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                                0.0000
## Beta                                 0.0799
## Beta+                               -0.3424
## Beta-                                0.3180
## R-squared                            0.0023
## Annualized Alpha                    -0.0022
## Correlation                          0.0481
## Correlation p-value                  0.4052
## Tracking Error                       0.4253
## Active Premium                       0.0017
## Information Ratio                    0.0040
## Treynor Ratio                       -0.9066
```

[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                           1.085           0.270           0.327
## Beta+                          1.077           0.137           0.044
## Beta-                          0.980           0.313           0.500
## R-squared                      0.681           0.177           0.154
## Annualized Alpha              -0.033           0.014           0.013
## Correlation                    0.825           0.421           0.392
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.173           0.216           0.236
## Active Premium                -0.053           0.107           0.093
## Information Ratio             -0.304           0.496           0.392
## Treynor Ratio                 -0.174          -0.107          -0.133
##                      X0004.HK to HSI X0005.HK to HSI X0006.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           1.208           0.988           0.184
## Beta+                          1.259           0.964           0.030
## Beta-                          1.139           1.099           0.243
## R-squared                      0.572           0.726           0.055
## Annualized Alpha               0.035           0.010           0.098
## Correlation                    0.756           0.852           0.235
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.247           0.141           0.258
## Active Premium                -0.027           0.002           0.193
## Information Ratio             -0.108           0.014           0.747
## Treynor Ratio                 -0.135          -0.136           0.309
##                      X0011.HK to HSI X0012.HK to HSI X0013.HK to HSI
## Alpha                          0.000           0.000           0.000
## Beta                           0.649           1.000           1.071
## Beta+                          0.641           0.944           1.056
## Beta-                          0.704           0.980           1.102
## R-squared                      0.499           0.560           0.609
## Annualized Alpha               0.012          -0.063           0.032
## Correlation                    0.706           0.748           0.780
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.171           0.205           0.199
## Active Premium                 0.052          -0.071           0.000
## Information Ratio              0.302          -0.346          -0.001
## Treynor Ratio                 -0.130          -0.207          -0.127
##                      X0016.HK to HSI X0017.HK to HSI X0019.HK to HSI
## Alpha                          0.000          -0.001           0.000
## Beta                           0.929           1.106           0.761
## Beta+                          0.999           0.806           0.772
## Beta-                          0.771           1.195           0.665
## R-squared                      0.564           0.454           0.346
## Annualized Alpha              -0.105          -0.145          -0.048
## Correlation                    0.751           0.674           0.588
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.190           0.282           0.248
## Active Premium                -0.095          -0.168          -0.033
## Information Ratio             -0.502          -0.596          -0.134
## Treynor Ratio                 -0.249          -0.275          -0.223
##                      X0023.HK to HSI X0066.HK to HSI X0083.HK to HSI
## Alpha                          0.000           0.000           0.000
```

```
## Beta                          0.884           0.539           1.173
## Beta+                         0.995           0.530           1.317
## Beta-                         0.861           0.565           1.198
## R-squared                     0.515           0.429           0.529
## Annualized Alpha             -0.056          -0.046          -0.054
## Correlation                   0.718           0.655           0.727
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.200           0.179           0.259
