CAPM and other Statistics for HSI Components Version 1.1

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Contents

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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                               -0.0002
## Beta                                 0.0026
## Beta+                               -0.3785
## Beta-                                0.2762
## R-squared                            0.0000
## Annualized Alpha                    -0.0480
## Correlation                          0.0017
## Correlation p-value                  0.9815
## Tracking Error                       0.4603
## Active Premium                      -0.0220
## Information Ratio                   -0.0478
## Treynor Ratio                      -44.9959
```

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

CAPM - Distinct for each stock

```
## Error: 'names' attribute [50] must be the same length as the vector [49]
##                      X0001.HK to HSI X0002.HK to HSI X0003.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           1.048           0.243           0.304
## Beta+                          1.071           0.062          -0.032
## Beta-                          1.015           0.274           0.498
## R-squared                      0.740           0.152           0.134
## Annualized Alpha              -0.043           0.023          -0.033
## Correlation                    0.860           0.389           0.366
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.161           0.245           0.269
## Active Premium                -0.054           0.152           0.080
## Information Ratio             -0.335           0.620           0.300
## Treynor Ratio                 -0.226          -0.126          -0.336
##                      X0004.HK to HSI X0005.HK to HSI X0006.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           1.192           1.014           0.152
## Beta+                          1.200           0.918          -0.040
## Beta-                          1.157           1.101           0.223
## R-squared                      0.615           0.792           0.040
## Annualized Alpha              -0.035           0.032           0.039
## Correlation                    0.784           0.890           0.200
## Correlation p-value            0.000           0.000           0.001
## Tracking Error                 0.248           0.134           0.291
## Active Premium                -0.086           0.016           0.177
## Information Ratio             -0.347           0.117           0.606
## Treynor Ratio                 -0.226          -0.165          -0.040
##                      X0011.HK to HSI X0012.HK to HSI X0013.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           0.648           1.004           1.042
## Beta+                          0.654           0.990           0.989
## Beta-                          0.737           0.976           1.109
## R-squared                      0.567           0.585           0.673
## Annualized Alpha              -0.042          -0.018          -0.077
## Correlation                    0.753           0.765           0.820
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.172           0.218           0.188
## Active Premium                 0.021          -0.034          -0.084
## Information Ratio              0.121          -0.158          -0.445
## Treynor Ratio                 -0.250          -0.216          -0.256
##                      X0016.HK to HSI X0017.HK to HSI X0019.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           0.898           1.104           0.704
## Beta+                          0.993           0.732           0.719
## Beta-                          0.732           1.311           0.655
## R-squared                      0.561           0.448           0.343
## Annualized Alpha              -0.086          -0.100          -0.122
## Correlation                    0.749           0.670           0.586
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.207           0.317           0.263
## Active Premium                -0.069          -0.136          -0.075
## Information Ratio             -0.335          -0.429          -0.287
## Treynor Ratio                 -0.280          -0.289          -0.366
##                      X0023.HK to HSI X0066.HK to HSI X0083.HK to HSI
## Alpha                          0.000           0.000           0.000
```

```
## Beta                          0.890           0.513           1.179
## Beta+                         1.043           0.480           1.306
## Beta-                         0.824           0.562           1.253
## R-squared                     0.533           0.435           0.566
## Annualized Alpha             -0.054          -0.015           0.082
## Correlation                   0.730           0.659           0.752
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.217           0.196           0.270
## Active Premium               -0.042           0.068          -0.001
## Information Ratio            -0.193           0.347          -0.002
## Treynor Ratio                -0.252          -0.223          -0.156
##                      X0101.HK to HSI X0144.HK to HSI X0151.HK to HSI
## Alpha                         0.000           0.000           0.002
## Beta                          1.059           1.165           0.670
## Beta+                         1.101           1.342           0.542
## Beta-                         1.136           1.210           0.840
## R-squared                     0.575           0.507           0.205
## Annualized Alpha             -0.029          -0.103           0.495
## Correlation                   0.758           0.712           0.452
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.235           0.300           0.351
## Active Premium               -0.056          -0.143           0.425
## Information Ratio            -0.236          -0.479           1.209
## Treynor Ratio                -0.225          -0.280           0.362
##                      X0267.HK to HSI X0291.HK to HSI X0293.HK to HSI
## Alpha                        -0.002           0.000          -0.001
## Beta                          1.157           0.772           0.728
## Beta+                         1.457           0.733           0.942
## Beta-                         1.030           0.880           0.643
## R-squared                     0.542           0.345           0.351
## Annualized Alpha             -0.309          -0.119          -0.194
## Correlation                   0.736           0.587           0.592
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.277           0.281           0.265
## Active Premium               -0.294          -0.087          -0.140
## Information Ratio            -1.060          -0.311          -0.526
## Treynor Ratio                -0.412          -0.350          -0.443
##                      X0322.HK to HSI X0330.HK to HSI X0386.HK to HSI
## Alpha                         0.000          -0.002           0.000
## Beta                          0.457           1.157           0.795
## Beta+                         0.719           1.248           0.744
## Beta-                         0.488           1.258           0.577
## R-squared                     0.120           0.148           0.482
## Annualized Alpha             -0.077          -0.381           0.063
## Correlation                   0.346           0.385           0.694
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.349           0.718           0.219
## Active Premium               -0.011          -0.443           0.073
## Information Ratio            -0.032          -0.617           0.333
## Treynor Ratio                -0.424          -0.541          -0.138
##                      X0388.HK to HSI X0494.HK to HSI X0688.HK to HSI
## Alpha                        -0.001           0.000           0.002
## Beta                          1.079           1.243           1.559
## Beta+                         1.194           1.155           2.265
## Beta-                         1.034           1.066           1.318
## R-squared                     0.661           0.427           0.553
## Annualized Alpha             -0.193           0.132           0.562
```

```
## Correlation                   0.813           0.653           0.744
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.201           0.377           0.389
## Active Premium               -0.183          -0.003           0.224
## Information Ratio            -0.912          -0.008           0.574
## Treynor Ratio                -0.339          -0.149           0.026
##                      X0700.HK to HSI X0762.HK to HSI X0836.HK to HSI
## Alpha                          0.001          -0.001           0.000
## Beta                           1.062           0.975           0.468
## Beta+                          1.363           1.165           0.227
## Beta-                          0.968           0.994           0.596
## R-squared                      0.496           0.420           0.124
## Annualized Alpha               0.281          -0.272           0.111
## Correlation                    0.704           0.648           0.352
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.277           0.296           0.349
## Active Premium                 0.177          -0.244           0.151
## Information Ratio              0.638          -0.825           0.432
## Treynor Ratio                 -0.006          -0.438          -0.068
##                      X0857.HK to HSI X0883.HK to HSI X0939.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           0.944           1.405           1.093
## Beta+                          0.875           1.680           1.134
## Beta-                          0.930           1.402           1.051
## R-squared                      0.661           0.754           0.758
## Annualized Alpha               0.110           0.033          -0.087
## Correlation                    0.813           0.869           0.871
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.175           0.232           0.161
## Active Premium                 0.088          -0.070          -0.097
## Information Ratio              0.502          -0.303          -0.599
## Treynor Ratio                 -0.100          -0.180          -0.255
##                      X0941.HK to HSI X1044.HK to HSI X1088.HK to HSI
## Alpha                          0.001           0.001           0.000
## Beta                           0.545           0.646           1.192
## Beta+                          0.338           0.848           1.229
## Beta-                          0.511           0.702           1.226
## R-squared                      0.382           0.276           0.672
## Annualized Alpha               0.266           0.258          -0.106
## Correlation                    0.618           0.525           0.820
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.214           0.285           0.220
## Active Premium                 0.309           0.256          -0.136
## Information Ratio              1.442           0.897          -0.617
## Treynor Ratio                  0.231           0.113          -0.267
##                      X1109.HK to HSI X1199.HK to HSI X1299.HK to HSI
## Alpha                          0.002           0.000           0.000
## Beta                           1.525           1.414           0.853
## Beta+                          2.140           1.408           0.795
## Beta-                          1.232           1.550           1.119
## R-squared                      0.499           0.612           0.445
## Annualized Alpha               0.648          -0.096           0.146
## Correlation                    0.706           0.782           0.667
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.417           0.310           0.249
## Active Premium                 0.277          -0.179           0.123
## Information Ratio              0.663          -0.578           0.493
```

```
## Treynor Ratio                0.062          -0.256          -0.070
##                     X1398.HK to HSI X1880.HK to HSI X1898.HK to HSI
## Alpha                         0.000           0.000           0.000
## Beta                          1.348           1.067           1.446
## Beta+                         1.602           1.298           1.546
## Beta-                         1.225           0.917           1.372
## R-squared                     0.774           0.379           0.661
## Annualized Alpha             -0.089          -0.019          -0.112
## Correlation                   0.880           0.616           0.813
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.208           0.353           0.291
## Active Premium               -0.146          -0.075          -0.192
## Information Ratio            -0.701          -0.213          -0.659
## Treynor Ratio                -0.244          -0.242          -0.259
##                     X1928.HK to HSI X2318.HK to HSI X2388.HK to HSI
## Alpha                         0.003           0.000           0.001
## Beta                          1.594           1.626           0.991
## Beta+                         2.181           1.966           1.041
## Beta-                         1.795           1.341           1.062
## R-squared                     0.436           0.682           0.621
## Annualized Alpha              0.941           0.088           0.208
## Correlation                   0.660           0.826           0.788
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.492           0.329           0.200
## Active Premium                0.411          -0.090           0.152
## Information Ratio             0.834          -0.274           0.763
## Treynor Ratio                 0.143          -0.168          -0.030
##                     X2600.HK to HSI X2628.HK to HSI X3328.HK to HSI
## Alpha                        -0.001           0.000          -0.001
## Beta                          1.479           1.365           1.346
## Beta+                         1.644           1.418           1.376
## Beta-                         1.266           1.261           1.342
## R-squared                     0.571           0.644           0.762
## Annualized Alpha             -0.278          -0.039          -0.134
## Correlation                   0.756           0.803           0.873
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.353           0.278           0.214
## Active Premium               -0.322          -0.124          -0.179
## Information Ratio            -0.912          -0.446          -0.840
## Treynor Ratio                -0.341          -0.225          -0.269
##                     X3988.HK to HSI
## Alpha                         0.000
## Beta                          1.131
## Beta+                         1.154
## Beta-                         1.110
## R-squared                     0.706
## Annualized Alpha             -0.125
## Correlation                   0.840
## Correlation p-value           0.000
## Tracking Error                0.191
## Active Premium               -0.136
## Information Ratio            -0.713
## Treynor Ratio                -0.282
```

3 HSI Components Risk

3.1 Correlation

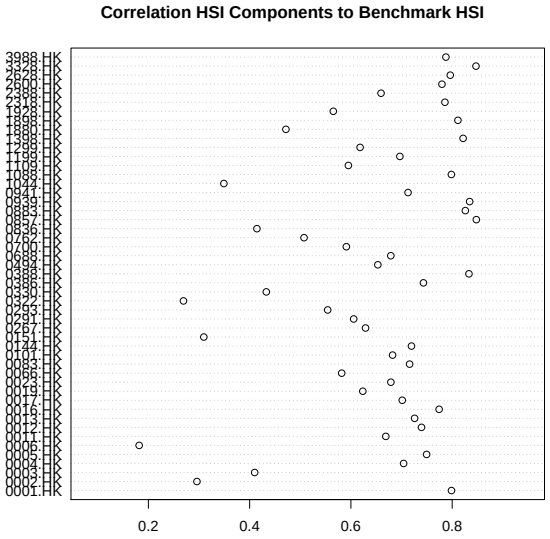
Correlation Combined

```
##                       Correlation p-value Lower CI Upper CI
## HSI Components to HSI      0.0017  0.9815  -0.1803   0.1835
```

Correlation - Distinct

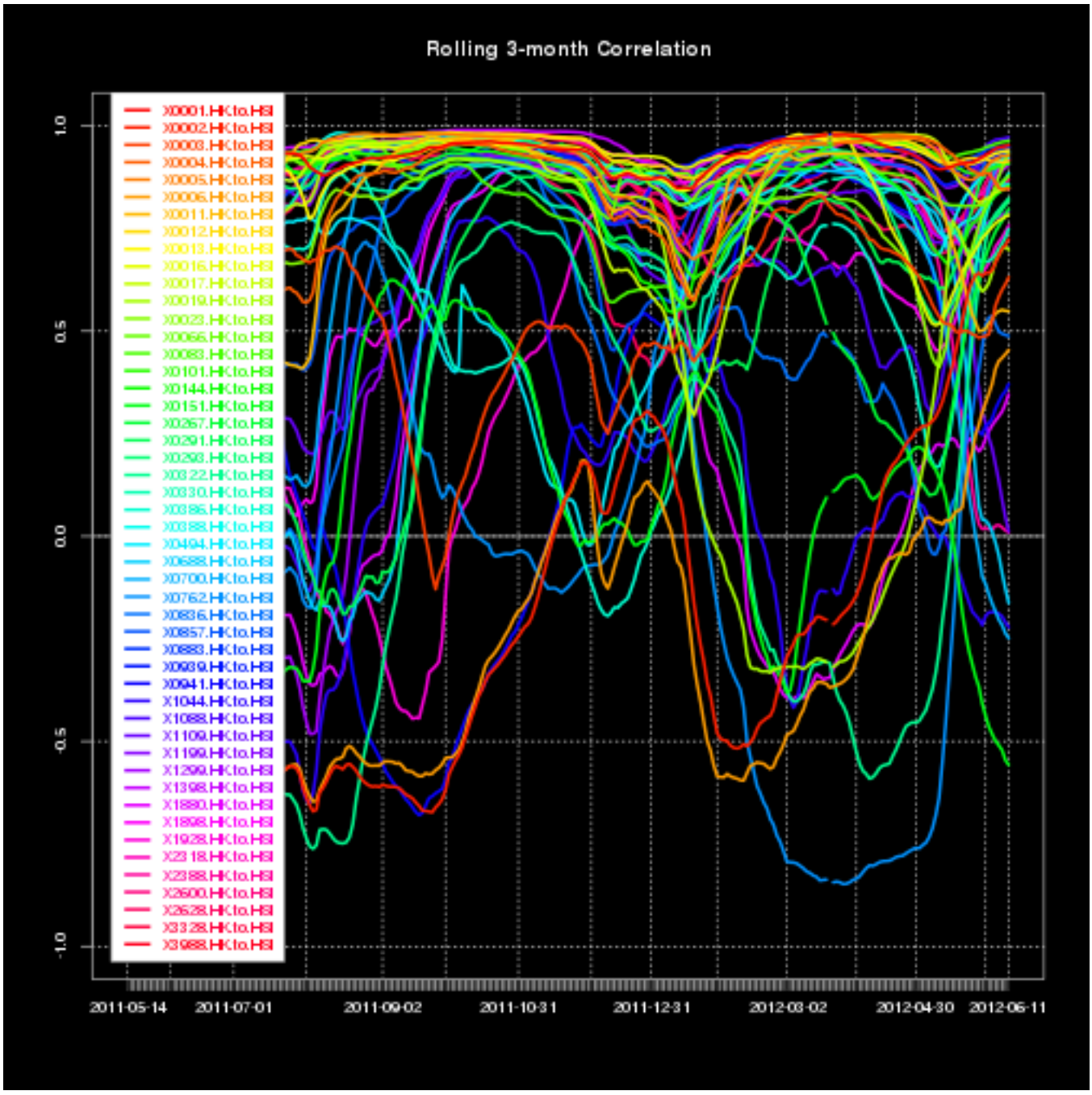
```
##         Correlation p-value Lower CI Upper CI
## 0001.HK      0.7986       0   0.7644   0.8283
## 0002.HK      0.2959       0   0.2136   0.3740
## 0003.HK      0.4099       0   0.3342   0.4804
## 0004.HK      0.7041       0   0.6569   0.7458
## 0005.HK      0.7495       0   0.7083   0.7856
## 0006.HK      0.1818       0   0.0955   0.2653
## 0011.HK      0.6689       0   0.6173   0.7147
## 0012.HK      0.7394       0   0.6969   0.7768
## 0013.HK      0.7258       0   0.6815   0.7649
## 0016.HK      0.7742       0   0.7364   0.8071
## 0017.HK      0.7014       0   0.6539   0.7435
## 0019.HK      0.6235       0   0.5667   0.6744
## 0023.HK      0.6789       0   0.6286   0.7236
## 0066.HK      0.5818       0   0.5206   0.6370
## 0083.HK      0.7159       0   0.6702   0.7561
## 0101.HK      0.6823       0   0.6324   0.7266
## 0144.HK      0.7196       0   0.6744   0.7594
## 0151.HK      0.3095       0   0.2280   0.3868
## 0267.HK      0.6289       0   0.5727   0.6792
## 0291.HK      0.6055       0   0.5468   0.6583
## 0293.HK      0.5541       0   0.4902   0.6121
## 0322.HK      0.2693       0   0.1858   0.3488
## 0330.HK      0.4329       0   0.3588   0.5016
## 0386.HK      0.7432       0   0.7011   0.7801
## 0388.HK      0.8331       0   0.8041   0.8581
## 0494.HK      0.6532       0   0.5512   0.7359
## 0688.HK      0.6788       0   0.6285   0.7235
## 0700.HK      0.5910       0   0.5308   0.6452
## 0762.HK      0.5074       0   0.4392   0.5697
## 0836.HK      0.4144       0   0.3390   0.4846
## 0857.HK      0.8477       0   0.8210   0.8707
## 0883.HK      0.8260       0   0.7959   0.8520
## 0939.HK      0.8345       0   0.8057   0.8593
## 0941.HK      0.7128       0   0.6667   0.7534
## 1044.HK      0.3491       0   0.2698   0.4238
## 1088.HK      0.7984       0   0.7641   0.8281
## 1109.HK      0.5950       0   0.5352   0.6489
## 1199.HK      0.6967       0   0.6486   0.7393
## 1299.HK      0.6181       0   0.5326   0.6911
## 1398.HK      0.8216       0   0.7909   0.8482
## 1880.HK      0.4716       0   0.4003   0.5371
## 1898.HK      0.8113       0   0.7790   0.8393
## 1928.HK      0.5652       0   0.4913   0.6310
## 2318.HK      0.7857       0   0.7496   0.8171
## 2388.HK      0.6595       0   0.6069   0.7064
## 2600.HK      0.7798       0   0.7429   0.8120
```

```
## 2628.HK      0.7962       0   0.7617   0.8262
## 3328.HK      0.8470       0   0.8202   0.8701
## 3988.HK      0.7876       0   0.7518   0.8188
```



3 Month Rolling Correlation

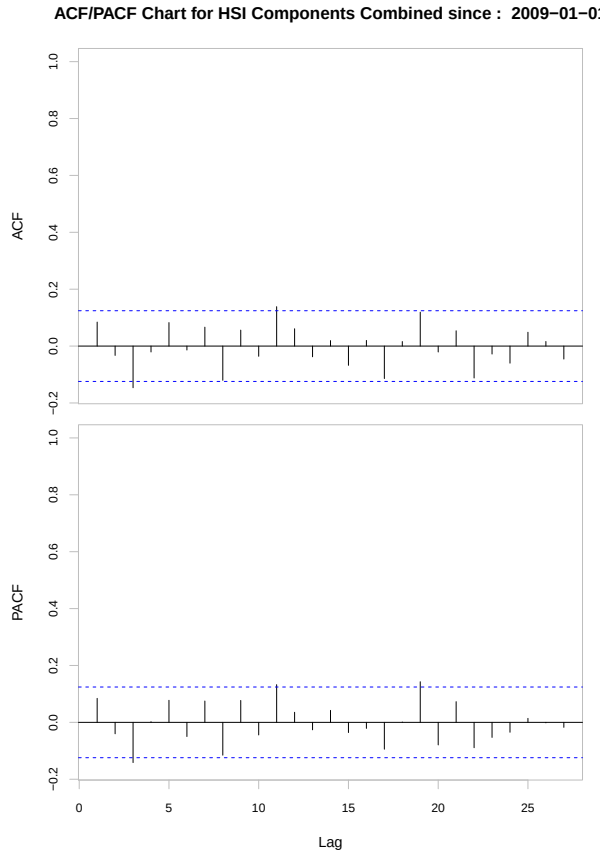
```
## Error: improper length of one or more arguments to merge.xts
```



3.2 Autocorrelation Coefficients - Combined

Autocorrelation Combined

```
##                  rho1    rho2    rho3    rho4   rho5    rho6 Q(6) p-value
## daily.returns 0.0844 -0.0328 -0.1465 -0.0208 0.0827 -0.0139       0.1332
```



3.3 Downside Risk - Combined

Downside Risk Combined

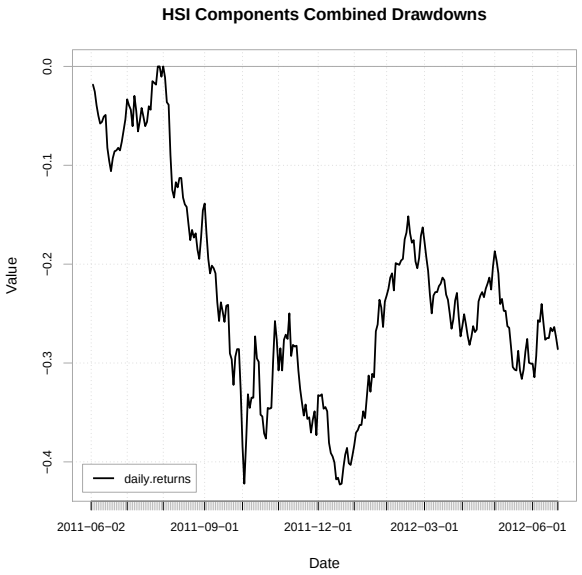
```
##                                HSI Components dailyReturn
## Semi Deviation                                      0.0236
## Gain Deviation                                      0.0177
## Loss Deviation                                      0.0154
## Downside Deviation (MAR=210%)                       0.0271
## Downside Deviation (Rf=0%)                          0.0243
## Downside Deviation (0%)                             0.0243
## Maximum Drawdown                                    0.4229
## Historical VaR (95%)                               -0.0368
## Historical ES (95%)                                -0.0538
## Modified VaR (95%)                                 -0.0386
## Modified ES (95%)                                  -0.0499
```

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    220        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%)          0.02427
```

3.6 Downside Deviation - Distinct

```
##                                0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## Downside Deviation (MAR = 0%)   0.019  0.0088  0.0161  0.0237  0.0245
##                                0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## Downside Deviation (MAR = 0%)   0.011  0.0146   0.021  0.0189  0.0201
##                                0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## Downside Deviation (MAR = 0%)  0.0244  0.0205  0.0201  0.0129  0.0251
##                                0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## Downside Deviation (MAR = 0%)  0.0247  0.0267  0.0217  0.0246  0.0231
##                                0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## Downside Deviation (MAR = 0%)  0.0212  0.0202  0.0368  0.0202  0.0194
##                                0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Downside Deviation (MAR = 0%)  0.0322  0.0258  0.0243  0.0231  0.0202
##                                0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## Downside Deviation (MAR = 0%)  0.0204  0.0236  0.0206  0.0156  0.0204
##                                1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## Downside Deviation (MAR = 0%)  0.0239  0.0286  0.0288  0.0192  0.0211
##                                1880.HK 1898.HK 1928.HK 2318.HK 2388.HK
## Downside Deviation (MAR = 0%)  0.0267  0.0289  0.0298  0.0263  0.0195
##                                2600.HK 2628.HK 3328.HK 3988.HK
## Downside Deviation (MAR = 0%)  0.0292   0.022  0.0221  0.0213
```

