.520   20.15  0.0564          15.239
## X0857.HK.Close           9.341     10.480   12.36  0.0496           9.353
## X0883.HK.Close          13.341     16.780   20.95  0.1174          13.538
## X0939.HK.Close           6.044      6.770    8.28  0.0313           6.046
## X0941.HK.Close          76.171     78.950   91.45  0.1550          75.997
## X1044.HK.Close          55.427     69.250   82.70  0.5073          56.709
## X1088.HK.Close          31.153     35.250   40.80  0.1945          31.386
## X1109.HK.Close          14.149     16.060   20.00  0.0863          14.201
## X1199.HK.Close          10.899     12.580   16.76  0.0785          10.966
## X1299.HK.Close          24.828     26.800   29.65  0.1102          24.702
## X1398.HK.Close           5.377      5.940    7.03  0.0287           5.380
## X1880.HK.Close          10.520     14.300   17.54  0.1304          10.999
## X1898.HK.Close          10.094     11.660   15.86  0.0741          10.175
## X2318.HK.Close          63.761     74.475   94.30  0.4469          64.251
## X2388.HK.Close          18.241     22.900   28.95  0.1726          18.659
## X2600.HK.Close           6.191      7.770   10.66  0.0636           6.316
## X2628.HK.Close          28.275     34.300   41.00  0.2143          28.538
## X3328.HK.Close           7.304      8.630   10.56  0.0537           7.351
## X3988.HK.Close           3.567      4.130    5.00  0.0240           3.577
##                 UCL Mean (0.95)  Variance   Stdev Skewness Kurtosis
## X0001.HK.Close          101.293  246.3940 15.6969  -0.1375   0.0264
## X0002.HK.Close           60.231   43.9828  6.6320   0.1940  -1.3836
## X0003.HK.Close           17.897    4.3379  2.0828  -1.6420   2.2725
## X0004.HK.Close           42.708  114.2080 10.6868  -0.5375   0.0190
## X0005.HK.Close           75.166  131.8734 11.4836  -0.6673   0.1781
## X0006.HK.Close           50.088   39.5857  6.2917   0.4246  -1.1813
## X0011.HK.Close          109.844  149.9450 12.2452  -0.4375   0.0855
## X0012.HK.Close           47.257   63.4125  7.9632  -0.8328   0.3288
## X0013.HK.Close           65.955  246.6899 15.7064   0.2161  -1.0624
## X0016.HK.Close          108.927  315.2036 17.7540  -0.7845   0.5740
## X0017.HK.Close           12.680   10.9499  3.3091  -0.3390  -1.1223
## X0019.HK.Close           93.463  370.4410 19.2468  -0.4082   0.1865
```

```
## X0023.HK.Close          28.605   23.9034  4.8891  -1.2976   1.4041
## X0066.HK.Close          26.321    9.9035  3.1470  -1.4708   1.6224
## X0083.HK.Close          13.224    5.7996  2.4082  -1.0431   0.9622
## X0101.HK.Close          28.916   29.0494  5.3898  -0.5163   0.1959
## X0144.HK.Close          26.248   23.8940  4.8881  -0.5188   0.5245
## X0151.HK.Close           6.160    2.3692  1.5392  -0.1942  -0.4847
## X0267.HK.Close          17.030   15.8050  3.9756  -0.2601  -0.7947
## X0291.HK.Close          26.655   40.0138  6.3256  -1.1080   0.1839
## X0293.HK.Close          15.341   15.3760  3.9212   0.1878  -0.6010
## X0322.HK.Close          18.755   19.7304  4.4419  -0.8982  -0.0045
## X0330.HK.Close          38.377  239.9644 15.4908  -0.4707  -1.0076
## X0386.HK.Close           7.016    1.2952  1.1381  -0.3897   0.2744
## X0388.HK.Close         137.969  846.4128 29.0932  -0.5268   0.4521
## X0494.HK.Close          15.614    3.2685  1.8079   0.1967  -0.7495
## X0688.HK.Close          15.375    3.5813  1.8924  -0.8066   0.3314
## X0700.HK.Close         156.541 2420.3919 49.1975  -0.6617  -0.2544
## X0762.HK.Close          12.167    6.0300  2.4556   0.6008  -0.9890
## X0836.HK.Close          15.461    2.6782  1.6365   0.2636  -0.2513
## X0857.HK.Close           9.548    2.0721  1.4395  -0.7258   0.5934
## X0883.HK.Close          13.999   11.5868  3.4039  -0.1984  -0.7115
## X0939.HK.Close           6.168    0.8215  0.9064  -0.7260   0.1950
## X0941.HK.Close          76.605   20.2318  4.4980   0.1869   0.3341
## X1044.HK.Close          58.701  219.5462 14.8171  -0.7213  -0.4824
## X1088.HK.Close          32.149   31.8438  5.6430  -1.4563   1.7451
## X1109.HK.Close          14.540    6.2694  2.5039  -0.4077  -0.0006
## X1199.HK.Close          11.274    5.1871  2.2775   0.0699  -0.3696
## X1299.HK.Close          25.135    4.7152  2.1714   0.0739  -1.1967
## X1398.HK.Close           5.493    0.6941  0.8331  -0.8900   0.4149
## X1880.HK.Close          11.511   14.3002  3.7816  -0.5690  -0.7920
## X1898.HK.Close          10.466    4.6202  2.1495  -0.3839   0.2084
## X2318.HK.Close          66.005  168.1750 12.9682  -0.1563  -0.1602
## X2388.HK.Close          19.336   25.0823  5.0082  -0.5428  -0.1044
## X2600.HK.Close           6.566    3.4051  1.8453  -0.2634  -1.0816
## X2628.HK.Close          29.379   38.6156  6.2141  -0.2136  -1.1987
## X3328.HK.Close           7.562    2.4290  1.5585  -0.2798  -1.1302
## X3988.HK.Close           3.671    0.4839  0.6956  -0.6513  -0.4782
```

4.1 Higher Moments - Combined

```
##                 HSI Components to HSI Combined
## CoSkewness                              0.0000
## CoKurtosis                              0.0000
## Beta CoVariance                         0.0085
## Beta CoSkewness                         1.1884
## Beta CoKurtosis                        -0.0614
```

5 Principal Components Analysis

Principal components analysis, or PCA, seeks to find a set of orthogonal axes such that the first axis, or first principal component, accounts for as much variability as possible and subsequent axes are chosen to maximize variance while maintaining orthogonality with previous axes. Principal components are typically computed either by a singular value decomposition of the data matrix or an eigenvalue decomposition of a covariance or correlation matrix.[3] The calculation and chart below based on correlation. Future improvement here is to use sparse pca to reduce the number of important components to a more manageable number.[4] Principal component analysis (PCA) is an orthogonal transformation of possibly correlated variables into uncorrelated variables called principal components.

Terminology Factor loadings: The factor loadings, also called component loadings in PCA, are the correlation coefficients between the variables (rows) and factors (columns). Analogous to Pearson's r, the squared factor loading is the percent of variance in that indicator variable explained by the factor. To get the percent of variance in all the variables accounted for by each factor, add the sum of the squared factor loadings for that factor (column) and divide by the number of variables. (Note the number of variables equals the sum of their variances as the variance of a standardized variable is 1.) This is the same as dividing the factor's eigenvalue by the number of variables.

Interpreting factor loadings: By one rule of thumb in confirmatory factor analysis, loadings should be .7 or higher to confirm that independent variables identified a priori are represented by a particular factor, on the rationale that the .7 level corresponds to about half of the variance in the indicator being explained by the factor. However, the .7 standard is a high one and real-life data may well not meet this criterion, which is why some researchers, particularly for exploratory purposes, will use a lower level such as .4 for the central factor and .25 for other factors call loadings above .6 "high" and those below .4 "low". In any event, factor loadings must be interpreted in the light of theory, not by arbitrary cutoff levels.

In oblique rotation, one gets both a pattern matrix and a structure matrix. The structure matrix is simply the factor loading matrix as in orthogonal rotation, representing the variance in a measured variable explained by a factor on both a unique and common contributions basis. The pattern matrix, in contrast, contains coefficients which just represent unique contributions. The more factors, the lower the pattern coefficients as a rule since there will be more common contributions to variance explained. For oblique rotation, the researcher looks at both the structure and pattern coefficients when attributing a label to a factor.

Communality: The sum of the squared factor loadings for all factors for a given variable (row) is the variance in that variable accounted for by all the factors, and this is called the communality. The communality measures the percent of variance in a given variable explained by all the factors jointly and may be interpreted as the reliability of the indicator.

Spurious solutions: If the communality exceeds 1.0, there is a spurious solution, which may reflect too small a sample or the researcher has too many or too few factors.

Uniqueness of a variable: That is, uniqueness is the variability of a variable minus its communality.

Eigenvalues:/Characteristic roots: The eigenvalue for a given factor measures the variance in all the variables which is accounted for by that factor. The ratio of eigenvalues is the ratio of explanatory importance of the factors with respect to the variables. If a factor has a low eigenvalue, then it is contributing little to the explanation of variances in the variables and may be ignored as redundant with more important factors. Eigenvalues measure the amount of variation in the total sample accounted for by each factor.

Extraction sums of squared loadings: Initial eigenvalues and eigenvalues after extraction are the same for PCA extraction, but for other extraction methods, eigenvalues after extraction will be lower than their initial counterparts.

Factor scores (also called component scores in PCA): are the scores of each case (row) on each factor (column). To compute the factor score for a given case for a given factor, one takes the case's standardized score on each variable, multiplies by the corresponding factor loading of the variable for the given factor, and sums these products. Computing factor scores allows one to look for factor outliers. Also, factor scores may be used as variables in subsequent modeling.

Criteria for determining the number of factors Using one or more of the methods below, the researcher determines an appropriate range of solutions to investigate. Methods may not agree. For instance, the Kaiser criterion may suggest five factors and the scree test may suggest two, so the researcher may request 3-, 4-, and 5-factor solutions discuss each in terms of their relation to external data and theory.

Comprehensibility: A purely subjective criterion would be to retain those factors whose meaning is comprehensible to the researcher. This is not recommended.[5]

[3] http://blog.revolutionanalytics.com/2011/06/big-data-pca.html

[4] http://statmath.wu.ac.at/courses/optimization/Presentations/Nops+Thomas-sPCA1.pdf

[5] http://en.wikipedia.org/wiki/Factoranalysis

5.1 PCA with stats package princomp function

```
## Importance of components:
##                         Comp.1  Comp.2  Comp.3  Comp.4  Comp.5  Comp.6
## Standard deviation     5.0066 1.46948 1.21225 1.14609 1.06447 1.00619
## Proportion of Variance 0.5222 0.04499 0.03062 0.02737 0.02361 0.02109
## Cumulative Proportion  0.5222 0.56720 0.59782 0.62519 0.64879 0.66988
##                         Comp.7 Comp.8  Comp.9 Comp.10 Comp.11 Comp.12
## Standard deviation     0.96452 0.9449 0.91176  0.8955 0.85369 0.84428
## Proportion of Variance 0.01938 0.0186 0.01732  0.0167 0.01518 0.01485
## Cumulative Proportion  0.68927 0.7079 0.72518  0.7419 0.75707 0.77192
##                        Comp.13 Comp.14 Comp.15 Comp.16 Comp.17 Comp.18
## Standard deviation      0.8019 0.78516 0.76996 0.74389 0.71767 0.71348
## Proportion of Variance  0.0134 0.01284 0.01235 0.01153 0.01073 0.01061
## Cumulative Proportion   0.7853 0.79816 0.81051 0.82204 0.83277 0.84338
##                        Comp.19  Comp.20  Comp.21  Comp.22  Comp.23
## Standard deviation     0.68830 0.677105 0.653148 0.639147 0.632415
## Proportion of Variance 0.00987 0.009551 0.008888 0.008511 0.008332
## Cumulative Proportion  0.85325 0.862797 0.871685 0.880196 0.888528
##                         Comp.24  Comp.25  Comp.26  Comp.27  Comp.28
## Standard deviation     0.608767 0.598084 0.589209 0.575769 0.560855
## Proportion of Variance 0.007721 0.007452 0.007233 0.006906 0.006553
## Cumulative Proportion  0.896249 0.903701 0.910933 0.917840 0.924393
##                         Comp.29  Comp.30 Comp.31  Comp.32  Comp.33
## Standard deviation     0.541695 0.535562 0.50389 0.502513 0.492061
## Proportion of Variance 0.006113 0.005976 0.00529 0.005261 0.005044
## Cumulative Proportion  0.930506 0.936482 0.94177 0.947032 0.952077
##                         Comp.34  Comp.35  Comp.36  Comp.37  Comp.38
## Standard deviation     0.476710 0.468684 0.448569 0.444289 0.428856
## Proportion of Variance 0.004734 0.004576 0.004192 0.004112 0.003832
## Cumulative Proportion  0.956811 0.961387 0.965579 0.969692 0.973523
##                         Comp.39  Comp.40 Comp.41  Comp.42  Comp.43
## Standard deviation     0.415907 0.407617 0.38883 0.373775 0.372409
## Proportion of Variance 0.003604 0.003461 0.00315 0.002911 0.002889
## Cumulative Proportion  0.977127 0.980589 0.98374 0.986649 0.989538
##                         Comp.44  Comp.45  Comp.46  Comp.47  Comp.48
## Standard deviation     0.365577 0.337010 0.313124 0.285397 0.274674
## Proportion of Variance 0.002784 0.002366 0.002043 0.001697 0.001572
## Cumulative Proportion  0.992323 0.994689 0.996731 0.998428 1.000000
##
## Loadings:
##         Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8 Comp.9
## 0001.HK -0.176         0.106 -0.178
## 0002.HK         0.483        -0.115 -0.171 -0.122  0.278
## 0003.HK         0.355        -0.284  0.131  0.158         0.246  0.119
## 0004.HK -0.164         0.116
## 0005.HK -0.172                                                 0.107
## 0006.HK         0.483         0.155 -0.149         0.361        -0.222
## 0011.HK -0.157               -0.226        -0.123        -0.153  0.171
## 0012.HK -0.159         0.161 -0.181                       0.231
## 0013.HK -0.169               -0.112        -0.144
## 0016.HK -0.154         0.212 -0.173                       0.205
## 0017.HK -0.140         0.200 -0.145                       0.171
## 0019.HK -0.121               -0.215         0.152 -0.226 -0.364 -0.149
## 0023.HK -0.149               -0.144 -0.193               -0.243
## 0066.HK -0.135  0.166        -0.171         0.115        -0.205  0.183
## 0083.HK -0.155         0.183 -0.121                       0.225 -0.127
```