## Active Premium               -0.048           0.014          -0.097
## Information Ratio            -0.240           0.081          -0.375
## Treynor Ratio                -0.209          -0.226          -0.199
##                     X0101.HK to HSI X0144.HK to HSI X0151.HK to HSI
## Alpha                         0.000           0.000           0.001
## Beta                          1.061           1.265           0.632
## Beta+                         1.017           1.293           0.480
## Beta-                         1.111           1.219           0.793
## R-squared                     0.520           0.496           0.160
## Annualized Alpha             -0.090           0.133           0.381
## Correlation                   0.721           0.704           0.400
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.236           0.302           0.345
## Active Premium               -0.107           0.030           0.334
## Information Ratio            -0.453           0.098           0.968
## Treynor Ratio                -0.229          -0.084           0.314
##                     X0267.HK to HSI X0291.HK to HSI X0293.HK to HSI
## Alpha                        -0.001           0.000          -0.001
## Beta                          1.165           0.815           0.774
## Beta+                         1.331           0.682           0.818
## Beta-                         1.100           0.930           0.600
## R-squared                     0.523           0.342           0.326
## Annualized Alpha             -0.190          -0.061          -0.192
## Correlation                   0.723           0.585           0.571
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.260           0.265           0.263
## Active Premium               -0.206          -0.055          -0.163
## Information Ratio            -0.792          -0.208          -0.621
## Treynor Ratio                -0.294          -0.235          -0.387
##                     X0322.HK to HSI X0330.HK to HSI X0386.HK to HSI
## Alpha                         0.000          -0.002           0.000
## Beta                          0.432           1.061           0.887
## Beta+                         0.607           1.143           0.752
## Beta-                         0.549           1.252           0.700
## R-squared                     0.092           0.143           0.486
## Annualized Alpha              0.067          -0.442           0.081
## Correlation                   0.303           0.378           0.697
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.341           0.600           0.213
## Active Premium                0.096          -0.468           0.067
## Information Ratio             0.281          -0.778           0.316
## Treynor Ratio                -0.093          -0.569          -0.078
##                     X0388.HK to HSI X0494.HK to HSI X0688.HK to HSI
## Alpha                         0.000          -0.001           0.001
## Beta                          1.110           1.265           1.450
## Beta+                         1.250           1.211           2.003
## Beta-                         1.023           1.204           1.246
## R-squared                     0.677           0.230           0.511
## Annualized Alpha             -0.108          -0.243           0.347
```

```
## Correlation                   0.823           0.479           0.715
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.179           0.539           0.344
## Active Premium               -0.120          -0.350           0.152
## Information Ratio            -0.668          -0.650           0.441
## Treynor Ratio                -0.231          -0.385           0.011
##                      X0700.HK to HSI X0762.HK to HSI X0836.HK to HSI
## Alpha                          0.001           0.000           0.000
## Beta                           1.114           0.980           0.488
## Beta+                          1.278           0.968           0.314
## Beta-                          1.025           1.056           0.580
## R-squared                      0.439           0.386           0.120
## Annualized Alpha               0.419           0.088           0.098
## Correlation                    0.662           0.621           0.347
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.293           0.286           0.328
## Active Premium                 0.288           0.042           0.119
## Information Ratio              0.983           0.147           0.364
## Treynor Ratio                  0.136          -0.096          -0.035
##                      X0857.HK to HSI X0883.HK to HSI X0939.HK to HSI
## Alpha                          0.001           0.000           0.000
## Beta                           0.999           1.376           1.097
## Beta+                          0.906           1.584           1.105
## Beta-                          0.991           1.388           1.020
## R-squared                      0.615           0.695           0.739
## Annualized Alpha               0.184           0.141          -0.066
## Correlation                    0.784           0.833           0.860
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.183           0.228           0.153