4 General Statistics

Statistics Distinct

```
##                Observations NAs Minimum Quartile 1 Median Arithmetic Mean
## X0001.HK.Close          860  12   56.00     91.550  98.38         100.028
## X0002.HK.Close          859  13   51.10     52.700  61.50          59.859
## X0003.HK.Close          860  12   10.78     17.255  18.24          17.741
## X0004.HK.Close          859  13   15.20     37.800  42.10          41.985
## X0005.HK.Close          859  13   33.00     65.925  76.85          74.186
## X0006.HK.Close          860  12   41.10     43.788  48.15          49.788
## X0011.HK.Close          859  13   67.00    102.350 109.40         108.873
## X0012.HK.Close          859  13   23.75     42.050  47.85          46.589
## X0013.HK.Close          860  12   36.40     53.538  61.85          64.905
## X0016.HK.Close          859  13   55.80     97.350 110.70         107.325
## X0017.HK.Close          859  13    6.20      9.280  13.20          12.379
## X0019.HK.Close          859  13   42.90     84.800  91.30          92.024
## X0023.HK.Close          860  12   12.34     26.688  28.95          28.226
## X0066.HK.Close          860  12   16.14     25.250  26.85          26.090
## X0083.HK.Close          860  12    5.60     11.755  13.46          13.015
## X0101.HK.Close          859  13   13.66     25.550  28.75          28.483
## X0144.HK.Close          860  12   12.20     23.100  26.15          25.848
## X0151.HK.Close          860  12    2.77      4.970   6.33           6.125
## X0267.HK.Close          859  13    7.18     13.690  16.58          16.649
## X0291.HK.Close          859  13   10.66     24.500  27.85          26.164
## X0293.HK.Close          859  13    6.98     12.490  14.54          15.017
## X0322.HK.Close          859  13    8.27     17.340  19.38          18.462
## X0330.HK.Close          860  12    7.93     21.350  41.00          36.765
## X0386.HK.Close          859  13    3.65      6.230   6.91           6.938
## X0388.HK.Close          860  12   54.60    122.375 134.45         135.435
## X0494.HK.Close          260 612   11.60     14.175  15.15          15.351
## X0688.HK.Close          859  13    9.41     14.430  15.56          15.280
## X0700.HK.Close          868   4   41.80    132.150 159.00         154.693
## X0762.HK.Close          866   6    8.31      9.898  11.10          11.971
## X0836.HK.Close          860  12   11.10     14.160  15.18          15.331
## X0857.HK.Close          859  13    5.10      8.760   9.52           9.465
## X0883.HK.Close          859  13    6.08     11.810  13.62          13.784
## X0939.HK.Close          860  12    3.66      5.558   6.20           6.091
## X0941.HK.Close          860  12   63.00     73.700  76.45          76.372
## X1044.HK.Close          871   1   24.25     50.800  61.45          58.081
## X1088.HK.Close          860  12   13.90     29.837  33.23          31.662
## X1109.HK.Close          859  13    7.50     13.080  14.54          14.386
## X1199.HK.Close          859  13    5.40      9.470  11.00          11.088
## X1299.HK.Close          407 465   19.86     23.050  24.85          24.960
## X1398.HK.Close          860  12    3.03      4.928   5.65           5.417
## X1880.HK.Close          859  13    2.98      8.480  12.56          11.281
## X1898.HK.Close          860  12    4.43      8.977  10.36          10.245
## X1928.HK.Close          633 239    9.23     12.140  18.52          18.497
## X2318.HK.Close          860  12   30.35     58.275  64.35          64.996
## X2388.HK.Close          859  13    6.30     16.890  18.86          19.066
## X2600.HK.Close          860  12    3.08      4.300   6.76           6.371
## X2628.HK.Close          860  12   17.08     22.650  29.45          28.731
## X3328.HK.Close          859  13    4.17      5.850   7.85           7.406
## X3988.HK.Close          860  12    1.84      3.020   3.84           3.608
##                Geometric Mean Quartile 3 Maximum SE Mean LCL Mean (0.95)
## X0001.HK.Close         98.770    111.750  135.70  0.5318           98.984
## X0002.HK.Close         59.504     64.875   75.00  0.2248           59.417
## X0003.HK.Close         17.609     19.080   21.00  0.0705           17.602
```

```
## X0004.HK.Close         40.411     49.800   62.00  0.3608          41.276
## X0005.HK.Close         73.221     82.625   98.00  0.3911          73.418
## X0006.HK.Close         49.409     55.962   64.80  0.2142          49.368
## X0011.HK.Close        108.167    116.600  134.00  0.4151         108.058
## X0012.HK.Close         45.834     52.600   60.50  0.2708          46.057
## X0013.HK.Close         63.061     77.650   95.90  0.5300          63.865
## X0016.HK.Close        105.673    118.400  146.30  0.6069         106.134
## X0017.HK.Close         11.928     15.180   18.54  0.1132          12.157
## X0019.HK.Close         89.816    106.350  136.40  0.6506          90.747
## X0023.HK.Close         27.735     31.900   35.90  0.1654          27.902
## X0066.HK.Close         25.884     28.050   31.15  0.1063          25.881
## X0083.HK.Close         12.771     14.700   18.56  0.0819          12.854
## X0101.HK.Close         27.939     31.900   40.30  0.1828          28.124
## X0144.HK.Close         25.354     28.700   37.55  0.1657          25.522
## X0151.HK.Close          5.933      7.183    9.82  0.0544           6.018
## X0267.HK.Close         16.155     20.375   24.40  0.1367          16.381
## X0291.HK.Close         25.234     30.525   35.25  0.2142          25.744
## X0293.HK.Close         14.532     18.090   24.05  0.1331          14.756
## X0322.HK.Close         17.848     21.400   25.95  0.1500          18.168
## X0330.HK.Close         32.382     48.975   64.30  0.5379          35.709
## X0386.HK.Close          6.853      7.720    9.64  0.0384           6.863
## X0388.HK.Close        131.845    150.775  197.50  0.9899         133.492
## X0494.HK.Close         15.258     16.795   19.86  0.1087          15.137
## X0688.HK.Close         15.161     16.610   19.44  0.0645          15.153
## X0700.HK.Close        143.944    190.825  247.00  1.6879         151.380
## X0762.HK.Close         11.755     13.920   17.40  0.0829          11.808
## X0836.HK.Close         15.251     16.500   20.15  0.0554          15.222
## X0857.HK.Close          9.357     10.480   12.36  0.0488           9.369
## X0883.HK.Close         13.364     16.740   20.95  0.1150          13.559
## X0939.HK.Close          6.028      6.760    8.28  0.0308           6.030
## X0941.HK.Close         76.242     79.013   91.45  0.1529          76.072
## X1044.HK.Close         55.788     69.650   82.70  0.5046          57.090
## X1088.HK.Close         31.053     35.200   40.80  0.1921          31.285
## X1109.HK.Close         14.169     16.030   20.00  0.0847          14.220
## X1199.HK.Close         10.871     12.520   16.76  0.0773          10.937
## X1299.HK.Close         24.872     26.775   29.65  0.1057          24.752
## X1398.HK.Close          5.357      5.940    7.03  0.0285           5.361
## X1880.HK.Close         10.559     14.260   17.54  0.1278          11.030
## X1898.HK.Close         10.012     11.620   15.86  0.0745          10.099
## X1928.HK.Close         17.518     22.450   32.70  0.2459          18.014
## X2318.HK.Close         63.652     74.150   94.30  0.4388          64.135
## X2388.HK.Close         18.316     22.925   28.95  0.1700          18.732
## X2600.HK.Close          6.109      7.755   10.66  0.0642           6.245
## X2628.HK.Close         28.019     34.250   41.00  0.2158          28.308
## X3328.HK.Close          7.250      8.620   10.56  0.0539           7.300
## X3988.HK.Close          3.551      4.120    5.00  0.0237           3.562
##                 UCL Mean (0.95)  Variance   Stdev Skewness Kurtosis
## X0001.HK.Close         101.072  243.2582 15.5967  -0.1038   0.0375
## X0002.HK.Close          60.300   43.4011  6.5880   0.1631  -1.3791
## X0003.HK.Close          17.879    4.2768  2.0680  -1.6242   2.2652
## X0004.HK.Close          42.693  111.8365 10.5753  -0.5431   0.0825
## X0005.HK.Close          74.954  131.4079 11.4633  -0.6209   0.1082
## X0006.HK.Close          50.209   39.4418  6.2803   0.3755  -1.2229
## X0011.HK.Close         109.688  148.0305 12.1668  -0.4066   0.0862
## X0012.HK.Close          47.120   62.9792  7.9359  -0.7867   0.2641
## X0013.HK.Close          65.945  241.5359 15.5414   0.2164  -1.0233
## X0016.HK.Close         108.516  316.3835 17.7872  -0.7229   0.4368
```

```
## X0017.HK.Close          12.601   11.0029  3.3171  -0.2891  -1.1759
## X0019.HK.Close          93.301  363.6501 19.0696  -0.3906   0.2263
## X0023.HK.Close          28.551   23.5150  4.8492  -1.2751   1.4061
## X0066.HK.Close          26.298    9.7138  3.1167  -1.4653   1.6695
## X0083.HK.Close          13.176    5.7713  2.4024  -0.9865   0.8505
## X0101.HK.Close          28.842   28.6990  5.3571  -0.4820   0.1872
## X0144.HK.Close          26.173   23.6121  4.8592  -0.4815   0.5069
## X0151.HK.Close           6.232    2.5447  1.5952  -0.1116  -0.4587
## X0267.HK.Close          16.918   16.0597  4.0075  -0.2151  -0.8701
## X0291.HK.Close          26.584   39.3975  6.2767  -1.0841   0.1765
## X0293.HK.Close          15.278   15.2180  3.9010   0.2242  -0.5841
## X0322.HK.Close          18.756   19.3223  4.3957  -0.9125   0.0643
## X0330.HK.Close          37.821  248.7842 15.7729  -0.4236  -1.1005
## X0386.HK.Close           7.014    1.2663  1.1253  -0.3984   0.3503
## X0388.HK.Close         137.377  842.6513 29.0285  -0.4773   0.3827
## X0494.HK.Close          15.565    3.0709  1.7524   0.2524  -0.6065
## X0688.HK.Close          15.406    3.5705  1.8896  -0.8271   0.3632
## X0700.HK.Close         158.006 2473.0006 49.7293  -0.6536  -0.2608
## X0762.HK.Close          12.134    5.9529  2.4399   0.6326  -0.9432
## X0836.HK.Close          15.440    2.6426  1.6256   0.2935  -0.2181
## X0857.HK.Close           9.560    2.0417  1.4289  -0.7539   0.6582
## X0883.HK.Close          14.010   11.3630  3.3709  -0.2132  -0.6662
## X0939.HK.Close           6.151    0.8161  0.9034  -0.6767   0.1273
## X0941.HK.Close          76.672   20.1006  4.4834   0.1533   0.3142
## X1044.HK.Close          59.071  221.8002 14.8930  -0.7318  -0.4641
## X1088.HK.Close          32.039   31.7202  5.6321  -1.3954   1.5932
## X1109.HK.Close          14.553    6.1555  2.4810  -0.4286   0.0580
## X1199.HK.Close          11.240    5.1270  2.2643   0.1039  -0.3538
## X1299.HK.Close          25.168    4.5470  2.1324   0.0256  -1.1459
## X1398.HK.Close           5.473    0.6995  0.8364  -0.8240   0.2526
## X1880.HK.Close          11.532   14.0345  3.7463  -0.5930  -0.7390
## X1898.HK.Close          10.392    4.7706  2.1842  -0.3418   0.0286
## X1928.HK.Close          18.980   38.2854  6.1875   0.3427  -0.8965
## X2318.HK.Close          65.857  165.5817 12.8679  -0.1294  -0.1355
## X2388.HK.Close          19.399   24.8306  4.9830  -0.5737  -0.0674
## X2600.HK.Close           6.497    3.5464  1.8832  -0.2364  -1.1361
## X2628.HK.Close          29.155   40.0599  6.3293  -0.1867  -1.2378
## X3328.HK.Close           7.512    2.4959  1.5798  -0.2411  -1.1913
## X3988.HK.Close           3.655    0.4849  0.6963  -0.5923  -0.5726
```

4.1 Higher Moments - Combined

```
##                 HSI Components to HSI Combined
## CoSkewness                              0.0000
## CoKurtosis                              0.0000
## Beta CoVariance                         0.0026
## Beta CoSkewness                         1.2398
## Beta CoKurtosis                        -0.0608
```

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     5.0239 1.45703 1.20284 1.15311 1.07441 1.03132
## Proportion of Variance 0.5151 0.04333 0.02953 0.02714 0.02356 0.02171
## Cumulative Proportion  0.5151 0.55843 0.58796 0.61509 0.63865 0.66036
##                         Comp.7  Comp.8  Comp.9 Comp.10 Comp.11 Comp.12
## Standard deviation     0.95834 0.95397 0.92313 0.89885 0.85825 0.84818
## Proportion of Variance 0.01874 0.01857 0.01739 0.01649 0.01503 0.01468
## Cumulative Proportion  0.67910 0.69767 0.71506 0.73155 0.74658 0.76127
##                        Comp.13 Comp.14 Comp.15 Comp.16 Comp.17 Comp.18
## Standard deviation     0.82961 0.79260 0.77835 0.74984 0.73796 0.72884
## Proportion of Variance 0.01405 0.01282 0.01236 0.01147 0.01111 0.01084
## Cumulative Proportion  0.77531 0.78813 0.80050 0.81197 0.82309 0.83393
##                        Comp.19  Comp.20  Comp.21 Comp.22  Comp.23 Comp.24
## Standard deviation     0.70677 0.681090 0.656534 0.65141 0.646714  0.6261
## Proportion of Variance 0.01019 0.009467 0.008797 0.00866 0.008535  0.0080
## Cumulative Proportion  0.84412 0.853587 0.862384 0.87104 0.879579  0.8876
##                         Comp.25  Comp.26  Comp.27  Comp.28  Comp.29
## Standard deviation     0.606754 0.604124 0.592468 0.578299 0.566207
## Proportion of Variance 0.007513 0.007448 0.007164 0.006825 0.006543
## Cumulative Proportion  0.895093 0.902541 0.909705 0.916530 0.923073
##                         Comp.30  Comp.31  Comp.32  Comp.33  Comp.34
## Standard deviation     0.548559 0.536990 0.523555 0.506796 0.495228
## Proportion of Variance 0.006141 0.005885 0.005594 0.005242 0.005005
## Cumulative Proportion  0.929214 0.935099 0.940693 0.945934 0.950939
##                         Comp.35  Comp.36  Comp.37 Comp.38  Comp.39
## Standard deviation     0.485246 0.470749 0.465728 0.44768 0.431034
## Proportion of Variance 0.004805 0.004523 0.004427 0.00409 0.003792
## Cumulative Proportion  0.955745 0.960267 0.964694 0.96878 0.972576
##                         Comp.40  Comp.41  Comp.42  Comp.43  Comp.44
## Standard deviation     0.417394 0.405997 0.392297 0.389028 0.378621
## Proportion of Variance 0.003555 0.003364 0.003141 0.003089 0.002926
## Cumulative Proportion  0.976131 0.979495 0.982636 0.985725 0.988650
##                         Comp.45  Comp.46  Comp.47  Comp.48  Comp.49
## Standard deviation     0.377691 0.363660 0.334365 0.292094 0.290047
## Proportion of Variance 0.002911 0.002699 0.002282 0.001741 0.001717
## Cumulative Proportion  0.991561 0.994260 0.996542 0.998283 1.000000
##
## Loadings:
##         Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8 Comp.9
## 0001.HK -0.175        -0.114 -0.155               -0.102
## 0002.HK         0.477                0.192  0.209  0.240        -0.119
## 0003.HK         0.348        -0.319 -0.144 -0.126         0.174
## 0004.HK -0.162 -0.101 -0.117
## 0005.HK -0.170
## 0006.HK         0.482         0.182  0.169  0.149  0.320
## 0011.HK -0.155               -0.198  0.108  0.142        -0.138
## 0012.HK -0.157        -0.172 -0.166               -0.120  0.227
## 0013.HK -0.169                                0.128               -0.137
## 0016.HK -0.153        -0.224 -0.163                       0.236
## 0017.HK -0.139        -0.227 -0.125 -0.101                0.254 -0.108
## 0019.HK -0.122               -0.226        -0.187 -0.112 -0.210 -0.475
## 0023.HK -0.148               -0.143  0.221                -0.253
## 0066.HK -0.134  0.170        -0.181                       -0.223
## 0083.HK -0.155        -0.179 -0.102         0.120         0.243  0.105
```