```
## 0101.HK -0.154         0.144                -0.151                 0.135
## 0144.HK -0.151                 0.168  0.128 -0.120  0.166         0.170
## 0151.HK               -0.490 -0.119         0.227         0.316 -0.121
## 0267.HK -0.158                -0.109         0.102        -0.211
## 0291.HK -0.125                       0.114         0.147  0.192 -0.214
## 0293.HK -0.127 -0.101                       -0.185        -0.328 -0.219
## 0322.HK               -0.451 -0.326 -0.131         0.158
## 0330.HK                              0.386  0.437  0.530 -0.162
## 0386.HK -0.132  0.225         0.302  0.192        -0.307
## 0388.HK -0.170                               0.121
## 0494.HK -0.131                0.121         0.172  0.146         0.515
## 0688.HK -0.154 -0.185               -0.102         0.118        -0.244
## 0700.HK -0.139                0.245 -0.164 -0.222
## 0762.HK -0.130  0.162 -0.219  0.170                -0.137  0.103
## 0836.HK               -0.159         0.654 -0.252        -0.161 -0.185
## 0857.HK -0.158  0.128         0.195  0.144        -0.183
## 0883.HK -0.171                0.156
## 0939.HK -0.174
## 0941.HK -0.112  0.324 -0.119                0.114 -0.166        -0.106
## 1044.HK -0.108        -0.423        -0.135                       0.175
## 1088.HK -0.170
## 1109.HK -0.149 -0.239                                            -0.238
## 1199.HK -0.159                0.172                0.148         0.148
## 1299.HK -0.134                                    -0.388                0.241
## 1398.HK -0.179                      -0.123
## 1880.HK -0.127        -0.174  0.147        -0.239  0.152
## 1898.HK -0.168                               0.126        -0.174
## 2318.HK -0.168                      -0.113  0.116 -0.114        -0.112
## 2388.HK -0.163                      -0.194               -0.181
## 2600.HK -0.157                               0.134                -0.193
## 2628.HK -0.157                               0.195 -0.103
## 3328.HK -0.175                0.105
## 3988.HK -0.172                               0.133
##         Comp.10 Comp.11 Comp.12 Comp.13 Comp.14 Comp.15 Comp.16 Comp.17
## 0001.HK                                                  0.130
## 0002.HK         -0.109                   0.156          -0.253
## 0003.HK  0.127   0.237                  -0.411  -0.193
## 0004.HK -0.111           0.137                           0.123
## 0005.HK                                                         -0.116
## 0006.HK         -0.300                  -0.187           0.321
## 0011.HK                  0.112                  -0.100
## 0012.HK                  0.130                   0.103          0.156
## 0013.HK                                                  0.144
## 0016.HK  0.104  -0.150                   0.125  -0.101
## 0017.HK  0.183  -0.221  -0.219   0.293   0.127   0.124
## 0019.HK  0.410  -0.150   0.112   0.157  -0.174                   0.105
## 0023.HK -0.108   0.182   0.140  -0.172  -0.105                  -0.295
## 0066.HK          0.151                   0.484           0.242
## 0083.HK                                  0.218
## 0101.HK                                 -0.214  -0.135           0.105
## 0144.HK         -0.122  -0.126                                  -0.273
## 0151.HK  0.125  -0.299                                          -0.333
## 0267.HK         -0.104   0.134           0.214
## 0291.HK  0.221   0.291  -0.200  -0.546           0.333  -0.162
## 0293.HK  0.380          -0.194  -0.258          -0.243  -0.112
## 0322.HK -0.312          -0.374                  -0.311  -0.217   0.241
## 0330.HK          0.196   0.168   0.199                  -0.168
```

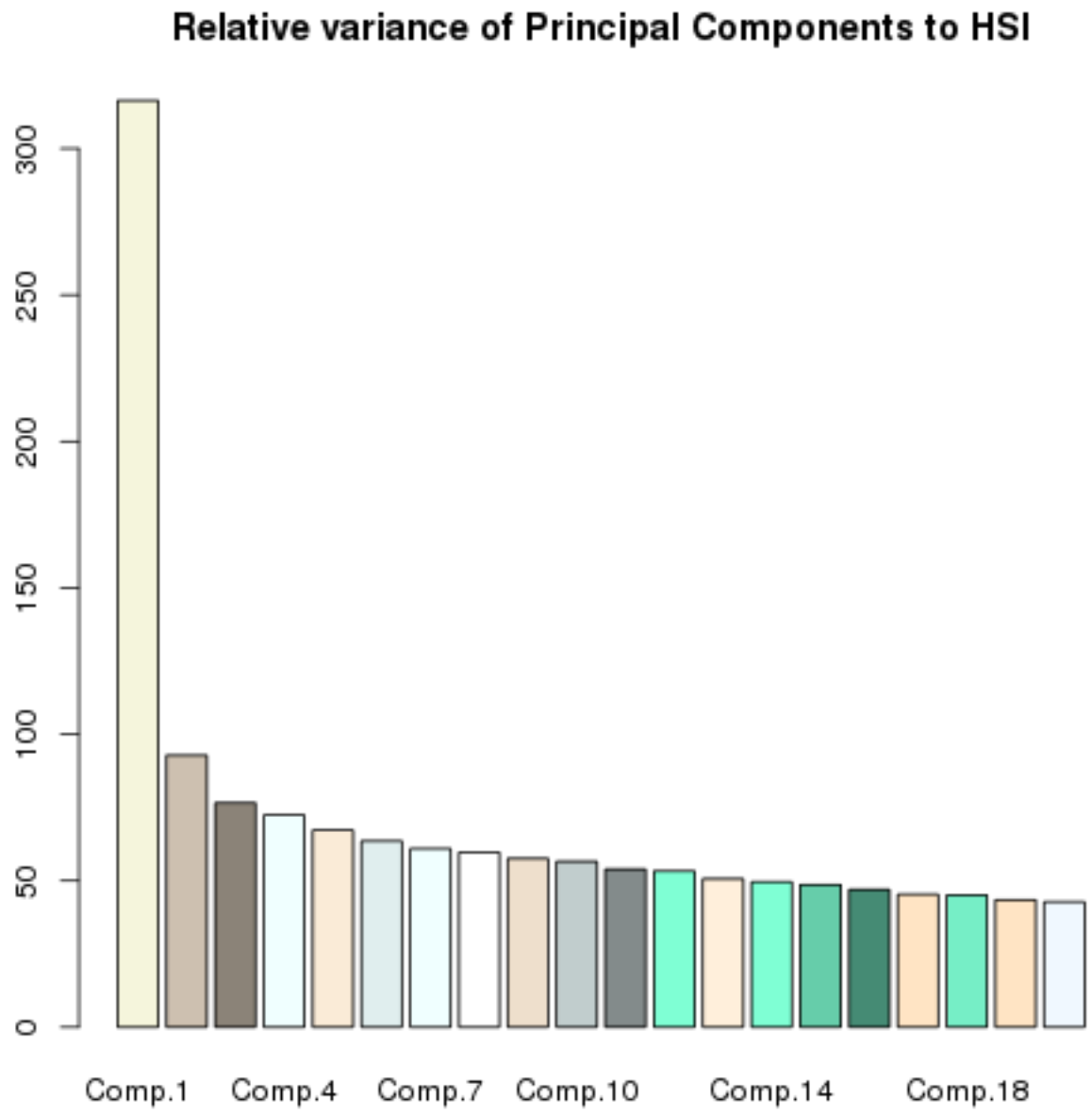
```
## 0386.HK                                          -0.154           0.251
## 0388.HK
## 0494.HK         -0.179          -0.317  -0.212
## 0688.HK -0.141   0.165   0.221                  -0.191   0.104
## 0700.HK                                  0.199  -0.212          -0.181
## 0762.HK                  0.367                   0.255  -0.416  -0.124
## 0836.HK -0.312  -0.212                                   0.180
## 0857.HK                                          -0.207  -0.204   0.181
## 0883.HK                                                  -0.235
## 0939.HK                 -0.232   0.131           0.190
## 0941.HK          0.354                   0.250           0.266  -0.115
## 1044.HK  0.122           0.210                   0.304   0.299   0.469
## 1088.HK                                  -0.137                  -0.192
## 1109.HK -0.158           0.290                  -0.145
## 1199.HK         -0.112  -0.213           0.174                  -0.155
## 1299.HK          0.261           0.322           0.146           0.102
## 1398.HK -0.144          -0.178                   0.143
## 1880.HK  0.335   0.283           0.343          -0.142
## 1898.HK                                  -0.116   0.164
## 2318.HK                                                  0.111   0.146
## 2388.HK                          0.147  -0.102   0.106  -0.131  -0.104
## 2600.HK
## 2628.HK -0.104                                   -0.208   0.126   0.228
## 3328.HK                 -0.169          -0.108   0.107
## 3988.HK -0.217          -0.208                   0.210
##         Comp.18 Comp.19 Comp.20 Comp.21 Comp.22 Comp.23 Comp.24 Comp.25
## 0001.HK                         -0.116
## 0002.HK                                  -0.269  -0.200
## 0003.HK  0.203  -0.331  -0.164  -0.106                           0.187
## 0004.HK                          0.112                          -0.188
## 0005.HK         -0.156          -0.170                          -0.249
## 0006.HK -0.101                           0.131   0.120          -0.123
## 0011.HK  0.117                   0.231   0.126
## 0012.HK          0.203  -0.110   0.185           0.162  -0.131
## 0013.HK                  0.101                   0.125           0.113
## 0016.HK          0.194          -0.207   0.204   0.149           0.164
## 0017.HK                  0.116          -0.394  -0.169  -0.155   0.181
## 0019.HK -0.356                   -0.146   0.148  -0.197  -0.125
## 0023.HK          0.122          -0.257   0.134          -0.158  -0.106
## 0066.HK         -0.135  -0.202   0.265          -0.102
## 0083.HK  0.143                   -0.138   0.344   0.115          -0.101
## 0101.HK          0.316   0.207   0.271  -0.117  -0.283  -0.302
## 0144.HK -0.222          -0.302                                   -0.213  -0.140
## 0151.HK  0.135   0.112           0.105   0.109  -0.201   0.201
## 0267.HK -0.129  -0.158                           0.347  -0.130
## 0291.HK -0.158  -0.225   0.154
## 0293.HK  0.305   0.217  -0.186          -0.157           0.314  -0.109
## 0322.HK -0.232                                   0.136
## 0330.HK  0.162   0.187   0.196  -0.102   0.124
## 0386.HK                  -0.105   0.111   0.183                   0.164
## 0388.HK  0.127  -0.170           0.207                   0.217
## 0494.HK -0.173   0.192                   -0.120   0.123   0.213   0.186
## 0688.HK                  -0.219  -0.137  -0.144  -0.115           0.162
## 0700.HK  0.178  -0.168   0.458           0.212          -0.135   0.415
## 0762.HK                                  -0.225   0.216   0.183
## 0836.HK         -0.140
## 0857.HK                  -0.111                           -0.208
```

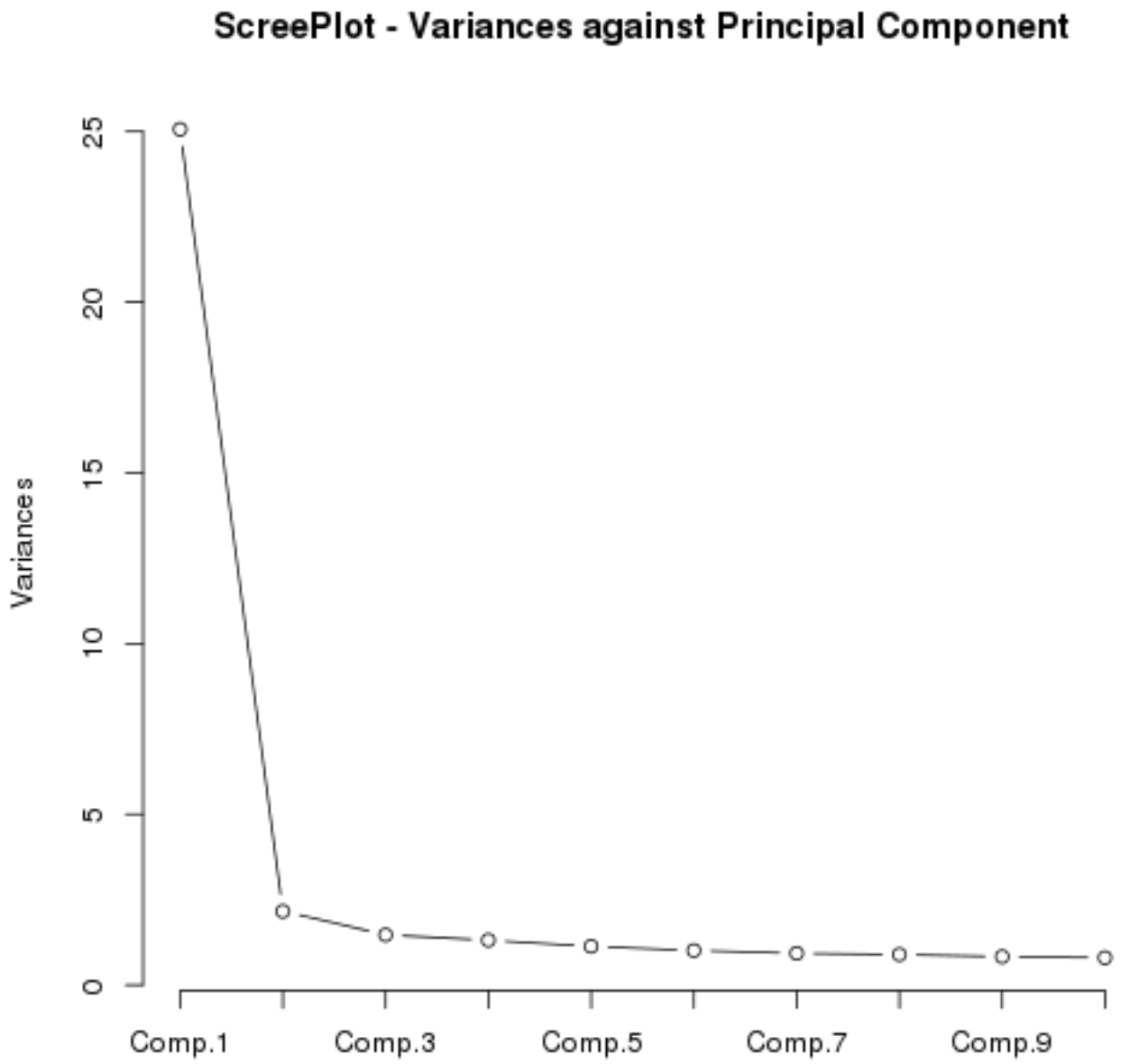
```
## 0883.HK  0.136          -0.162                   0.101
## 0939.HK  0.125   0.143                                    0.106
## 0941.HK -0.214   0.369   0.152          -0.244            0.144
## 1044.HK  0.274          -0.105  -0.170          -0.163  -0.216
## 1088.HK                  0.128                           -0.204  -0.210
## 1109.HK                 -0.253          -0.216  -0.129
## 1199.HK         -0.117  -0.155  -0.261
## 1299.HK -0.195                  -0.191   0.101  -0.253   0.466
## 1398.HK          0.108
## 1880.HK                          0.369           0.326          -0.201
## 1898.HK                                          0.166           0.294
## 2318.HK                  0.207                   0.220   0.107  -0.153
## 2388.HK  0.240                                  -0.135           0.144
## 2600.HK -0.241  -0.102  -0.221   0.284   0.245  -0.234   0.138   0.174
## 2628.HK         -0.332   0.254  -0.141  -0.133           0.183  -0.329
## 3328.HK  0.142                   0.103   0.129
## 3988.HK  0.128   0.124
##         Comp.26 Comp.27 Comp.28 Comp.29 Comp.30 Comp.31 Comp.32 Comp.33
## 0001.HK  0.133                                           -0.115   0.297
## 0002.HK  0.265          -0.111   0.103           0.285
## 0003.HK -0.222                   0.140   0.120
## 0004.HK          0.343  -0.246   0.203          -0.181   0.529   0.153
## 0005.HK  0.181                  -0.101   0.155          -0.184
## 0006.HK                  0.128          -0.223  -0.248
## 0011.HK -0.145           0.209  -0.507  -0.136   0.269           0.190
## 0012.HK         -0.228  -0.149                   0.185           0.148
## 0013.HK  0.117          -0.270          -0.139  -0.249  -0.417   0.200
## 0016.HK  0.263   0.154          -0.300   0.186                   -0.140
## 0017.HK -0.226   0.216   0.302                  -0.117
## 0019.HK  0.130  -0.199                   0.125           0.168
## 0023.HK -0.171   0.359   0.199   0.110   0.176
## 0066.HK  0.142  -0.186   0.175   0.103          -0.314
## 0083.HK -0.185  -0.249   0.146                  -0.119  -0.154  -0.194
## 0101.HK         -0.130   0.102   0.224                          -0.209
## 0144.HK -0.235  -0.210  -0.260  -0.123           0.154           0.226
## 0151.HK                          0.114  -0.280
## 0267.HK -0.292                           -0.349   0.198          -0.371
## 0291.HK                         -0.130  -0.197           0.170
## 0293.HK -0.196                                           -0.125
## 0322.HK                                  0.124  -0.180
## 0330.HK                                                          0.138
## 0386.HK                          -0.317          -0.119   0.130
## 0388.HK                  -0.200           0.157  -0.208          -0.265
## 0494.HK         -0.186   0.232
## 0688.HK         -0.142   0.136
## 0700.HK -0.123  -0.204           0.122                           0.106
## 0762.HK -0.185           0.108           0.210  -0.251  -0.124   0.129
## 0836.HK  0.138           0.123           0.164   0.131
## 0857.HK          0.185           0.132  -0.312  -0.106           0.117
## 0883.HK  0.133           0.177   0.282  -0.121           0.160   0.206
## 0939.HK         -0.152                                   0.123
## 0941.HK -0.106          -0.137                   0.123
## 1044.HK
## 1088.HK  0.109          -0.357  -0.144  -0.104          -0.147  -0.321
## 1109.HK  0.111                  -0.130          -0.216
## 1199.HK  0.126                                   0.226           0.127  -0.249
## 1299.HK                          0.135  -0.248
```

```
## 1398.HK                                                0.104   0.178
## 1880.HK  0.183   0.107   0.224          0.174                  -0.119
## 1898.HK  0.196   0.232          0.231          0.231  -0.305  -0.111
## 2318.HK         -0.171  -0.132                         0.127   0.182
## 2388.HK  0.194          -0.136  -0.211  -0.207
## 2600.HK -0.250   0.248  -0.119          0.185   0.136  -0.217   0.185
## 2628.HK                                        0.274  -0.194
## 3328.HK                 0.156          0.127
## 3988.HK         -0.141
##         Comp.34 Comp.35 Comp.36 Comp.37 Comp.38 Comp.39 Comp.40 Comp.41
## 0001.HK                                                 0.143   0.100
## 0002.HK  0.166  -0.156   0.181   0.114          -0.190
## 0003.HK          0.105
## 0004.HK  0.114          0.114                  0.142   0.191
## 0005.HK -0.232          -0.391   0.413                 0.412   0.105
## 0006.HK -0.114   0.106  -0.214
## 0011.HK -0.164   0.160   0.133                  0.278          -0.265
## 0012.HK                 -0.406          0.340   0.144          -0.136
## 0013.HK          0.109   0.197   0.255          -0.201  -0.144  -0.153
## 0016.HK          0.191  -0.137  -0.157  -0.243  -0.122  -0.214   0.135
## 0017.HK  0.138                          0.233
## 0019.HK                         0.113          0.187
## 0023.HK  0.119  -0.273                          -0.213  -0.169
## 0066.HK  0.105   0.138          -0.192
## 0083.HK -0.100  -0.370   0.421                                 0.142   0.111
## 0101.HK -0.132   0.143                  -0.414  -0.163
## 0144.HK  0.231  -0.248          -0.106  -0.301
## 0151.HK                                        -0.104          -0.153
## 0267.HK          0.176  -0.170   0.159          -0.217
## 0291.HK                                 -0.101
## 0293.HK                         -0.108
## 0322.HK                                                 0.105
## 0330.HK
## 0386.HK  0.270  -0.172                          -0.245   0.164  -0.196
## 0388.HK         -0.336  -0.176   0.229  -0.149   0.234          -0.113
## 0494.HK         -0.144   0.133   0.102   0.261                  0.166
## 0688.HK  0.135                  0.103                  0.290
## 0700.HK                 -0.169          0.115   0.113
## 0762.HK          0.175          -0.136  -0.151
## 0836.HK -0.128                                                 0.152
## 0857.HK -0.160  -0.171          -0.194          0.109  -0.149
## 0883.HK          0.130   0.162   0.281  -0.133   0.144  -0.215
## 0939.HK          0.213          0.216                          0.152
## 0941.HK -0.275                                  0.131
## 1044.HK
## 1088.HK  0.151   0.220   0.204          0.352   0.177          0.196
## 1109.HK                                        0.135  -0.194  -0.158
## 1199.HK -0.338   0.216   0.144  -0.178                         -0.404
## 1299.HK                 -0.189          0.127
## 1398.HK                                        -0.103          0.179
## 1880.HK         -0.106                                 -0.107
## 1898.HK  0.142                  -0.119  -0.149   0.375   0.276  -0.220
## 2318.HK -0.128          0.146                  -0.359          -0.349
## 2388.HK -0.346  -0.224          -0.380  -0.125                  0.274
## 2600.HK -0.324                                 -0.162  -0.102   0.244
## 2628.HK  0.181                  -0.141  -0.186          -0.228   0.152
## 3328.HK  0.183   0.141          -0.271   0.210           0.323
```

```
## 3988.HK                          0.141                  -0.319  -0.182
##         Comp.42 Comp.43 Comp.44 Comp.45 Comp.46 Comp.47 Comp.48
## 0001.HK  0.429           0.129   0.330   0.433   0.395
## 0002.HK                          -0.127
## 0003.HK                  -0.103
## 0004.HK -0.106  -0.242  -0.197  -0.178
## 0005.HK -0.109          -0.170  -0.127           0.108
## 0006.HK
## 0011.HK
## 0012.HK -0.168  -0.184           0.192          -0.194
## 0013.HK         -0.223   0.129          -0.319  -0.184  -0.129
## 0016.HK          0.199          -0.254  -0.100           0.111
## 0017.HK -0.160   0.107
## 0019.HK         -0.103
## 0023.HK                          0.249
## 0066.HK          0.162  -0.134
## 0083.HK
## 0101.HK
## 0144.HK
## 0151.HK
## 0267.HK  0.114  -0.182          -0.119
## 0291.HK
## 0293.HK -0.100          -0.111
## 0322.HK
## 0330.HK                          0.110
## 0386.HK -0.180  -0.180           0.174   0.137
## 0388.HK  0.270   0.278   0.333                  -0.101
## 0494.HK
## 0688.HK  0.130                   0.101          -0.575
## 0700.HK
## 0762.HK                                                 -0.127
## 0836.HK
## 0857.HK  0.480          -0.167  -0.122  -0.217  -0.116
## 0883.HK -0.377   0.159   0.372           0.111           0.162
## 0939.HK  0.112          -0.358   0.369  -0.383   0.169   0.335
## 0941.HK                  0.173
## 1044.HK
## 1088.HK          0.273           0.101   0.215
## 1109.HK -0.146                   -0.142  -0.139   0.517
## 1199.HK         -0.189           0.212
## 1299.HK
## 1398.HK          0.161                   -0.120          -0.811
## 1880.HK                  -0.106
## 1898.HK -0.146           -0.242
## 2318.HK          0.486  -0.122                           0.150
## 2388.HK -0.200  -0.195                           -0.114
## 2600.HK
## 2628.HK         -0.237           0.160
## 3328.HK  0.124           0.499  -0.290  -0.265           0.228
## 3988.HK  0.104  -0.240  -0.148  -0.416   0.493  -0.130
##
##                Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8
## SS loadings     1.000  1.000  1.000  1.000  1.000  1.000  1.000  1.000
## Proportion Var  0.021  0.021  0.021  0.021  0.021  0.021  0.021  0.021
## Cumulative Var  0.021  0.042  0.062  0.083  0.104  0.125  0.146  0.167
##                Comp.9 Comp.10 Comp.11 Comp.12 Comp.13 Comp.14 Comp.15
## SS loadings     1.000   1.000   1.000   1.000   1.000   1.000   1.000
```