## Active Premium                 0.143           0.036          -0.080
## Information Ratio              0.779           0.158          -0.521
## Treynor Ratio                  0.006          -0.073          -0.197
##                      X0941.HK to HSI X1044.HK to HSI X1088.HK to HSI
## Alpha                          0.000           0.001           0.000
## Beta                           0.551           0.636           1.171
## Beta+                          0.404           0.741           1.154
## Beta-                          0.558           0.735           1.212
## R-squared                      0.388           0.222           0.618
## Annualized Alpha               0.066           0.163          -0.044
## Correlation                    0.623           0.471           0.786
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.191           0.288           0.217
## Active Premium                 0.113           0.162          -0.081
## Information Ratio              0.593           0.563          -0.373
## Treynor Ratio                 -0.042           0.041          -0.185
##                      X1109.HK to HSI X1199.HK to HSI X1299.HK to HSI
## Alpha                          0.001           0.001           0.001
## Beta                           1.478           1.413           0.806
## Beta+                          2.005           1.482           0.805
## Beta-                          1.192           1.582           1.055
## R-squared                      0.483           0.557           0.383
## Annualized Alpha               0.354           0.164           0.207
## Correlation                    0.695           0.746           0.619
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.371           0.307           0.241
## Active Premium                 0.143           0.029           0.184
## Information Ratio              0.386           0.096           0.762
```

```
## Treynor Ratio                0.005          -0.076           0.059
##                     X1398.HK to HSI X1880.HK to HSI X1898.HK to HSI
## Alpha                         0.000           0.000          -0.001
## Beta                          1.301           1.034           1.360
## Beta+                         1.474           1.228           1.504
## Beta-                         1.204           0.906           1.290
## R-squared                     0.750           0.360           0.587
## Annualized Alpha             -0.035           0.025          -0.215
## Correlation                   0.866           0.600           0.766
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.187           0.319           0.277
## Active Premium               -0.086          -0.028          -0.251
## Information Ratio            -0.458          -0.086          -0.907
## Treynor Ratio                -0.171          -0.158          -0.285
##                     X1928.HK to HSI X2318.HK to HSI X2388.HK to HSI
## Alpha                         0.003           0.000           0.000
## Beta                          1.492           1.574           0.983
## Beta+                         1.971           1.913           0.965
## Beta-                         1.663           1.371           0.980
## R-squared                     0.377           0.658           0.559
## Annualized Alpha              0.926           0.047           0.108
## Correlation                   0.614           0.811           0.748
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.458           0.294           0.202
## Active Premium                0.516          -0.080           0.077
## Information Ratio             1.126          -0.270           0.380
## Treynor Ratio                 0.254          -0.137          -0.060
##                     X2600.HK to HSI X2628.HK to HSI X3328.HK to HSI
## Alpha                        -0.001          -0.001          -0.001
## Beta                          1.427           1.293           1.255
## Beta+                         1.617           1.429           1.284
## Beta-                         1.301           1.209           1.254
## R-squared                     0.557           0.629           0.709
## Annualized Alpha             -0.230          -0.169          -0.167
## Correlation                   0.746           0.793           0.842
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.311           0.240           0.195
## Active Premium               -0.275          -0.201          -0.189
## Information Ratio            -0.885          -0.841          -0.966
## Treynor Ratio                -0.288          -0.261          -0.259
##                     X3988.HK to HSI
## Alpha                        -0.001
## Beta                          1.118
## Beta+                         1.076
## Beta-                         1.105
## R-squared                     0.700
## Annualized Alpha             -0.143
## Correlation                   0.837
## Correlation p-value           0.000
## Tracking Error                0.172
## Active Premium               -0.149
## Information Ratio            -0.870
## Treynor Ratio                -0.255
```