```
## 0101.HK -0.154        -0.139                0.166
## 0144.HK -0.150                0.184 -0.119  0.111
## 0151.HK                0.450 -0.193 -0.124 -0.312         0.282
## 0267.HK -0.157                                           -0.134 -0.153
## 0291.HK -0.123                               0.138         0.232
## 0293.HK -0.126                               0.169        -0.181 -0.362
## 0322.HK                0.453 -0.354  0.112         0.189         0.303
## 0330.HK                             -0.421 -0.208  0.672
## 0386.HK -0.132  0.220         0.288 -0.183        -0.280 -0.140
## 0388.HK -0.166        -0.119               -0.115
## 0494.HK -0.132                0.118        -0.183               -0.158
## 0688.HK -0.153 -0.195         0.111                      0.105  0.123
## 0700.HK -0.141                0.250  0.133  0.118               -0.119
## 0762.HK -0.130  0.152  0.218  0.205                -0.193  0.118
## 0836.HK                0.141        -0.605  0.334        -0.257  0.195
## 0857.HK -0.158  0.133         0.171 -0.151        -0.159
## 0883.HK -0.171                0.151
## 0939.HK -0.170                                                    0.199
## 0941.HK -0.115  0.329               -0.104 -0.128
## 1044.HK -0.110         0.418                            0.181 -0.195
## 1088.HK -0.167
## 1109.HK -0.148 -0.243
## 1199.HK -0.159                0.194                0.102
## 1299.HK -0.134                                     0.350 -0.111
## 1398.HK -0.173                          0.148 -0.109        -0.180  0.220
## 1880.HK -0.126         0.196  0.156         0.146         0.157 -0.190
## 1898.HK -0.166                                        0.123 -0.152
## 1928.HK -0.139 -0.129  0.132         0.156  0.264                0.105
## 2318.HK -0.168                               -0.142
## 2388.HK -0.161                          0.204                -0.133
## 2600.HK -0.156                                -0.128  0.122         0.114
## 2628.HK -0.158                                -0.194
## 3328.HK -0.173                                -0.114        -0.133  0.147
## 3988.HK -0.164                                -0.146        -0.223  0.279
##         Comp.10 Comp.11 Comp.12 Comp.13 Comp.14 Comp.15 Comp.16 Comp.17
## 0001.HK                                                   0.123  -0.107
## 0002.HK                 -0.116                                     0.191
## 0003.HK         -0.448                   0.420          -0.285
## 0004.HK                 -0.179          -0.106           0.143  -0.132
## 0005.HK                                          -0.118
## 0006.HK -0.175   0.188  -0.148  -0.289   0.146                   -0.236
## 0011.HK  0.193          -0.121
## 0012.HK                                                   0.194
## 0013.HK                                                          -0.119
## 0016.HK                                                   0.128
## 0017.HK          0.174   0.153  -0.197  -0.146   0.170  -0.209
## 0019.HK -0.237                                    0.172  -0.210   0.215
## 0023.HK         -0.113  -0.112   0.183                           -0.144
## 0066.HK  0.178                   0.300  -0.280  -0.104          -0.297
## 0083.HK                                                   0.141
## 0101.HK  0.158                  -0.168   0.194  -0.145   0.131
## 0144.HK  0.146           0.128                   0.167  -0.330  -0.126
## 0151.HK -0.112                  -0.266                   0.157  -0.189
## 0267.HK          0.102  -0.179   0.149  -0.113          -0.229
## 0291.HK -0.223   0.169   0.311   0.598   0.222   0.144
## 0293.HK -0.328           0.278           0.235  -0.319   0.198
## 0322.HK          0.174                  -0.128  -0.348  -0.249   0.268
```

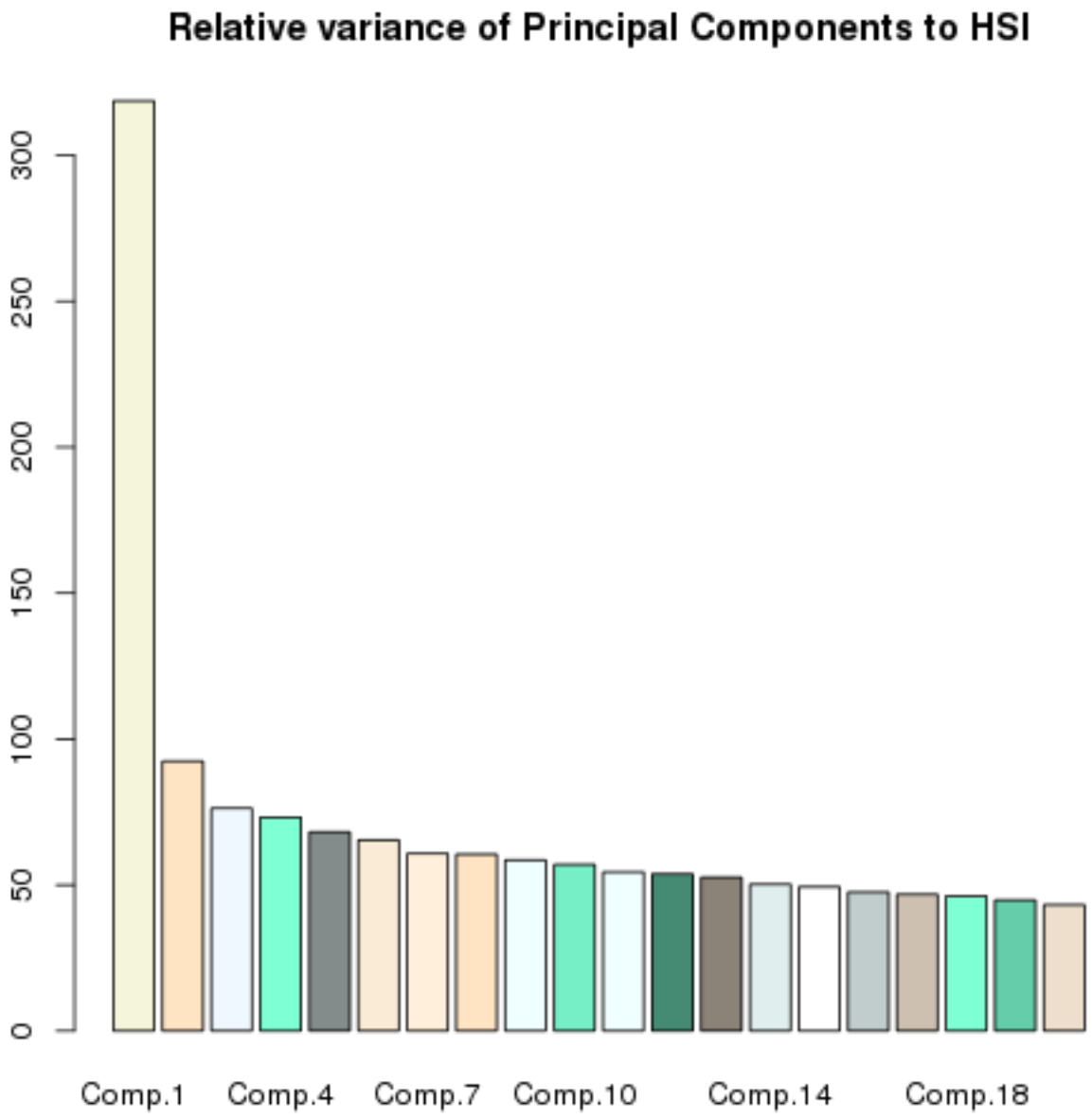
```
## 0330.HK         -0.235                  -0.162           0.267   0.206
## 0386.HK                         -0.119          -0.156           0.220
## 0388.HK          0.113
## 0494.HK  0.507   0.107                   0.372  -0.148
## 0688.HK -0.208  -0.253  -0.241                                   -0.141
## 0700.HK                                         -0.245          -0.128
## 0762.HK                 -0.295   0.136           0.232           0.355
## 0836.HK          0.210  -0.268           0.107   0.111          -0.144
## 0857.HK                                         -0.259           0.202
## 0883.HK                                         -0.122           0.158
## 0939.HK                  0.194  -0.113           0.163   0.130
## 0941.HK -0.134  -0.151   0.159   0.255  -0.266  -0.143          -0.284
## 1044.HK  0.176          -0.114                   0.239   0.212  -0.154
## 1088.HK                                  0.204
## 1109.HK -0.202  -0.195  -0.344
## 1199.HK  0.147   0.191   0.167                                  -0.196
## 1299.HK  0.250  -0.299                  -0.225   0.251           0.135
## 1398.HK                  0.121  -0.127           0.159
## 1880.HK -0.126  -0.409   0.249  -0.204  -0.179
## 1898.HK                                  0.101   0.141
## 1928.HK                                  0.189                   0.172
## 2318.HK -0.127          -0.109
## 2388.HK                                                          0.138
## 2600.HK -0.154          -0.109                           -0.244
## 2628.HK                                          -0.202  -0.224
## 3328.HK                  0.147  -0.107           0.107
## 3988.HK                  0.138                   0.202   0.146
##         Comp.18 Comp.19 Comp.20 Comp.21 Comp.22 Comp.23 Comp.24 Comp.25
## 0001.HK  0.101                                           0.104  -0.141
## 0002.HK -0.212                   0.128   0.249          -0.109
## 0003.HK          0.286   0.182  -0.143
## 0004.HK                         0.119
## 0005.HK                  0.238  -0.125           0.151
## 0006.HK  0.240                                  -0.103   0.115          -0.102
## 0011.HK -0.109                           0.143           0.207           0.132
## 0012.HK                 -0.199   0.114                           0.230   0.104
## 0013.HK         -0.101   0.128                                   0.148  -0.172
## 0016.HK                 -0.186  -0.251  -0.115   0.170   0.107  -0.245
## 0017.HK                                  0.102  -0.424  -0.146   0.129
## 0019.HK  0.261  -0.134  -0.132          -0.174   0.113  -0.210
## 0023.HK         -0.253          -0.339                                   0.264
## 0066.HK -0.170   0.230  -0.202   0.300           0.162          -0.104
## 0083.HK          0.194          -0.218  -0.247   0.131
## 0101.HK  0.152  -0.156           0.220          -0.234  -0.182   0.447
## 0144.HK -0.186          -0.246  -0.151   0.139           0.131   0.154
## 0151.HK -0.313  -0.102                  -0.101   0.139  -0.189
## 0267.HK          0.177                                   0.330   0.168
## 0291.HK  0.157  -0.172   0.170   0.185           0.158  -0.105
## 0293.HK          0.116          -0.101   0.305
## 0322.HK  0.186  -0.142                                   0.116
## 0330.HK                  0.103  -0.147  -0.157
## 0386.HK  0.106   0.142  -0.133   0.122           0.120          -0.117
## 0388.HK                  0.158   0.265                           -0.137
## 0494.HK  0.132  -0.164  -0.189                  -0.125          -0.249
## 0688.HK                                  0.232          -0.114  -0.105
## 0700.HK -0.234           0.308          -0.503  -0.140  -0.134   0.102
## 0762.HK -0.240  -0.153                          -0.129   0.169
```

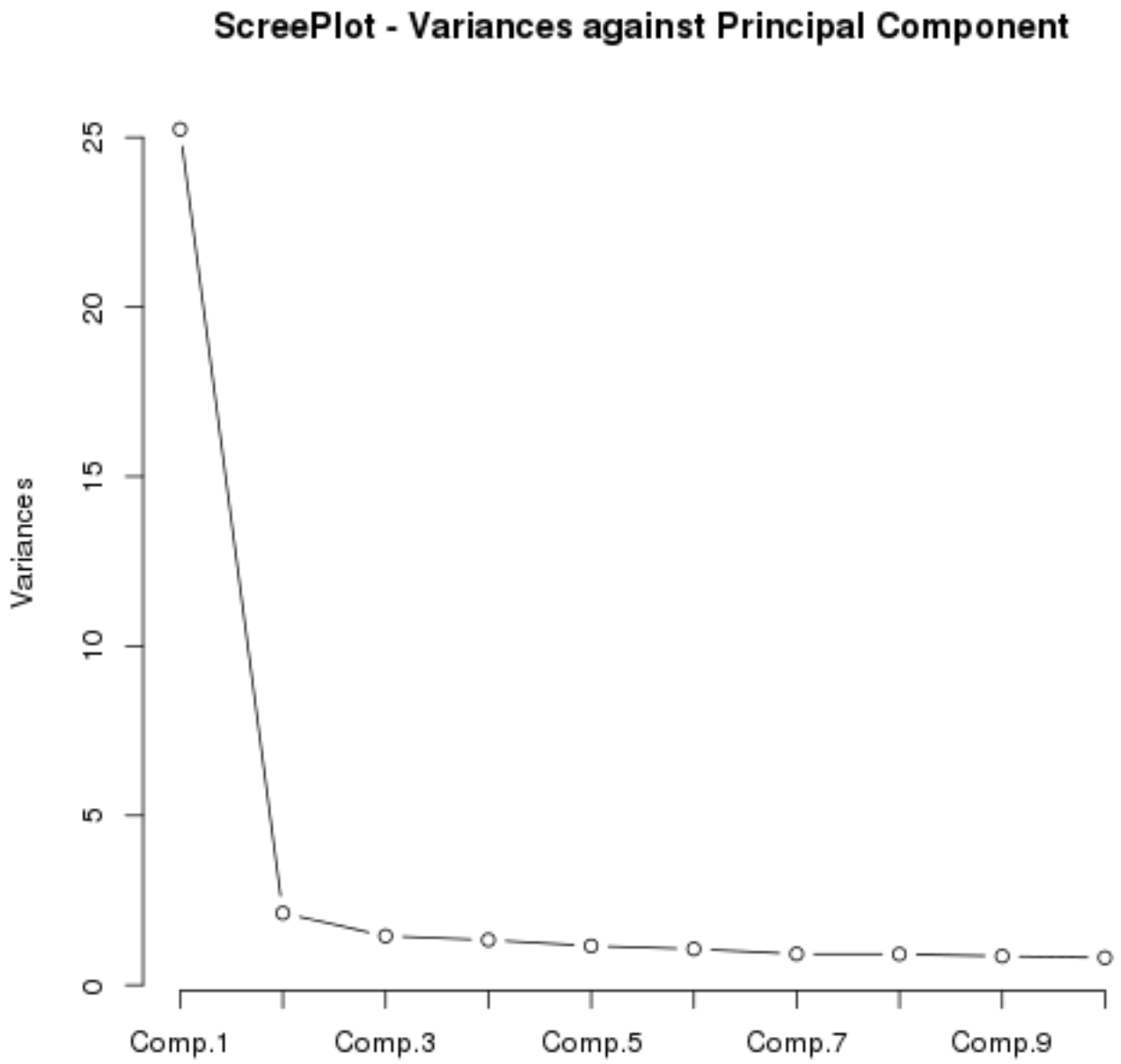
```
## 0836.HK                  0.160                                    -0.115
## 0857.HK                                  0.159                     0.164
## 0883.HK                        -0.161    0.140   0.189   0.123    0.122
## 0939.HK                                          -0.192
## 0941.HK  0.112  -0.243  -0.207                   -0.422
## 1044.HK  0.388   0.447   0.104  -0.126   0.173           -0.141    0.197
## 1088.HK -0.118  -0.201
## 1109.HK                                  0.306           -0.123  -0.117
## 1199.HK -0.160                  -0.233           0.138
## 1299.HK  0.110  -0.155          -0.109                   -0.381  -0.258
## 1398.HK
## 1880.HK  0.106                   0.311           0.208   0.389
## 1898.HK  0.144                                           0.164
## 1928.HK          0.360  -0.269          -0.304  -0.191           -0.170
## 2318.HK  0.190           0.143          -0.138  -0.122   0.173  -0.133
## 2388.HK -0.169           0.243   0.117          -0.168           -0.206
## 2600.HK                 -0.226   0.262           0.193  -0.222    0.156
## 2628.HK  0.193           0.346                          -0.133
## 3328.HK
## 3988.HK                                                          0.116
##         Comp.26 Comp.27 Comp.28 Comp.29 Comp.30 Comp.31 Comp.32 Comp.33
## 0001.HK
## 0002.HK  0.119                           -0.248           0.325   0.152
## 0003.HK                                          -0.148
## 0004.HK          0.186  -0.205  -0.235  -0.270  -0.308  -0.184   0.263
## 0005.HK  0.170   0.137                           -0.187
## 0006.HK          0.128                   0.137           -0.289
## 0011.HK -0.172                           0.536   0.151   0.160   0.240
## 0012.HK         -0.128   0.318           -0.161
## 0013.HK  0.163                  -0.279           0.179  -0.109  -0.262
## 0016.HK                 -0.133           0.177  -0.129   0.373  -0.113
## 0017.HK                 -0.259   0.254   0.224           -0.186  -0.180
## 0019.HK  0.183           0.223                  -0.165           0.150
## 0023.HK                 -0.263                  -0.251  -0.175  -0.122
## 0066.HK  0.139           0.195   0.188                  -0.192  -0.244
## 0083.HK -0.163           0.225   0.104   0.125   0.139  -0.145
## 0101.HK                  0.142   0.116  -0.115           0.105
## 0144.HK                  0.266  -0.333   0.116                   0.149
## 0151.HK          0.191  -0.116          -0.106   0.197           0.126
## 0267.HK -0.157   0.163  -0.176                   0.269           0.204
## 0291.HK                                  0.105                   0.188
## 0293.HK -0.373                                                   -0.189
## 0322.HK         -0.166   0.114  -0.108                           -0.149
## 0330.HK
## 0386.HK         -0.150          -0.191   0.297
## 0388.HK -0.156                  -0.279          -0.226  -0.107
## 0494.HK -0.138  -0.143           0.283                           0.113
## 0688.HK  0.141  -0.133           0.157                           0.121
## 0700.HK         -0.411   0.110          -0.104
## 0762.HK -0.272                   0.118          -0.235  -0.156  -0.267
## 0836.HK         -0.139           0.146          -0.122   0.115
## 0857.HK  0.228          -0.141                   0.193  -0.269
## 0883.HK                 -0.110   0.201  -0.225   0.111  -0.157   0.176
## 0939.HK -0.107                                                   0.167
## 0941.HK                 -0.136  -0.104                   0.111   0.112
## 1044.HK                         -0.118                   0.116
## 1088.HK  0.217   0.252          -0.294           0.170   0.252  -0.251
```

```
## 1109.HK  0.133           0.111                            -0.104
## 1199.HK                                    -0.131  -0.248   0.149
## 1299.HK -0.273   0.104                     -0.175   0.267
## 1398.HK                                                          0.119
## 1880.HK                          0.240           -0.168
## 1898.HK         -0.206  -0.302   0.132  -0.263   0.265   0.243  -0.251
## 1928.HK  0.249   0.365  -0.111                   -0.193
## 2318.HK -0.124   0.191   0.165                                   0.200
## 2388.HK  0.299  -0.105          -0.139   0.137   0.125  -0.152   0.111
## 2600.HK -0.245  -0.171  -0.304  -0.188                           -0.133
## 2628.HK -0.154   0.396                                   0.240  -0.122
## 3328.HK                                          -0.117
## 3988.HK                  0.212
##         Comp.34 Comp.35 Comp.36 Comp.37 Comp.38 Comp.39 Comp.40 Comp.41
## 0001.HK  0.199  -0.228          -0.116           -0.113          -0.221
## 0002.HK                 -0.179  -0.236            0.193
## 0003.HK                  0.103
## 0004.HK -0.187  -0.232           0.126   0.265           0.179   0.134
## 0005.HK  0.296   0.143   0.162  -0.104  -0.476           0.415   0.146
## 0006.HK                  0.141   0.138  -0.119
## 0011.HK  0.223  -0.107   0.137   0.110   0.203           0.149
## 0012.HK  0.121          -0.200   0.296  -0.357   0.111   0.170
## 0013.HK  0.156  -0.156   0.276  -0.359            0.129  -0.144  -0.169
## 0016.HK -0.225                   0.176           -0.161  -0.252   0.102
## 0017.HK         -0.151  -0.128                    0.203
## 0019.HK                  0.103           0.131
## 0023.HK                 -0.343          -0.193   0.105  -0.187
## 0066.HK         -0.149
## 0083.HK  0.111   0.338  -0.160  -0.313   0.367   0.114
## 0101.HK          0.167   0.168                   -0.386  -0.174  -0.128
## 0144.HK         -0.200  -0.277  -0.129           -0.287           0.172
## 0151.HK                 -0.104                   -0.124
## 0267.HK -0.289   0.144   0.189          -0.291                   -0.271
## 0291.HK -0.150
## 0293.HK                          0.136
## 0322.HK
## 0330.HK         -0.113
## 0386.HK -0.226          -0.189  -0.184                           -0.164
## 0388.HK -0.207   0.382          -0.282           -0.226           0.126
## 0494.HK                         -0.116            0.298
## 0688.HK         -0.112          -0.165           -0.157   0.147  -0.173
## 0700.HK -0.105  -0.139                  -0.110                    0.127
## 0762.HK         -0.130   0.198                   -0.219
## 0836.HK          0.106                                           0.102
## 0857.HK                                                  -0.124   0.146
## 0883.HK                  0.148           0.157
## 0939.HK                  0.266  -0.138                            0.102
## 0941.HK  0.189   0.196                   0.141
## 1044.HK
## 1088.HK -0.264                   0.110   0.186   0.367   0.208
## 1109.HK -0.119   0.116                                           0.137
## 1199.HK          0.287   0.192   0.269   0.172                   -0.322
## 1299.HK                          0.102  -0.148
## 1398.HK -0.123
## 1880.HK          0.132
## 1898.HK                 -0.204           0.159  -0.279   0.353   0.219
## 1928.HK  0.183                                                   0.132
```

```
## 2318.HK  0.157                    0.140           0.112  -0.168
## 2388.HK  0.110   0.309  -0.160   0.325          -0.132  -0.182
## 2600.HK  0.413                                   0.152  -0.216
## 2628.HK         -0.150  -0.222                   -0.122  -0.204
## 3328.HK         -0.169  -0.213   0.109                    0.315  -0.551
## 3988.HK         -0.109   0.133                           -0.182   0.227
##         Comp.42 Comp.43 Comp.44 Comp.45 Comp.46 Comp.47 Comp.48 Comp.49
## 0001.HK -0.204          -0.239  -0.102  -0.282   0.349   0.276   0.475
## 0002.HK                 -0.102
## 0003.HK
## 0004.HK         -0.213           0.297
## 0005.HK  0.162  -0.287
## 0006.HK
## 0011.HK          0.276
## 0012.HK          0.308   0.180   0.115           0.111          -0.174
## 0013.HK  0.125   0.136   0.115   0.135   0.200  -0.195          -0.320
## 0016.HK         -0.174          -0.132   0.153  -0.211  -0.149
## 0017.HK                         -0.101
## 0019.HK -0.106                   0.108
## 0023.HK          0.119   0.120          -0.177
## 0066.HK         -0.130                  -0.121
## 0083.HK         -0.198           0.133
## 0101.HK  0.127  -0.112
## 0144.HK         -0.108                           -0.110
## 0151.HK  0.163
## 0267.HK                 -0.133   0.114   0.138
## 0291.HK
## 0293.HK         -0.136
## 0322.HK
## 0330.HK
## 0386.HK  0.316           0.143   0.131           0.204
## 0388.HK -0.214   0.238          -0.330                   -0.142
## 0494.HK -0.122
## 0688.HK         -0.117                  -0.201   0.216  -0.363  -0.371
## 0700.HK                 -0.119
## 0762.HK
## 0836.HK -0.123
## 0857.HK -0.120   0.220  -0.505                   -0.218          -0.180
## 0883.HK -0.203           0.620  -0.142   0.152                    0.145
## 0939.HK                  0.111   0.144  -0.556  -0.437  -0.125   0.143
## 0941.HK -0.105                           0.173
## 1044.HK
## 1088.HK -0.173                  -0.195  -0.200
## 1109.HK          0.183           0.118   0.259  -0.289   0.343   0.312
## 1199.HK  0.220   0.334           0.132           0.123
## 1299.HK
## 1398.HK -0.128  -0.149          -0.203           0.103   0.626  -0.457
## 1880.HK
## 1898.HK  0.253
## 1928.HK          0.162                           0.111
## 2318.HK  0.472                  -0.498                   -0.111
## 2388.HK         -0.298           0.284
## 2600.HK         -0.205
## 2628.HK -0.215           0.172   0.298                           -0.127
## 3328.HK -0.263                           0.293  -0.326  -0.134
## 3988.HK  0.114          -0.214   0.196   0.350   0.377  -0.318   0.166
##
```