```
## Proportion Var  0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var  0.187   0.208   0.229   0.250   0.271   0.292   0.312
##                Comp.16 Comp.17 Comp.18 Comp.19 Comp.20 Comp.21 Comp.22
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.333   0.354   0.375   0.396   0.417   0.438   0.458
##                Comp.23 Comp.24 Comp.25 Comp.26 Comp.27 Comp.28 Comp.29
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.479   0.500   0.521   0.542   0.562   0.583   0.604
##                Comp.30 Comp.31 Comp.32 Comp.33 Comp.34 Comp.35 Comp.36
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.625   0.646   0.667   0.688   0.708   0.729   0.750
##                Comp.37 Comp.38 Comp.39 Comp.40 Comp.41 Comp.42 Comp.43
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.771   0.792   0.812   0.833   0.854   0.875   0.896
##                Comp.44 Comp.45 Comp.46 Comp.47 Comp.48
## SS loadings      1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.917   0.938   0.958   0.979   1.000
```


Relative variance of Principal Components to HSI
0
50
100
150
200
250
300
Comp.1
Comp.4
Comp.7
Comp.10
Comp.14
Comp.18



The Cattell scree test plots the components as the X axis and the corresponding eigenvalues as the Y-axis. As one moves to the right, toward later components, the eigenvalues drop. When the drop ceases and the curve makes an elbow toward less steep decline, Cattell's scree test says to drop all further components after the one starting the elbow. This rule is sometimes criticised for being amenable to researcher-controlled "fudging". That is, as picking the "elbow" can be subjective because the curve has multiple elbows or is a smooth curve, the researcher may be tempted to set the cut-off at the number of factors desired by his or her research agenda.

5.2 PCA with psyche package principal Function

principal(...) Does an eigen value decomposition and returns eigen values, loadings, and degree of fit for a specified number of components. Basically it is just doing a principal components analysis (PCA) for n principal components of either a correlation or covariance matrix. Can show the residual correlations as well. The quality of reduction in the squared correlations is reported by comparing residual correlations to original correlations. Unlike princomp, this returns a subset of just the best nfactors. The eigen vectors are rescaled by the sqrt of the eigen values to produce the component loadings more typical in factor analysis.[6]

Rotation Methods[7] The unrotated output maximises the variance accounted for by the first and subsequent factors, and forcing the factors to be orthogonal. This data-compression comes at the cost of having most items load on the early factors, and usually, of having many items load substantially on more than one factor. Rotation serves to make the output more understandable, by seeking so-called "Simple Structure": A pattern of loadings where items load most strongly on one factor, and much more weakly on the other factors. Rotations can be orthogonal or oblique (allowing the factors to correlate).

[6] from psyche package help(principal)

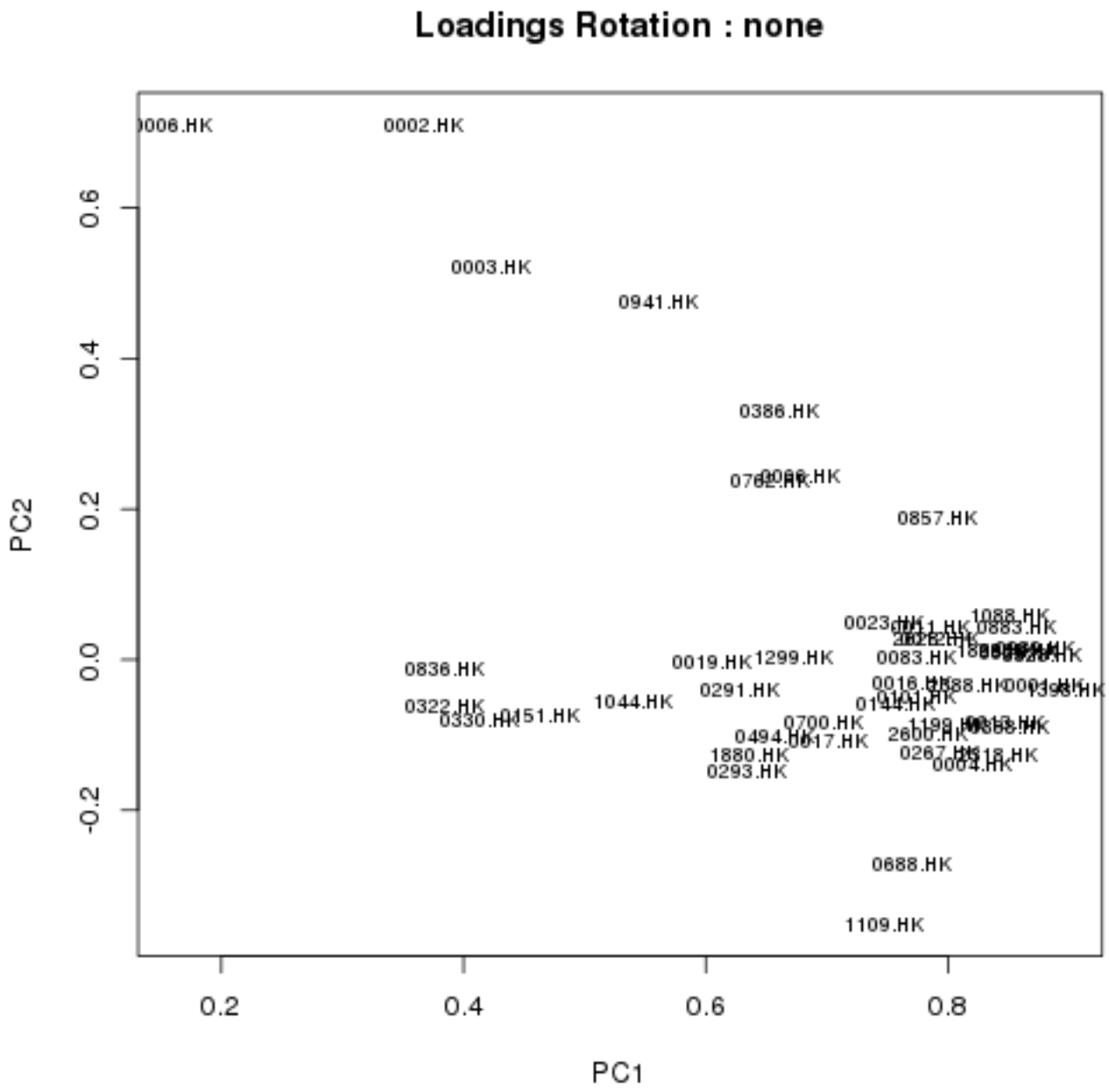
[7] http://en.wikipedia.org/wiki/Factoranalysis

5.2.1 Rotation : none

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "none")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item  PC1   PC2   PC3   PC4   PC5   h2   u2
## 1398.HK   40 0.90 -0.04 -0.02 -0.08 -0.13 0.83 0.17
## 0001.HK    1 0.88 -0.03 -0.13  0.20  0.02 0.83 0.17
## 3328.HK   47 0.88  0.01 -0.01 -0.12 -0.02 0.79 0.21
## 0939.HK   33 0.87  0.02  0.02 -0.06 -0.08 0.77 0.23
## 3988.HK   48 0.86  0.01  0.01 -0.05 -0.07 0.75 0.25
## 0005.HK    5 0.86  0.01 -0.07 -0.06 -0.01 0.75 0.25
## 0883.HK   32 0.86  0.04  0.03 -0.18 -0.01 0.77 0.23
## 0388.HK   25 0.85 -0.09 -0.11  0.11 -0.05 0.76 0.24
## 1088.HK   36 0.85  0.06  0.08 -0.09  0.04 0.74 0.26
## 0013.HK    9 0.85 -0.08 -0.08  0.13  0.09 0.76 0.24
## 2318.HK   43 0.84 -0.12 -0.09 -0.08 -0.12 0.75 0.25
## 1898.HK   42 0.84  0.01 -0.01 -0.09 -0.04 0.71 0.29
## 0004.HK    4 0.82 -0.14 -0.14  0.11  0.00 0.72 0.28
## 2388.HK   44 0.82 -0.03 -0.01  0.09 -0.21 0.72 0.28
## 1199.HK   38 0.80 -0.09 -0.08 -0.20  0.10 0.70 0.30
## 0012.HK    8 0.79  0.03 -0.19  0.21  0.04 0.71 0.29
## 0267.HK   19 0.79 -0.12  0.06  0.13  0.05 0.67 0.33
## 0857.HK   31 0.79  0.19  0.01 -0.22  0.15 0.73 0.27
## 2628.HK   46 0.79  0.03 -0.06 -0.10 -0.07 0.64 0.36
## 0011.HK    7 0.79  0.04 -0.04  0.26 -0.07 0.69 0.31
## 2600.HK   45 0.78 -0.10 -0.06 -0.10 -0.09 0.65 0.35
## 0083.HK   15 0.77  0.00 -0.22  0.14  0.04 0.67 0.33
## 0101.HK   16 0.77 -0.05 -0.17  0.05  0.10 0.64 0.36
## 0688.HK   27 0.77 -0.27 -0.06 -0.11 -0.11 0.70 0.30
## 0016.HK   10 0.77 -0.03 -0.26  0.20 -0.04 0.70 0.30
## 0144.HK   17 0.76 -0.06  0.07 -0.19  0.14 0.64 0.36
## 1109.HK   37 0.75 -0.35 -0.03 -0.09 -0.07 0.70 0.30
## 0023.HK   13 0.75  0.05  0.09  0.17 -0.21 0.64 0.36
## 0017.HK   11 0.70 -0.11 -0.24  0.17  0.08 0.60 0.40
## 0700.HK   28 0.70 -0.08  0.05 -0.28 -0.17 0.60 0.40
## 0066.HK   14 0.68  0.24  0.05  0.20  0.07 0.57 0.43
## 1299.HK   39 0.67  0.00  0.03  0.07  0.06 0.46 0.54
## 0386.HK   24 0.66  0.33 -0.02 -0.35  0.20 0.71 0.29
## 0494.HK   26 0.66 -0.10  0.03 -0.14 -0.02 0.46 0.54
## 0762.HK   29 0.65  0.24  0.27 -0.19 -0.02 0.59 0.41
## 1880.HK   41 0.64 -0.13  0.21 -0.17 -0.04 0.49 0.51
## 0293.HK   21 0.63 -0.15  0.03  0.05  0.04 0.43 0.57
## 0291.HK   20 0.63 -0.04  0.03  0.03  0.12 0.41 0.59
## 0019.HK   12 0.60  0.00  0.07  0.25 -0.03 0.43 0.57
## 0941.HK   34 0.56  0.48  0.14 -0.08  0.08 0.58 0.42
## 1044.HK   35 0.54 -0.05  0.51 -0.04 -0.14 0.58 0.42
## 0330.HK   23 0.41 -0.08  0.02 -0.08  0.41 0.35 0.65
## 0002.HK    2 0.37  0.71 -0.03  0.13 -0.18 0.69 0.31
## 0006.HK    6 0.16  0.71 -0.10 -0.18 -0.16 0.60 0.40
## 0003.HK    3 0.42  0.52 -0.04  0.33  0.14 0.58 0.42
## 0151.HK   18 0.46 -0.07  0.59  0.14  0.03 0.59 0.41
## 0322.HK   22 0.39 -0.06  0.55  0.37 -0.14 0.61 0.39
## 0836.HK   30 0.38 -0.01  0.19  0.10  0.70 0.68 0.32
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.07 2.16 1.47 1.31 1.13
```

```
## Proportion Var  0.52 0.04 0.03 0.03 0.02
## Cumulative Var  0.52 0.57 0.60 0.63 0.65
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  44.91 0.3
## The degrees of freedom for the model are 898  and the objective function was  7.27
##  0.3The number of observations was  242  with Chi Square =  1605  with prob <  1.2e-42
##  0.3
## Fit based upon off diagonal values = 1
##             PC1       PC2
## 0001.HK 0.8796 -0.032449
## 0002.HK 0.3678  0.710395
## 0003.HK 0.4226  0.521918
## 0004.HK 0.8203 -0.139148
## 0005.HK 0.8593  0.008231
## 0006.HK 0.1608  0.710250
## 0011.HK 0.7857  0.043107
## 0012.HK 0.7938  0.026850
## 0013.HK 0.8477 -0.083271
## 0016.HK 0.7706 -0.029544
## 0017.HK 0.7013 -0.108729
## 0019.HK 0.6049 -0.004503
## 0023.HK 0.7467  0.049781
## 0066.HK 0.6782  0.243905
## 0083.HK 0.7742  0.004266
## 0101.HK 0.7733 -0.050090
## 0144.HK 0.7564 -0.057914
## 0151.HK 0.4628 -0.073532
## 0267.HK 0.7925 -0.123482
## 0291.HK 0.6274 -0.039980
## 0293.HK 0.6341 -0.149121
## 0322.HK 0.3850 -0.061389
## 0330.HK 0.4127 -0.081453
## 0386.HK 0.6606  0.330043
## 0388.HK 0.8518 -0.090278
## 0494.HK 0.6573 -0.100544
## 0688.HK 0.7711 -0.272539
## 0700.HK 0.6974 -0.083727
## 0762.HK 0.6528  0.238099
## 0836.HK 0.3848 -0.012142
## 0857.HK 0.7906  0.188654
## 0883.HK 0.8564  0.043924
## 0939.HK 0.8718  0.016520
## 0941.HK 0.5613  0.475989
## 1044.HK 0.5405 -0.054705
## 1088.HK 0.8505  0.059076
## 1109.HK 0.7471 -0.351183
## 1199.HK 0.7983 -0.085439
## 1299.HK 0.6725  0.004501
## 1398.HK 0.8979 -0.039335
## 1880.HK 0.6356 -0.127981
## 1898.HK 0.8389  0.012536
## 2318.HK 0.8406 -0.124987
## 2388.HK 0.8172 -0.033144
## 2600.HK 0.7839 -0.099002
## 2628.HK 0.7881  0.027949
```

```
## 3328.HK 0.8785  0.007638
## 3988.HK 0.8594  0.012437
```



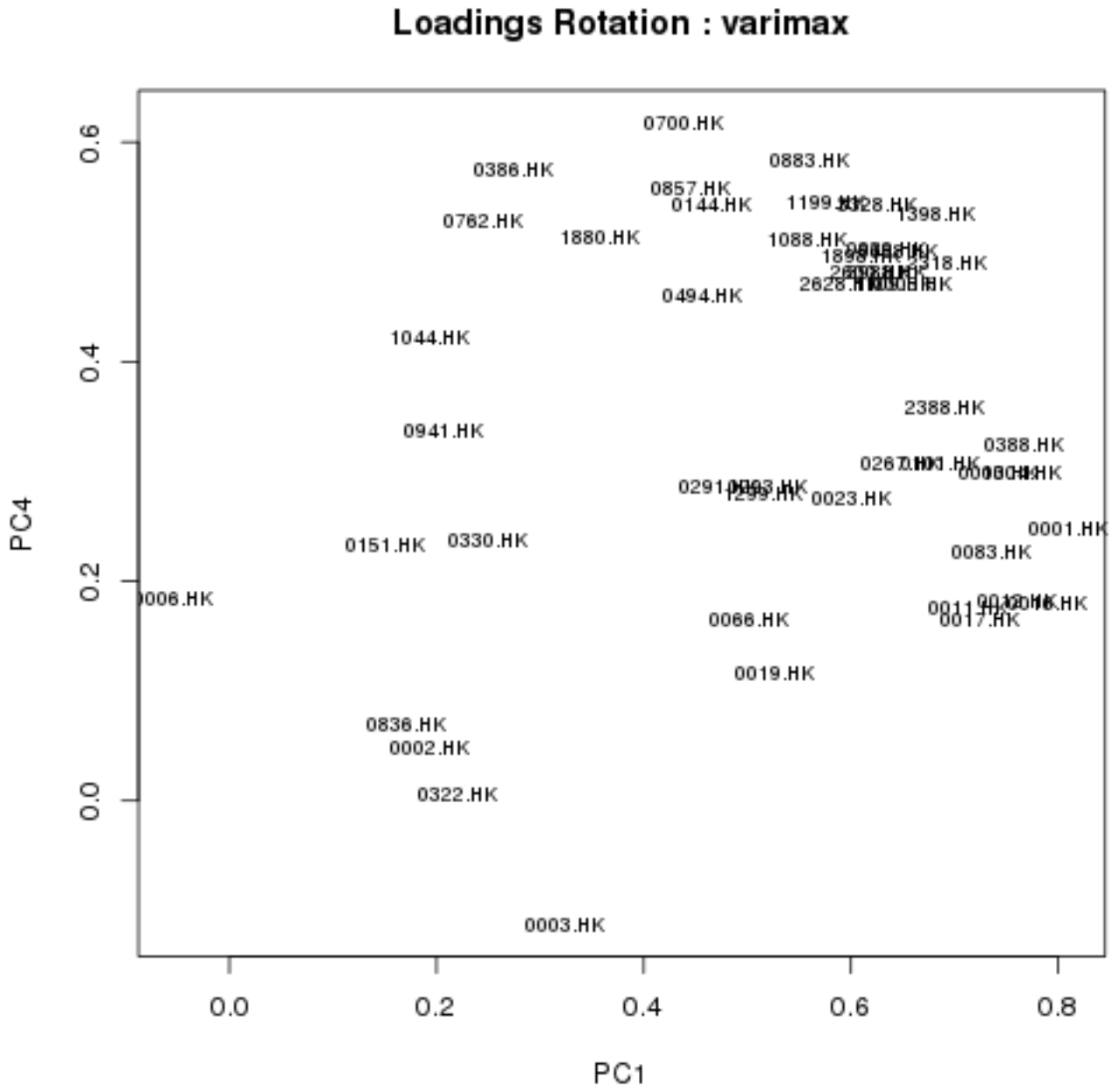
5.2.2 Rotation : varimax

Varimax rotation is an orthogonal rotation of the factor axes to maximize the variance of the squared loadings of a factor (column) on all the variables (rows) in a factor matrix, which has the effect of differentiating the original variables by extracted factor. Each factor will tend to have either large or small loadings of any particular variable. A varimax solution yields results which make it as easy as possible to identify each variable with a single factor. This is the most common rotation option.