3 HSI Components Risk

3.1 Correlation

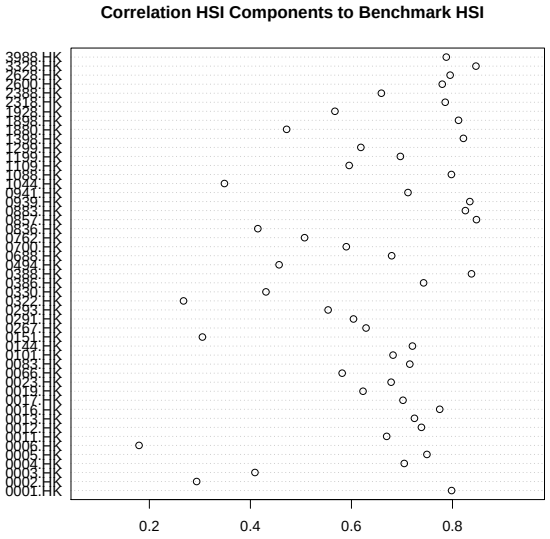
Correlation Combined

```
##                       Correlation p-value Lower CI Upper CI
## HSI Components to HSI      0.0481  0.4052  -0.1005   0.1946
```

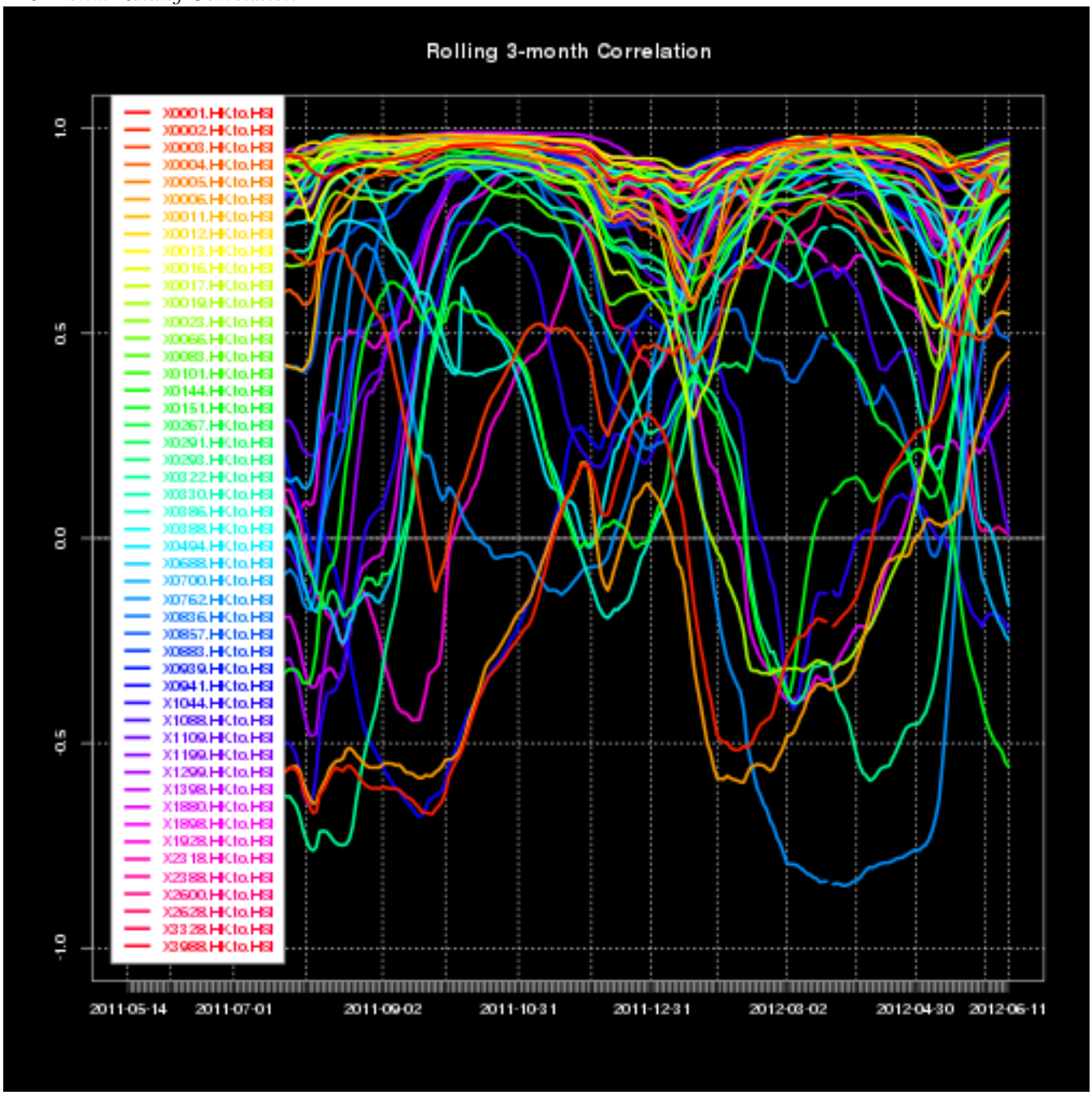
Correlation - Distinct

```
##         Correlation p-value Lower CI Upper CI
## 0001.HK      0.7982       0   0.7638   0.8281
## 0002.HK      0.2936       0   0.2109   0.3721
## 0003.HK      0.4090       0   0.3329   0.4798
## 0004.HK      0.7045       0   0.6572   0.7463
## 0005.HK      0.7494       0   0.7081   0.7857
## 0006.HK      0.1796       0   0.0930   0.2635
## 0011.HK      0.6697       0   0.6181   0.7156
## 0012.HK      0.7385       0   0.6957   0.7761
## 0013.HK      0.7247       0   0.6800   0.7640
## 0016.HK      0.7747       0   0.7369   0.8077
## 0017.HK      0.7020       0   0.6544   0.7441
## 0019.HK      0.6229       0   0.5659   0.6740
## 0023.HK      0.6785       0   0.6279   0.7234
## 0066.HK      0.5816       0   0.5201   0.6370
## 0083.HK      0.7155       0   0.6696   0.7559
## 0101.HK      0.6823       0   0.6322   0.7267
## 0144.HK      0.7207       0   0.6755   0.7605
## 0151.HK      0.3050       0   0.2229   0.3829
## 0267.HK      0.6289       0   0.5725   0.6794
## 0291.HK      0.6040       0   0.5449   0.6571
## 0293.HK      0.5538       0   0.4896   0.6120