```
##                Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8
## SS loadings      1.00  1.000  1.000  1.000  1.000  1.000  1.000  1.000
## Proportion Var   0.02  0.020  0.020  0.020  0.020  0.020  0.020  0.020
## Cumulative Var   0.02  0.041  0.061  0.082  0.102  0.122  0.143  0.163
##                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  0.020   0.020   0.020   0.020   0.020   0.020   0.020
## Cumulative Var  0.184   0.204   0.224   0.245   0.265   0.286   0.306
##                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   0.020   0.020   0.020   0.020   0.020   0.020   0.020
## Cumulative Var   0.327   0.347   0.367   0.388   0.408   0.429   0.449
##                Comp.23 Comp.24 Comp.25 Comp.26 Comp.27 Comp.28 Comp.29
## SS loadings      1.000    1.00    1.00   1.000   1.000   1.000   1.000
## Proportion Var   0.020    0.02    0.02   0.020   0.020   0.020   0.020
## Cumulative Var   0.469    0.49    0.51   0.531   0.551   0.571   0.592
##                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   0.020   0.020   0.020   0.020   0.020   0.020   0.020
## Cumulative Var   0.612   0.633   0.653   0.673   0.694   0.714   0.735
##                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   0.020   0.020   0.020   0.020   0.020   0.020   0.020
## Cumulative Var   0.755   0.776   0.796   0.816   0.837   0.857   0.878
##                Comp.44 Comp.45 Comp.46 Comp.47 Comp.48 Comp.49
## SS loadings      1.000   1.000   1.000   1.000    1.00    1.00
## Proportion Var   0.020   0.020   0.020   0.020    0.02    0.02
## Cumulative Var   0.898   0.918   0.939   0.959    0.98    1.00
```


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)

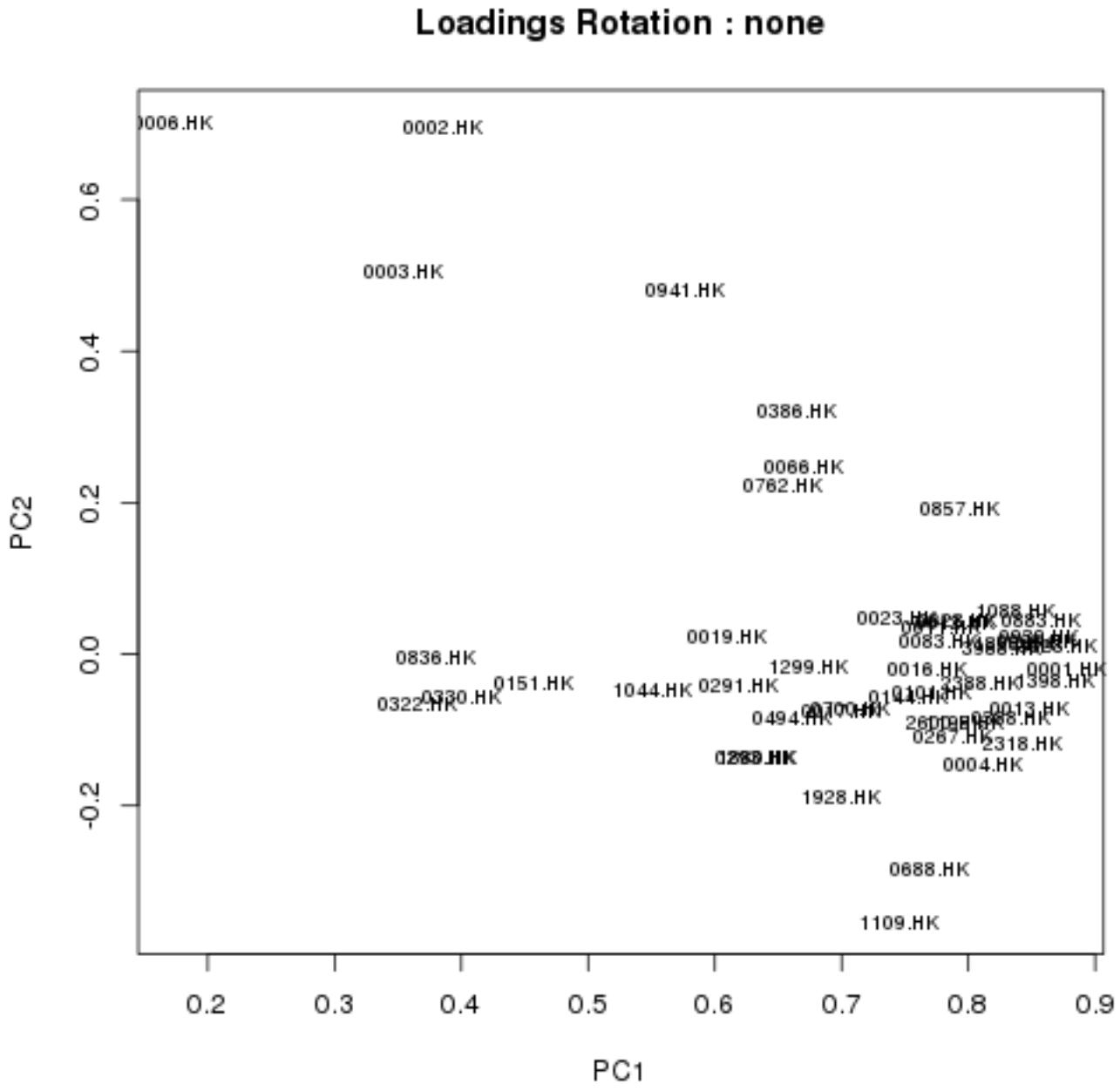
[7] http://en.wikipedia.org/wiki/Factoranalysis

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
## 0001.HK    1 0.88 -0.02 -0.14  0.18  0.02 0.82 0.18
## 3328.HK   48 0.87  0.01 -0.01 -0.05 -0.04 0.76 0.24
## 1398.HK   40 0.87 -0.04 -0.01  0.00 -0.16 0.78 0.22
## 0883.HK   32 0.86  0.05  0.04 -0.17  0.01 0.77 0.23
## 0939.HK   33 0.86  0.02  0.02  0.00 -0.09 0.74 0.26
## 0005.HK    5 0.85  0.02 -0.08 -0.05  0.00 0.74 0.26
## 0013.HK    9 0.85 -0.07 -0.08  0.09  0.07 0.74 0.26
## 2318.HK   44 0.84 -0.12 -0.09 -0.06 -0.09 0.74 0.26
## 1088.HK   36 0.84  0.06  0.07 -0.10  0.03 0.72 0.28
## 1898.HK   42 0.83  0.01 -0.01 -0.08 -0.04 0.71 0.29
## 0388.HK   25 0.83 -0.08 -0.14  0.10 -0.04 0.74 0.26
## 3988.HK   49 0.83  0.01  0.00  0.03 -0.10 0.69 0.31
## 0004.HK    4 0.81 -0.15 -0.14  0.07  0.01 0.71 0.29
## 2388.HK   45 0.81 -0.04  0.00  0.09 -0.22 0.71 0.29
## 1199.HK   38 0.80 -0.09 -0.06 -0.22  0.07 0.70 0.30
## 0857.HK   31 0.79  0.19  0.01 -0.20  0.16 0.73 0.27
## 2628.HK   47 0.79  0.05 -0.07 -0.08 -0.03 0.64 0.36
## 0012.HK    8 0.79  0.04 -0.21  0.19  0.07 0.71 0.29
## 0267.HK   19 0.79 -0.11  0.02  0.11  0.09 0.65 0.35
## 2600.HK   46 0.78 -0.09 -0.08 -0.09 -0.05 0.64 0.36
## 0011.HK    7 0.78  0.03 -0.04  0.23 -0.12 0.67 0.33
## 0083.HK   15 0.78  0.02 -0.22  0.12  0.02 0.66 0.34
## 0101.HK   16 0.77 -0.05 -0.17  0.04  0.07 0.63 0.37
## 0688.HK   27 0.77 -0.28 -0.04 -0.13 -0.10 0.70 0.30
## 0016.HK   10 0.77 -0.02 -0.27  0.19 -0.03 0.70 0.30
## 0144.HK   17 0.75 -0.06  0.06 -0.21  0.13 0.64 0.36
## 1109.HK   37 0.75 -0.35 -0.04 -0.08 -0.05 0.69 0.31
## 0023.HK   13 0.74  0.05  0.11  0.17 -0.24 0.65 0.35
## 0700.HK   28 0.71 -0.07  0.09 -0.29 -0.14 0.62 0.38
## 0017.HK   11 0.70 -0.07 -0.27  0.14  0.11 0.60 0.40
## 1928.HK   43 0.70 -0.19  0.16 -0.02 -0.17 0.58 0.42
## 1299.HK   39 0.67 -0.02  0.05  0.05  0.00 0.46 0.54
## 0066.HK   14 0.67  0.25  0.04  0.21  0.06 0.56 0.44
## 0386.HK   24 0.66  0.32 -0.01 -0.33  0.20 0.69 0.31
## 0494.HK   26 0.66 -0.08  0.03 -0.14 -0.02 0.46 0.54
## 0762.HK   29 0.65  0.22  0.26 -0.24 -0.01 0.60 0.40
## 1880.HK   41 0.63 -0.14  0.24 -0.18  0.02 0.51 0.49
## 0293.HK   21 0.63 -0.14  0.04  0.05  0.06 0.42 0.58
## 0291.HK   20 0.62 -0.04  0.05 -0.02  0.07 0.39 0.61
## 0019.HK   12 0.61  0.02  0.02  0.26  0.03 0.44 0.56
## 0941.HK   34 0.58  0.48  0.12 -0.06  0.11 0.59 0.41
## 1044.HK   35 0.55 -0.05  0.50 -0.06 -0.10 0.57 0.43
## 0006.HK    6 0.17  0.70 -0.06 -0.21 -0.18 0.60 0.40
## 0002.HK    2 0.39  0.69 -0.01  0.07 -0.21 0.68 0.32
## 0003.HK    3 0.36  0.51 -0.06  0.37  0.16 0.55 0.45
## 0322.HK   22 0.36 -0.07  0.55  0.41 -0.12 0.62 0.38
## 0151.HK   18 0.46 -0.04  0.54  0.22  0.13 0.57 0.43
## 0836.HK   30 0.38  0.00  0.17  0.09  0.65 0.60 0.40
## 0330.HK   23 0.40 -0.06 -0.02 -0.07  0.45 0.37 0.63
##
##                 PC1  PC2  PC3  PC4  PC5
```

```
## SS loadings    25.24 2.12 1.45 1.33 1.15
## Proportion Var  0.52 0.04 0.03 0.03 0.02
## Cumulative Var  0.52 0.56 0.59 0.62 0.64
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  44.38 0.3
## The degrees of freedom for the model are 941  and the objective function was  7.32
##  0.3The number of observations was  260  with Chi Square =  1745  with prob <  8.8e-51
##  0.3
## Fit based upon off diagonal values = 1
##            PC1       PC2
## 0001.HK 0.8785 -0.019834
## 0002.HK 0.3863  0.694318
## 0003.HK 0.3552  0.506612
## 0004.HK 0.8120 -0.146994
## 0005.HK 0.8539  0.017339
## 0006.HK 0.1734  0.702164
## 0011.HK 0.7780  0.034358
## 0012.HK 0.7889  0.042246
## 0013.HK 0.8474 -0.072395
## 0016.HK 0.7677 -0.020889
## 0017.HK 0.7001 -0.074854
## 0019.HK 0.6105  0.022534
## 0023.HK 0.7440  0.047526
## 0066.HK 0.6708  0.247974
## 0083.HK 0.7767  0.016769
## 0101.HK 0.7718 -0.049601
## 0144.HK 0.7531 -0.057843
## 0151.HK 0.4574 -0.038605
## 0267.HK 0.7882 -0.108869
## 0291.HK 0.6195 -0.042521
## 0293.HK 0.6310 -0.136580
## 0322.HK 0.3648 -0.067257
## 0330.HK 0.4003 -0.057552
## 0386.HK 0.6643  0.321270
## 0388.HK 0.8341 -0.083438
## 0494.HK 0.6618 -0.082685
## 0688.HK 0.7686 -0.284691
## 0700.HK 0.7070 -0.071539
## 0762.HK 0.6534  0.221585
## 0836.HK 0.3798 -0.004133
## 0857.HK 0.7929  0.193277
## 0883.HK 0.8582  0.045167
## 0939.HK 0.8562  0.023761
## 0941.HK 0.5758  0.479186
## 1044.HK 0.5511 -0.047381
## 1088.HK 0.8377  0.056674
## 1109.HK 0.7453 -0.353672
## 1199.HK 0.7977 -0.089102
## 1299.HK 0.6739 -0.015970
## 1398.HK 0.8686 -0.036443
## 1880.HK 0.6329 -0.136351
## 1898.HK 0.8349  0.014408
## 1928.HK 0.6990 -0.188553
## 2318.HK 0.8421 -0.119476
## 2388.HK 0.8092 -0.037963
```

```
## 2600.HK 0.7828 -0.091600
## 2628.HK 0.7918  0.045274
## 3328.HK 0.8698  0.012102
## 3988.HK 0.8259  0.007300
```



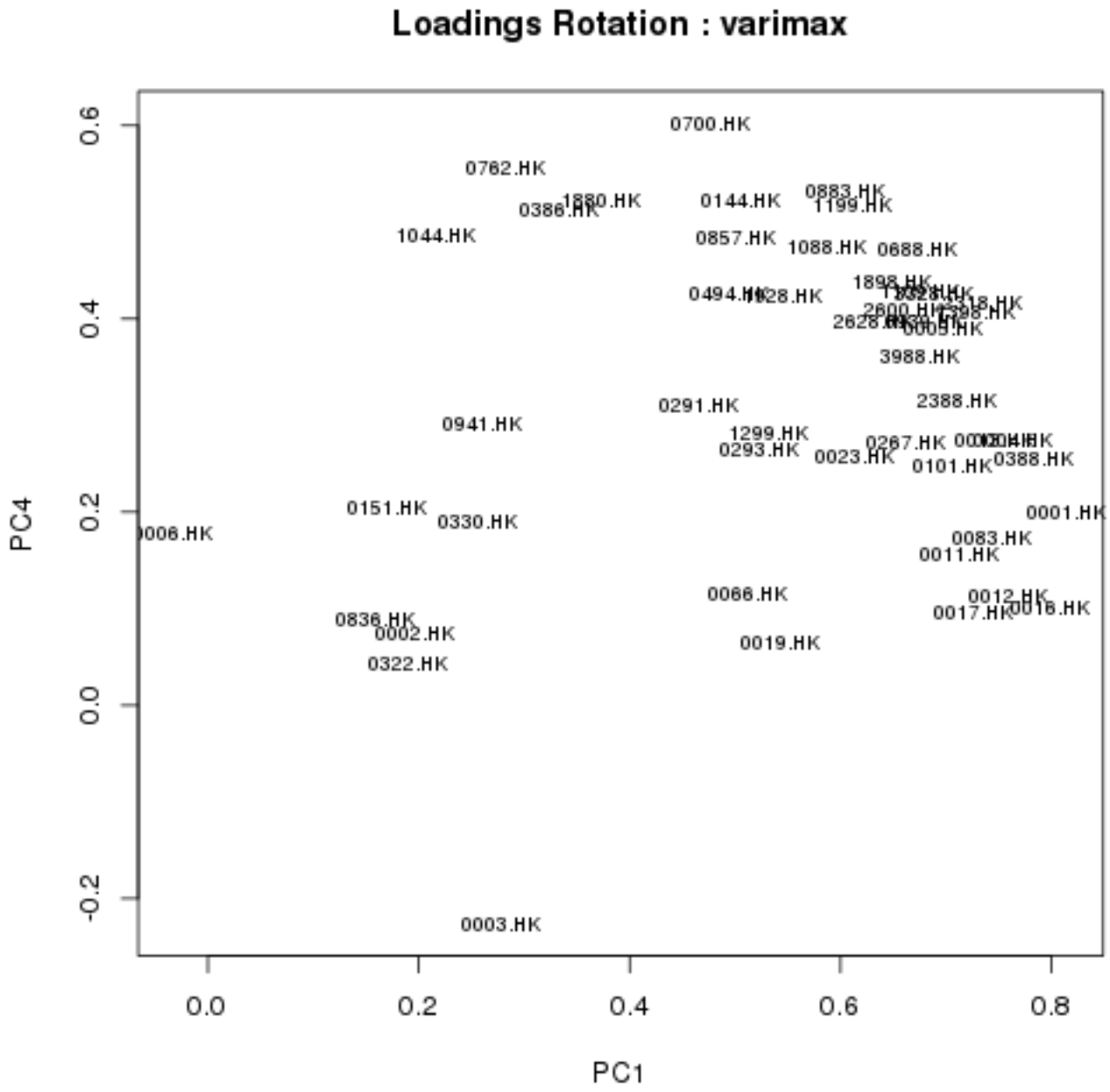
5.2.2 Rotation : varimax

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  0.82  0.20  0.20  0.19  0.20 0.82 0.18
## 0016.HK   10  0.80  0.10  0.18  0.07  0.12 0.70 0.30
## 0388.HK   25  0.78  0.25  0.13  0.15  0.13 0.74 0.26
## 0004.HK    4  0.76  0.27  0.06  0.13  0.17 0.71 0.29
## 0012.HK    8  0.76  0.11  0.24  0.11  0.23 0.71 0.29
## 0013.HK    9  0.74  0.28  0.13  0.19  0.25 0.74 0.26
## 0083.HK   15  0.74  0.17  0.21  0.07  0.18 0.66 0.34
## 2318.HK   44  0.74  0.42  0.10  0.11  0.08 0.74 0.26
## 1398.HK   40  0.73  0.41  0.19  0.22  0.03 0.78 0.22
## 0017.HK   11  0.73  0.10  0.10  0.01  0.24 0.60 0.40
## 0011.HK    7  0.71  0.16  0.24  0.28  0.06 0.67 0.33
## 2388.HK   45  0.71  0.32  0.18  0.27 -0.04 0.71 0.29
## 0101.HK   16  0.71  0.25  0.14  0.07  0.22 0.63 0.37
## 0005.HK    5  0.70  0.39  0.23  0.12  0.18 0.74 0.26
## 3328.HK   48  0.69  0.43  0.23  0.18  0.14 0.76 0.24
## 0939.HK   33  0.68  0.40  0.24  0.23  0.10 0.74 0.26
## 3988.HK   49  0.68  0.36  0.22  0.23  0.08 0.69 0.31
## 1109.HK   37  0.68  0.43 -0.16  0.14  0.10 0.69 0.31
## 0688.HK   27  0.67  0.47 -0.08  0.12  0.05 0.70 0.30
## 0267.HK   19  0.66  0.27  0.08  0.27  0.26 0.65 0.35
## 2600.HK   46  0.66  0.41  0.11  0.10  0.11 0.64 0.36
## 1898.HK   42  0.65  0.44  0.22  0.16  0.14 0.71 0.29
## 2628.HK   47  0.63  0.40  0.24  0.09  0.14 0.64 0.36
## 0023.HK   13  0.61  0.26  0.25  0.38 -0.06 0.65 0.35
## 1199.HK   38  0.61  0.52  0.10  0.03  0.23 0.70 0.30
## 0883.HK   32  0.61  0.53  0.25  0.15  0.19 0.77 0.23
## 1088.HK   36  0.59  0.47  0.25  0.21  0.22 0.72 0.28
## 1928.HK   43  0.54  0.42  0.00  0.32 -0.01 0.58 0.42
## 0019.HK   12  0.54  0.06  0.17  0.29  0.17 0.44 0.56
## 1299.HK   39  0.53  0.28  0.15  0.23  0.15 0.46 0.54
## 0293.HK   21  0.52  0.26  0.02  0.21  0.19 0.42 0.58
## 0066.HK   14  0.51  0.11  0.40  0.28  0.22 0.56 0.44
## 0857.HK   31  0.50  0.48  0.36  0.07  0.33 0.73 0.27
## 0494.HK   26  0.50  0.43  0.08  0.13  0.12 0.46 0.54
## 0291.HK   20  0.46  0.31  0.10  0.17  0.20 0.39 0.61
## 0700.HK   28  0.48  0.60  0.11  0.12  0.01 0.62 0.38
## 0762.HK   29  0.28  0.56  0.36  0.24  0.16 0.60 0.40
## 1880.HK   41  0.37  0.52  0.01  0.26  0.16 0.51 0.49
## 0144.HK   17  0.51  0.52  0.11  0.11  0.29 0.64 0.36
## 0386.HK   24  0.33  0.51  0.45 -0.06  0.34 0.69 0.31
## 0002.HK    2  0.20  0.07  0.78  0.10 -0.09 0.68 0.32
## 0006.HK    6 -0.03  0.18  0.73 -0.14 -0.12 0.60 0.40
## 0941.HK   34  0.26  0.29  0.59  0.16  0.26 0.59 0.41
## 0003.HK    3  0.28 -0.23  0.57  0.17  0.25 0.55 0.45
## 0322.HK   22  0.19  0.04  0.03  0.76  0.00 0.62 0.38
## 0151.HK   18  0.17  0.20  0.06  0.65  0.27 0.57 0.43
```

```
## 1044.HK   35  0.22  0.49  0.08  0.53  0.05 0.57 0.43
## 0836.HK   30  0.16  0.09  0.03  0.20  0.73 0.60 0.40
## 0330.HK   23  0.26  0.19  0.00  0.00  0.52 0.37 0.63
##
##                  PC1  PC4  PC2  PC3  PC5
## SS loadings    16.56 6.14 3.49 2.84 2.28
## Proportion Var  0.34 0.13 0.07 0.06 0.05
## Cumulative Var  0.34 0.46 0.53 0.59 0.64
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  44.38 0.3
## The degrees of freedom for the model are 941  and the objective function was  7.32
##  0.3The number of observations was  260  with Chi Square =  1745  with prob <  8.8e-51
##  0.3
## Fit based upon off diagonal values = 1
##              PC1      PC4
## 0001.HK  0.81525  0.20018
## 0002.HK  0.19726  0.07345
## 0003.HK  0.27847 -0.22613
## 0004.HK  0.76282  0.27417
## 0005.HK  0.69767  0.39074
## 0006.HK -0.03222  0.17888
## 0011.HK  0.71325  0.15710
## 0012.HK  0.75871  0.11409
## 0013.HK  0.74489  0.27526
## 0016.HK  0.79799  0.10187
## 0017.HK  0.72625  0.09646
## 0019.HK  0.54223  0.06470
## 0023.HK  0.61321  0.25735
## 0066.HK  0.51200  0.11444
## 0083.HK  0.74412  0.17242
## 0101.HK  0.70606  0.24864
## 0144.HK  0.50601  0.52255
## 0151.HK  0.17054  0.20401
## 0267.HK  0.66170  0.27149
## 0291.HK  0.46470  0.31030
## 0293.HK  0.52260  0.26389
## 0322.HK  0.19047  0.04263
## 0330.HK  0.25501  0.19027
## 0386.HK  0.33414  0.51306
## 0388.HK  0.78416  0.25473
## 0494.HK  0.49505  0.42708
## 0688.HK  0.67228  0.47272
## 0700.HK  0.47739  0.60239
## 0762.HK  0.28198  0.55510
## 0836.HK  0.15951  0.08989
## 0857.HK  0.50087  0.48401
## 0883.HK  0.60533  0.53313
## 0939.HK  0.68075  0.39717
## 0941.HK  0.25976  0.29132
## 1044.HK  0.21592  0.48664
## 1088.HK  0.58696  0.47323
## 1109.HK  0.67507  0.42778
## 1199.HK  0.61075  0.51672
## 1299.HK  0.53144  0.28202
## 1398.HK  0.72743  0.40765
```