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "varimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item   PC1   PC4   PC2   PC3   PC5   h2   u2
## 0001.HK    1  0.81  0.25  0.20  0.20  0.19 0.83 0.17
## 0016.HK   10  0.79  0.18  0.18  0.07  0.09 0.70 0.30
## 0388.HK   25  0.77  0.32  0.13  0.19  0.12 0.76 0.24
## 0004.HK    4  0.76  0.30  0.07  0.15  0.15 0.72 0.28
## 0012.HK    8  0.76  0.18  0.24  0.11  0.19 0.71 0.29
## 0013.HK    9  0.74  0.30  0.13  0.19  0.25 0.76 0.24
## 0083.HK   15  0.74  0.23  0.20  0.06  0.18 0.67 0.33
## 0017.HK   11  0.72  0.17  0.08  0.04  0.19 0.60 0.40
## 0011.HK    7  0.71  0.18  0.25  0.28  0.09 0.69 0.31
## 2318.HK   43  0.69  0.49  0.08  0.15  0.04 0.75 0.25
## 2388.HK   44  0.69  0.36  0.18  0.28 -0.03 0.72 0.28
## 0101.HK   16  0.69  0.31  0.14  0.06  0.24 0.64 0.36
## 1398.HK   40  0.68  0.53  0.18  0.22  0.06 0.83 0.17
## 0005.HK    5  0.66  0.47  0.21  0.14  0.16 0.75 0.25
## 0267.HK   19  0.65  0.31  0.07  0.31  0.22 0.67 0.33
## 0688.HK   27  0.64  0.50 -0.08  0.15  0.04 0.70 0.30
## 1109.HK   37  0.64  0.47 -0.16  0.17  0.08 0.70 0.30
## 0939.HK   33  0.63  0.50  0.22  0.24  0.10 0.77 0.23
## 3988.HK   48  0.63  0.48  0.22  0.23  0.12 0.75 0.25
## 3328.HK   47  0.63  0.54  0.21  0.18  0.16 0.79 0.21
## 2600.HK   45  0.62  0.48  0.09  0.14  0.07 0.65 0.35
## 1898.HK   42  0.61  0.50  0.21  0.18  0.14 0.71 0.29
## 0023.HK   13  0.60  0.28  0.25  0.37 -0.03 0.64 0.36
## 2628.HK   46  0.59  0.47  0.21  0.13  0.09 0.64 0.36
## 1199.HK   38  0.58  0.54  0.09  0.06  0.25 0.70 0.30
## 1088.HK   36  0.56  0.51  0.25  0.24  0.23 0.74 0.26
## 0019.HK   12  0.53  0.12  0.16  0.32  0.11 0.43 0.57
## 0293.HK   21  0.52  0.29  0.01  0.21  0.18 0.43 0.57
## 1299.HK   39  0.52  0.28  0.17  0.22  0.21 0.46 0.54
## 0066.HK   14  0.50  0.17  0.41  0.27  0.23 0.57 0.43
## 0291.HK   20  0.47  0.29  0.10  0.18  0.25 0.41 0.59
## 0700.HK   28  0.44  0.62  0.07  0.15 -0.03 0.60 0.40
## 0883.HK   32  0.56  0.58  0.23  0.18  0.17 0.77 0.23
## 0386.HK   24  0.27  0.58  0.44 -0.04  0.33 0.71 0.29
## 0857.HK   31  0.45  0.56  0.34  0.09  0.31 0.73 0.27
## 0144.HK   17  0.47  0.54  0.10  0.17  0.29 0.64 0.36
## 0762.HK   29  0.25  0.53  0.36  0.31  0.15 0.59 0.41
## 1880.HK   41  0.36  0.51  0.01  0.30  0.12 0.49 0.51
## 0494.HK   26  0.46  0.46  0.05  0.16  0.11 0.46 0.54
## 0002.HK    2  0.19  0.05  0.80  0.10 -0.09 0.69 0.31
## 0006.HK    6 -0.05  0.18  0.72 -0.14 -0.13 0.60 0.40
## 0003.HK    3  0.32 -0.11  0.62  0.14  0.23 0.58 0.42
## 0941.HK   34  0.21  0.34  0.58  0.19  0.22 0.58 0.42
## 0322.HK   22  0.22  0.01  0.05  0.75  0.03 0.61 0.39
## 0151.HK   18  0.15  0.23  0.03  0.69  0.21 0.59 0.41
## 1044.HK   35  0.19  0.42  0.07  0.60  0.04 0.58 0.42
```

```
## 0836.HK   30  0.17  0.07  0.04  0.18  0.78 0.68 0.32
## 0330.HK   23  0.25  0.24 -0.01  0.02  0.48 0.35 0.65
##
##                  PC1  PC4  PC2  PC3  PC5
## SS loadings    15.10 7.32 3.45 3.08 2.19
## Proportion Var  0.31 0.15 0.07 0.06 0.05
## Cumulative Var  0.31 0.47 0.54 0.60 0.65
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  44.91 0.3
## The degrees of freedom for the model are 898  and the objective function was  7.27
##  0.3The number of observations was  242  with Chi Square =  1605  with prob <  1.2e-42
##  0.3
## Fit based upon off diagonal values = 1
##              PC1       PC4
## 0001.HK  0.81080  0.247370
## 0002.HK  0.19366  0.047414
## 0003.HK  0.32385 -0.112664
## 0004.HK  0.76392  0.299101
## 0005.HK  0.65983  0.471355
## 0006.HK -0.05315  0.184960
## 0011.HK  0.71408  0.176352
## 0012.HK  0.76010  0.182678
## 0013.HK  0.74159  0.298143
## 0016.HK  0.78992  0.179075
## 0017.HK  0.72365  0.165758
## 0019.HK  0.52655  0.116755
## 0023.HK  0.60074  0.275028
## 0066.HK  0.50103  0.165112
## 0083.HK  0.73667  0.225677
## 0101.HK  0.68537  0.307730
## 0144.HK  0.46617  0.542746
## 0151.HK  0.15066  0.234076
## 0267.HK  0.64755  0.307369
## 0291.HK  0.47239  0.285091
## 0293.HK  0.51954  0.286759
## 0322.HK  0.22004  0.006395
## 0330.HK  0.24975  0.236367
## 0386.HK  0.27334  0.575272
## 0388.HK  0.76827  0.323940
## 0494.HK  0.45693  0.461072
## 0688.HK  0.64467  0.500073
## 0700.HK  0.43961  0.617842
## 0762.HK  0.24607  0.529250
## 0836.HK  0.17080  0.068945
## 0857.HK  0.44565  0.558202
## 0883.HK  0.56003  0.583073
## 0939.HK  0.63468  0.503340
## 0941.HK  0.20741  0.336605
## 1044.HK  0.19264  0.422667
## 1088.HK  0.55715  0.511746
## 1109.HK  0.64123  0.471381
## 1199.HK  0.57519  0.544414
## 1299.HK  0.51545  0.280673
## 1398.HK  0.68172  0.534402
## 1880.HK  0.35760  0.512661
```

```
## 1898.HK  0.60878  0.496735
## 2318.HK  0.69236  0.490579
## 2388.HK  0.69100  0.357532
## 2600.HK  0.61903  0.480751
## 2628.HK  0.58835  0.470412
## 3328.HK  0.62558  0.542439
## 3988.HK  0.63386  0.480575
```



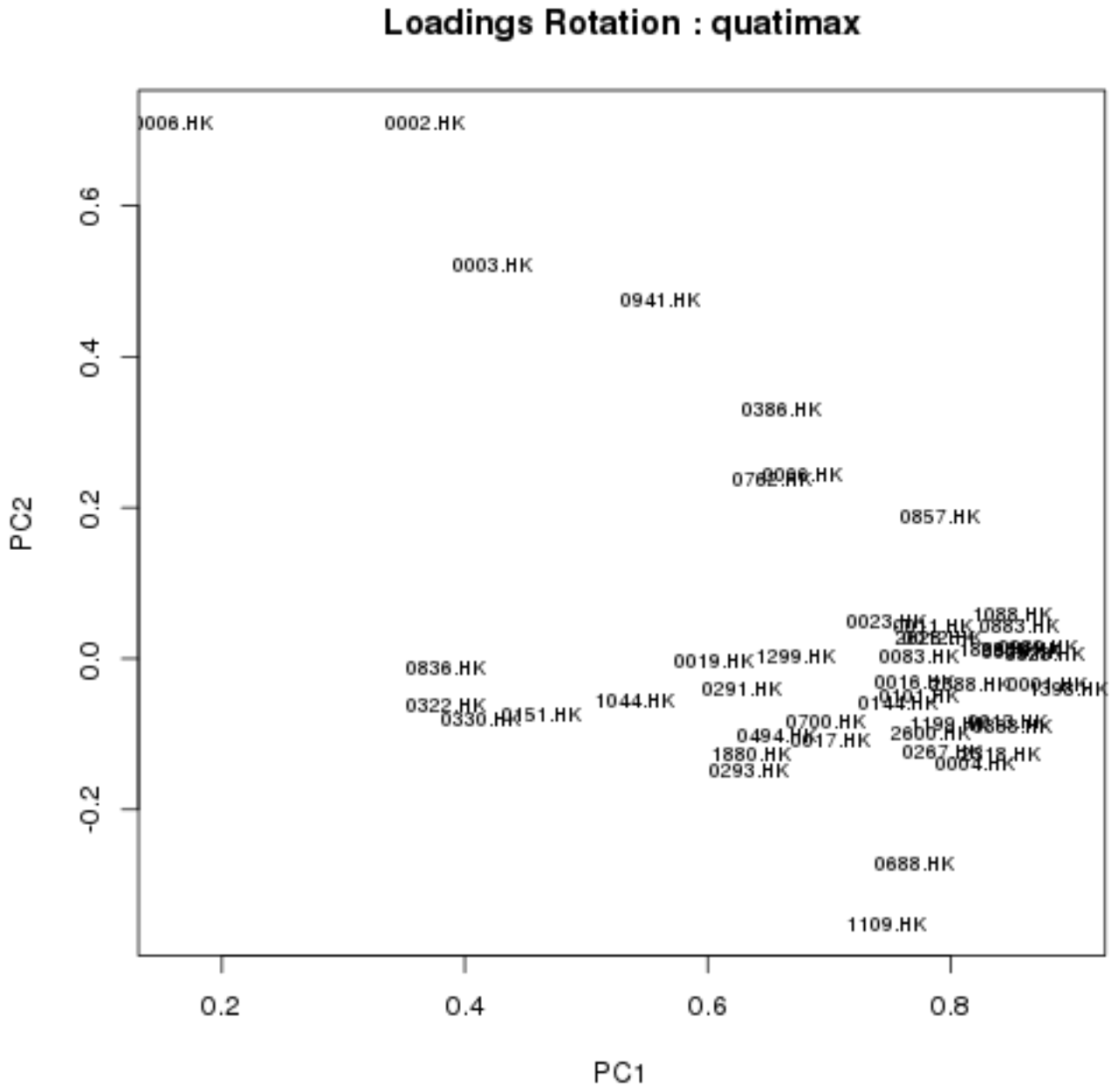
5.2.3 Rotation : quatimax

Quartimax rotation is an orthogonal alternative which minimizes the number of factors needed to explain each variable. This type of rotation often generates a general factor on which most variables are loaded to a high or medium degree. Such a factor structure is usually not helpful to the research purpose.

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "quatimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item  PC1   PC2   PC3   PC4   PC5   h2   u2
## 1398.HK   40 0.90 -0.04 -0.02 -0.08 -0.13 0.83 0.17
## 0001.HK    1 0.88 -0.03 -0.13  0.20  0.02 0.83 0.17
## 3328.HK   47 0.88  0.01 -0.01 -0.12 -0.02 0.79 0.21
## 0939.HK   33 0.87  0.02  0.02 -0.06 -0.08 0.77 0.23
## 3988.HK   48 0.86  0.01  0.01 -0.05 -0.07 0.75 0.25
## 0005.HK    5 0.86  0.01 -0.07 -0.06 -0.01 0.75 0.25
## 0883.HK   32 0.86  0.04  0.03 -0.18 -0.01 0.77 0.23
## 0388.HK   25 0.85 -0.09 -0.11  0.11 -0.05 0.76 0.24
## 1088.HK   36 0.85  0.06  0.08 -0.09  0.04 0.74 0.26
## 0013.HK    9 0.85 -0.08 -0.08  0.13  0.09 0.76 0.24
## 2318.HK   43 0.84 -0.12 -0.09 -0.08 -0.12 0.75 0.25
## 1898.HK   42 0.84  0.01 -0.01 -0.09 -0.04 0.71 0.29
## 0004.HK    4 0.82 -0.14 -0.14  0.11  0.00 0.72 0.28
## 2388.HK   44 0.82 -0.03 -0.01  0.09 -0.21 0.72 0.28
## 1199.HK   38 0.80 -0.09 -0.08 -0.20  0.10 0.70 0.30
## 0012.HK    8 0.79  0.03 -0.19  0.21  0.04 0.71 0.29
## 0267.HK   19 0.79 -0.12  0.06  0.13  0.05 0.67 0.33
## 0857.HK   31 0.79  0.19  0.01 -0.22  0.15 0.73 0.27
## 2628.HK   46 0.79  0.03 -0.06 -0.10 -0.07 0.64 0.36
## 0011.HK    7 0.79  0.04 -0.04  0.26 -0.07 0.69 0.31
## 2600.HK   45 0.78 -0.10 -0.06 -0.10 -0.09 0.65 0.35
## 0083.HK   15 0.77  0.00 -0.22  0.14  0.04 0.67 0.33
## 0101.HK   16 0.77 -0.05 -0.17  0.05  0.10 0.64 0.36
## 0688.HK   27 0.77 -0.27 -0.06 -0.11 -0.11 0.70 0.30
## 0016.HK   10 0.77 -0.03 -0.26  0.20 -0.04 0.70 0.30
## 0144.HK   17 0.76 -0.06  0.07 -0.19  0.14 0.64 0.36
## 1109.HK   37 0.75 -0.35 -0.03 -0.09 -0.07 0.70 0.30
## 0023.HK   13 0.75  0.05  0.09  0.17 -0.21 0.64 0.36
## 0017.HK   11 0.70 -0.11 -0.24  0.17  0.08 0.60 0.40
## 0700.HK   28 0.70 -0.08  0.05 -0.28 -0.17 0.60 0.40
## 0066.HK   14 0.68  0.24  0.05  0.20  0.07 0.57 0.43
## 1299.HK   39 0.67  0.00  0.03  0.07  0.06 0.46 0.54
## 0386.HK   24 0.66  0.33 -0.02 -0.35  0.20 0.71 0.29
## 0494.HK   26 0.66 -0.10  0.03 -0.14 -0.02 0.46 0.54
## 0762.HK   29 0.65  0.24  0.27 -0.19 -0.02 0.59 0.41
## 1880.HK   41 0.64 -0.13  0.21 -0.17 -0.04 0.49 0.51
## 0293.HK   21 0.63 -0.15  0.03  0.05  0.04 0.43 0.57
## 0291.HK   20 0.63 -0.04  0.03  0.03  0.12 0.41 0.59
## 0019.HK   12 0.60  0.00  0.07  0.25 -0.03 0.43 0.57
## 0941.HK   34 0.56  0.48  0.14 -0.08  0.08 0.58 0.42
## 1044.HK   35 0.54 -0.05  0.51 -0.04 -0.14 0.58 0.42
## 0330.HK   23 0.41 -0.08  0.02 -0.08  0.41 0.35 0.65
## 0002.HK    2 0.37  0.71 -0.03  0.13 -0.18 0.69 0.31
## 0006.HK    6 0.16  0.71 -0.10 -0.18 -0.16 0.60 0.40
## 0003.HK    3 0.42  0.52 -0.04  0.33  0.14 0.58 0.42
## 0151.HK   18 0.46 -0.07  0.59  0.14  0.03 0.59 0.41
## 0322.HK   22 0.39 -0.06  0.55  0.37 -0.14 0.61 0.39
## 0836.HK   30 0.38 -0.01  0.19  0.10  0.70 0.68 0.32
```

```
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.07 2.16 1.47 1.31 1.13
## Proportion Var  0.52 0.04 0.03 0.03 0.02
## Cumulative Var  0.52 0.57 0.60 0.63 0.65
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  44.91 0.3
## The degrees of freedom for the model are 898  and the objective function was  7.27
##  0.3The number of observations was  242  with Chi Square =  1605  with prob <  1.2e-42
##  0.3
## Fit based upon off diagonal values = 1
##            PC1       PC2
## 0001.HK 0.8796 -0.032449
## 0002.HK 0.3678  0.710395
## 0003.HK 0.4226  0.521918
## 0004.HK 0.8203 -0.139148
## 0005.HK 0.8593  0.008231
## 0006.HK 0.1608  0.710250
## 0011.HK 0.7857  0.043107
## 0012.HK 0.7938  0.026850
## 0013.HK 0.8477 -0.083271
## 0016.HK 0.7706 -0.029544
## 0017.HK 0.7013 -0.108729
## 0019.HK 0.6049 -0.004503
## 0023.HK 0.7467  0.049781
## 0066.HK 0.6782  0.243905
## 0083.HK 0.7742  0.004266
## 0101.HK 0.7733 -0.050090
## 0144.HK 0.7564 -0.057914
## 0151.HK 0.4628 -0.073532
## 0267.HK 0.7925 -0.123482
## 0291.HK 0.6274 -0.039980
## 0293.HK 0.6341 -0.149121
## 0322.HK 0.3850 -0.061389
## 0330.HK 0.4127 -0.081453
## 0386.HK 0.6606  0.330043
## 0388.HK 0.8518 -0.090278
## 0494.HK 0.6573 -0.100544
## 0688.HK 0.7711 -0.272539
## 0700.HK 0.6974 -0.083727
## 0762.HK 0.6528  0.238099
## 0836.HK 0.3848 -0.012142
## 0857.HK 0.7906  0.188654
## 0883.HK 0.8564  0.043924
## 0939.HK 0.8718  0.016520
## 0941.HK 0.5613  0.475989
## 1044.HK 0.5405 -0.054705
## 1088.HK 0.8505  0.059076
## 1109.HK 0.7471 -0.351183
## 1199.HK 0.7983 -0.085439
## 1299.HK 0.6725  0.004501
## 1398.HK 0.8979 -0.039335
## 1880.HK 0.6356 -0.127981
## 1898.HK 0.8389  0.012536
## 2318.HK 0.8406 -0.124987
```

```
## 2388.HK 0.8172 -0.033144
## 2600.HK 0.7839 -0.099002
## 2628.HK 0.7881  0.027949
## 3328.HK 0.8785  0.007638
## 3988.HK 0.8594  0.012437
```