## 0322.HK      0.2676       0   0.1839   0.3475
## 0330.HK      0.4308       0   0.3562   0.5000
## 0386.HK      0.7428       0   0.7006   0.7799
## 0388.HK      0.8376       0   0.8092   0.8621
## 0494.HK      0.4568       0   0.3837   0.5241
## 0688.HK      0.6796       0   0.6292   0.7243
## 0700.HK      0.5898       0   0.5292   0.6443
## 0762.HK      0.5072       0   0.4387   0.5697
## 0836.HK      0.4147       0   0.3390   0.4851
## 0857.HK      0.8474       0   0.8206   0.8705
## 0883.HK      0.8255       0   0.7952   0.8517
## 0939.HK      0.8343       0   0.8054   0.8592
## 0941.HK      0.7119       0   0.6656   0.7528
## 1044.HK      0.3486       0   0.2690   0.4236
## 1088.HK      0.7978       0   0.7634   0.8277
## 1109.HK      0.5955       0   0.5354   0.6495
## 1199.HK      0.6968       0   0.6485   0.7395
## 1299.HK      0.6186       0   0.5325   0.6921
## 1398.HK      0.8216       0   0.7907   0.8483
## 1880.HK      0.4717       0   0.4003   0.5374
## 1898.HK      0.8119       0   0.7795   0.8399
## 1928.HK      0.5673       0   0.4934   0.6331
## 2318.HK      0.7856       0   0.7494   0.8172
## 2388.HK      0.6592       0   0.6064   0.7063
## 2600.HK      0.7797       0   0.7426   0.8120
```

```
## 2628.HK      0.7953       0   0.7605   0.8256
## 3328.HK      0.8464       0   0.8194   0.8697
## 3988.HK      0.7877       0   0.7518   0.8190
```