```
## 1880.HK  0.37347  0.52346
## 1898.HK  0.64798  0.43849
## 1928.HK  0.54471  0.42291
## 2318.HK  0.73552  0.41662
## 2388.HK  0.71012  0.31618
## 2600.HK  0.66094  0.40811
## 2628.HK  0.63200  0.39636
## 3328.HK  0.68829  0.42699
## 3988.HK  0.67526  0.36026
```



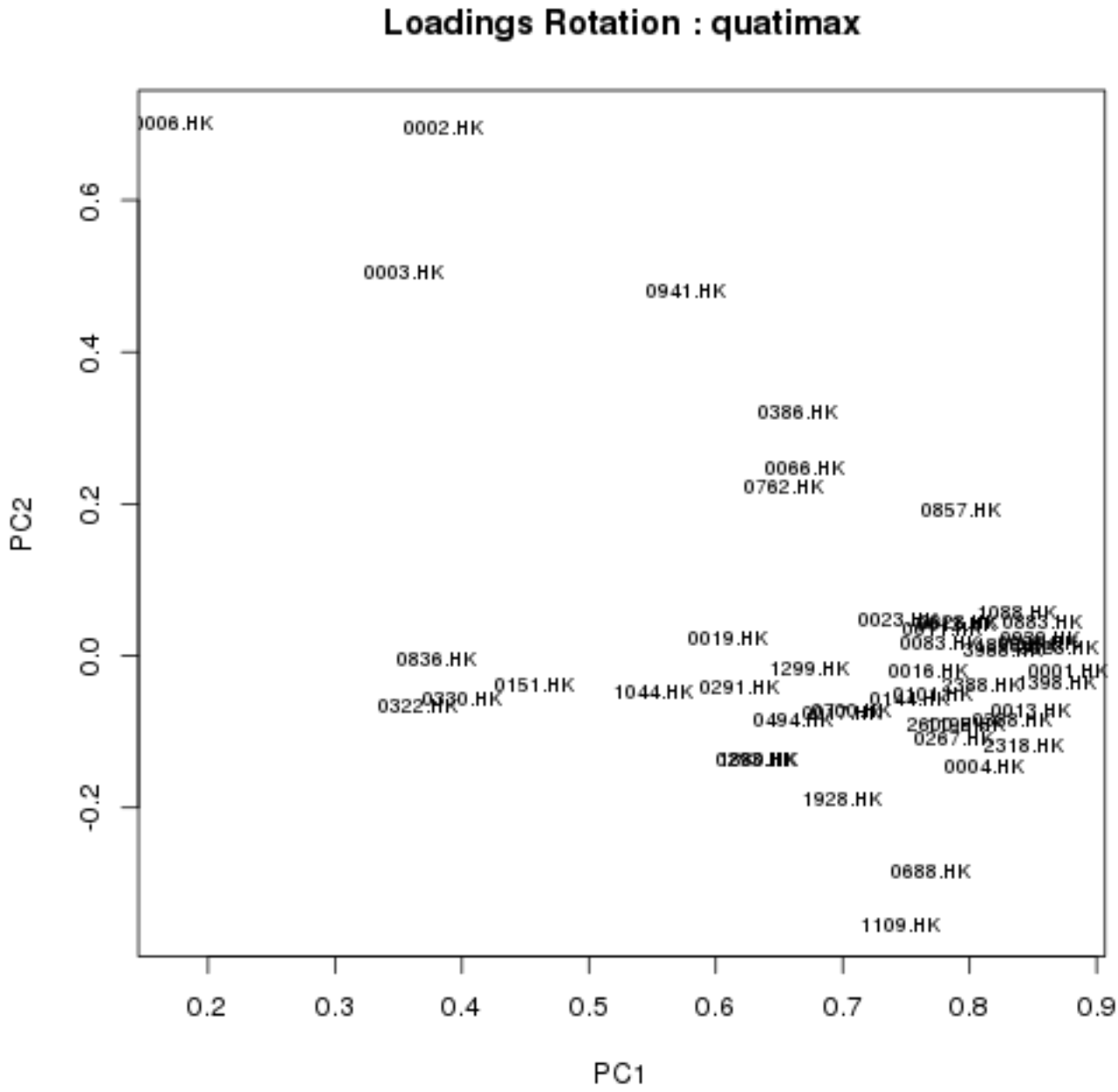
5.2.3 Rotation : quatimax

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
## 0001.HK    1 0.88 -0.02 -0.14  0.18  0.02 0.82 0.18
## 3328.HK   48 0.87  0.01 -0.01 -0.05 -0.04 0.76 0.24
## 1398.HK   40 0.87 -0.04 -0.01  0.00 -0.16 0.78 0.22
## 0883.HK   32 0.86  0.05  0.04 -0.17  0.01 0.77 0.23
## 0939.HK   33 0.86  0.02  0.02  0.00 -0.09 0.74 0.26
## 0005.HK    5 0.85  0.02 -0.08 -0.05  0.00 0.74 0.26
## 0013.HK    9 0.85 -0.07 -0.08  0.09  0.07 0.74 0.26
## 2318.HK   44 0.84 -0.12 -0.09 -0.06 -0.09 0.74 0.26
## 1088.HK   36 0.84  0.06  0.07 -0.10  0.03 0.72 0.28
## 1898.HK   42 0.83  0.01 -0.01 -0.08 -0.04 0.71 0.29
## 0388.HK   25 0.83 -0.08 -0.14  0.10 -0.04 0.74 0.26
## 3988.HK   49 0.83  0.01  0.00  0.03 -0.10 0.69 0.31
## 0004.HK    4 0.81 -0.15 -0.14  0.07  0.01 0.71 0.29
## 2388.HK   45 0.81 -0.04  0.00  0.09 -0.22 0.71 0.29
## 1199.HK   38 0.80 -0.09 -0.06 -0.22  0.07 0.70 0.30
## 0857.HK   31 0.79  0.19  0.01 -0.20  0.16 0.73 0.27
## 2628.HK   47 0.79  0.05 -0.07 -0.08 -0.03 0.64 0.36
## 0012.HK    8 0.79  0.04 -0.21  0.19  0.07 0.71 0.29
## 0267.HK   19 0.79 -0.11  0.02  0.11  0.09 0.65 0.35
## 2600.HK   46 0.78 -0.09 -0.08 -0.09 -0.05 0.64 0.36
## 0011.HK    7 0.78  0.03 -0.04  0.23 -0.12 0.67 0.33
## 0083.HK   15 0.78  0.02 -0.22  0.12  0.02 0.66 0.34
## 0101.HK   16 0.77 -0.05 -0.17  0.04  0.07 0.63 0.37
## 0688.HK   27 0.77 -0.28 -0.04 -0.13 -0.10 0.70 0.30
## 0016.HK   10 0.77 -0.02 -0.27  0.19 -0.03 0.70 0.30
## 0144.HK   17 0.75 -0.06  0.06 -0.21  0.13 0.64 0.36
## 1109.HK   37 0.75 -0.35 -0.04 -0.08 -0.05 0.69 0.31
## 0023.HK   13 0.74  0.05  0.11  0.17 -0.24 0.65 0.35
## 0700.HK   28 0.71 -0.07  0.09 -0.29 -0.14 0.62 0.38
## 0017.HK   11 0.70 -0.07 -0.27  0.14  0.11 0.60 0.40
## 1928.HK   43 0.70 -0.19  0.16 -0.02 -0.17 0.58 0.42
## 1299.HK   39 0.67 -0.02  0.05  0.05  0.00 0.46 0.54
## 0066.HK   14 0.67  0.25  0.04  0.21  0.06 0.56 0.44
## 0386.HK   24 0.66  0.32 -0.01 -0.33  0.20 0.69 0.31
## 0494.HK   26 0.66 -0.08  0.03 -0.14 -0.02 0.46 0.54
## 0762.HK   29 0.65  0.22  0.26 -0.24 -0.01 0.60 0.40
## 1880.HK   41 0.63 -0.14  0.24 -0.18  0.02 0.51 0.49
## 0293.HK   21 0.63 -0.14  0.04  0.05  0.06 0.42 0.58
## 0291.HK   20 0.62 -0.04  0.05 -0.02  0.07 0.39 0.61
## 0019.HK   12 0.61  0.02  0.02  0.26  0.03 0.44 0.56
## 0941.HK   34 0.58  0.48  0.12 -0.06  0.11 0.59 0.41
## 1044.HK   35 0.55 -0.05  0.50 -0.06 -0.10 0.57 0.43
## 0006.HK    6 0.17  0.70 -0.06 -0.21 -0.18 0.60 0.40
## 0002.HK    2 0.39  0.69 -0.01  0.07 -0.21 0.68 0.32
## 0003.HK    3 0.36  0.51 -0.06  0.37  0.16 0.55 0.45
## 0322.HK   22 0.36 -0.07  0.55  0.41 -0.12 0.62 0.38
## 0151.HK   18 0.46 -0.04  0.54  0.22  0.13 0.57 0.43
## 0836.HK   30 0.38  0.00  0.17  0.09  0.65 0.60 0.40
```

```
## 0330.HK   23 0.40 -0.06 -0.02 -0.07  0.45 0.37 0.63
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.24 2.12 1.45 1.33 1.15
## Proportion Var  0.52 0.04 0.03 0.03 0.02
## Cumulative Var  0.52 0.56 0.59 0.62 0.64
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  44.38 0.3
## The degrees of freedom for the model are 941  and the objective function was  7.32
##  0.3The number of observations was  260  with Chi Square =  1745  with prob <  8.8e-51
##  0.3
## Fit based upon off diagonal values = 1
##            PC1       PC2
## 0001.HK 0.8785 -0.019834
## 0002.HK 0.3863  0.694318
## 0003.HK 0.3552  0.506612
## 0004.HK 0.8120 -0.146994
## 0005.HK 0.8539  0.017339
## 0006.HK 0.1734  0.702164
## 0011.HK 0.7780  0.034358
## 0012.HK 0.7889  0.042246
## 0013.HK 0.8474 -0.072395
## 0016.HK 0.7677 -0.020889
## 0017.HK 0.7001 -0.074854
## 0019.HK 0.6105  0.022534
## 0023.HK 0.7440  0.047526
## 0066.HK 0.6708  0.247974
## 0083.HK 0.7767  0.016769
## 0101.HK 0.7718 -0.049601
## 0144.HK 0.7531 -0.057843
## 0151.HK 0.4574 -0.038605
## 0267.HK 0.7882 -0.108869
## 0291.HK 0.6195 -0.042521
## 0293.HK 0.6310 -0.136580
## 0322.HK 0.3648 -0.067257
## 0330.HK 0.4003 -0.057552
## 0386.HK 0.6643  0.321270
## 0388.HK 0.8341 -0.083438
## 0494.HK 0.6618 -0.082685
## 0688.HK 0.7686 -0.284691
## 0700.HK 0.7070 -0.071539
## 0762.HK 0.6534  0.221585
## 0836.HK 0.3798 -0.004133
## 0857.HK 0.7929  0.193277
## 0883.HK 0.8582  0.045167
## 0939.HK 0.8562  0.023761
## 0941.HK 0.5758  0.479186
## 1044.HK 0.5511 -0.047381
## 1088.HK 0.8377  0.056674
## 1109.HK 0.7453 -0.353672
## 1199.HK 0.7977 -0.089102
## 1299.HK 0.6739 -0.015970
## 1398.HK 0.8686 -0.036443
## 1880.HK 0.6329 -0.136351
## 1898.HK 0.8349  0.014408
```

```
## 1928.HK 0.6990 -0.188553
## 2318.HK 0.8421 -0.119476
## 2388.HK 0.8092 -0.037963
## 2600.HK 0.7828 -0.091600
## 2628.HK 0.7918  0.045274
## 3328.HK 0.8698  0.012102
## 3988.HK 0.8259  0.007300
```



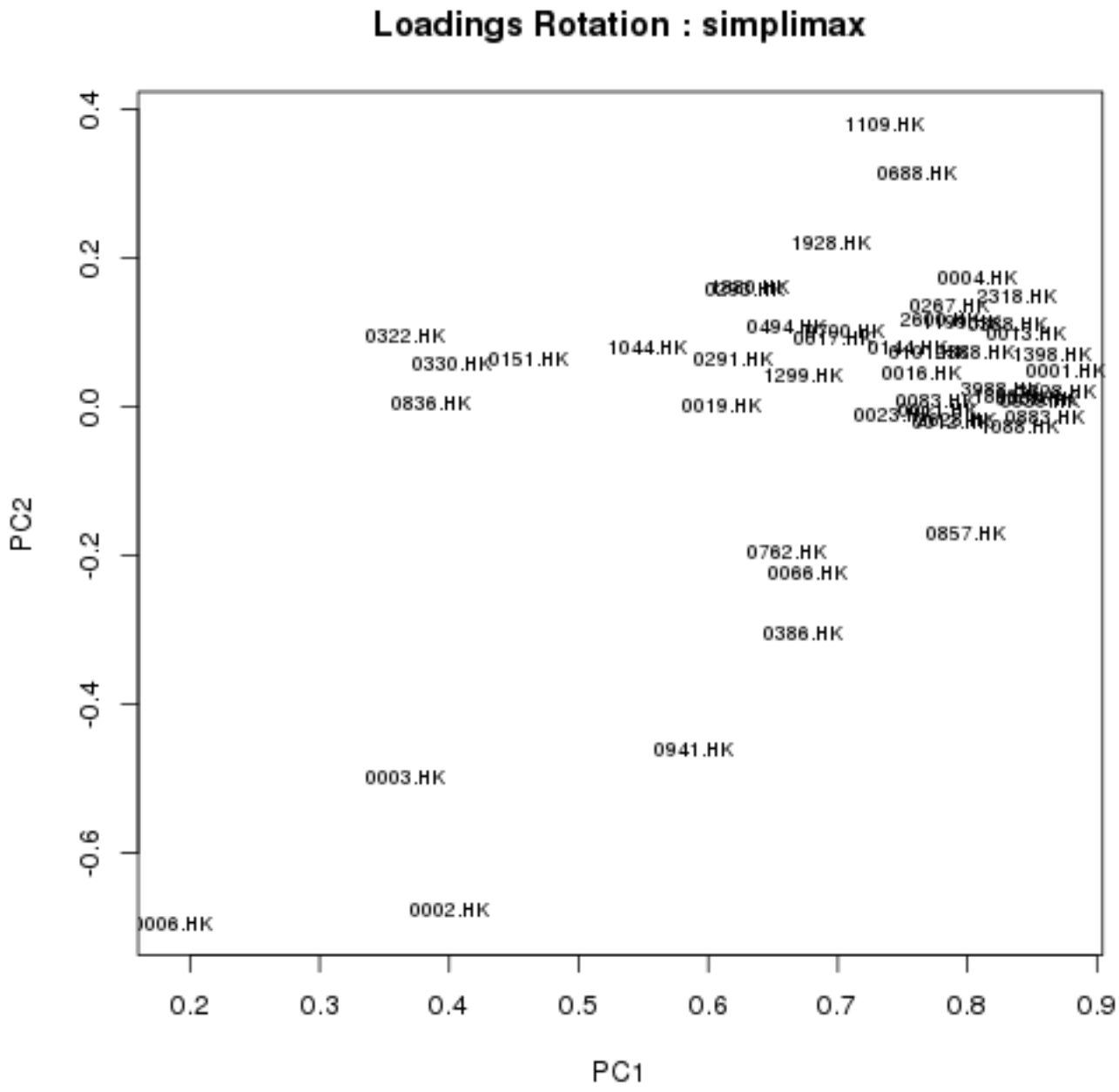
5.2.4 Rotation : simplimax

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
## 0001.HK    1 0.88  0.05 -0.16  0.17  0.00 0.82 0.18
## 3328.HK   48 0.87  0.02 -0.02 -0.05  0.05 0.76 0.24
## 1398.HK   40 0.87  0.07 -0.02 -0.01  0.17 0.78 0.22
## 0883.HK   32 0.86 -0.02  0.04 -0.16 -0.01 0.77 0.23
## 0939.HK   33 0.86  0.01  0.01  0.00  0.10 0.74 0.26
## 0005.HK    5 0.85  0.01 -0.08 -0.05  0.00 0.74 0.26
## 0013.HK    9 0.85  0.10 -0.10  0.11 -0.05 0.74 0.26
## 1088.HK   36 0.84 -0.03  0.07 -0.08 -0.02 0.72 0.28
## 2318.HK   44 0.84  0.15 -0.09 -0.07  0.08 0.74 0.26
## 1898.HK   42 0.83  0.02 -0.01 -0.08  0.04 0.71 0.29
## 0388.HK   25 0.83  0.11 -0.16  0.09  0.06 0.74 0.26
## 3988.HK   49 0.83  0.03  0.00  0.02  0.12 0.69 0.31
## 0004.HK    4 0.81  0.17 -0.15  0.07  0.00 0.71 0.29
## 2388.HK   45 0.81  0.07 -0.01  0.07  0.24 0.71 0.29
## 0857.HK   31 0.80 -0.17  0.02 -0.17 -0.17 0.73 0.27
## 1199.HK   38 0.80  0.11 -0.06 -0.20 -0.09 0.70 0.30
## 2628.HK   47 0.79 -0.02 -0.07 -0.09  0.03 0.64 0.36
## 0012.HK    8 0.79 -0.02 -0.23  0.18 -0.05 0.71 0.29
## 0267.HK   19 0.79  0.14  0.01  0.14 -0.06 0.65 0.35
## 2600.HK   46 0.78  0.12 -0.07 -0.09  0.04 0.64 0.36
## 0011.HK    7 0.78  0.00 -0.06  0.21  0.15 0.67 0.33
## 0083.HK   15 0.78  0.01 -0.23  0.10 -0.01 0.66 0.34
## 0101.HK   16 0.77  0.07 -0.18  0.04 -0.06 0.63 0.37
## 0016.HK   10 0.76  0.04 -0.29  0.16  0.04 0.70 0.30
## 0688.HK   27 0.76  0.31 -0.03 -0.12  0.09 0.70 0.30
## 0144.HK   17 0.75  0.08  0.07 -0.17 -0.14 0.64 0.36
## 0023.HK   13 0.74 -0.01  0.10  0.15  0.28 0.65 0.35
## 1109.HK   37 0.74  0.38 -0.04 -0.06  0.04 0.69 0.31
## 0700.HK   28 0.70  0.10  0.11 -0.28  0.12 0.62 0.38
## 0017.HK   11 0.70  0.09 -0.29  0.14 -0.10 0.60 0.40
## 1928.HK   43 0.69  0.22  0.16 -0.01  0.18 0.58 0.42
## 0066.HK   14 0.68 -0.22  0.01  0.21 -0.01 0.56 0.44
## 1299.HK   39 0.67  0.04  0.04  0.06  0.01 0.46 0.54
## 0386.HK   24 0.67 -0.31  0.01 -0.31 -0.22 0.69 0.31
## 0762.HK   29 0.66 -0.19  0.27 -0.21  0.01 0.60 0.40
## 0494.HK   26 0.66  0.11  0.04 -0.12  0.01 0.46 0.54
## 1880.HK   41 0.63  0.16  0.25 -0.13 -0.01 0.51 0.49
## 0293.HK   21 0.63  0.16  0.03  0.08 -0.04 0.42 0.58
## 0291.HK   20 0.62  0.06  0.04  0.00 -0.06 0.39 0.61
## 0019.HK   12 0.61  0.00 -0.01  0.27  0.01 0.44 0.56
## 0941.HK   34 0.59 -0.46  0.11 -0.05 -0.09 0.59 0.41
## 1044.HK   35 0.55  0.08  0.51  0.00  0.13 0.57 0.43
## 0006.HK    6 0.19 -0.69 -0.04 -0.28  0.17 0.60 0.40
## 0002.HK    2 0.40 -0.68 -0.01  0.00  0.24 0.68 0.32
## 0003.HK    3 0.37 -0.50 -0.10  0.35 -0.10 0.55 0.45
## 0151.HK   18 0.46  0.06  0.52  0.31 -0.06 0.57 0.43
## 0322.HK   22 0.37  0.10  0.52  0.46  0.21 0.62 0.38
## 0836.HK   30 0.39  0.00  0.14  0.20 -0.62 0.60 0.40
## 0330.HK   23 0.40  0.06 -0.03  0.00 -0.45 0.37 0.63
```

```
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.22 2.14 1.45 1.33 1.16
## Proportion Var  0.51 0.04 0.03 0.03 0.02
## Cumulative Var  0.51 0.56 0.59 0.61 0.64
##
##  With component correlations of
##       PC1   PC2   PC3   PC4   PC5
## PC1  1.00 -0.01  0.00 -0.01 -0.01
## PC2 -0.01  1.00 -0.02 -0.06  0.00
## PC3  0.00 -0.02  1.00 -0.05 -0.09
## PC4 -0.01 -0.06 -0.05  1.00  0.02
## PC5 -0.01  0.00 -0.09  0.02  1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  44.38 0.3
## The degrees of freedom for the model are 941  and the objective function was  7.32
##  0.3The number of observations was  260  with Chi Square =  1745  with prob <  8.8e-51
##  0.3
## Fit based upon off diagonal values = 1
##            PC1        PC2
## 0001.HK 0.8768  0.0489193
## 0002.HK 0.4001 -0.6756590
## 0003.HK 0.3672 -0.4977273
## 0004.HK 0.8074  0.1735173
## 0005.HK 0.8536  0.0112050
## 0006.HK 0.1875 -0.6944957
## 0011.HK 0.7770 -0.0030349
## 0012.HK 0.7885 -0.0189732
## 0013.HK 0.8456  0.0998171
## 0016.HK 0.7645  0.0447756
## 0017.HK 0.6970  0.0924058
## 0019.HK 0.6110  0.0004837
## 0023.HK 0.7434 -0.0115564
## 0066.HK 0.6769 -0.2238263
## 0083.HK 0.7753  0.0066516
## 0101.HK 0.7699  0.0723055
## 0144.HK 0.7536  0.0814821
## 0151.HK 0.4616  0.0638935
## 0267.HK 0.7864  0.1359884
## 0291.HK 0.6195  0.0637967
## 0293.HK 0.6285  0.1589139
## 0322.HK 0.3658  0.0970983
## 0330.HK 0.4030  0.0592802
## 0386.HK 0.6737 -0.3051568
## 0388.HK 0.8304  0.1121786
## 0494.HK 0.6601  0.1067578
## 0688.HK 0.7609  0.3136101
## 0700.HK 0.7050  0.1007088
## 0762.HK 0.6607 -0.1944048
## 0836.HK 0.3868  0.0046263
## 0857.HK 0.7990 -0.1703071
## 0883.HK 0.8596 -0.0150174
## 0939.HK 0.8560  0.0095157
## 0941.HK 0.5887 -0.4600665
## 1044.HK 0.5530  0.0796367
```