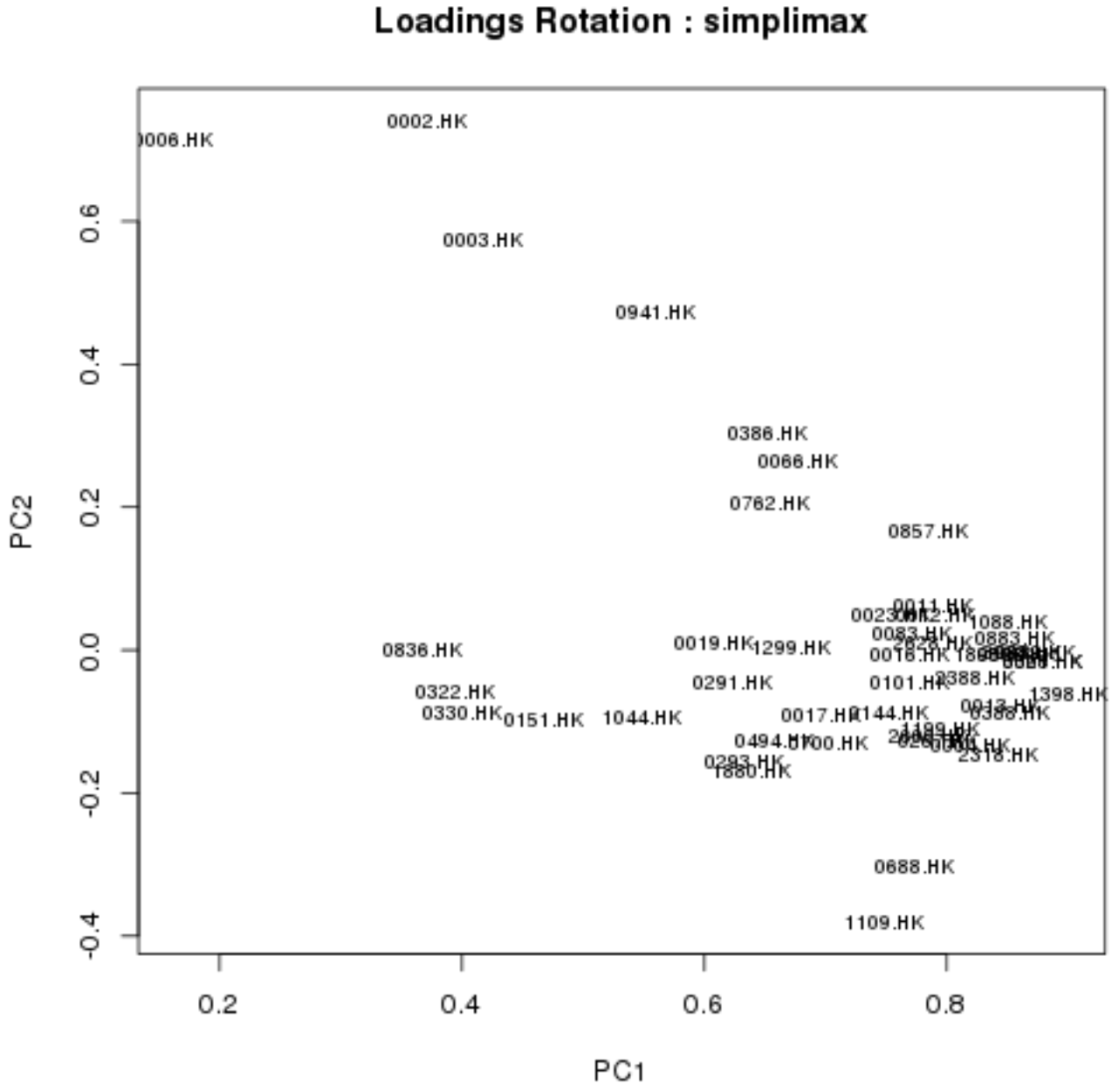
5.2.4 Rotation : simplimax

A compromise between Varimax and Quartimax criteria.

```
## Warning message: convergence not obtained in GPFoblq. 1000 iterations used.
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "simplimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item  PC1   PC2   PC3   PC4   PC5   h2   u2
## 1398.HK   40 0.90 -0.06 -0.04  0.09 -0.09 0.83 0.17
## 3328.HK   47 0.88 -0.01 -0.03  0.13  0.01 0.79 0.21
## 0001.HK    1 0.88 -0.02 -0.14 -0.18  0.07 0.83 0.17
## 0939.HK   33 0.87  0.00  0.00  0.06 -0.05 0.77 0.23
## 3988.HK   48 0.86  0.00  0.00  0.05 -0.03 0.75 0.25
## 0005.HK    5 0.86  0.00 -0.09  0.08  0.02 0.75 0.25
## 0883.HK   32 0.86  0.02  0.01  0.18  0.01 0.77 0.23
## 0388.HK   25 0.85 -0.09 -0.13 -0.08  0.00 0.76 0.24
## 1088.HK   36 0.85  0.04  0.06  0.10  0.07 0.74 0.26
## 0013.HK    9 0.84 -0.08 -0.10 -0.08  0.14 0.76 0.24
## 2318.HK   43 0.84 -0.14 -0.11  0.10 -0.08 0.75 0.25
## 1898.HK   42 0.84 -0.01 -0.03  0.10  0.00 0.71 0.29
## 2388.HK   44 0.82 -0.04 -0.02 -0.11 -0.15 0.72 0.28
## 0004.HK    4 0.82 -0.13 -0.16 -0.07  0.05 0.72 0.28
## 1199.HK   38 0.79 -0.11 -0.10  0.25  0.12 0.70 0.30
## 0267.HK   19 0.79 -0.13  0.04 -0.09  0.11 0.67 0.33
## 0012.HK    8 0.79  0.05 -0.20 -0.18  0.08 0.71 0.29
## 2628.HK   46 0.79  0.01 -0.07  0.10 -0.04 0.64 0.36
## 0011.HK    7 0.79  0.06 -0.05 -0.27 -0.02 0.69 0.31
## 2600.HK   45 0.79 -0.12 -0.08  0.12 -0.06 0.65 0.35
## 0857.HK   31 0.79  0.17  0.01  0.23  0.15 0.73 0.27
## 0688.HK   27 0.77 -0.30 -0.09  0.17 -0.06 0.70 0.30
## 0083.HK   15 0.77  0.02 -0.23 -0.11  0.08 0.67 0.33
## 0016.HK   10 0.77 -0.01 -0.27 -0.17  0.00 0.70 0.30
## 0101.HK   16 0.77 -0.05 -0.19  0.00  0.13 0.64 0.36
## 0023.HK   13 0.75  0.05  0.09 -0.20 -0.15 0.64 0.36
## 0144.HK   17 0.75 -0.09  0.05  0.23  0.16 0.64 0.36
## 1109.HK   37 0.75 -0.38 -0.07  0.16 -0.01 0.70 0.30
## 0700.HK   28 0.70 -0.13  0.02  0.28 -0.16 0.60 0.40
## 0017.HK   11 0.70 -0.09 -0.26 -0.11  0.12 0.60 0.40
## 0066.HK   14 0.68  0.26  0.06 -0.23  0.11 0.57 0.43
## 1299.HK   39 0.67  0.00  0.02 -0.05  0.10 0.46 0.54
## 0494.HK   26 0.66 -0.13  0.01  0.16  0.01 0.46 0.54
## 0762.HK   29 0.65  0.21  0.27  0.14 -0.01 0.59 0.41
## 0386.HK   24 0.65  0.30 -0.01  0.33  0.17 0.71 0.29
## 1880.HK   41 0.64 -0.17  0.19  0.19  0.00 0.49 0.51
## 0293.HK   21 0.63 -0.16  0.01 -0.01  0.09 0.43 0.57
## 0291.HK   20 0.62 -0.04  0.01  0.01  0.16 0.41 0.59
## 0019.HK   12 0.61  0.01  0.07 -0.25  0.03 0.43 0.57
## 0941.HK   34 0.56  0.47  0.17  0.00  0.07 0.58 0.42
## 1044.HK   35 0.55 -0.10  0.50  0.00 -0.08 0.58 0.42
## 0002.HK    2 0.37  0.74  0.01 -0.29 -0.22 0.69 0.31
## 0006.HK    6 0.16  0.72 -0.06  0.03 -0.24 0.60 0.40
## 0003.HK    3 0.42  0.57  0.00 -0.40  0.14 0.58 0.42
## 0151.HK   18 0.47 -0.10  0.59 -0.15  0.11 0.59 0.41
## 0322.HK   22 0.40 -0.06  0.55 -0.42 -0.04 0.61 0.39
## 0330.HK   23 0.40 -0.09  0.00  0.17  0.43 0.35 0.65
## 0836.HK   30 0.37  0.00  0.19  0.00  0.73 0.68 0.32
##
```

```
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.03 2.17 1.48 1.30 1.17
## Proportion Var  0.52 0.05 0.03 0.03 0.02
## Cumulative Var  0.52 0.57 0.60 0.62 0.65
##
##  With component correlations of
##       PC1  PC2   PC3   PC4   PC5
## PC1  1.00 0.01  0.01  0.00 -0.02
## PC2  0.01 1.00  0.00  0.27  0.05
## PC3  0.01 0.00  1.00  0.11 -0.07
## PC4  0.00 0.27  0.11  1.00 -0.06
## PC5 -0.02 0.05 -0.07 -0.06  1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  44.91 0.3
## The degrees of freedom for the model are 898  and the objective function was  7.27
##  0.3The number of observations was  242  with Chi Square =  1605  with prob <  1.2e-42
##  0.3
## Fit based upon off diagonal values = 1
##            PC1       PC2
## 0001.HK 0.8784 -0.016018
## 0002.HK 0.3718  0.740874
## 0003.HK 0.4182  0.572716
## 0004.HK 0.8194 -0.134679
## 0005.HK 0.8587 -0.004559
## 0006.HK 0.1626  0.715447
## 0011.HK 0.7880  0.062554
## 0012.HK 0.7913  0.050336
## 0013.HK 0.8448 -0.076614
## 0016.HK 0.7700 -0.007315
## 0017.HK 0.6974 -0.089836
## 0019.HK 0.6072  0.009329
## 0023.HK 0.7537  0.050841
## 0066.HK 0.6767  0.263323
## 0083.HK 0.7713  0.021594
## 0101.HK 0.7690 -0.045071
## 0144.HK 0.7526 -0.088930
## 0151.HK 0.4680 -0.095993
## 0267.HK 0.7922 -0.125796
## 0291.HK 0.6243 -0.044215
## 0293.HK 0.6335 -0.156726
## 0322.HK 0.3953 -0.059570
## 0330.HK 0.4009 -0.089024
## 0386.HK 0.6530  0.303126
## 0388.HK 0.8526 -0.087151
## 0494.HK 0.6580 -0.127874
## 0688.HK 0.7737 -0.301739
## 0700.HK 0.7021 -0.129402
## 0762.HK 0.6548  0.205060
## 0836.HK 0.3669 -0.000998
## 0857.HK 0.7853  0.165536
## 0883.HK 0.8561  0.015704
## 0939.HK 0.8741 -0.002253
## 0941.HK 0.5591  0.472132
## 1044.HK 0.5493 -0.095245
## 1088.HK 0.8495  0.038864
```

```
## 1109.HK 0.7491 -0.380346
## 1199.HK 0.7942 -0.111702
## 1299.HK 0.6711  0.003647
## 1398.HK 0.9012 -0.061505
## 1880.HK 0.6383 -0.168108
## 1898.HK 0.8394 -0.006039
## 2318.HK 0.8431 -0.144956
## 2388.HK 0.8233 -0.038293
## 2600.HK 0.7857 -0.120367
## 2628.HK 0.7891  0.011402
## 3328.HK 0.8786 -0.014656
## 3988.HK 0.8611 -0.003902
```



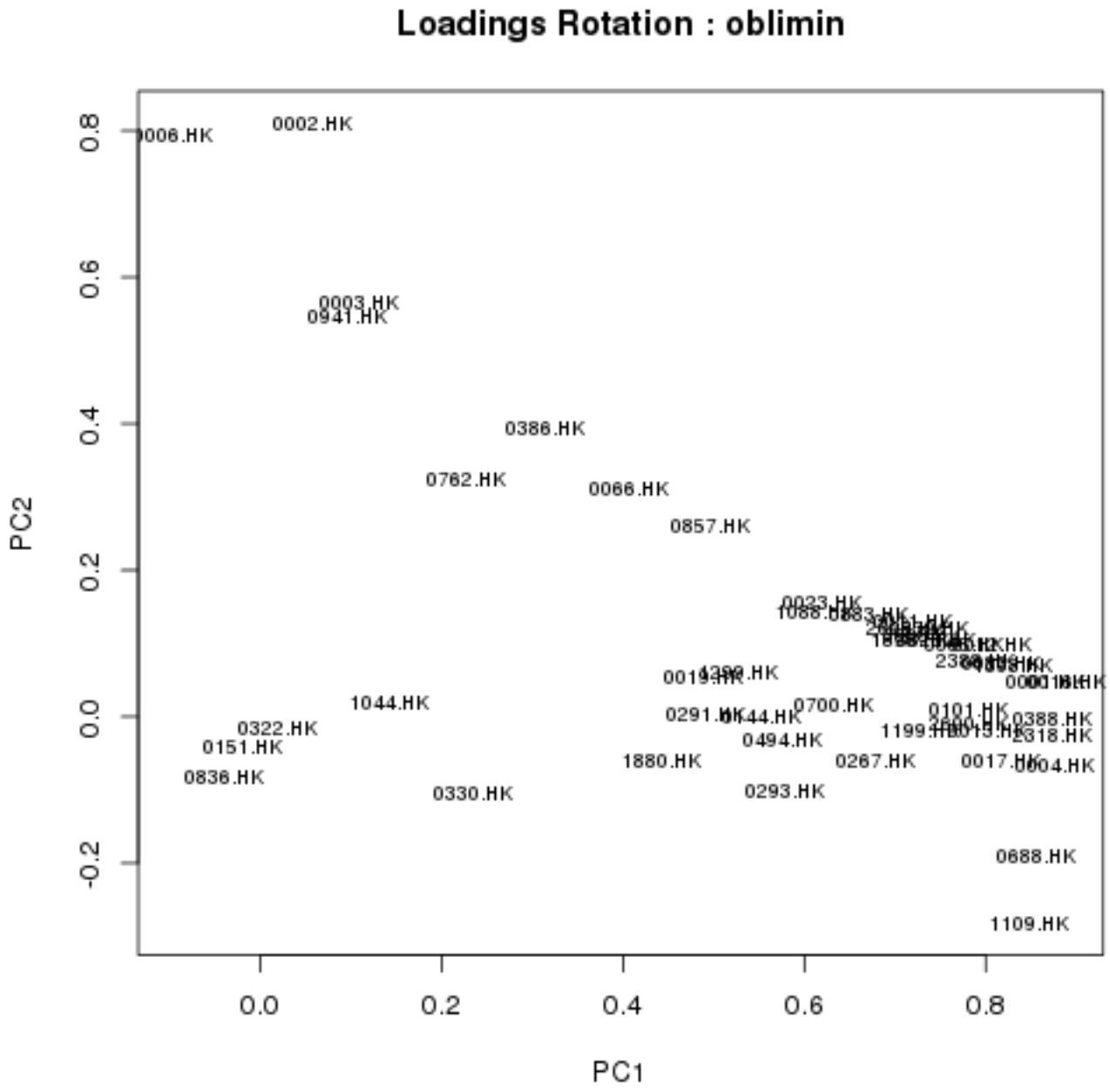
5.2.5 Rotation : oblimin

Direct oblimin rotation is the standard method when one wishes a non-orthogonal (oblique) solution – that is, one in which the factors are allowed to be correlated. This will result in higher eigenvalues but diminished interpretability of the factors.

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "oblimin")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item   PC1   PC2   PC3   PC5   PC4   h2   u2
## 0016.HK   10  0.89  0.05 -0.11 -0.03 -0.21 0.70 0.30
## 0004.HK    4  0.88 -0.07 -0.02  0.03 -0.10 0.72 0.28
## 0388.HK   25  0.87  0.00  0.03 -0.01 -0.09 0.76 0.24
## 2318.HK   43  0.87 -0.03  0.01 -0.08  0.11 0.75 0.25
## 0001.HK    1  0.87  0.05  0.02  0.07 -0.18 0.83 0.17
## 0688.HK   27  0.86 -0.19  0.03 -0.08  0.15 0.70 0.30
## 1109.HK   37  0.85 -0.28  0.05 -0.04  0.13 0.70 0.30
## 1398.HK   40  0.83  0.07  0.09 -0.06  0.13 0.83 0.17
## 0083.HK   15  0.82  0.07 -0.11  0.07 -0.15 0.67 0.33
## 0017.HK   11  0.82 -0.06 -0.14  0.09 -0.18 0.60 0.40
## 0012.HK    8  0.81  0.10 -0.06  0.08 -0.21 0.71 0.29
## 0013.HK    9  0.80 -0.02  0.03  0.15 -0.10 0.76 0.24
## 2388.HK   44  0.79  0.08  0.16 -0.15 -0.04 0.72 0.28
## 2600.HK   45  0.78 -0.01  0.02 -0.04  0.13 0.65 0.35
## 0101.HK   16  0.78  0.01 -0.10  0.14 -0.05 0.64 0.36
## 0005.HK    5  0.78  0.10  0.01  0.05  0.09 0.75 0.25
## 3328.HK   47  0.74  0.10  0.06  0.06  0.17 0.79 0.21
## 0939.HK   33  0.74  0.12  0.12  0.00  0.12 0.77 0.23
## 3988.HK   48  0.73  0.11  0.11  0.01  0.10 0.75 0.25
## 1199.HK   38  0.73 -0.02 -0.07  0.16  0.22 0.70 0.30
## 0011.HK    7  0.72  0.13  0.14 -0.01 -0.22 0.69 0.31
## 1898.HK   42  0.72  0.11  0.07  0.04  0.13 0.71 0.29
## 2628.HK   46  0.71  0.12  0.02 -0.01  0.12 0.64 0.36
## 0267.HK   19  0.68 -0.06  0.19  0.13 -0.07 0.67 0.33
## 0883.HK   32  0.67  0.14  0.07  0.08  0.23 0.77 0.23
## 0700.HK   28  0.63  0.02  0.09 -0.12  0.33 0.60 0.40
## 0023.HK   13  0.62  0.15  0.28 -0.13 -0.10 0.64 0.36
## 1088.HK   36  0.61  0.14  0.14  0.15  0.15 0.74 0.26
## 0293.HK   21  0.58 -0.10  0.11  0.10 -0.01 0.43 0.57
## 0494.HK   26  0.58 -0.03  0.08  0.03  0.18 0.46 0.54
## 0144.HK   17  0.55  0.00  0.08  0.23  0.25 0.64 0.36
## 1299.HK   39  0.53  0.06  0.12  0.13 -0.02 0.46 0.54
## 0857.HK   31  0.50  0.26  0.00  0.26  0.26 0.73 0.27
## 0291.HK   20  0.49  0.00  0.08  0.19  0.01 0.41 0.59
## 0019.HK   12  0.49  0.06  0.23  0.03 -0.19 0.43 0.57
## 1880.HK   41  0.44 -0.06  0.26  0.05  0.26 0.49 0.51
## 0066.HK   14  0.41  0.31  0.17  0.17 -0.15 0.57 0.43
## 0002.HK    2  0.06  0.81  0.07 -0.11 -0.13 0.69 0.31
## 0006.HK    6 -0.10  0.79 -0.13 -0.11  0.15 0.60 0.40
## 0003.HK    3  0.11  0.56  0.06  0.23 -0.32 0.58 0.42
## 0941.HK   34  0.10  0.55  0.16  0.21  0.13 0.58 0.42
## 0386.HK   24  0.31  0.39 -0.10  0.31  0.36 0.71 0.29
## 0762.HK   29  0.23  0.32  0.30  0.12  0.29 0.59 0.41
## 0322.HK   22  0.02 -0.02  0.77 -0.01 -0.21 0.61 0.39
## 0151.HK   18 -0.02 -0.04  0.72  0.19  0.03 0.59 0.41
## 1044.HK   35  0.14  0.02  0.63  0.00  0.20 0.58 0.42
## 0836.HK   30 -0.04 -0.08  0.12  0.82 -0.05 0.68 0.32
## 0330.HK   23  0.23 -0.10 -0.05  0.48  0.10 0.35 0.65
```

```
##
##                  PC1  PC2  PC3  PC5  PC4
## SS loadings    21.15 3.16 2.97 2.24 1.63
## Proportion Var  0.44 0.07 0.06 0.05 0.03
## Cumulative Var  0.44 0.51 0.57 0.61 0.65
##
##  With component correlations of
##      PC1  PC2  PC3  PC5  PC4
## PC1 1.00 0.35 0.47 0.42 0.18
## PC2 0.35 1.00 0.16 0.19 0.05
## PC3 0.47 0.16 1.00 0.21 0.11
## PC5 0.42 0.19 0.21 1.00 0.05
## PC4 0.18 0.05 0.11 0.05 1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  44.91 0.3
## The degrees of freedom for the model are 898  and the objective function was  7.27
##  0.3The number of observations was  242  with Chi Square =  1605  with prob <  1.2e-42
##  0.3
## Fit based upon off diagonal values = 1
##              PC1        PC2
## 0001.HK  0.86668  0.0472727
## 0002.HK  0.05691  0.8104207
## 0003.HK  0.10979  0.5641100
## 0004.HK  0.87730 -0.0660911
## 0005.HK  0.77517  0.0988823
## 0006.HK -0.09534  0.7934905
## 0011.HK  0.72045  0.1299224
## 0012.HK  0.80776  0.0978519
## 0013.HK  0.80141 -0.0183058
## 0016.HK  0.89019  0.0490558
## 0017.HK  0.81643 -0.0587791
## 0019.HK  0.48894  0.0551131
## 0023.HK  0.62002  0.1547239
## 0066.HK  0.40585  0.3097173
## 0083.HK  0.81770  0.0737947
## 0101.HK  0.78051  0.0096071
## 0144.HK  0.55232 -0.0005619
## 0151.HK -0.02051 -0.0398369
## 0267.HK  0.67876 -0.0605592
## 0291.HK  0.49239  0.0021739
## 0293.HK  0.57815 -0.1008964
## 0322.HK  0.01804 -0.0151873
## 0330.HK  0.23361 -0.1041436
## 0386.HK  0.31325  0.3923643
## 0388.HK  0.87484 -0.0038519
## 0494.HK  0.57620 -0.0327074
## 0688.HK  0.85615 -0.1900877
## 0700.HK  0.63218  0.0153403
## 0762.HK  0.22641  0.3240962
## 0836.HK -0.03920 -0.0818712
## 0857.HK  0.49675  0.2610691
## 0883.HK  0.67207  0.1384314
## 0939.HK  0.73862  0.1198719
## 0941.HK  0.09706  0.5473174
## 1044.HK  0.14135  0.0183717
```