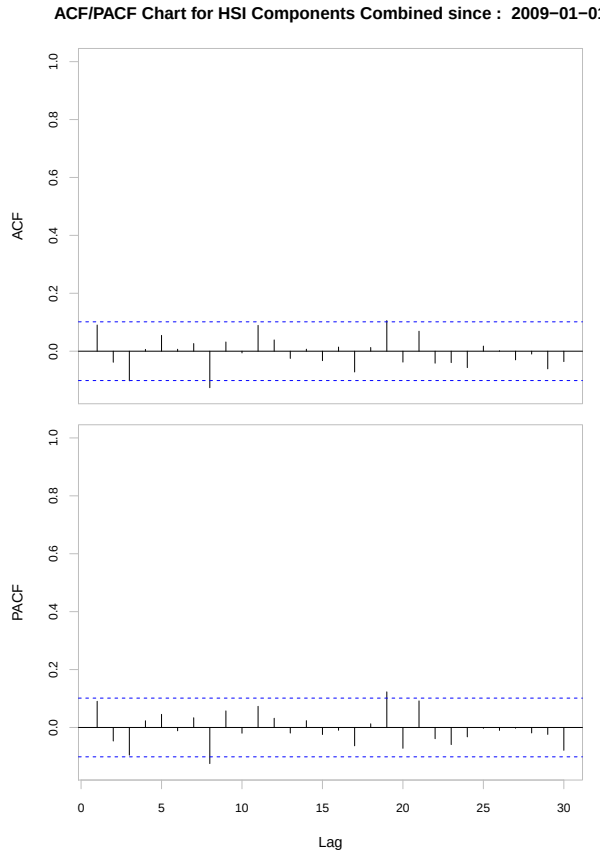
3 Month Rolling Correlation



3.2 Autocorrelation Coefficients - Combined

Autocorrelation Combined

```
##                  rho1    rho2    rho3   rho4   rho5   rho6 Q(6) p-value
## daily.returns 0.0904 -0.0382 -0.1023 0.0063 0.0546 0.0068       0.1672
```



3.3 Downside Risk - Combined

Downside Risk Combined

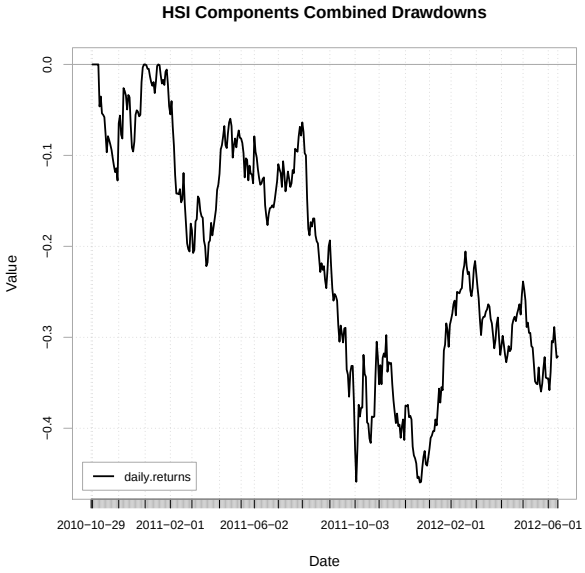
```
##                                HSI Components dailyReturn
## Semi Deviation                                      0.0220
## Gain Deviation                                      0.0170
## Loss Deviation                                      0.0143
## Downside Deviation (MAR=210%)                       0.0254
## Downside Deviation (Rf=0%)                          0.0221
## Downside Deviation (0%)                             0.0221
## Maximum Drawdown                                    0.4597
## Historical VaR (95%)                               -0.0349
## Historical ES (95%)                                -0.0481
## Modified VaR (95%)                                 -0.0357
## Modified ES (95%)                                  -0.0456
```

3.4 Drawdowns - Combined

Drawdowns Combined

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

```
##         From     Trough         To   Depth Length To Trough Recovery
## 1 2011-01-19 2011-12-19       <NA> -0.4597    334       218       NA
## 2 2010-11-09 2010-11-30 2010-12-31 -0.1276     38        16       22
## 3 2011-01-04 2011-01-13 2011-01-18 -0.0315     11         8        3
```



3.5 Downside Deviation - Combined

Downside Deviation Combined

```
##                                 HSI Components
## Downside Deviation (MAR = 0%)          0.02215
```

3.6 Downside Deviation - Distinct

```
##                                0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## Downside Deviation (MAR = 0%)  0.0191  0.0088  0.0161  0.0238  0.0246
##                                0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## Downside Deviation (MAR = 0%)   0.011  0.0146   0.021   0.019  0.0202
##                                0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## Downside Deviation (MAR = 0%)  0.0245  0.0205  0.0202  0.0129  0.0251
##                                0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## Downside Deviation (MAR = 0%)  0.0247  0.0267  0.0216  0.0247  0.0231
##                                0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## Downside Deviation (MAR = 0%)  0.0212  0.0201   0.037  0.0202  0.0193
##                                0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Downside Deviation (MAR = 0%)  0.0374  0.0258  0.0242   0.023  0.0202
##                                0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## Downside Deviation (MAR = 0%)  0.0204  0.0235  0.0207  0.0157  0.0204
##                                1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## Downside Deviation (MAR = 0%)  0.0239  0.0286  0.0288  0.0193  0.0212
##                                1880.HK 1898.HK 1928.HK 2318.HK 2388.HK
## Downside Deviation (MAR = 0%)  0.0268  0.0289  0.0298  0.0263  0.0196
##                                2600.HK 2628.HK 3328.HK 3988.HK
## Downside Deviation (MAR = 0%)  0.0292  0.0221  0.0221  0.0214
```