```
## 1088.HK 0.8398 -0.0266618
## 1109.HK 0.7365  0.3807282
## 1199.HK 0.7960  0.1132118
## 1299.HK 0.6738  0.0411863
## 1398.HK 0.8661  0.0714348
## 1880.HK 0.6319  0.1625015
## 1898.HK 0.8348  0.0157111
## 1928.HK 0.6943  0.2212957
## 2318.HK 0.8378  0.1497346
## 2388.HK 0.8060  0.0732074
## 2600.HK 0.7796  0.1188207
## 2628.HK 0.7920 -0.0182064
## 3328.HK 0.8695  0.0195308
## 3988.HK 0.8250  0.0250841
```



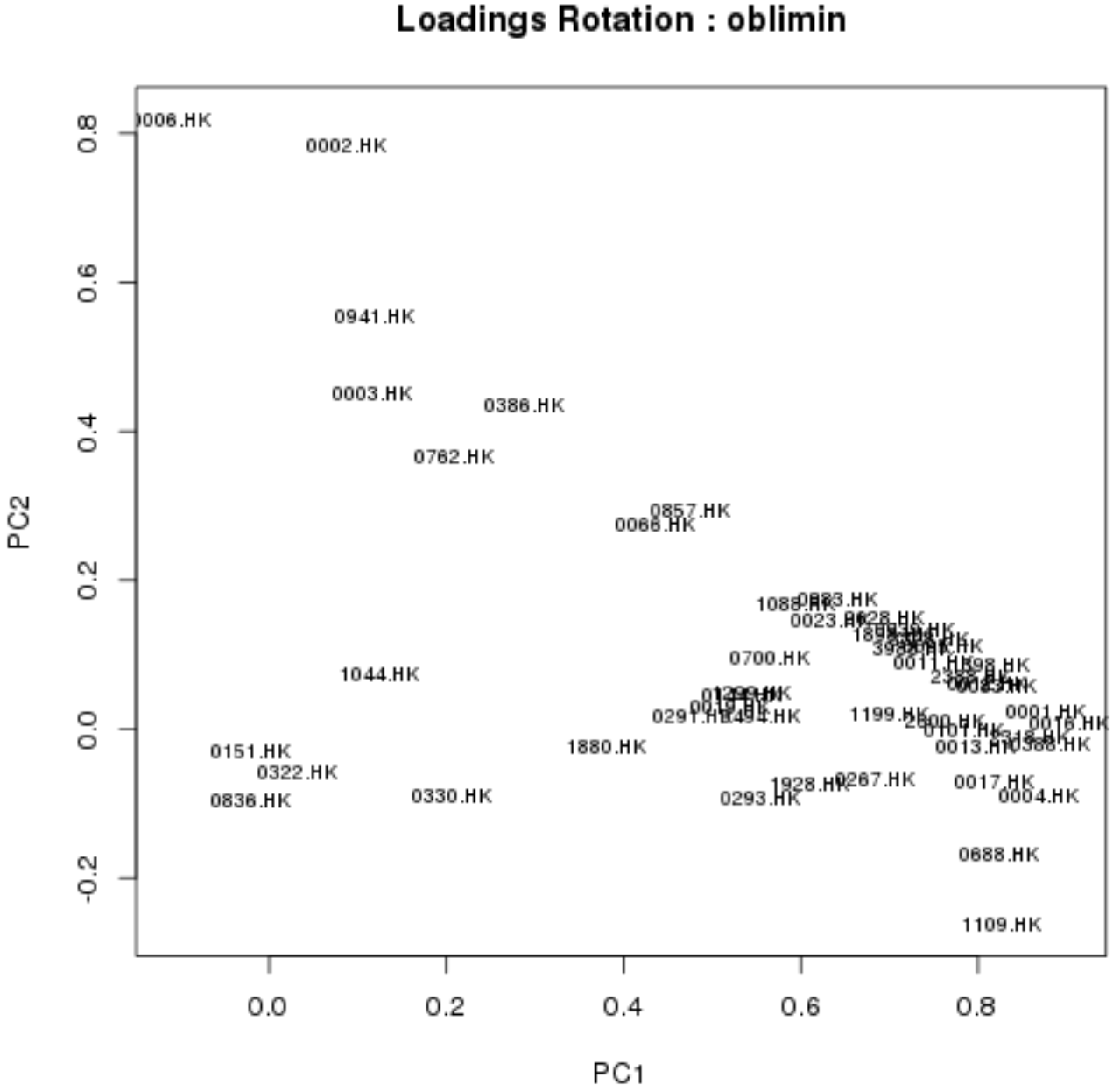
5.2.5 Rotation : oblimin

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  0.90  0.01 -0.10 -0.04 -0.21 0.70 0.30
## 0388.HK   25  0.88 -0.02  0.00 -0.02 -0.07 0.74 0.26
## 0001.HK    1  0.88  0.02  0.03  0.06 -0.16 0.82 0.18
## 0004.HK    4  0.87 -0.09 -0.02  0.04 -0.03 0.71 0.29
## 2318.HK   44  0.86 -0.01 -0.02 -0.04  0.11 0.74 0.26
## 1109.HK   37  0.83 -0.26  0.02 -0.01  0.19 0.69 0.31
## 0688.HK   27  0.82 -0.17  0.01 -0.05  0.22 0.70 0.30
## 0083.HK   15  0.82  0.06 -0.09  0.04 -0.15 0.66 0.34
## 0017.HK   11  0.82 -0.07 -0.15  0.10 -0.19 0.60 0.40
## 1398.HK   40  0.81  0.09  0.10 -0.09  0.08 0.78 0.22
## 0012.HK    8  0.81  0.06 -0.05  0.09 -0.22 0.71 0.29
## 0013.HK    9  0.80 -0.02  0.05  0.12 -0.06 0.74 0.26
## 2388.HK   45  0.79  0.07  0.16 -0.17  0.01 0.71 0.29
## 0101.HK   16  0.78  0.00 -0.07  0.10 -0.06 0.63 0.37
## 2600.HK   46  0.76  0.01 -0.02  0.01  0.13 0.64 0.36
## 0005.HK    5  0.76  0.11 -0.01  0.08  0.06 0.74 0.26
## 0011.HK    7  0.75  0.09  0.16 -0.08 -0.17 0.67 0.33
## 3328.HK   48  0.74  0.12  0.07  0.04  0.10 0.76 0.24
## 0939.HK   33  0.73  0.13  0.12 -0.01  0.07 0.74 0.26
## 3988.HK   49  0.73  0.11  0.12 -0.03  0.04 0.69 0.31
## 1898.HK   42  0.70  0.13  0.05  0.05  0.12 0.71 0.29
## 1199.HK   38  0.70  0.02 -0.08  0.16  0.24 0.70 0.30
## 2628.HK   47  0.69  0.15 -0.02  0.05  0.10 0.64 0.36
## 0267.HK   19  0.68 -0.07  0.15  0.15 -0.04 0.65 0.35
## 0883.HK   32  0.64  0.18  0.05  0.13  0.22 0.77 0.23
## 0023.HK   13  0.63  0.15  0.29 -0.18 -0.04 0.65 0.35
## 1928.HK   43  0.61 -0.07  0.25 -0.10  0.18 0.58 0.42
## 1088.HK   36  0.59  0.17  0.12  0.15  0.15 0.72 0.28
## 0700.HK   28  0.57  0.09  0.06 -0.04  0.38 0.62 0.38
## 0494.HK   26  0.56  0.02  0.05  0.06  0.19 0.46 0.54
## 0293.HK   21  0.55 -0.09  0.13  0.11  0.02 0.42 0.58
## 1299.HK   39  0.54  0.05  0.14  0.07  0.02 0.46 0.54
## 0144.HK   17  0.53  0.04  0.04  0.24  0.25 0.64 0.36
## 0019.HK   12  0.52  0.03  0.20  0.06 -0.21 0.44 0.56
## 0291.HK   20  0.48  0.02  0.10  0.14  0.07 0.39 0.61
## 0857.HK   31  0.48  0.30 -0.01  0.30  0.17 0.73 0.27
## 0066.HK   14  0.43  0.28  0.19  0.13 -0.20 0.56 0.44
## 1880.HK   41  0.38 -0.02  0.23  0.13  0.31 0.51 0.49
## 0006.HK    6 -0.11  0.82 -0.13 -0.09  0.08 0.60 0.40
## 0002.HK    2  0.09  0.78  0.07 -0.12 -0.14 0.68 0.32
## 0941.HK   34  0.12  0.56  0.13  0.26  0.02 0.59 0.41
## 0386.HK   24  0.29  0.43 -0.11  0.35  0.25 0.69 0.31
## 0762.HK   29  0.21  0.37  0.23  0.16  0.31 0.60 0.40
## 0322.HK   22  0.03 -0.06  0.79 -0.04 -0.13 0.62 0.38
## 0151.HK   18 -0.02 -0.03  0.68  0.26  0.00 0.57 0.43
## 1044.HK   35  0.13  0.07  0.56  0.05  0.29 0.57 0.43
## 0836.HK   30 -0.02 -0.10  0.17  0.76 -0.10 0.60 0.40
## 0330.HK   23  0.21 -0.09 -0.06  0.52  0.02 0.37 0.63
```

```
## 0003.HK    3  0.12  0.45  0.10  0.20 -0.46 0.55 0.45
##
##                  PC1  PC2  PC3  PC5  PC4
## SS loadings    21.19 3.20 2.81 2.36 1.73
## Proportion Var  0.43 0.07 0.06 0.05 0.04
## Cumulative Var  0.43 0.50 0.56 0.60 0.64
##
##  With component correlations of
##      PC1  PC2  PC3  PC5  PC4
## PC1 1.00 0.37 0.45 0.43 0.20
## PC2 0.37 1.00 0.18 0.19 0.03
## PC3 0.45 0.18 1.00 0.18 0.10
## PC5 0.43 0.19 0.18 1.00 0.08
## PC4 0.20 0.03 0.10 0.08 1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  44.38 0.3
## The degrees of freedom for the model are 941  and the objective function was  7.32
##  0.3The number of observations was  260  with Chi Square =  1745  with prob <  8.8e-51
##  0.3
## Fit based upon off diagonal values = 1
##              PC1       PC2
## 0001.HK  0.87583  0.022456
## 0002.HK  0.08644  0.783984
## 0003.HK  0.11546  0.450023
## 0004.HK  0.86847 -0.089743
## 0005.HK  0.76131  0.112942
## 0006.HK -0.10978  0.819033
## 0011.HK  0.75019  0.089909
## 0012.HK  0.81042  0.061002
## 0013.HK  0.79884 -0.023019
## 0016.HK  0.90423  0.009125
## 0017.HK  0.81964 -0.071424
## 0019.HK  0.52053  0.029541
## 0023.HK  0.63258  0.146121
## 0066.HK  0.43469  0.275186
## 0083.HK  0.82261  0.056900
## 0101.HK  0.78499 -0.002114
## 0144.HK  0.53413  0.044419
## 0151.HK -0.02128 -0.028626
## 0267.HK  0.68384 -0.067623
## 0291.HK  0.47674  0.017117
## 0293.HK  0.55447 -0.092297
## 0322.HK  0.03046 -0.058458
## 0330.HK  0.20555 -0.089353
## 0386.HK  0.28871  0.434424
## 0388.HK  0.88328 -0.019168
## 0494.HK  0.55539  0.018965
## 0688.HK  0.82355 -0.168557
## 0700.HK  0.56568  0.094991
## 0762.HK  0.20831  0.366009
## 0836.HK -0.02238 -0.096179
## 0857.HK  0.47660  0.295386
## 0883.HK  0.64249  0.175738
## 0939.HK  0.72766  0.134124
## 0941.HK  0.11884  0.555339
```

```
## 1044.HK  0.12548  0.073486
## 1088.HK  0.59451  0.167674
## 1109.HK  0.82545 -0.261535
## 1199.HK  0.70021  0.021970
## 1299.HK  0.54496  0.047741
## 1398.HK  0.81378  0.085360
## 1880.HK  0.38091 -0.023393
## 1898.HK  0.70336  0.127289
## 1928.HK  0.61096 -0.073106
## 2318.HK  0.85797 -0.009402
## 2388.HK  0.79158  0.070124
## 2600.HK  0.76244  0.011013
## 2628.HK  0.69492  0.149559
## 3328.HK  0.74412  0.122534
## 3988.HK  0.72749  0.109453
```


Loadings Rotation : oblimin
PC2
PC1
0.8
0.6
0.4
0.2
0.0
-0.2
0.0
0.2
0.4
0.6
0.8
0006.HK
0002.HK
0941.HK
0003.HK
0386.HK
0762.HK
0857.HK
0066.HK
0700.HK
1044.HK
0151.HK
0322.HK
0836.HK
0330.HK
1880.HK
0293.HK
1928.HK
0267.HK
1199.HK
0017.HK
0004.HK
0001.HK
0688.HK
1109.HK

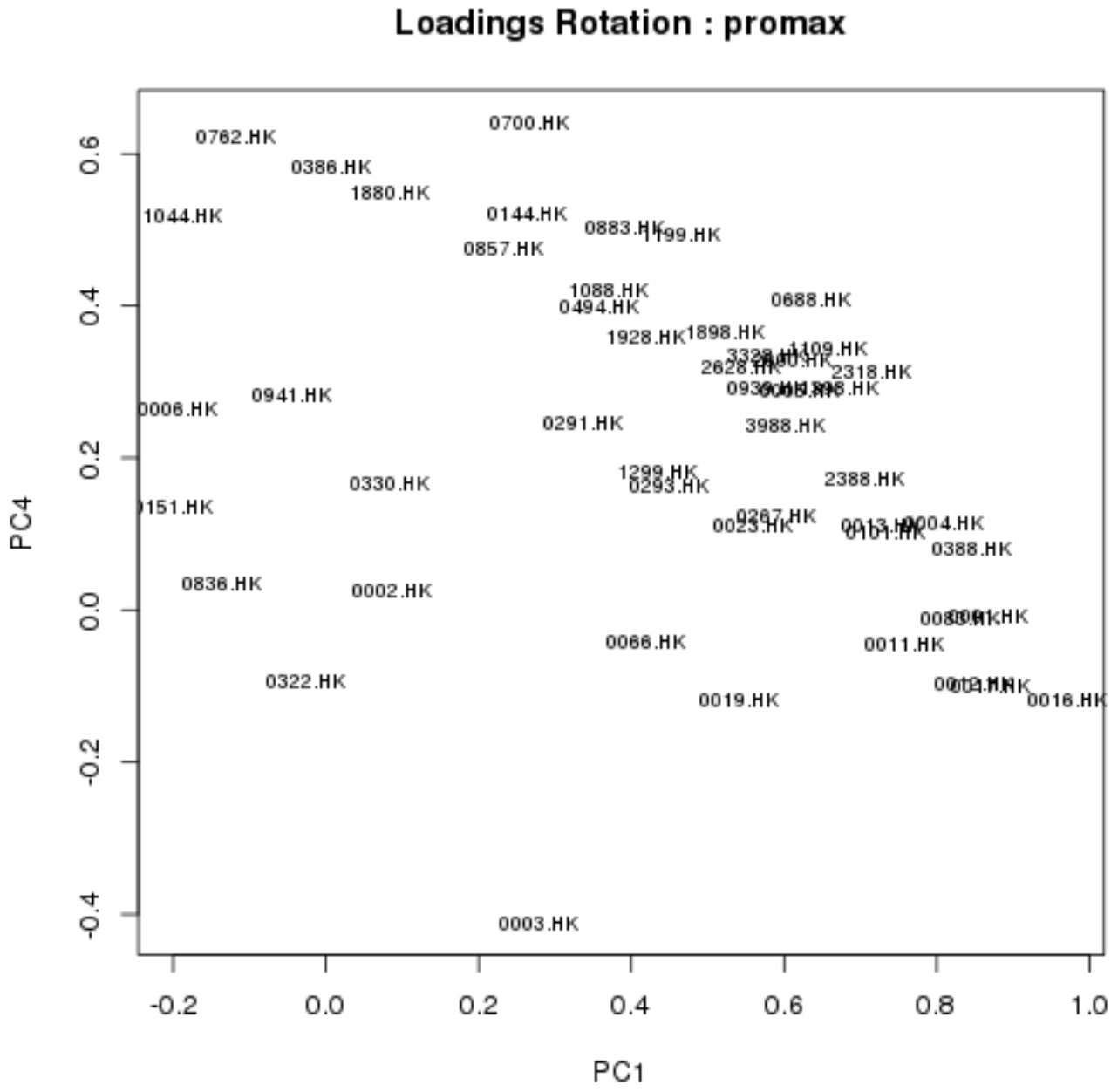
5.2.6 Rotation : promax

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  0.97 -0.12  0.03 -0.11 -0.04 0.70 0.30
## 0017.HK   11  0.87 -0.10 -0.07 -0.16  0.12 0.60 0.40
## 0001.HK    1  0.87 -0.01  0.02  0.02  0.05 0.82 0.18
## 0012.HK    8  0.85 -0.10  0.07 -0.06  0.09 0.71 0.29
## 0388.HK   25  0.85  0.08 -0.03 -0.03 -0.04 0.74 0.26
## 0083.HK   15  0.83 -0.01  0.06 -0.11  0.03 0.66 0.34
## 0004.HK    4  0.81  0.11 -0.11 -0.05  0.02 0.71 0.29
## 0011.HK    7  0.76 -0.04  0.11  0.15 -0.10 0.67 0.33
## 0101.HK   16  0.73  0.10 -0.03 -0.10  0.09 0.63 0.37
## 0013.HK    9  0.73  0.11 -0.05  0.02  0.12 0.74 0.26
## 2318.HK   44  0.72  0.31 -0.05 -0.07 -0.09 0.74 0.26
## 2388.HK   45  0.71  0.17  0.07  0.13 -0.22 0.71 0.29
## 1398.HK   40  0.67  0.29  0.06  0.05 -0.15 0.78 0.22
## 1109.HK   37  0.66  0.35 -0.32 -0.02 -0.04 0.69 0.31
## 0688.HK   27  0.63  0.41 -0.23 -0.04 -0.10 0.70 0.30
## 0005.HK    5  0.62  0.29  0.07 -0.06  0.03 0.74 0.26
## 2600.HK   46  0.61  0.33 -0.03 -0.07 -0.04 0.64 0.36
## 3988.HK   49  0.60  0.24  0.09  0.08 -0.08 0.69 0.31
## 0267.HK   19  0.59  0.12 -0.10  0.13  0.16 0.65 0.35
## 0939.HK   33  0.58  0.29  0.11  0.07 -0.06 0.74 0.26
## 3328.HK   48  0.58  0.33  0.08  0.01 -0.02 0.76 0.24
## 0023.HK   13  0.56  0.11  0.16  0.28 -0.22 0.65 0.35
## 2628.HK   47  0.55  0.32  0.11 -0.08 -0.02 0.64 0.36
## 0019.HK   12  0.54 -0.12  0.04  0.21  0.09 0.44 0.56
## 1898.HK   42  0.52  0.36  0.08 -0.01 -0.01 0.71 0.29
## 0293.HK   21  0.45  0.16 -0.13  0.11  0.11 0.42 0.58
## 1299.HK   39  0.43  0.18  0.02  0.11  0.05 0.46 0.54
## 1928.HK   43  0.42  0.36 -0.11  0.22 -0.14 0.58 0.42
## 0066.HK   14  0.42 -0.04  0.28  0.18  0.12 0.56 0.44
## 0291.HK   20  0.34  0.25 -0.03  0.06  0.12 0.39 0.61
## 0700.HK   28  0.27  0.64  0.02 -0.03 -0.14 0.62 0.38
## 0762.HK   29 -0.12  0.62  0.29  0.14  0.06 0.60 0.40
## 0386.HK   24  0.01  0.58  0.35 -0.22  0.25 0.69 0.31
## 1880.HK   41  0.08  0.55 -0.11  0.17  0.08 0.51 0.49
## 0144.HK   17  0.26  0.52 -0.05 -0.04  0.19 0.64 0.36
## 0883.HK   32  0.39  0.50  0.11 -0.03  0.04 0.77 0.23
## 1199.HK   38  0.47  0.49 -0.06 -0.16  0.09 0.70 0.30
## 0857.HK   31  0.23  0.48  0.22 -0.09  0.22 0.73 0.27
## 1088.HK   36  0.37  0.42  0.11  0.05  0.08 0.72 0.28
## 0494.HK   26  0.36  0.40 -0.04 -0.01  0.01 0.46 0.54
## 0006.HK    6 -0.19  0.27  0.84 -0.20 -0.23 0.60 0.40
## 0002.HK    2  0.09  0.03  0.84  0.03 -0.22 0.68 0.32
## 0941.HK   34 -0.05  0.28  0.53  0.07  0.19 0.59 0.41
## 0003.HK    3  0.28 -0.41  0.51  0.13  0.22 0.55 0.45
## 0322.HK   22 -0.03 -0.09 -0.05  0.84  0.01 0.62 0.38
## 0151.HK   18 -0.20  0.14 -0.08  0.70  0.31 0.57 0.43
## 1044.HK   35 -0.19  0.52  0.01  0.52  0.01 0.57 0.43
## 0836.HK   30 -0.14  0.04 -0.18  0.17  0.84 0.60 0.40
## 0330.HK   23  0.08  0.17 -0.17 -0.09  0.55 0.37 0.63
```