```
## 1088.HK  0.61210  0.1439498
## 1109.HK  0.84738 -0.2819225
## 1199.HK  0.72770 -0.0190498
## 1299.HK  0.52853  0.0617344
## 1398.HK  0.82945  0.0711767
## 1880.HK  0.44133 -0.0611321
## 1898.HK  0.71653  0.1055932
## 2318.HK  0.87414 -0.0264340
## 2388.HK  0.79033  0.0766890
## 2600.HK  0.78119 -0.0090372
## 2628.HK  0.71101  0.1217042
## 3328.HK  0.74451  0.1034563
## 3988.HK  0.73117  0.1110469
```



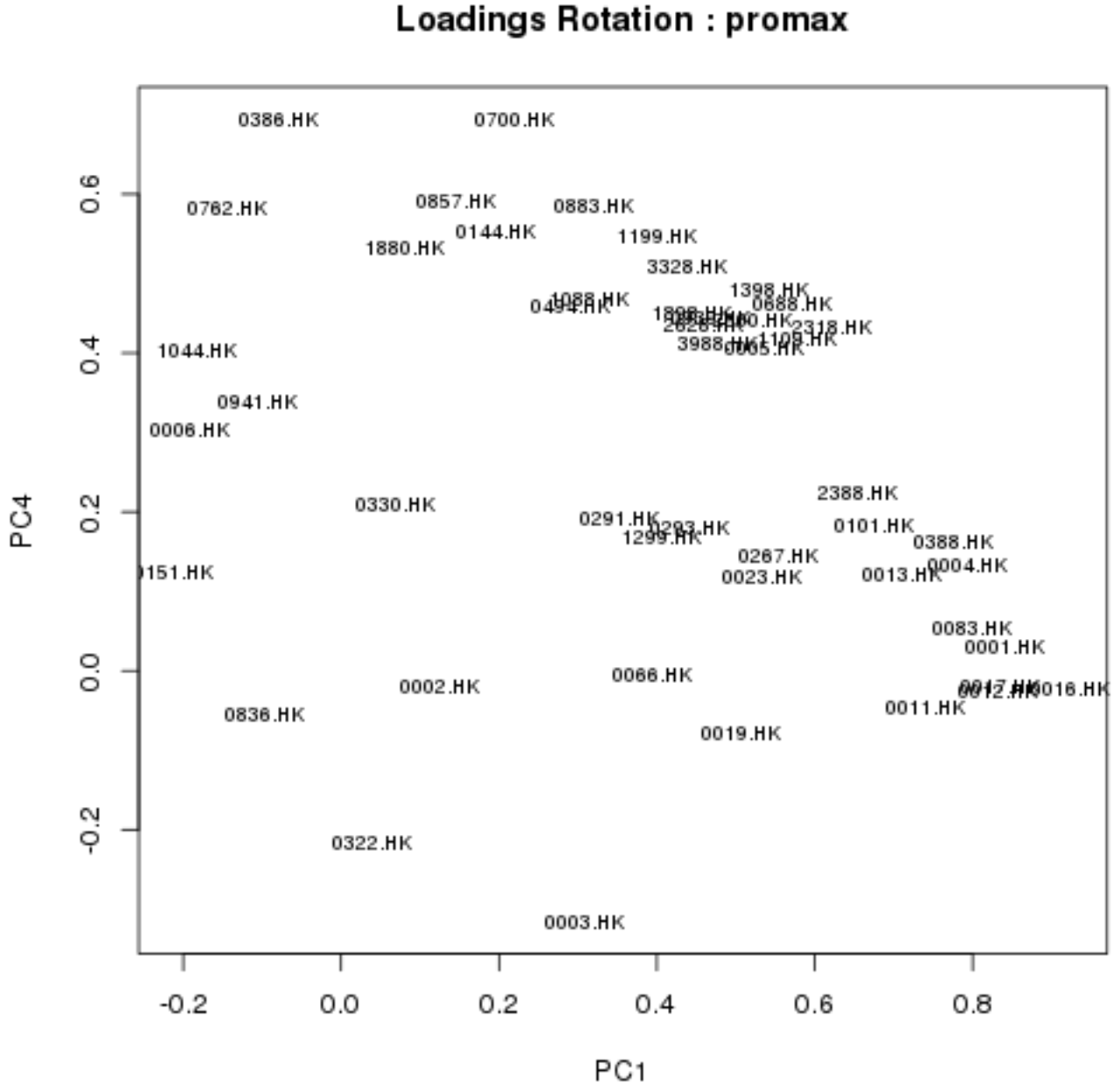
5.2.6 Rotation : promax

Promax rotation is an alternative non-orthogonal (oblique) rotation method which is computationally faster than the direct oblimin method and therefore is sometimes used for very large datasets.

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "promax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item   PC1   PC4   PC2   PC3   PC5   h2   u2
## 0016.HK   10  0.93 -0.02  0.06 -0.13 -0.06 0.70 0.30
## 0001.HK    1  0.84  0.03  0.04  0.01  0.05 0.83 0.17
## 0017.HK   11  0.84 -0.02 -0.06 -0.15  0.08 0.60 0.40
## 0012.HK    8  0.83 -0.03  0.10 -0.08  0.06 0.71 0.29
## 0083.HK   15  0.80  0.05  0.07 -0.14  0.04 0.67 0.33
## 0004.HK    4  0.79  0.13 -0.08 -0.04  0.01 0.72 0.28
## 0388.HK   25  0.78  0.16 -0.02  0.01 -0.04 0.76 0.24
## 0011.HK    7  0.74 -0.05  0.14  0.14 -0.04 0.69 0.31
## 0013.HK    9  0.71  0.12 -0.04  0.01  0.13 0.76 0.24
## 0101.HK   16  0.68  0.18 -0.02 -0.14  0.11 0.64 0.36
## 2388.HK   44  0.65  0.22  0.07  0.14 -0.21 0.72 0.28
## 2318.HK   43  0.62  0.43 -0.05 -0.04 -0.14 0.75 0.25
## 1109.HK   37  0.58  0.42 -0.32  0.01 -0.07 0.70 0.30
## 0688.HK   27  0.57  0.46 -0.23 -0.02 -0.12 0.70 0.30
## 0267.HK   19  0.55  0.14 -0.09  0.18  0.12 0.67 0.33
## 1398.HK   40  0.54  0.48  0.04  0.03 -0.13 0.83 0.17
## 0005.HK    5  0.54  0.41  0.06 -0.05  0.00 0.75 0.25
## 0023.HK   13  0.53  0.12  0.16  0.27 -0.18 0.64 0.36
## 2600.HK   45  0.52  0.44 -0.04 -0.04 -0.10 0.65 0.35
## 0019.HK   12  0.51 -0.08  0.06  0.25  0.03 0.43 0.57
## 3988.HK   48  0.48  0.41  0.08  0.06 -0.05 0.75 0.25
## 0939.HK   33  0.47  0.44  0.08  0.06 -0.07 0.77 0.23
## 2628.HK   46  0.46  0.43  0.09 -0.05 -0.07 0.64 0.36
## 0293.HK   21  0.44  0.18 -0.13  0.10  0.09 0.43 0.57
## 1299.HK   39  0.41  0.17  0.03  0.09  0.11 0.46 0.54
## 0066.HK   14  0.39 -0.01  0.30  0.16  0.15 0.57 0.43
## 0291.HK   20  0.35  0.19 -0.03  0.06  0.18 0.41 0.59
## 0700.HK   28  0.22  0.69 -0.03  0.01 -0.20 0.60 0.40
## 0386.HK   24 -0.08  0.69  0.31 -0.22  0.23 0.71 0.29
## 0857.HK   31  0.14  0.59  0.19 -0.09  0.19 0.73 0.27
## 0883.HK   32  0.32  0.59  0.08 -0.01  0.01 0.77 0.23
## 0762.HK   29 -0.14  0.58  0.26  0.23  0.04 0.59 0.41
## 0144.HK   17  0.20  0.55 -0.07  0.01  0.19 0.64 0.36
## 1199.HK   38  0.40  0.55 -0.08 -0.15  0.11 0.70 0.30
## 1880.HK   41  0.08  0.53 -0.12  0.21  0.01 0.49 0.51
## 3328.HK   47  0.44  0.51  0.06 -0.01 -0.01 0.79 0.21
## 1088.HK   36  0.31  0.47  0.09  0.08  0.09 0.74 0.26
## 0494.HK   26  0.29  0.46 -0.08  0.03 -0.01 0.46 0.54
## 1898.HK   42  0.44  0.45  0.07  0.01 -0.02 0.71 0.29
## 0002.HK    2  0.12 -0.02  0.84  0.04 -0.20 0.69 0.31
## 0006.HK    6 -0.19  0.30  0.80 -0.21 -0.23 0.60 0.40
## 0003.HK    3  0.31 -0.32  0.58  0.07  0.20 0.58 0.42
## 0941.HK   34 -0.11  0.34  0.51  0.10  0.15 0.58 0.42
## 0322.HK   22  0.04 -0.22 -0.01  0.85  0.01 0.61 0.39
## 0151.HK   18 -0.21  0.12 -0.09  0.75  0.20 0.59 0.41
## 1044.HK   35 -0.18  0.40 -0.03  0.62 -0.03 0.58 0.42
## 0836.HK   30 -0.10 -0.06 -0.17  0.13  0.90 0.68 0.32
## 0330.HK   23  0.07  0.21 -0.17 -0.08  0.50 0.35 0.65
##
```

```
##                  PC1  PC4  PC2  PC3  PC5
## SS loadings    14.89 9.44 2.73 2.39 1.70
## Proportion Var  0.31 0.20 0.06 0.05 0.04
## Cumulative Var  0.31 0.51 0.56 0.61 0.65
##
##  With component correlations of
##      PC1  PC4  PC2  PC3  PC5
## PC1 1.00 0.70 0.36 0.56 0.52
## PC4 0.70 1.00 0.31 0.51 0.46
## PC2 0.36 0.31 1.00 0.24 0.37
## PC3 0.56 0.51 0.24 1.00 0.31
## PC5 0.52 0.46 0.37 0.31 1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  44.91 0.3
## The degrees of freedom for the model are 898  and the objective function was  7.27
##  0.3The number of observations was  242  with Chi Square =  1605  with prob <  1.2e-42
##  0.3
## Fit based upon off diagonal values = 1
##              PC1       PC4
## 0001.HK  0.84206  0.031520
## 0002.HK  0.12496 -0.020775
## 0003.HK  0.30944 -0.315834
## 0004.HK  0.79300  0.133442
## 0005.HK  0.53641  0.406037
## 0006.HK -0.19150  0.302550
## 0011.HK  0.73925 -0.047403
## 0012.HK  0.83160 -0.025545
## 0013.HK  0.71145  0.121955
## 0016.HK  0.92501 -0.022848
## 0017.HK  0.83596 -0.019947
## 0019.HK  0.50561 -0.079934
## 0023.HK  0.53385  0.117151
## 0066.HK  0.39351 -0.005741
## 0083.HK  0.80058  0.054085
## 0101.HK  0.67637  0.181548
## 0144.HK  0.19586  0.552973
## 0151.HK -0.21093  0.123367
## 0267.HK  0.55338  0.143736
## 0291.HK  0.35223  0.191562
## 0293.HK  0.44140  0.179532
## 0322.HK  0.03895 -0.215489
## 0330.HK  0.07028  0.209570
## 0386.HK -0.08024  0.692550
## 0388.HK  0.77587  0.161006
## 0494.HK  0.28941  0.457784
## 0688.HK  0.57185  0.462897
## 0700.HK  0.22031  0.694459
## 0762.HK -0.14488  0.581483
## 0836.HK -0.09615 -0.055896
## 0857.HK  0.14436  0.591226
## 0883.HK  0.31889  0.585415
## 0939.HK  0.46822  0.444000
## 0941.HK -0.10545  0.339589
## 1044.HK -0.18246  0.403977
## 1088.HK  0.31379  0.469008
```

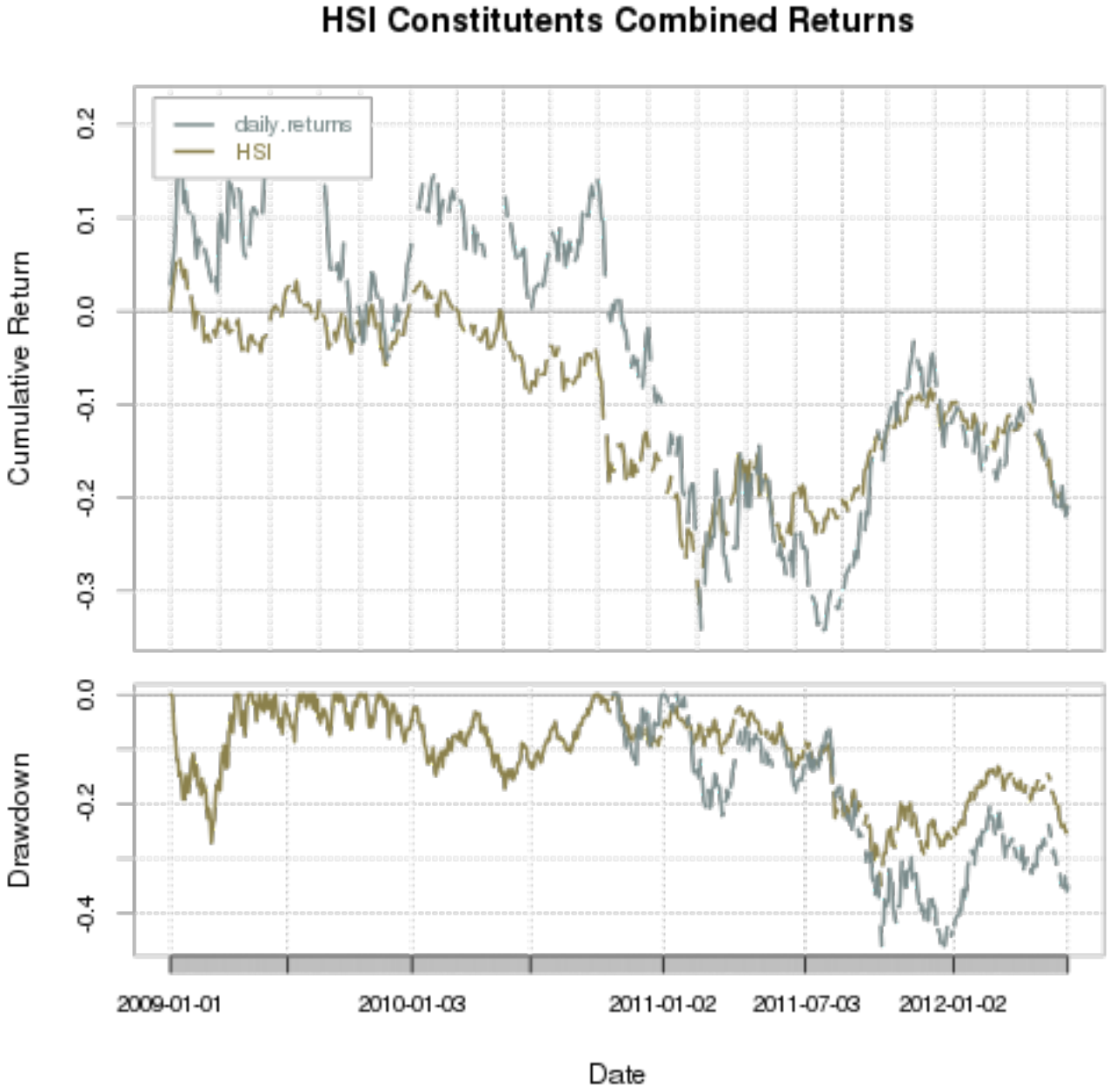
```
## 1109.HK  0.57715  0.418240
## 1199.HK  0.39915  0.547522
## 1299.HK  0.40715  0.166763
## 1398.HK  0.54282  0.480777
## 1880.HK  0.08198  0.533430
## 1898.HK  0.44480  0.451039
## 2318.HK  0.62146  0.432782
## 2388.HK  0.65379  0.223322
## 2600.HK  0.52031  0.442094
## 2628.HK  0.46081  0.434695
## 3328.HK  0.43805  0.508485
## 3988.HK  0.47847  0.412903
```



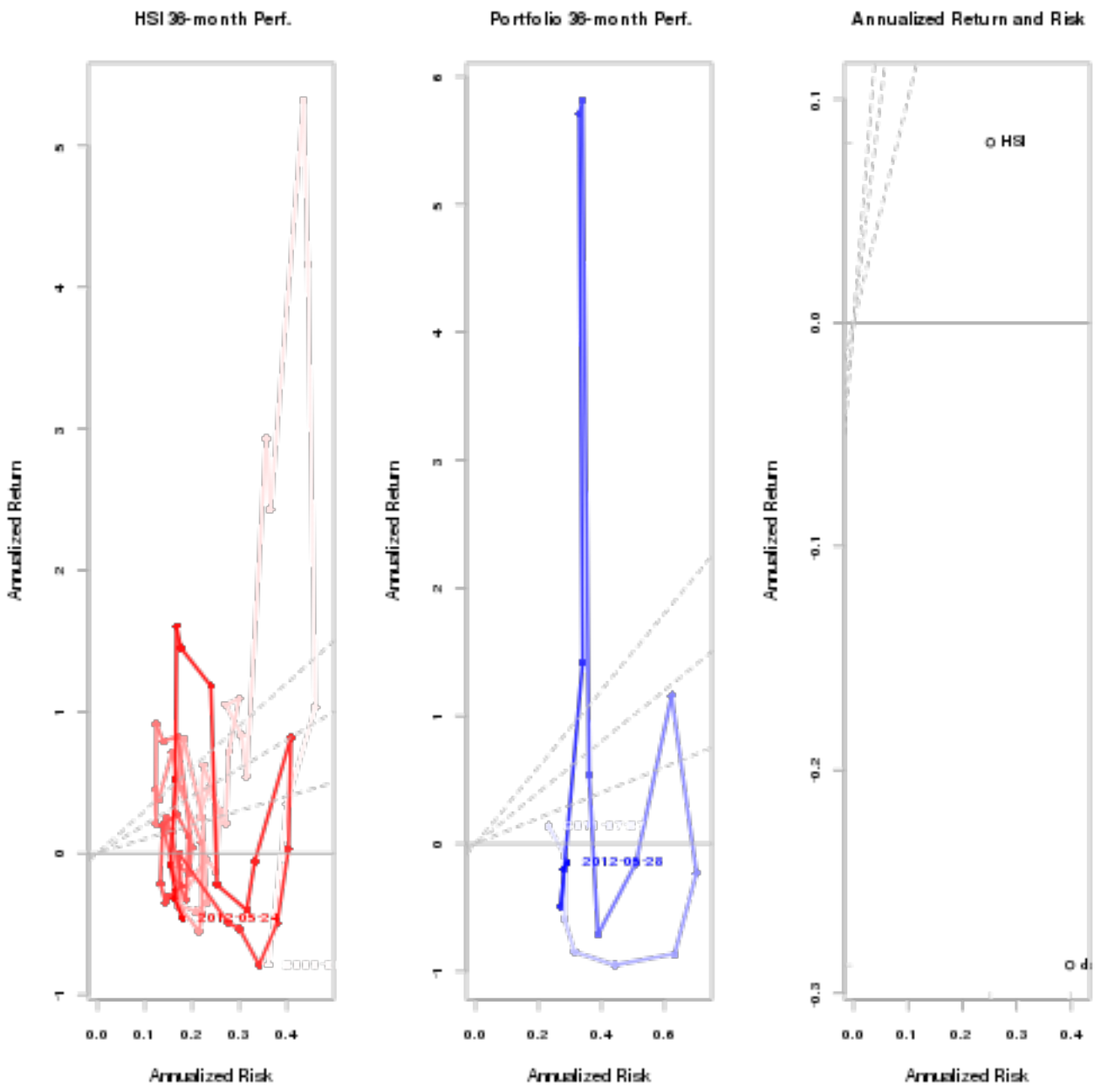
PCA is a science in itself and can not be fully covered and even less interpreted in this paper. The factors produced by principal component analysis are conceptualized as being linear combinations of the variables whereas the factors produced by common factor analysis are conceptualized as being latent variables. Note : Kaiser criterion: The Kaiser rule is to drop all components with eigenvalues under 1.0 – this being the eigenvalue equal to the information accounted for by an average single item.