4 General Statistics

Statistics Distinct

	Observations	NAs	Minimum	Quartile 1	Median	Arithmetic Mean
X0001.HK.Close	853	13	56.00	91.550	98.40	100.078
X0002.HK.Close	853	13	51.10	52.700	60.90	59.826
X0003.HK.Close	854	12	10.78	17.280	18.26	17.750
X0004.HK.Close	853	13	15.20	37.750	42.10	41.983
X0005.HK.Close	853	13	33.00	65.900	76.90	74.233
X0006.HK.Close	854	12	41.10	43.750	48.00	49.742
X0011.HK.Close	854	12	67.00	102.300	109.40	108.904
X0012.HK.Close	853	13	23.75	42.400	47.85	46.625
X0013.HK.Close	853	13	36.40	53.450	61.75	64.879
X0016.HK.Close	853	13	55.80	98.000	110.70	107.447
X0017.HK.Close	854	12	6.20	9.320	13.22	12.398
X0019.HK.Close	853	13	42.90	84.750	91.35	92.048
X0023.HK.Close	853	13	12.34	26.700	29.00	28.238
X0066.HK.Close	853	13	16.14	25.250	26.90	26.091
X0083.HK.Close	854	12	5.60	11.850	13.48	13.028
X0101.HK.Close	854	12	13.66	25.600	28.75	28.504
X0144.HK.Close	854	12	12.20	23.150	26.18	25.870
X0151.HK.Close	853	13	2.77	4.970	6.32	6.097
X0267.HK.Close	853	13	7.18	13.700	16.64	16.685
X0291.HK.Close	854	12	10.66	24.650	27.90	26.188
X0293.HK.Close	854	12	6.98	12.540	14.56	15.035
X0322.HK.Close	854	12	8.27	17.320	19.40	18.462
X0330.HK.Close	853	13	7.93	21.850	41.15	36.975
X0386.HK.Close	853	13	3.65	6.230	6.90	6.938
X0388.HK.Close	854	12	54.60	122.500	134.70	135.617
X0494.HK.Close	844	22	11.60	16.455	27.50	27.939
X0688.HK.Close	854	12	9.41	14.405	15.54	15.265
X0700.HK.Close	862	4	41.80	130.725	158.80	154.152
X0762.HK.Close	860	6	8.31	9.887	11.11	11.982
X0836.HK.Close	853	13	11.10	14.140	15.20	15.336
X0857.HK.Close	853	13	5.10	8.760	9.51	9.457
X0883.HK.Close	853	13	6.08	11.800	13.56	13.775
X0939.HK.Close	854	12	3.66	5.593	6.21	6.096
X0941.HK.Close	853	13	63.00	73.650	76.40	76.327
X1044.HK.Close	865	1	24.25	50.300	61.25	57.946
X1088.HK.Close	854	12	13.90	29.950	33.25	31.694
X1109.HK.Close	853	13	7.50	13.060	14.50	14.379
X1199.HK.Close	854	12	5.40	9.470	11.03	11.097
X1299.HK.Close	401	465	19.86	23.050	24.80	24.943
X1398.HK.Close	853	13	3.03	4.940	5.66	5.424
X1880.HK.Close	854	12	2.98	8.457	12.61	11.278
X1898.HK.Close	853	13	4.43	9.060	10.36	10.271
X1928.HK.Close	628	238	9.23	12.135	18.49	18.450
X2318.HK.Close	853	13	30.35	58.200	64.35	65.029
X2388.HK.Close	854	12	6.30	16.880	18.84	19.038
X2600.HK.Close	854	12	3.08	4.332	6.78	6.393
X2628.HK.Close	853	13	17.08	22.800	29.55	28.807
X3328.HK.Close	854	12	4.17	5.893	7.86	7.420
X3988.HK.Close	853	13	1.84	3.040	3.84	3.614