```
##
##                  PC1  PC4  PC2  PC3  PC5
## SS loadings    16.85 7.70 2.77 2.18 1.80
## Proportion Var  0.34 0.16 0.06 0.04 0.04
## Cumulative Var  0.34 0.50 0.56 0.60 0.64
##
##  With component correlations of
##      PC1  PC4  PC2  PC3  PC5
## PC1 1.00 0.68 0.41 0.53 0.52
## PC4 0.68 1.00 0.27 0.43 0.38
## PC2 0.41 0.27 1.00 0.25 0.41
## PC3 0.53 0.43 0.25 1.00 0.24
## PC5 0.52 0.38 0.41 0.24 1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  44.38 0.3
## The degrees of freedom for the model are 941  and the objective function was  7.32
##  0.3The number of observations was  260  with Chi Square =  1745  with prob <  8.8e-51
##  0.3
## Fit based upon off diagonal values = 1
##               PC1       PC4
## 0001.HK  0.867257 -0.009470
## 0002.HK  0.087850  0.025425
## 0003.HK  0.277925 -0.411502
## 0004.HK  0.811004  0.113730
## 0005.HK  0.620538  0.289079
## 0006.HK -0.193763  0.265134
## 0011.HK  0.756518 -0.044299
## 0012.HK  0.850657 -0.097488
## 0013.HK  0.725951  0.112174
## 0016.HK  0.972370 -0.118943
## 0017.HK  0.870389 -0.099355
## 0019.HK  0.541020 -0.117816
## 0023.HK  0.560701  0.110147
## 0066.HK  0.418521 -0.041455
## 0083.HK  0.831523 -0.009658
## 0101.HK  0.734216  0.102937
## 0144.HK  0.264589  0.522293
## 0151.HK -0.198784  0.136825
## 0267.HK  0.589391  0.122965
## 0291.HK  0.335289  0.246726
## 0293.HK  0.449306  0.162921
## 0322.HK -0.026918 -0.092732
## 0330.HK  0.083862  0.167256
## 0386.HK  0.007891  0.581283
## 0388.HK  0.845086  0.079198
## 0494.HK  0.357672  0.399855
## 0688.HK  0.634475  0.408219
## 0700.HK  0.266720  0.641361
## 0762.HK -0.117744  0.620929
## 0836.HK -0.135427  0.035358
## 0857.HK  0.232912  0.476462
## 0883.HK  0.392650  0.503476
## 0939.HK  0.578097  0.290679
## 0941.HK -0.045863  0.283898
## 1044.HK -0.189166  0.517347
```

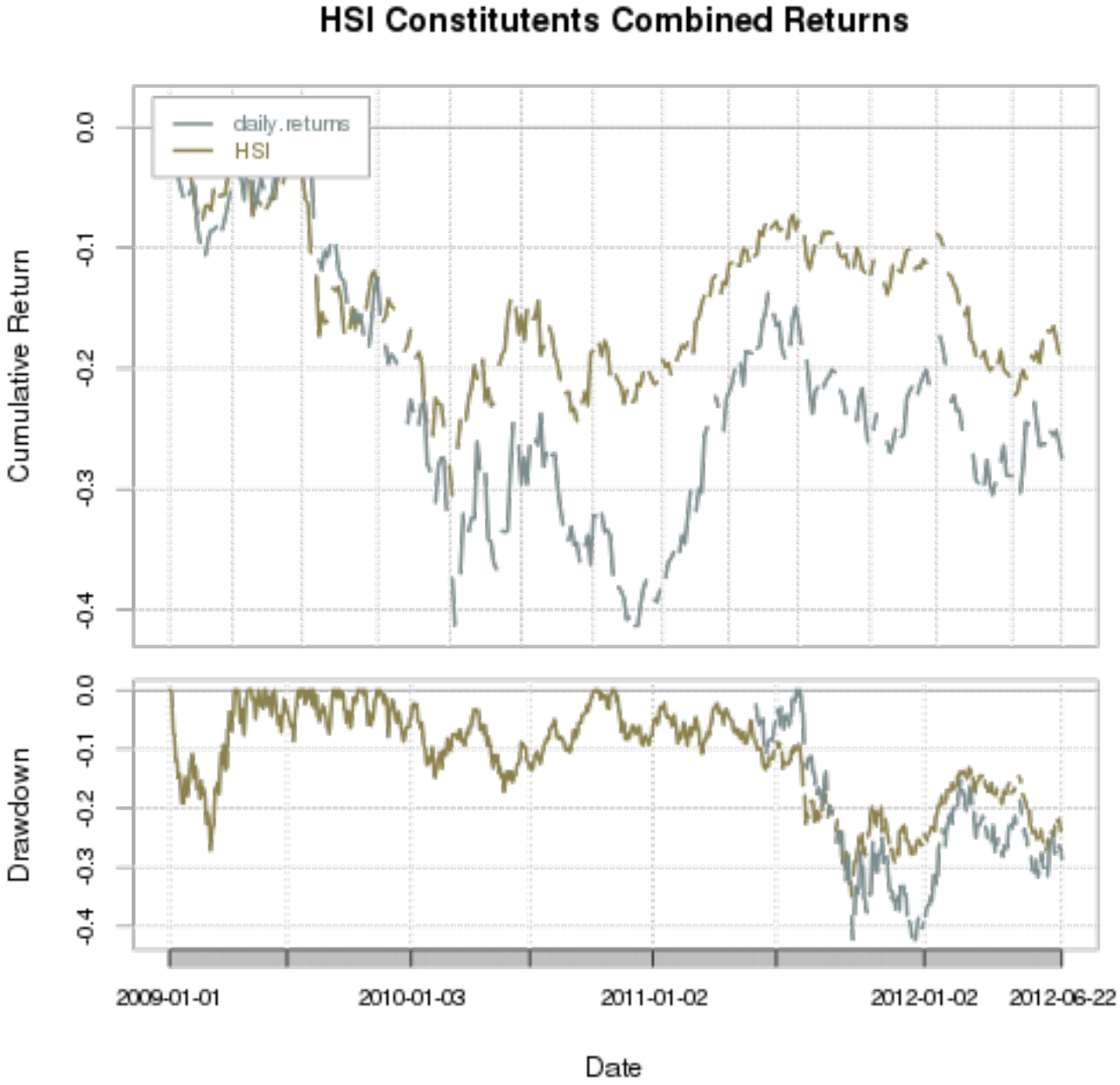
```
## 1088.HK  0.371414  0.421706
## 1109.HK  0.658467  0.345195
## 1199.HK  0.466290  0.493999
## 1299.HK  0.434086  0.183009
## 1398.HK  0.673162  0.292870
## 1880.HK  0.084233  0.548514
## 1898.HK  0.523954  0.363914
## 1928.HK  0.419555  0.358037
## 2318.HK  0.716011  0.314390
## 2388.HK  0.707106  0.171517
## 2600.HK  0.610936  0.327605
## 2628.HK  0.545094  0.320387
## 3328.HK  0.577221  0.333472
## 3988.HK  0.601539  0.243759
```



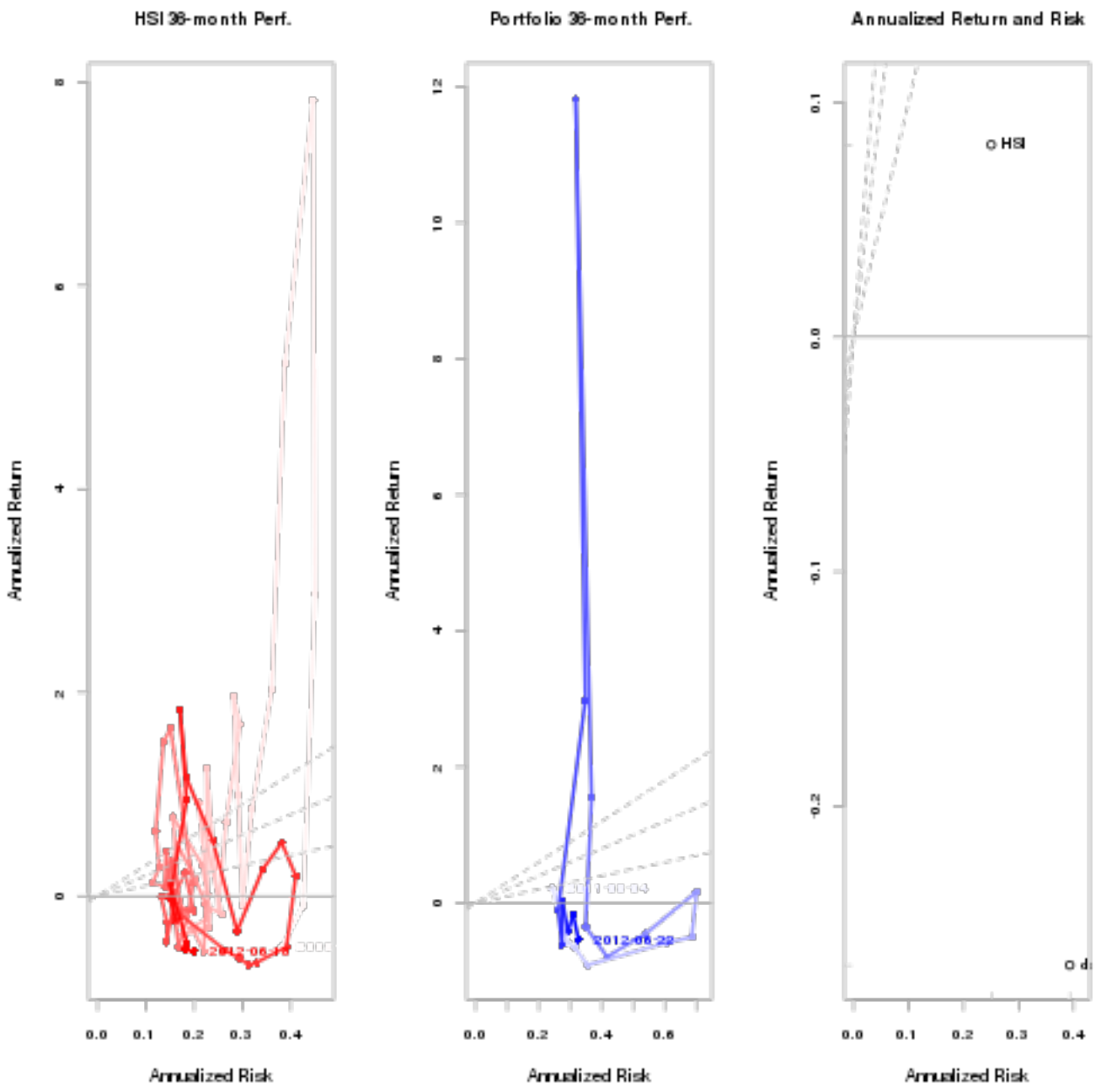
PCA is a science in itself and can not be fully covered and even less interpreted in this paper. The factors produced by principal component analysis are conceptualized as being linear combinations of the variables whereas the factors produced by common factor analysis are conceptualized as being latent 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

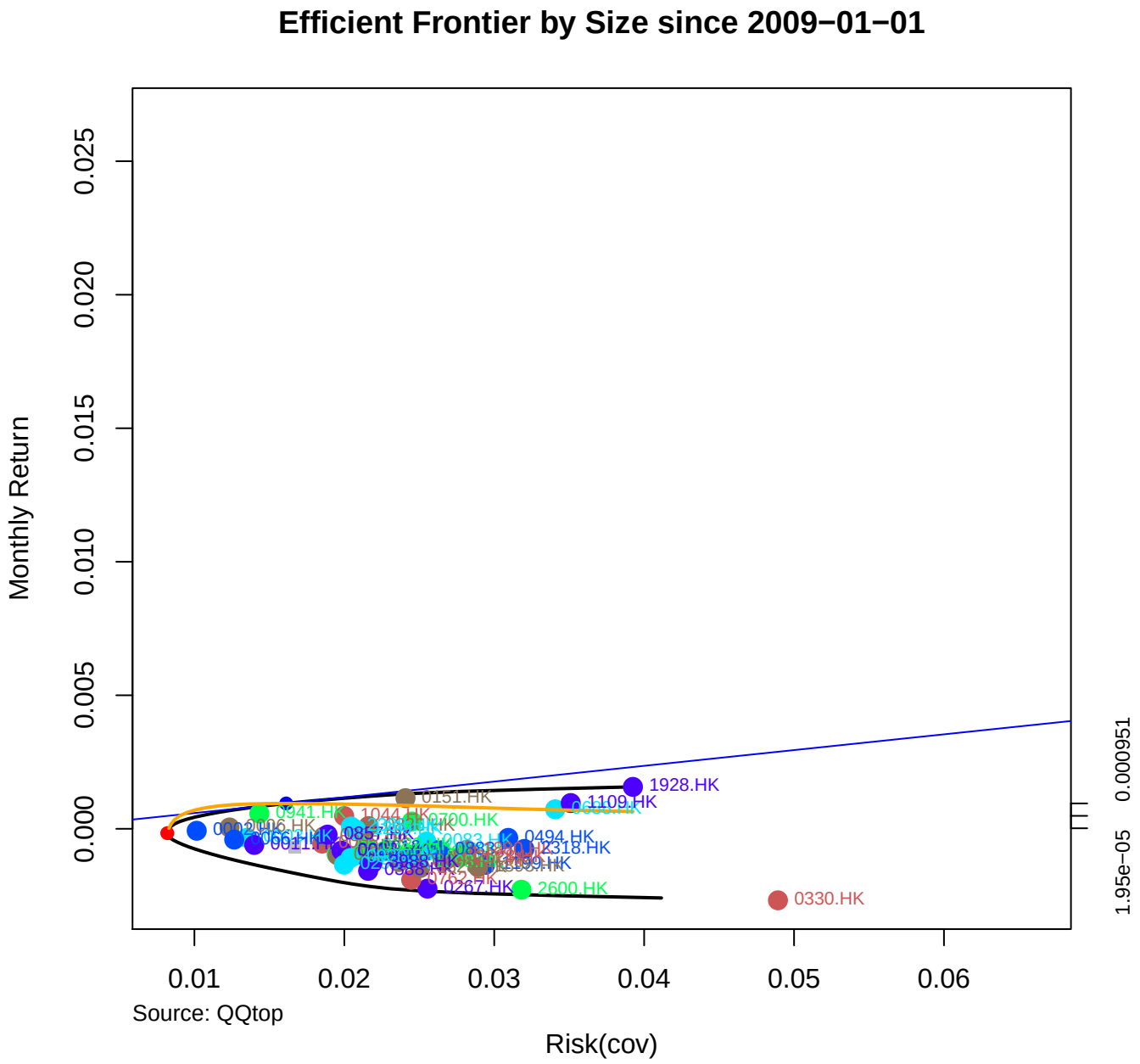
6.1 Performance Chart



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  0.1443  0.0000  0.0000  0.0290  0.0000  0.0000  0.0000
```

```
## 25  0.0000  0.1740  0.1742  0.0000  0.0000  0.2154  0.0199  0.0000  0.0000
## 37  0.0000  0.0485  0.0000  0.0000  0.0000  0.3219  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  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0320  0.0000  0.1012  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  0.2029
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK 0388.HK 0494.HK 0688.HK
## 1   0.0491  0.0000  0.0000  0.0000  0.7872  0.0000  0.0000  0.0000  0.0000
## 13  0.2100  0.0000  0.2224  0.0431  0.0605  0.0000  0.0335  0.0000  0.0000
## 25  0.0138  0.0239  0.1215  0.0767  0.0119  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  0.2518  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0356  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0245  0.0000  0.0000  0.0000  0.3193  0.0263  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 1928.HK 2318.HK 2388.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  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0055  0.0000  0.0000  0.0000  0.0000  0.0000  0.0511  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  1.0000  0.0000  0.0000
##    2600.HK 2628.HK 3328.HK 3988.HK
## 1   0.1637  0.0000  0.0000  0.0000
## 13  0.0055  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  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  0.0493  0.0000  0.0000  0.0038  0.0000  0.0000  0.0000
## 25  0.0000  0.1415  0.1611  0.0000  0.0000  0.1639  0.0207  0.0000  0.0000
## 37  0.0000  0.0246  0.0000  0.0000  0.0000  0.1959  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  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0385  0.0000  0.0966  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  0.3058
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK 0388.HK 0494.HK 0688.HK
## 1   0.0138  0.0000  0.0000  0.0000  0.9271  0.0000  0.0000  0.0000  0.0000
## 13  0.2884  0.0000  0.1974  0.0215  0.0974  0.0000  0.0339  0.0000  0.0000
## 25  0.0240  0.0290  0.1646  0.0804  0.0228  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  0.3006  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0569  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
```

```
## 37  0.0000  0.0000  0.0160  0.0000  0.0000  0.0000  0.3305  0.0252  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 1928.HK 2318.HK 2388.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  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0075  0.0000  0.0000  0.0000  0.0000  0.0000  0.0946  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  1.0000  0.0000  0.0000
##    2600.HK 2628.HK 3328.HK 3988.HK
## 1   0.0591  0.0000  0.0000  0.0000
## 13  0.0077  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000
##
## Target Return and Risks:
##       mean      mu     Cov   Sigma    CVaR     VaR
## 1  -0.0026 -0.0026  0.0412  0.0412  0.1045  0.0713
## 13 -0.0016 -0.0016  0.0157  0.0157  0.0359  0.0287
## 25 -0.0005 -0.0005  0.0089  0.0089  0.0199  0.0165
## 37  0.0005  0.0005  0.0108  0.0108  0.0229  0.0176
## 49  0.0016  0.0016  0.0393  0.0393  0.0804  0.0553
##
## Description:
##  Mon Jun 25 20:58:53 2012 by user:
```

7 HSI Components Ratios

7.1 Sharpe Ratio - Combined

```
##                                daily.returns
## StdDev Sharpe (Rf=0%, p=95%):       -0.0376
## VaR Sharpe (Rf=0%, p=95%):          -0.0241
## ES Sharpe (Rf=0%, p=95%):           -0.0187
```

7.2 Sharpe - Distinct

```
##                                0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0199  0.0326  0.0312  0.0418  0.0056
## VaR Sharpe (Rf=0%, p=95%):     0.0132  0.0206  0.0182  0.0287  0.0037
## ES Sharpe (Rf=0%, p=95%):      0.0103  0.0146  0.0071  0.0226  0.0020
##                                0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0338  0.0063  0.0262  0.0379  0.0262
## VaR Sharpe (Rf=0%, p=95%):     0.0217  0.0046  0.0183  0.0261  0.0169
## ES Sharpe (Rf=0%, p=95%):      0.0152  0.0046  0.0147  0.0203  0.0114
##                                0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0171  0.0364  0.0344  0.0357  0.0253
## VaR Sharpe (Rf=0%, p=95%):     0.0113  0.0228  0.0268  0.0263  0.0168
## ES Sharpe (Rf=0%, p=95%):      0.0079  0.0134  0.0268  0.0226  0.0123
##                                0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0268  0.0295  0.0668  0.0190  0.0353
## VaR Sharpe (Rf=0%, p=95%):     0.0185  0.0197  0.0452  0.0139  0.0234
## ES Sharpe (Rf=0%, p=95%):      0.0147  0.0154  0.0344  0.0121  0.0182
##                                0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0286  0.0522 -0.0314  0.0291  0.0295
## VaR Sharpe (Rf=0%, p=95%):     0.0187  0.0431 -0.0197  0.0187  0.0210
## ES Sharpe (Rf=0%, p=95%):      0.0140  0.0431 -0.0112  0.0141  0.0173
##                                0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## StdDev Sharpe (Rf=0%, p=95%): -0.0109  0.0306  0.0813  0.0117  0.0090
## VaR Sharpe (Rf=0%, p=95%):    -0.0068  0.0221  0.0542  0.0080  0.0058
## ES Sharpe (Rf=0%, p=95%):     -0.0054  0.0186  0.0400  0.0063  0.0046
##                                0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0299  0.0423  0.0183  0.0079  0.0686
## VaR Sharpe (Rf=0%, p=95%):     0.0189  0.0278  0.0114  0.0052  0.0473
## ES Sharpe (Rf=0%, p=95%):      0.0143  0.0209  0.0079  0.0040  0.0366
##                                1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0316  0.0312  0.0217  0.0239  0.0109
## VaR Sharpe (Rf=0%, p=95%):     0.0200  0.0229  0.0149  0.0151  0.0077
## ES Sharpe (Rf=0%, p=95%):      0.0153  0.0196  0.0118  0.0087  0.0063
##                                1880.HK 1898.HK 1928.HK 2318.HK 2388.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0654  0.0140  0.0634  0.0310  0.0631
## VaR Sharpe (Rf=0%, p=95%):     0.0467  0.0086  0.0516  0.0207  0.0456
## ES Sharpe (Rf=0%, p=95%):      0.0371  0.0058  0.0516  0.0148  0.0368
##                                2600.HK 2628.HK 3328.HK 3988.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0031 -0.0028  0.0031  0.0264
## VaR Sharpe (Rf=0%, p=95%):     0.0021 -0.0017  0.0019  0.0174
## ES Sharpe (Rf=0%, p=95%):      0.0016 -0.0012  0.0014  0.0125
```

7.3 Information Ratio - Combined

```
## [1] "Information Ratio :  -0.0528"
```

7.4 Information Ratio - Distinct

```
##                        0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK
## Information Ratio: HSI -0.0904 -0.0882  0.0147  0.2527 -0.2685   -0.02
##                        0011.HK 0012.HK 0013.HK 0016.HK 0017.HK 0019.HK
## Information Ratio: HSI -0.2783  0.0045  0.1688 -0.0024 -0.1218  0.1401
```

```
##                         0023.HK 0066.HK 0083.HK 0101.HK 0144.HK 0151.HK
## Information Ratio: HSI  0.1185  0.0586 -0.0064  0.0169  0.0564  0.6507
##                         0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK
## Information Ratio: HSI -0.0961  0.1387  0.0376  0.3991 -0.7236  0.0375
##                         0388.HK 0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Information Ratio: HSI  0.0487 -0.0055  0.0759  0.9816 -0.1871 -0.2283
##                         0857.HK 0883.HK 0939.HK 0941.HK 1044.HK 1088.HK
## Information Ratio: HSI  0.0492  0.2538 -0.1123 -0.2467  0.7018  0.0862
##                         1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK
## Information Ratio: HSI  0.0854  -0.063  0.5198 -0.2077  0.7086 -0.1735
##                         1928.HK 2318.HK 2388.HK 2600.HK 2628.HK 3328.HK
## Information Ratio: HSI  0.9141  0.0798  0.5883 -0.3217 -0.3687 -0.3129
##                         3988.HK
## Information Ratio: HSI   5e-04
```

8 HSI Components Table Latest Quotes

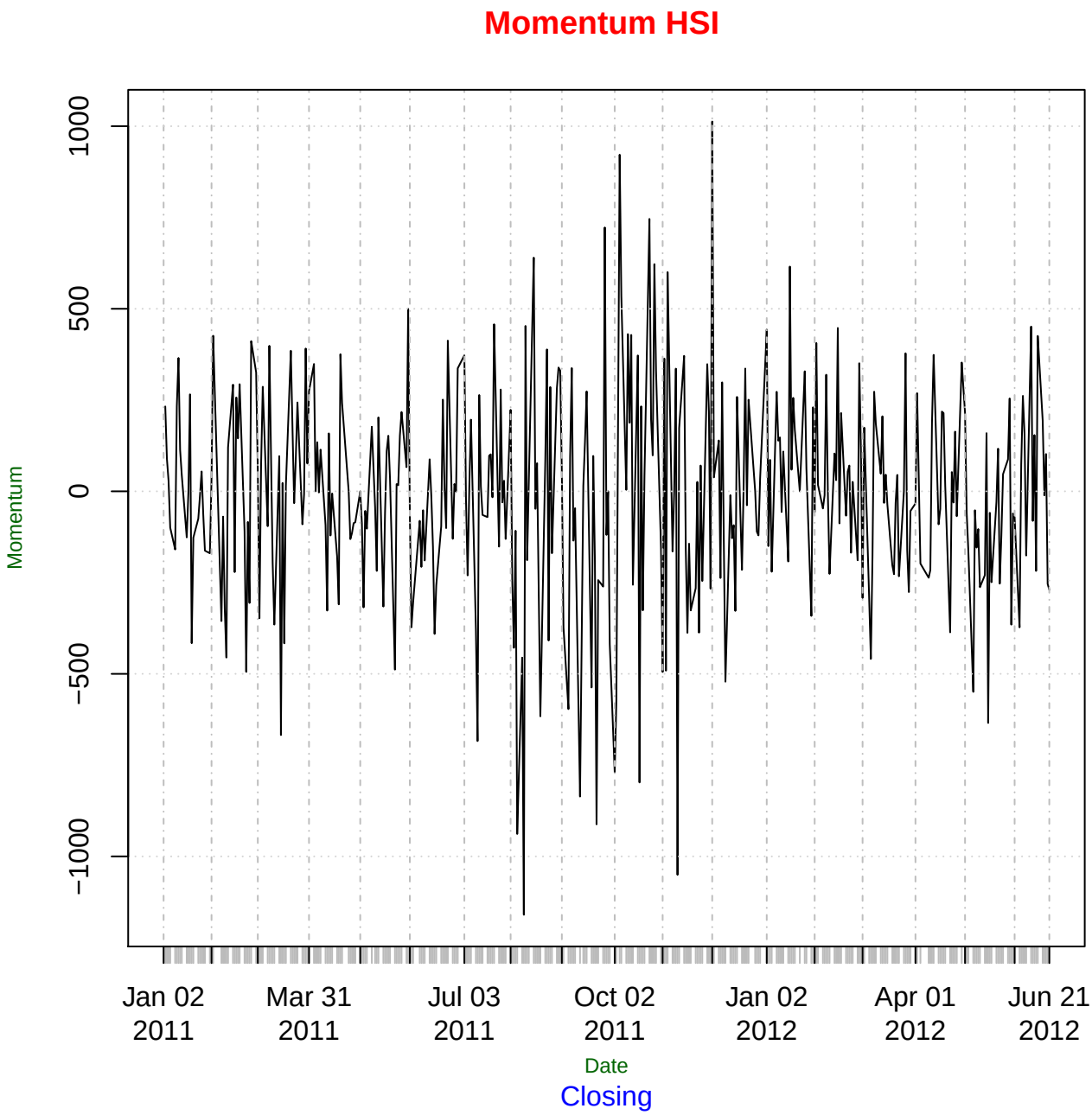
```
## [1] "Date :  2012-06-25 03:59:00"
##                    Name    Bid    Ask Change   52-week Range
## 0001.HK     CHEUNG KONG  90.80  90.90 -0.500  79.10 - 122.40
## 0002.HK    CLP HOLDINGS  64.55  64.60  0.200   62.10 - 75.20
## 0003.HK  HK & CHINA GAS  16.40  16.44  0.060   16.02 - 20.65
## 0004.HK  WHARF HOLDINGS  41.15  41.25 -0.400   33.15 - 59.00
## 0005.HK   HSBC HOLDINGS  67.75  67.80  0.350   56.00 - 78.85
## 0006.HK    POWER ASSETS  56.55  56.65  0.650   52.55 - 64.80
## 0011.HK  HANG SENG BANK 103.00 103.10  0.000  84.40 - 125.00
## 0012.HK  HENDERSON LAND  40.55  40.70  0.050   33.20 - 51.05
## 0013.HK       HUTCHISON  64.40  64.50 -0.950   53.60 - 93.10
## 0016.HK         SHK PPT  89.35  89.45  0.250  85.30 - 122.00
## 0017.HK   NEW WORLD DEV   8.78   8.80 -0.210    6.13 - 12.28
## 0019.HK SWIRE PACIFIC A  87.75  87.85  0.000  75.10 - 116.00
## 0023.HK  BANK OF E ASIA  26.00  26.05  0.000   21.85 - 32.55
## 0066.HK MTR CORPORATION  25.55  25.60  0.050   22.45 - 28.00
## 0083.HK       SINO LAND  11.06  11.12  0.020    9.28 - 14.16
## 0101.HK   HANG LUNG PPT  25.50  25.60  0.550   20.85 - 32.95
## 0144.HK  CHINA MER HOLD  21.85  21.95 -0.600   19.00 - 30.85
## 0151.HK WANT WANT CHINA   9.11   9.12 -0.240    6.03 - 10.24
## 0267.HK   CITIC PACIFIC  11.50  11.52 -0.120   10.26 - 20.10
## 0291.HK CHINA RESOURCES  22.20  22.25 -0.250   22.20 - 35.50
## 0293.HK  CATHAY PAC AIR  12.28  12.32 -0.180   11.76 - 18.88
## 0322.HK          TINGYI  19.00  19.02 -0.180   17.84 - 26.00
## 0330.HK ESPRIT HOLDINGS   9.86   9.88 -0.220    7.55 - 25.75
## 0386.HK    SINOPEC CORP   6.74   6.75 -0.160     6.22 - 9.67
## 0388.HK            HKEX 108.50 108.70 -0.100  99.15 - 170.00
## 0494.HK       LI & FUNG  14.42  14.44 -0.060   10.82 - 20.15
## 0688.HK  CHINA OVERSEAS  16.80  16.82  0.040    9.99 - 18.48
## 0700.HK         TENCENT 221.20 221.60 -1.400 139.80 - 248.80
## 0762.HK    CHINA UNICOM   9.51   9.53 -0.180    9.68 - 17.64
## 0836.HK CHINA RES POWER  14.94  14.98  0.280   10.82 - 16.20
## 0857.HK      PETROCHINA  10.06  10.08 -0.120    8.59 - 11.92
## 0883.HK           CNOOC  14.28  14.30 -0.100   11.20 - 18.64
## 0939.HK             CCB   5.13   5.14 -0.080     4.41 - 6.62
## 0941.HK    CHINA MOBILE  82.20  82.25  0.950   68.20 - 89.85
## 1044.HK    HENGAN INT'L  73.85  73.90 -0.100   56.80 - 83.45
## 1088.HK   CHINA SHENHUA  25.60  25.65 -0.450   24.15 - 40.20
## 1109.HK  CHINA RES LAND  14.84  14.86 -0.134    7.28 - 16.10
## 1199.HK   COSCO PACIFIC   9.37   9.39 -0.210    7.52 - 14.58
## 1299.HK             AIA  25.50  25.55 -0.350   19.84 - 29.90
## 1398.HK            ICBC   4.23   4.24 -0.080     3.46 - 6.06
## 1880.HK     BELLE INT'L  11.84  11.86 -0.260   11.38 - 17.54
## 1898.HK      CHINA COAL   6.27   6.28 -0.180    6.44 - 11.66
## 1928.HK SANDS CHINA LTD  24.10  24.15 -0.550   14.90 - 33.05
## 2318.HK         PING AN  58.75  58.80 -0.850   37.35 - 83.75
## 2388.HK   BOC HONG KONG  23.55  23.60  0.200   14.24 - 24.45
## 2600.HK          CHALCO   3.19   3.20 -0.080     3.07 - 6.83
## 2628.HK      CHINA LIFE  18.76  18.78 -0.220   17.04 - 28.10
## 3328.HK        BANKCOMM   4.95   4.96 -0.080     4.15 - 7.61
## 3988.HK   BANK OF CHINA   2.86   2.87 -0.030     2.20 - 3.88
```