6 HSI Components Performance

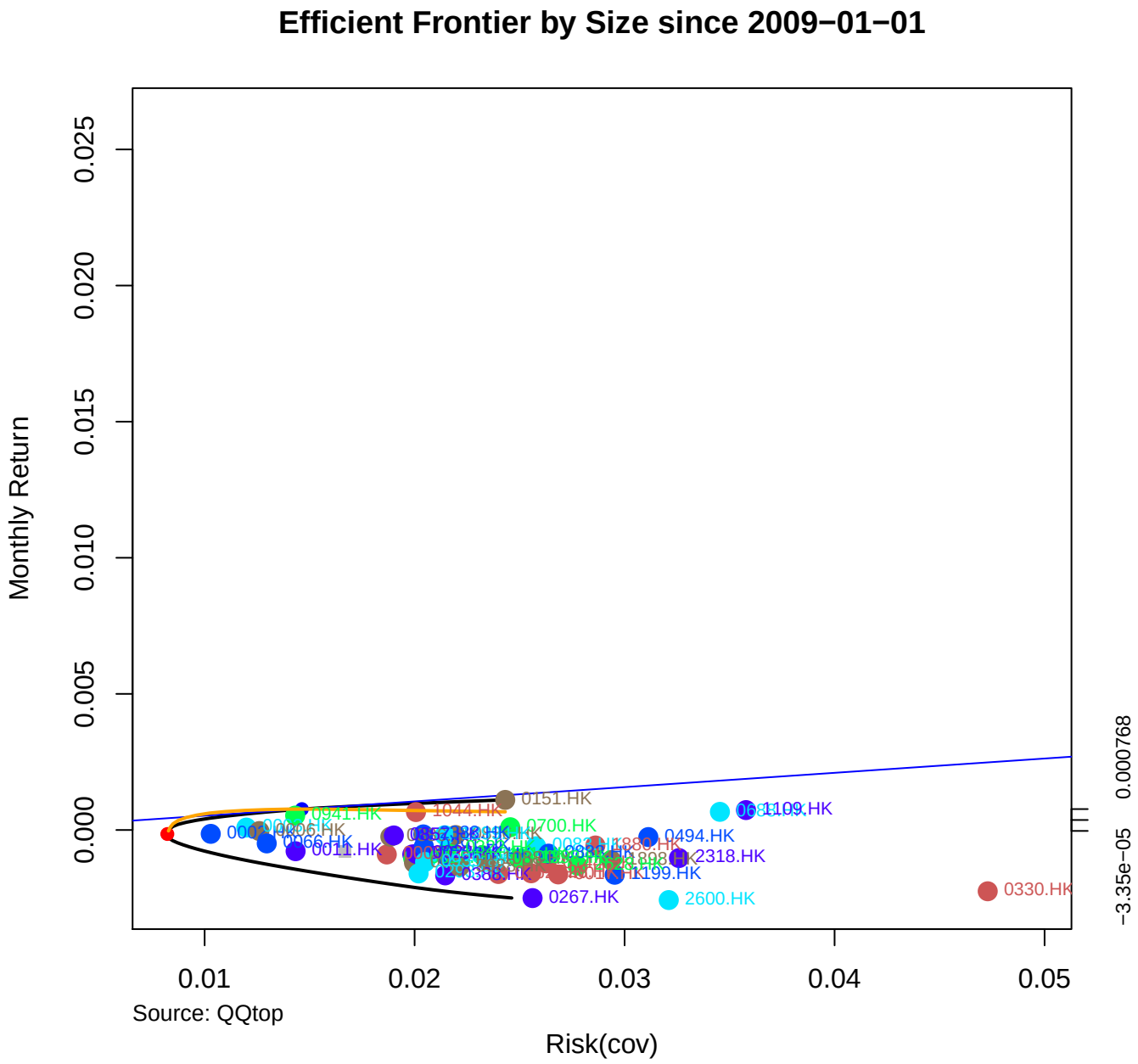
6.1 Performance Chart



6.2 Performance SnailTrail Chart



6.3 HSI Components Frontier




```
##
## Title:
##  MV Portfolio Frontier
##  Estimator:         covEstimator
##  Solver:            solveRquadprog
##  Optimize:          minRisk
##  Constraints:       LongOnly
##  Portfolio Points:  5 of 49
##
## Portfolio Weights:
##    0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK 0011.HK 0012.HK 0013.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.2041  0.0000  0.0000  0.0000
```

```
## 25  0.0000  0.2187  0.0545  0.0000  0.0000  0.2434  0.0185  0.0000  0.0000
## 37  0.0000  0.2128  0.2095  0.0000  0.0000  0.2161  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    0016.HK 0017.HK 0019.HK 0023.HK 0066.HK 0083.HK 0101.HK 0144.HK 0151.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0188  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0523  0.0000  0.0817  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0858
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  1.0000
##    0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK 0388.HK 0494.HK 0688.HK
## 1   0.7106  0.0000  0.0174  0.0000  0.0212  0.0000  0.0000  0.0000  0.0000
## 13  0.2968  0.0000  0.2778  0.0159  0.0226  0.0000  0.0000  0.0000  0.0000
## 25  0.0779  0.0000  0.1583  0.0657  0.0098  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    0700.HK 0762.HK 0836.HK 0857.HK 0883.HK 0939.HK 0941.HK 1044.HK 1088.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.1073  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0176  0.0015  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0404  0.0000  0.0000  0.0000  0.1367  0.0986  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.2509
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0567
## 25  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    2628.HK 3328.HK 3988.HK
## 1   0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000
##
## Covariance Risk Budgets:
##    0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK 0011.HK 0012.HK 0013.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.0391  0.0000  0.0000  0.0000
## 25  0.0000  0.1603  0.0339  0.0000  0.0000  0.1662  0.0192  0.0000  0.0000
## 37  0.0000  0.1777  0.1980  0.0000  0.0000  0.1912  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    0016.HK 0017.HK 0019.HK 0023.HK 0066.HK 0083.HK 0101.HK 0144.HK 0151.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0150  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0652  0.0000  0.0737  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1226
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  1.0000
##    0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK 0388.HK 0494.HK 0688.HK
## 1   0.7118  0.0000  0.0081  0.0000  0.0181  0.0000  0.0000  0.0000  0.0000
## 13  0.4359  0.0000  0.2776  0.0083  0.0303  0.0000  0.0000  0.0000  0.0000
## 25  0.1456  0.0000  0.2269  0.0651  0.0172  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    0700.HK 0762.HK 0836.HK 0857.HK 0883.HK 0939.HK 0941.HK 1044.HK 1088.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.1084  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0255  0.0012  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
```

```
## 37  0.0000  0.0000  0.0329  0.0000  0.0000  0.0000  0.1578  0.1199  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.2620
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0854
## 25  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    2628.HK 3328.HK 3988.HK
## 1   0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000
##
## Target Return and Risks:
##       mean      mu     Cov   Sigma    CVaR     VaR
## 1  -0.0025 -0.0025  0.0246  0.0246  0.0586  0.0424
## 13 -0.0016 -0.0016  0.0155  0.0155  0.0343  0.0266
## 25 -0.0007 -0.0007  0.0096  0.0096  0.0213  0.0160
## 37  0.0002  0.0002  0.0087  0.0087  0.0188  0.0144
## 49  0.0011  0.0011  0.0243  0.0243  0.0489  0.0348
##
## Description:
##  Tue May 29 22:02:59 2012 by user:
```

7 HSI Components Ratios

7.1 Sharpe Ratio - Combined

```
##                                daily.returns
## StdDev Sharpe (Rf=0%, p=95%):       -0.0413
## VaR Sharpe (Rf=0%, p=95%):          -0.0264
## ES Sharpe (Rf=0%, p=95%):           -0.0204
```

7.2 Sharpe - Distinct

```
##                                0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0209  0.0317  0.0417  0.0422  0.0019
## VaR Sharpe (Rf=0%, p=95%):     0.0140  0.0201  0.0252  0.0289  0.0013
## ES Sharpe (Rf=0%, p=95%):      0.0109  0.0142  0.0110  0.0228  0.0007
##                                0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0319  0.0049  0.0247  0.0399  0.0259
## VaR Sharpe (Rf=0%, p=95%):     0.0204  0.0036  0.0172  0.0276  0.0167
## ES Sharpe (Rf=0%, p=95%):      0.0143  0.0036  0.0138  0.0215  0.0113
##                                0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0132  0.0349  0.0349  0.0350  0.0248
## VaR Sharpe (Rf=0%, p=95%):     0.0087  0.0219  0.0272  0.0257  0.0165
## ES Sharpe (Rf=0%, p=95%):      0.0061  0.0129  0.0272  0.0220  0.0121
##                                0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0267  0.0305  0.0665  0.0184  0.0404
## VaR Sharpe (Rf=0%, p=95%):     0.0184  0.0205  0.0449  0.0135  0.0272
## ES Sharpe (Rf=0%, p=95%):      0.0147  0.0162  0.0341  0.0118  0.0216
##                                0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0271  0.0532 -0.0273  0.0309  0.0302
## VaR Sharpe (Rf=0%, p=95%):     0.0177  0.0444 -0.0179  0.0199  0.0216
## ES Sharpe (Rf=0%, p=95%):      0.0132  0.0444 -0.0122  0.0149  0.0178
##                                0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## StdDev Sharpe (Rf=0%, p=95%): -0.0083  0.0300  0.0808  0.0185  0.0052
## VaR Sharpe (Rf=0%, p=95%):    -0.0052  0.0218  0.0538  0.0127  0.0033
## ES Sharpe (Rf=0%, p=95%):     -0.0042  0.0185  0.0397  0.0100  0.0026
##                                0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0304  0.0433  0.0185  0.0065  0.0717
## VaR Sharpe (Rf=0%, p=95%):     0.0192  0.0286  0.0115  0.0043  0.0498
## ES Sharpe (Rf=0%, p=95%):      0.0145  0.0214  0.0080  0.0033  0.0386
##                                1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0352  0.0290  0.0203  0.0183  0.0152
## VaR Sharpe (Rf=0%, p=95%):     0.0224  0.0213  0.0139  0.0116  0.0108
## ES Sharpe (Rf=0%, p=95%):      0.0171  0.0182  0.0111  0.0068  0.0089
##                                1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0694  0.0186  0.0293  0.0610  0.0023
## VaR Sharpe (Rf=0%, p=95%):     0.0497  0.0115  0.0195  0.0443  0.0015
## ES Sharpe (Rf=0%, p=95%):      0.0394  0.0078  0.0140  0.0360  0.0012
##                                2628.HK 3328.HK 3988.HK
## StdDev Sharpe (Rf=0%, p=95%): -0.0054  0.0030  0.0275
## VaR Sharpe (Rf=0%, p=95%):    -0.0034  0.0019  0.0182
## ES Sharpe (Rf=0%, p=95%):     -0.0024  0.0014  0.0132
```

7.3 Information Ratio - Combined

```
## [1] "Information Ratio :  -0.2156"
```

7.4 Information Ratio - Distinct

```
##                        0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK
## Information Ratio: HSI -0.0566 -0.0681  0.1651  0.2769 -0.2974 -0.0092
##                        0011.HK 0012.HK 0013.HK 0016.HK 0017.HK 0019.HK
## Information Ratio: HSI -0.2717  -5e-04  0.2201  0.0123 -0.1597  0.1387
```

```
##                         0023.HK 0066.HK 0083.HK 0101.HK 0144.HK 0151.HK
## Information Ratio: HSI   0.145  0.0763  0.0045  0.0324  0.0885    0.66
##                         0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK
## Information Ratio: HSI -0.0892  0.2321  0.0351  0.4329 -0.6704  0.0814
##                         0388.HK 0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Information Ratio: HSI   0.079  0.0929  0.0815  0.9881 -0.0815 -0.2571
##                         0857.HK 0883.HK 0939.HK 0941.HK 1044.HK 1088.HK
## Information Ratio: HSI  0.0742  0.2862 -0.0884 -0.2395   0.781  0.1601
##                         1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK
## Information Ratio: HSI  0.0629 -0.0694  0.5026 -0.1314  0.8078 -0.0925
##                         2318.HK 2388.HK 2600.HK 2628.HK 3328.HK 3988.HK
## Information Ratio: HSI  0.0684  0.5708 -0.3168 -0.3811 -0.2939  0.0386
```

8 HSI Components Table Latest Quotes

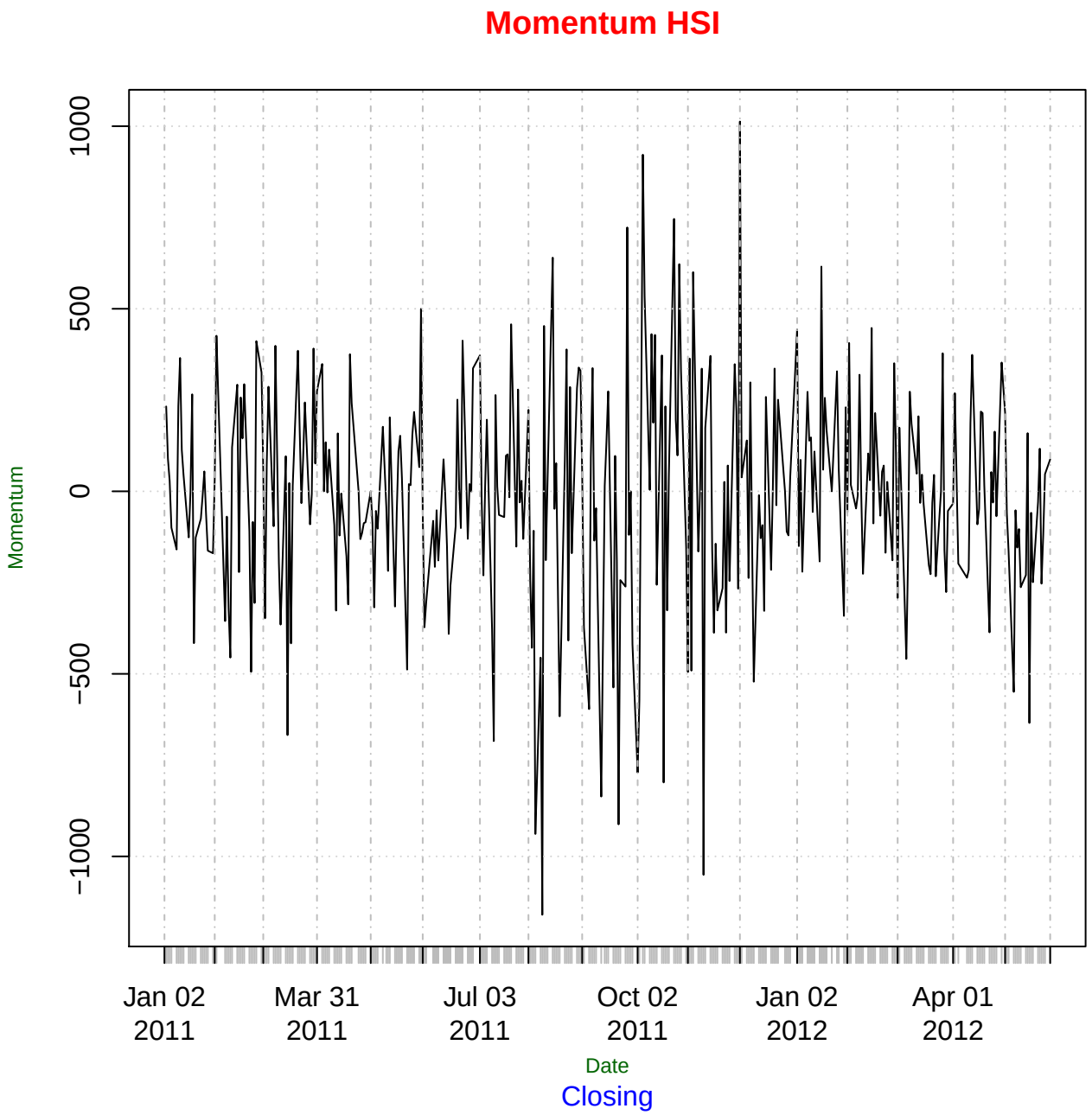
```
## [1] "Date :  2012-05-29 03:59:00"
##                    Name    Bid    Ask Change   52-week Range
## 0001.HK     CHEUNG KONG  94.20  94.30  1.800  79.10 - 123.00
## 0002.HK    CLP HOLDINGS  63.70  63.85  0.050   62.10 - 75.20
## 0003.HK  HK & CHINA GAS  18.34  18.38  0.020   16.68 - 20.65
## 0004.HK  WHARF HOLDINGS  42.00  42.05  0.800   33.15 - 59.00
## 0005.HK   HSBC HOLDINGS  62.95  63.00  0.200   56.00 - 85.00
## 0006.HK    POWER ASSETS  54.60  54.65  0.100   52.00 - 64.80
## 0011.HK  HANG SENG BANK 101.80 102.00  0.800  84.40 - 125.00
## 0012.HK  HENDERSON LAND  39.70  39.80  0.600   33.20 - 53.50
## 0013.HK       HUTCHISON  68.00  68.05  1.050   53.60 - 93.10
## 0016.HK         SHK PPT  89.00  89.10  0.750  85.45 - 122.40
## 0017.HK   NEW WORLD DEV   8.62   8.63  0.380    6.13 - 13.78
## 0019.HK SWIRE PACIFIC A  85.90  86.10  1.200  75.10 - 120.90
## 0023.HK  BANK OF E ASIA  26.50  26.65  0.600   21.85 - 34.45
## 0066.HK MTR CORPORATION  25.35  25.40  0.150   22.45 - 28.80
## 0083.HK       SINO LAND  10.86  10.88  0.000    9.28 - 14.16
## 0101.HK   HANG LUNG PPT  25.50  25.60  0.650   20.85 - 35.30
## 0144.HK  CHINA MER HOLD  23.70  23.80  0.950   19.00 - 36.25
## 0151.HK WANT WANT CHINA   9.14   9.15  0.040     6.03 - 9.58
## 0267.HK   CITIC PACIFIC  11.94  11.98  0.520   10.26 - 23.40
## 0291.HK CHINA RESOURCES  24.55  24.65  0.170   24.00 - 35.50
## 0293.HK  CATHAY PAC AIR  12.24  12.30  0.240   11.80 - 20.15
## 0322.HK          TINGYI  18.00  18.02 -1.180   17.84 - 26.00
## 0330.HK ESPRIT HOLDINGS  12.78  12.80  0.300    7.55 - 33.30
## 0386.HK    SINOPEC CORP   7.17   7.18  0.090     6.22 - 9.67
## 0388.HK            HKEX 112.60 112.80  3.300  99.15 - 178.90
## 0494.HK       LI & FUNG  15.22  15.26  0.280   10.82 - 20.15
## 0688.HK  CHINA OVERSEAS  16.92  16.94  0.540    9.99 - 17.86
## 0700.HK         TENCENT 215.80 216.60  2.200 139.80 - 241.00
## 0762.HK    CHINA UNICOM  11.16  11.18  0.080   12.60 - 17.68
## 0836.HK CHINA RES POWER  13.82  13.86  0.120   10.82 - 16.20
## 0857.HK      PETROCHINA  10.26  10.28  0.080    8.59 - 11.92
## 0883.HK           CNOOC  14.72  14.74  0.220   11.20 - 19.70
## 0939.HK             CCB   5.30   5.31  0.100     4.41 - 7.48
## 0941.HK    CHINA MOBILE  80.80  80.85  1.200   68.05 - 87.60
## 1044.HK    HENGAN INT'L  76.70  76.95 -0.350   56.80 - 83.45
## 1088.HK   CHINA SHENHUA  28.85  28.90  1.050   27.10 - 40.20
## 1109.HK  CHINA RES LAND  14.84  14.86  0.720    7.28 - 15.60
## 1199.HK   COSCO PACIFIC   9.45   9.48  0.240    7.52 - 16.50
## 1299.HK             AIA  25.15  25.20  0.500   19.84 - 29.90
## 1398.HK            ICBC   4.72   4.73  0.060     3.46 - 6.68
## 1880.HK     BELLE INT'L  13.10  13.16  0.140   11.38 - 17.54
## 1898.HK      CHINA COAL   7.32   7.33  0.364    6.59 - 11.66
## 2318.HK         PING AN  58.50  58.55  1.800   37.35 - 85.45
## 2388.HK   BOC HONG KONG  22.65  22.70  0.600   14.24 - 24.65
## 2600.HK          CHALCO   3.38   3.39  0.180     3.20 - 7.35
## 2628.HK      CHINA LIFE  18.70  18.72  0.500   17.04 - 28.10
## 3328.HK        BANKCOMM   5.14   5.15  0.090     4.15 - 8.36
## 3988.HK   BANK OF CHINA   2.95   2.96  0.030     2.20 - 4.36
```