9 Hang Seng Index

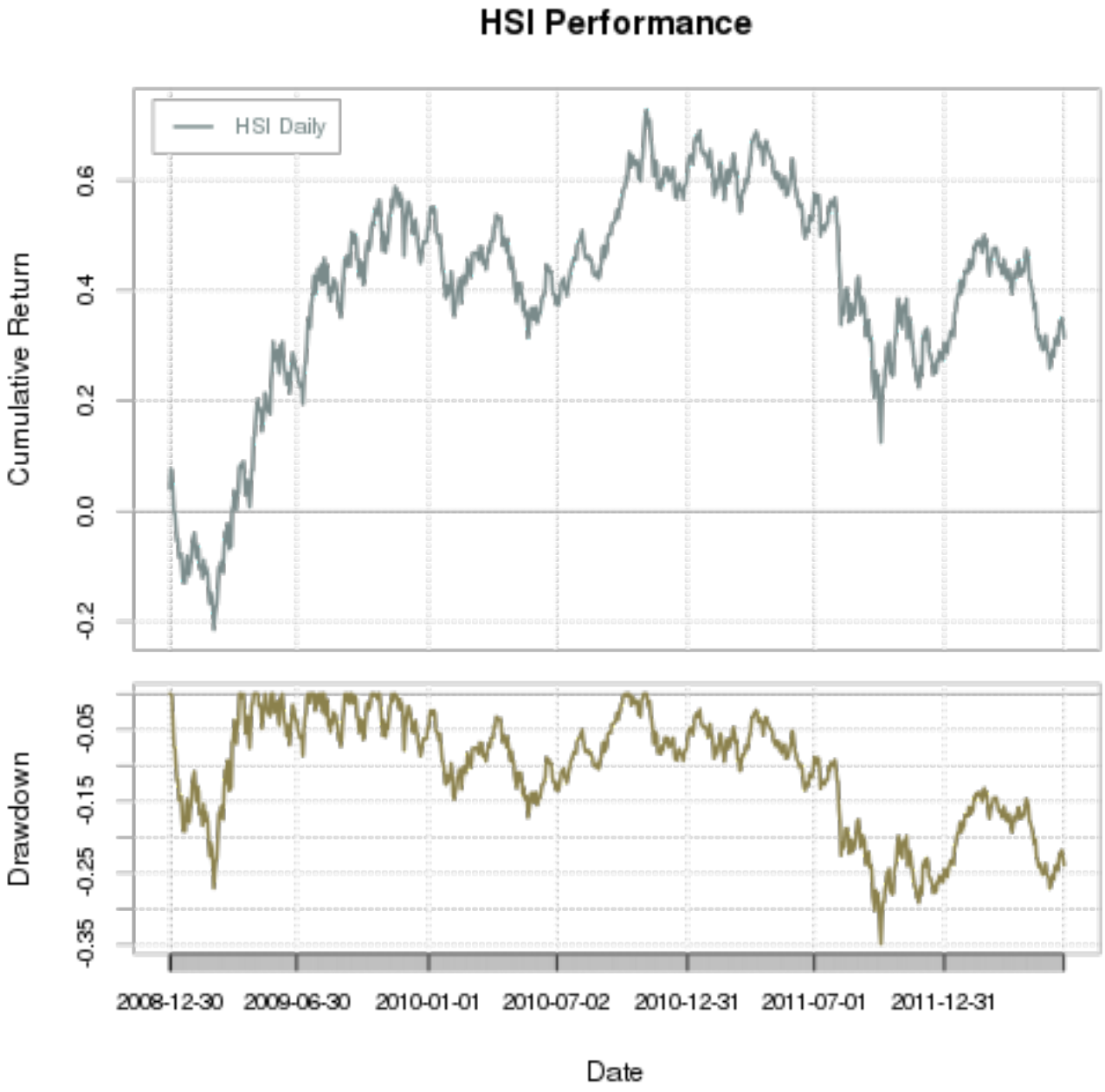
Latest Hang Seng Index

	Trade Time	Name	Last	Change	Days Range	52−week Range
^HSI	2012−06−25 04:01:00	HANG SENG INDEX	18897	−97.68	18861.561 − 19066.75	16170.30 − 22835.00

9.1 Hang Seng Index - Momentum

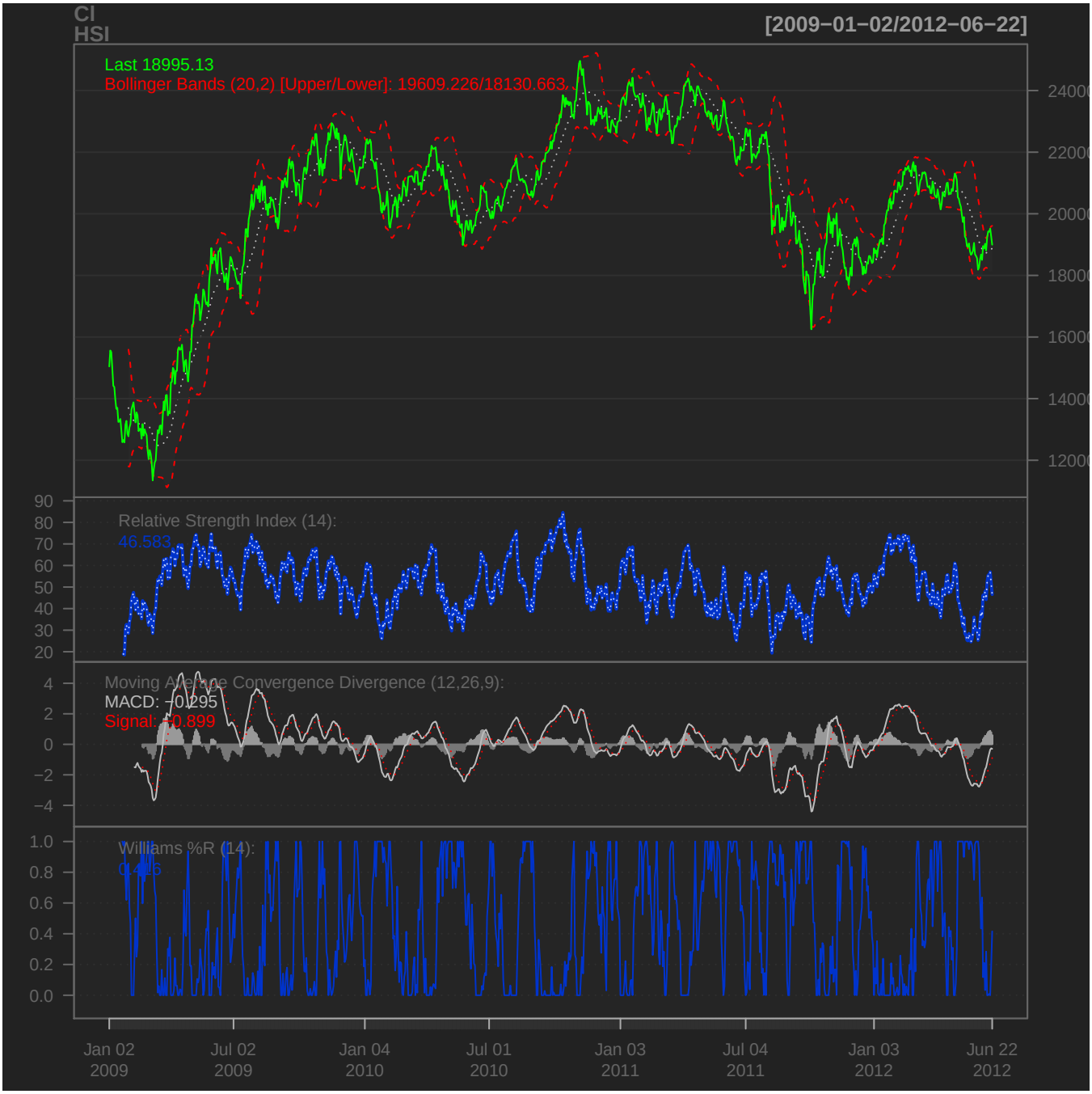


9.2 HSI Performance

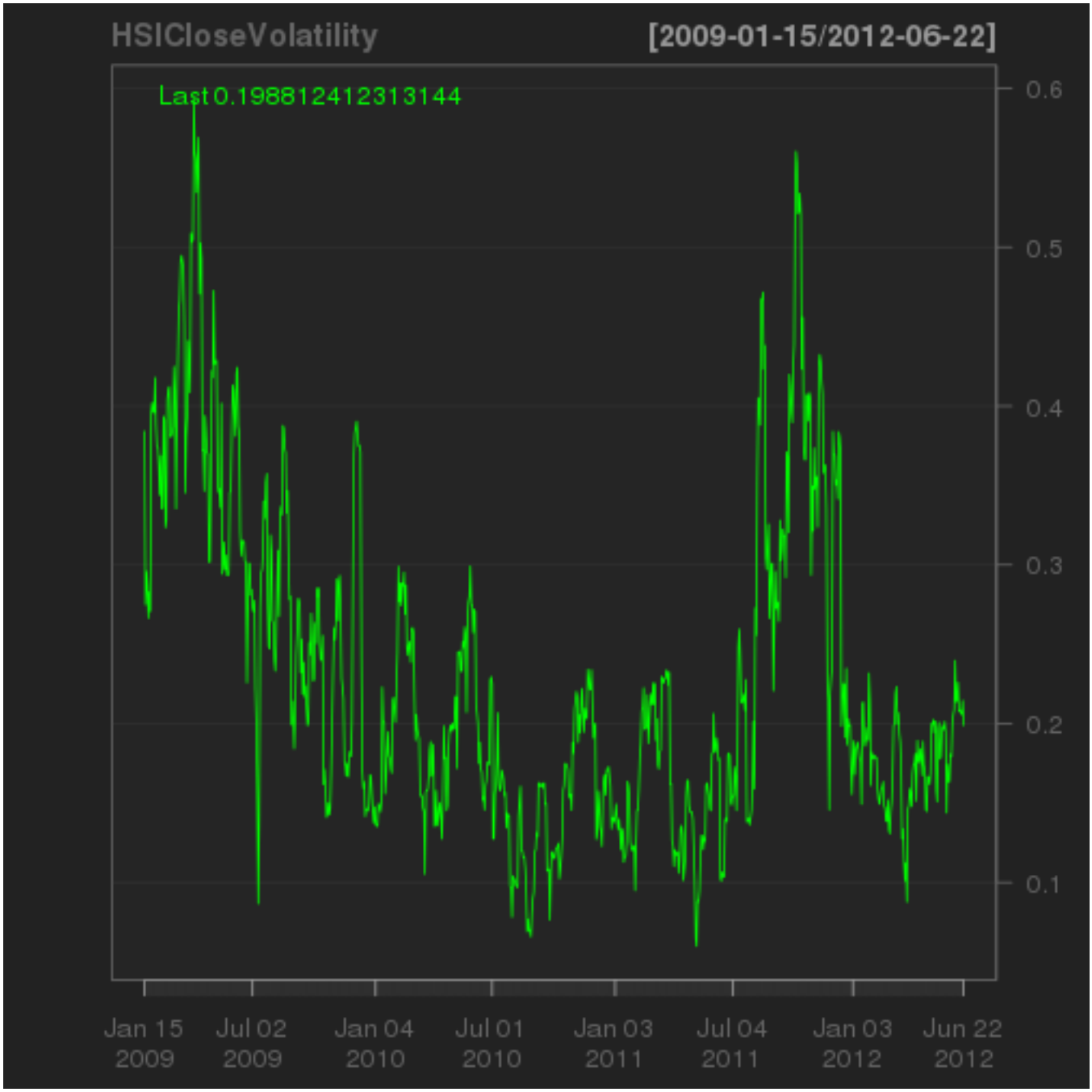


9.3 HSI Ratios

```
##                RSI
## 2012-06-10 46.29
## 2012-06-11 44.91
## 2012-06-12 48.08
## 2012-06-13 44.19
## 2012-06-14 52.30
## 2012-06-17 55.47
## 2012-06-18 55.24
## 2012-06-19 56.98
## 2012-06-20 51.61
## 2012-06-21 46.58
##                 macd  signal
## 2012-06-10 -2.1096 -2.4407
## 2012-06-11 -1.8906 -2.3307
## 2012-06-12 -1.6320 -2.1910
## 2012-06-13 -1.5032 -2.0534
## 2012-06-14 -1.2050 -1.8837
## 2012-06-17 -0.8762 -1.6822
## 2012-06-18 -0.6138 -1.4686
## 2012-06-19 -0.3589 -1.2466
## 2012-06-20 -0.2613 -1.0496
## 2012-06-21 -0.2945 -0.8986
## [1] "BBands"
##                 dn  mavg    up   pctB
## 2012-06-10 18075 18813 19552 0.5949
## 2012-06-11 18213 18762 19312 0.6003
## 2012-06-12 18235 18751 19266 0.7675
## 2012-06-13 18257 18731 19205 0.5816
## 2012-06-14 18231 18745 19259 0.9752
## 2012-06-17 18180 18770 19361 1.0565
## 2012-06-18 18144 18789 19435 0.9860
## 2012-06-19 18106 18826 19545 0.9816
## 2012-06-20 18116 18856 19596 0.7765
## 2012-06-21 18131 18870 19609 0.5847
##             WPR %
## 2012-06-10 11.71
## 2012-06-11 21.03
## 2012-06-12  3.33
## 2012-06-13 28.40
## 2012-06-14  0.00
## 2012-06-17  0.00
## 2012-06-18  0.90
## 2012-06-19  0.00
## 2012-06-20 19.03
## 2012-06-21 41.57
```


CI
HSI
[2009−01−02/2012−06−22]
Last 18995.13
Bollinger Bands (20,2) [Upper/Lower]: 19609.226/18130.663
Relative Strength Index (14):
46.583
Moving Average Convergence Divergence (12,26,9):
MACD: −0.295
Signal: −0.899
Williams %R (14):
Jan 02 2009
Jul 02 2009
Jan 04 2010
Jul 01 2010
Jan 03 2011
Jul 04 2011
Jan 03 2012
Jun 22 2012

9.4 HSI Volatility



9.5 HSI Statistics

```
##                                HSI-Daily HSI-Monthly
## StdDev Sharpe (Rf=0%, p=95%):   0.02769     0.11354
## VaR Sharpe (Rf=0%, p=95%):      0.01787     0.07618
## ES Sharpe (Rf=0%, p=95%):       0.01318     0.06032
##          HSI-Daily HSI-Monthly
## Skewness    0.1268     0.07215
##          HSI-Daily HSI-Monthly
## Kurtosis     1.501     -0.1336
```

```
##      Index              HSI Daily
##  Min.   :2008-12-31   Min.   :-0.05661
##  1st Qu.:2009-11-10   1st Qu.:-0.00816
##  Median :2010-09-25   Median : 0.00003
##  Mean   :2010-09-24   Mean   : 0.00044
##  3rd Qu.:2011-08-06   3rd Qu.: 0.00993
##  Max.   :2012-06-20   Max.   : 0.07415
##      Index             HSI Monthly
##  Min.   :2009-01-28   Min.   :-0.14329
##  1st Qu.:2009-12-05   1st Qu.:-0.03222
##  Median :2010-10-12   Median : 0.00817
##  Mean   :2010-10-12   Mean   : 0.00795
##  3rd Qu.:2011-08-20   3rd Qu.: 0.03680
##  Max.   :2012-06-20   Max.   : 0.17074
```

10 Dataset First and Last Rows Info

```
##            X0001.HK.Close
## 2009-01-02          76.90
## 2012-06-22          91.25
##            X0002.HK.Close
## 2009-01-02          52.40
## 2012-06-22          64.45
##            X0003.HK.Close
## 2009-01-02          12.08
## 2012-06-22          16.32
##            X0004.HK.Close
## 2009-01-02          22.00
## 2012-06-22          41.45
##            X0005.HK.Close
## 2009-01-02           77.0
## 2012-06-22           67.5
##            X0006.HK.Close
## 2009-01-02          42.75
## 2012-06-22          55.85
##            X0011.HK.Close
## 2009-01-02          104.7
## 2012-06-22          103.1
##            X0012.HK.Close
## 2009-01-02          30.35
## 2012-06-22          40.55
##            X0013.HK.Close
## 2009-01-02          39.85
## 2012-06-22          65.30
##            X0016.HK.Close
## 2009-01-02           67.3
## 2012-06-22           89.1
##            X0017.HK.Close
## 2009-01-02           8.18
## 2012-06-22           8.98
##            X0019.HK.Close
## 2009-01-02          55.75
## 2012-06-22          87.75
##            X0023.HK.Close
## 2009-01-02          16.68
## 2012-06-22          26.00
##            X0066.HK.Close
## 2009-01-02          18.08
## 2012-06-22          25.50
##            X0083.HK.Close
## 2009-01-02           8.36
## 2012-06-22          11.02
##            X0101.HK.Close
## 2009-01-02          18.36
## 2012-06-22          25.00
##            X0144.HK.Close
## 2009-01-02          15.40
## 2012-06-22          22.45
##            X0151.HK.Close
## 2009-01-02           3.17
## 2012-06-22           9.36
##            X0267.HK.Close
```

```
## 2009-01-02          10.20
## 2012-06-22          11.64
##            X0291.HK.Close
## 2009-01-02          14.00
## 2012-06-22          22.55
##            X0293.HK.Close
## 2009-01-02           8.91
## 2012-06-22          12.44
##            X0322.HK.Close
## 2009-01-02           8.98
## 2012-06-22          19.14
##            X0330.HK.Close
## 2009-01-02           44.8
## 2012-06-22           10.1
##            X0386.HK.Close
## 2009-01-02           4.96
## 2012-06-22           6.91
##            X0388.HK.Close
## 2009-01-02           76.6
## 2012-06-22          108.8
##            X0494.HK.Close
## 2011-06-02          17.92
## 2012-06-22          14.50
##            X0688.HK.Close
## 2009-01-02          11.22
## 2012-06-22          16.76
##            X0700.HK.Close
## 2009-01-01           50.0
## 2012-06-22          222.8
##            X0762.HK.Close
## 2009-01-01           9.63
## 2012-06-22           9.71
##            X0836.HK.Close
## 2009-01-02          15.12
## 2012-06-22          14.70
##            X0857.HK.Close
## 2009-01-02           7.20
## 2012-06-22          10.18
##            X0883.HK.Close
## 2009-01-02           7.59
## 2012-06-22          14.36
##            X0939.HK.Close
## 2009-01-02           4.52
## 2012-06-22           5.21
##            X0941.HK.Close
## 2009-01-02          81.20
## 2012-06-22          81.15
##            X1044.HK.Close
## 2009-01-01           24.9
## 2012-06-22           74.0
##            X1088.HK.Close
## 2009-01-02           17.4
## 2012-06-22           26.1
##            X1109.HK.Close
## 2009-01-02           9.90
## 2012-06-22          15.14
##            X1199.HK.Close
```

```
## 2009-01-02           8.07
## 2012-06-22           9.59
##            X1299.HK.Close
## 2010-10-29           23.1
## 2012-06-22           25.8
##            X1398.HK.Close
## 2009-01-02           4.30
## 2012-06-22           4.31
##            X1880.HK.Close
## 2009-01-02            3.5
## 2012-06-22           12.1
##            X1898.HK.Close
## 2009-01-02           6.55
## 2012-06-22           6.45
##            X1928.HK.Close
## 2009-11-30           9.31
## 2012-06-22          24.70
##            X2318.HK.Close
## 2009-01-02          39.60
## 2012-06-22          59.55
##            X2388.HK.Close
## 2009-01-02           9.06
## 2012-06-22          23.35
##            X2600.HK.Close
## 2009-01-02           4.55
## 2012-06-22           3.26
##            X2628.HK.Close
## 2009-01-02          24.75
## 2012-06-22          18.96
##            X3328.HK.Close
## 2009-01-02           5.91
## 2012-06-22           5.05
##            X3988.HK.Close
## 2009-01-02           2.17
## 2012-06-22           2.89
```

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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