9 Hang Seng Index

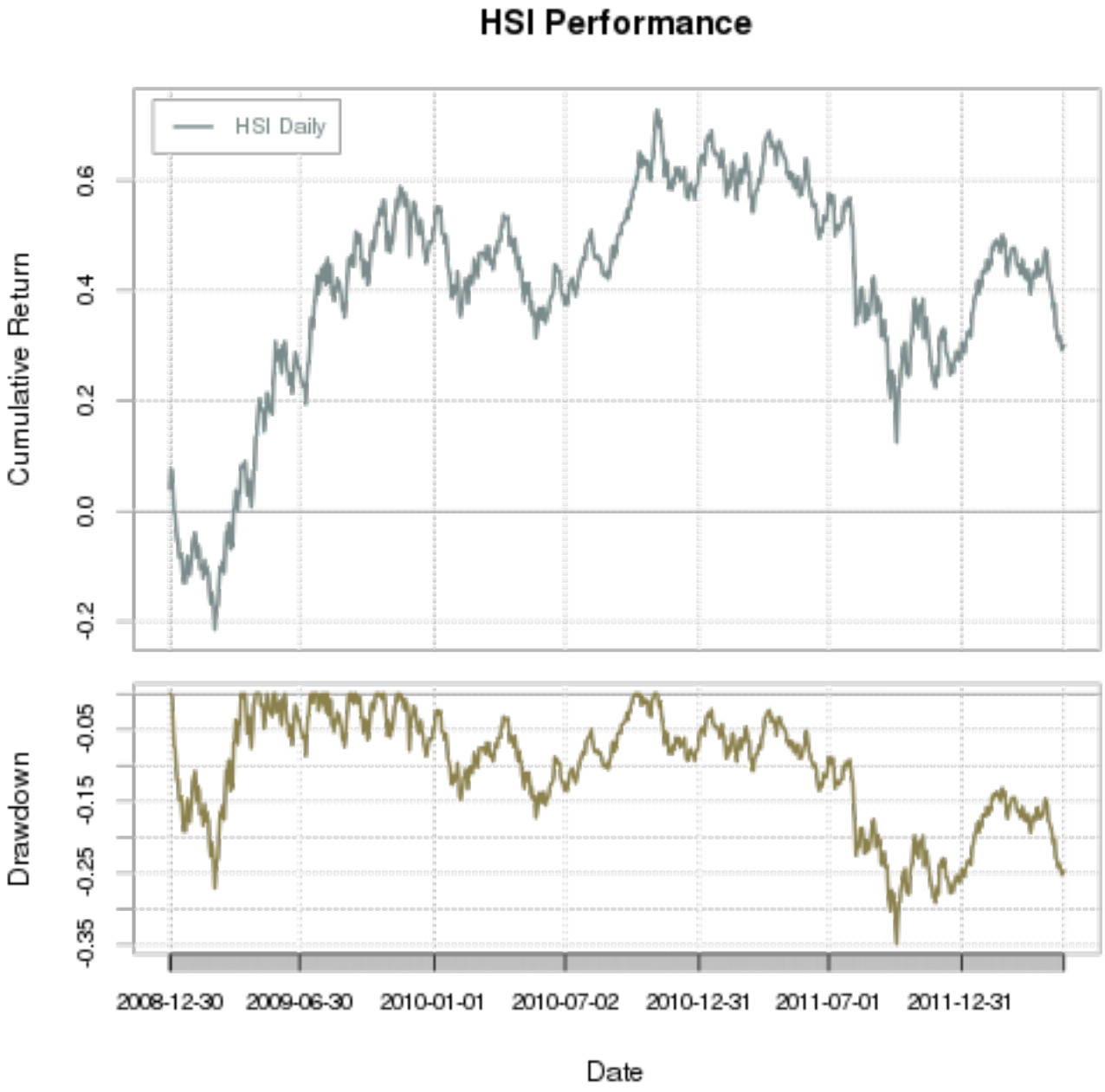
Latest Hang Seng Index

	Trade Time	Name	Last	Change	Days Range	52−week Range
^HSI	2012−05−29 04:01:00	HANG SENG INDEX	19055	254.5	18735.50 − 19058.471	16170.30 − 23924.50

9.1 Hang Seng Index - Momentum

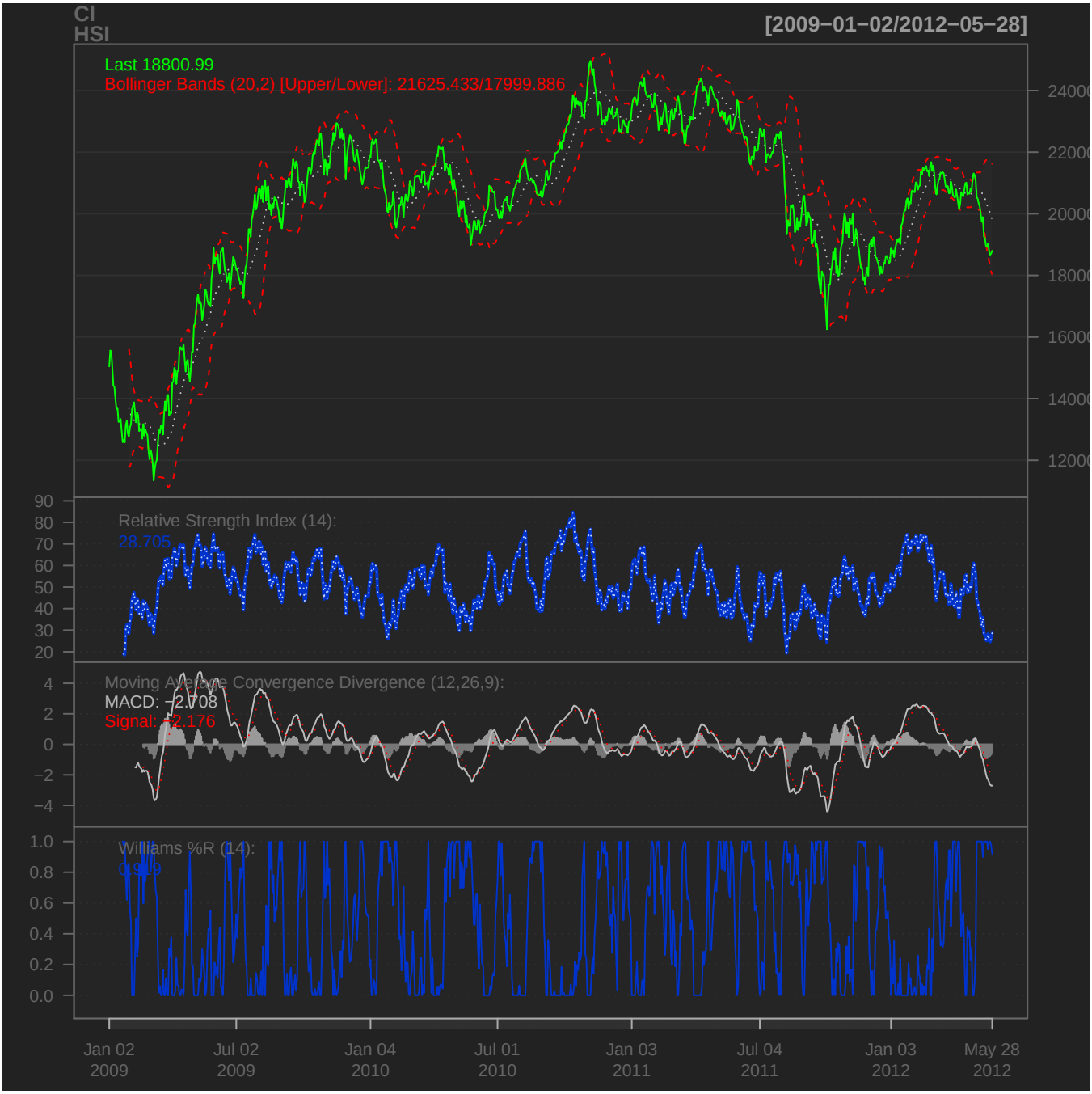


9.2 HSI Performance

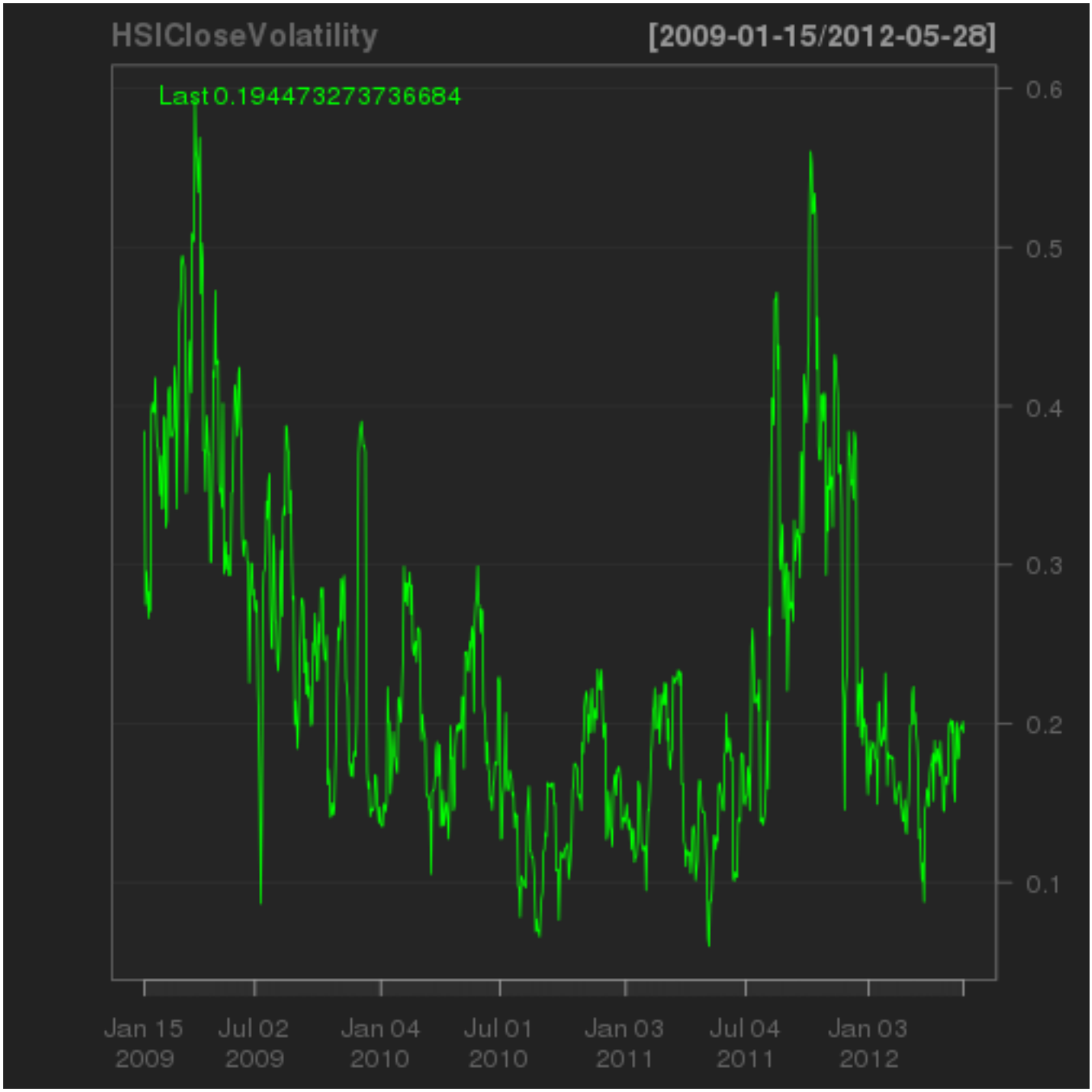


9.3 HSI Ratios

```
##              RSI
## 2012-05-14 35.92
## 2012-05-15 28.35
## 2012-05-16 27.76
## 2012-05-17 25.38
## 2012-05-20 25.10
## 2012-05-21 28.41
## 2012-05-22 25.76
## 2012-05-23 24.58
## 2012-05-24 26.01
## 2012-05-27 28.70
##              macd  signal
## 2012-05-14 -1.004 -0.4291
## 2012-05-15 -1.358 -0.6150
## 2012-05-16 -1.647 -0.8215
## 2012-05-17 -1.958 -1.0488
## 2012-05-20 -2.195 -1.2780
## 2012-05-21 -2.311 -1.4845
## 2012-05-22 -2.481 -1.6837
## 2012-05-23 -2.637 -1.8745
## 2012-05-24 -2.714 -2.0423
## 2012-05-27 -2.708 -2.1755
## [1] "BBands"
##                dn  mavg    up    pctB
## 2012-05-14 19779 20638 21497  0.0669
## 2012-05-15 19525 20573 21621 -0.1262
## 2012-05-16 19293 20494 21695 -0.0384
## 2012-05-17 19041 20392 21743 -0.0329
## 2012-05-20 18825 20287 21749  0.0331
## 2012-05-21 18659 20208 21757  0.1228
## 2012-05-22 18463 20113 21764  0.0980
## 2012-05-23 18269 20014 21760  0.1139
## 2012-05-24 18116 19910 21703  0.1665
## 2012-05-27 18000 19813 21625  0.2210
##             WPR %
## 2012-05-14  89.88
## 2012-05-15 100.00
## 2012-05-16 100.00
## 2012-05-17 100.00
## 2012-05-20 100.00
## 2012-05-21  94.98
## 2012-05-22 100.00
## 2012-05-23 100.00
## 2012-05-24  97.41
## 2012-05-27  91.91
```


CI
HSI
[2009−01−02/2012−05−28]
Last 18800.99
Bollinger Bands (20,2) [Upper/Lower]: 21625.433/17999.886
Relative Strength Index (14):
28.705
Moving Average Convergence Divergence (12,26,9):
MACD: −2.708
Signal: −2.176
Williams %R (14):
Jan 02 2009
Jul 02 2009
Jan 04 2010
Jul 01 2010
Jan 03 2011
Jul 04 2011
Jan 03 2012
May 28 2012

9.4 HSI Volatility



9.5 HSI Statistics

```
##                                HSI-Daily HSI-Monthly
## StdDev Sharpe (Rf=0%, p=95%):   0.02733     0.11151
## VaR Sharpe (Rf=0%, p=95%):      0.01764     0.07510
## ES Sharpe (Rf=0%, p=95%):       0.01300     0.06002
##          HSI-Daily HSI-Monthly
## Skewness    0.1268      0.1006
##          HSI-Daily HSI-Monthly
## Kurtosis     1.514     -0.2019
```

```
##      Index              HSI Daily
##  Min.   :2008-12-31   Min.   :-5.66e-02
##  1st Qu.:2009-11-03   1st Qu.:-8.10e-03
##  Median :2010-09-09   Median : 6.01e-05
##  Mean   :2010-09-10   Mean   : 4.33e-04
##  3rd Qu.:2011-07-17   3rd Qu.: 9.92e-03
##  Max.   :2012-05-26   Max.   : 7.41e-02
##      Index             HSI Monthly
##  Min.   :2009-01-28   Min.   :-0.14329
##  1st Qu.:2009-11-28   1st Qu.:-0.03514
##  Median :2010-09-28   Median : 0.00812
##  Mean   :2010-09-27   Mean   : 0.00786
##  3rd Qu.:2011-07-27   3rd Qu.: 0.03806
##  Max.   :2012-05-26   Max.   : 0.17074
```

10 Dataset First and Last Rows Info

```
##            X0001.HK.Close
## 2009-01-02           76.9
## 2012-05-28           92.5
##            X0002.HK.Close
## 2009-01-02           52.4
## 2012-05-28           63.8
##            X0003.HK.Close
## 2009-01-02          12.08
## 2012-05-28          18.32
##            X0004.HK.Close
## 2009-01-02           22.0
## 2012-05-28           41.3
##            X0005.HK.Close
## 2009-01-02           77.0
## 2012-05-28           62.8
##            X0006.HK.Close
## 2009-01-02          42.75
## 2012-05-28          54.60
##            X0011.HK.Close
## 2009-01-02          104.7
## 2012-05-28          101.2
##            X0012.HK.Close
## 2009-01-02          30.35
## 2012-05-28          39.15
##            X0013.HK.Close
## 2009-01-02          39.85
## 2012-05-28          66.90
##            X0016.HK.Close
## 2009-01-02          67.30
## 2012-05-28          88.25
##            X0017.HK.Close
## 2009-01-02           8.18
## 2012-05-28           8.22
##            X0019.HK.Close
## 2009-01-02          55.75
## 2012-05-28          84.85
##            X0023.HK.Close
## 2009-01-02          16.68
## 2012-05-28          26.05
##            X0066.HK.Close
## 2009-01-02          18.08
## 2012-05-28          25.15
##            X0083.HK.Close
## 2009-01-02           8.36
## 2012-05-28          10.84
##            X0101.HK.Close
## 2009-01-02          18.36
## 2012-05-28          24.85
##            X0144.HK.Close
## 2009-01-02           15.4
## 2012-05-28           22.8
##            X0151.HK.Close
## 2009-01-02           3.17
## 2012-05-28           9.11
##            X0267.HK.Close
```

```
## 2009-01-02          10.20
## 2012-05-28          11.44
##            X0291.HK.Close
## 2009-01-02          14.00
## 2012-05-28          24.65
##            X0293.HK.Close
## 2009-01-02           8.91
## 2012-05-28          12.02
##            X0322.HK.Close
## 2009-01-02           8.98
## 2012-05-28          19.18
##            X0330.HK.Close
## 2009-01-02          44.80
## 2012-05-28          12.46
##            X0386.HK.Close
## 2009-01-02           4.96
## 2012-05-28           7.09
##            X0388.HK.Close
## 2009-01-02           76.6
## 2012-05-28          109.4
##            X0494.HK.Close
## 2011-06-02          17.92
## 2012-05-28          14.98
##            X0688.HK.Close
## 2009-01-02          11.22
## 2012-05-28          16.40
##            X0700.HK.Close
## 2009-01-01           50.0
## 2012-05-28          213.8
##            X0762.HK.Close
## 2009-01-01           9.63
## 2012-05-28          11.08
##            X0836.HK.Close
## 2009-01-02          15.12
## 2012-05-28          13.72
##            X0857.HK.Close
## 2009-01-02            7.2
## 2012-05-28           10.2
##            X0883.HK.Close
## 2009-01-02           7.59
## 2012-05-28          14.46
##            X0939.HK.Close
## 2009-01-02           4.52
## 2012-05-28           5.21
##            X0941.HK.Close
## 2009-01-02          81.20
## 2012-05-28          79.65
##            X1044.HK.Close
## 2009-01-01           24.9
## 2012-05-28           76.9
##            X1088.HK.Close
## 2009-01-02          17.40
## 2012-05-28          27.85
##            X1109.HK.Close
## 2009-01-02           9.90
## 2012-05-28          14.14
##            X1199.HK.Close
```

```
## 2009-01-02           8.07
## 2012-05-28           9.21
##            X1299.HK.Close
## 2010-10-29          23.10
## 2012-05-28          24.65
##            X1398.HK.Close
## 2009-01-02           4.30
## 2012-05-28           4.66
##            X1880.HK.Close
## 2009-01-02            3.5
## 2012-05-28           13.0
##            X1898.HK.Close
## 2009-01-02           6.55
## 2012-05-28           7.22
##            X2318.HK.Close
## 2009-01-02           39.6
## 2012-05-28           56.7
##            X2388.HK.Close
## 2009-01-02           9.06
## 2012-05-28          22.10
##            X2600.HK.Close
## 2009-01-02           4.55
## 2012-05-28           3.21
##            X2628.HK.Close
## 2009-01-02          24.75
## 2012-05-28          18.18
##            X3328.HK.Close
## 2009-01-02           5.91
## 2012-05-28           5.05
##            X3988.HK.Close
## 2009-01-02           2.17
## 2012-05-28           2.93
```

11 Notes

This paper was generated using R and following R libraries :
qmao XML quantmod PerformanceAnalytics
fPortfolio fBasic grid gridExtra knitr

Market Data Source : yahoo.finance

Currently this paper is automatically generated with a daily cron job.
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This is the End !