	Geometric Mean	Quartile 3	Maximum	SE Mean	LCL Mean (0.95)
X0001.HK.Close	98.811	112.00	135.70	0.5357	99.026
X0002.HK.Close	59.471	64.85	75.00	0.2260	59.382
X0003.HK.Close	17.617	19.08	21.00	0.0709	17.611

```
## X0004.HK.Close         40.398      49.85   62.00  0.3634          41.269
## X0005.HK.Close         73.263      82.65   98.00  0.3934          73.461
## X0006.HK.Close         49.363      55.89   64.80  0.2148          49.320
## X0011.HK.Close        108.195     116.67  134.00  0.4173         108.085
## X0012.HK.Close         45.867      52.60   60.50  0.2723          46.091
## X0013.HK.Close         63.022      77.65   95.90  0.5340          63.831
## X0016.HK.Close        105.793     118.40  146.30  0.6091         106.252
## X0017.HK.Close         11.947      15.18   18.54  0.1135          12.175
## X0019.HK.Close         89.825     106.60  136.40  0.6551          90.763
## X0023.HK.Close         27.743      31.95   35.90  0.1666          27.910
## X0066.HK.Close         25.884      28.05   31.15  0.1071          25.881
## X0083.HK.Close         12.783      14.70   18.56  0.0823          12.866
## X0101.HK.Close         27.958      31.90   40.30  0.1836          28.143
## X0144.HK.Close         25.373      28.70   37.55  0.1666          25.543
## X0151.HK.Close          5.910       7.17    9.70  0.0538           5.991
## X0267.HK.Close         16.192      20.40   24.40  0.1369          16.416
## X0291.HK.Close         25.253      30.55   35.25  0.2153          25.765
## X0293.HK.Close         14.549      18.10   24.05  0.1337          14.773
## X0322.HK.Close         17.844      21.45   25.95  0.1509          18.166
## X0330.HK.Close         32.664      49.05   64.30  0.5363          35.923
## X0386.HK.Close          6.852       7.72    9.64  0.0387           6.862
## X0388.HK.Close        132.017     151.15  197.50  0.9940         133.665
## X0494.HK.Close         25.539      38.16   51.90  0.3995          27.155
## X0688.HK.Close         15.146      16.60   19.44  0.0646          15.138
## X0700.HK.Close        143.464     189.68  247.00  1.6851         150.844
## X0762.HK.Close         11.764      13.96   17.40  0.0834          11.818
## X0836.HK.Close         15.255      16.50   20.15  0.0559          15.226
## X0857.HK.Close          9.349      10.46   12.36  0.0490           9.361
## X0883.HK.Close         13.353      16.76   20.95  0.1158          13.547
## X0939.HK.Close          6.034       6.76    8.28  0.0309           6.036
## X0941.HK.Close         76.198      78.95   91.45  0.1532          76.026
## X1044.HK.Close         55.661      69.50   82.70  0.5051          56.955
## X1088.HK.Close         31.082      35.24   40.80  0.1930          31.315
## X1109.HK.Close         14.160      16.04   20.00  0.0852          14.211
## X1199.HK.Close         10.878      12.54   16.76  0.0776          10.945
## X1299.HK.Close         24.855      26.80   29.65  0.1070          24.733
## X1398.HK.Close          5.364       5.94    7.03  0.0286           5.368
## X1880.HK.Close         10.551      14.28   17.54  0.1286          11.025
## X1898.HK.Close         10.040      11.62   15.86  0.0744          10.125
## X1928.HK.Close         17.471      22.30   32.70  0.2471          17.965
## X2318.HK.Close         63.675      74.30   94.30  0.4422          64.161
## X2388.HK.Close         18.288      22.89   28.95  0.1706          18.703
## X2600.HK.Close          6.134       7.77   10.66  0.0641           6.267
## X2628.HK.Close         28.101      34.25   41.00  0.2157          28.384
## X3328.HK.Close          7.265       8.62   10.56  0.0539           7.314
## X3988.HK.Close          3.556       4.13    5.00  0.0238           3.567
##                 UCL Mean (0.95)  Variance   Stdev Skewness Kurtosis
## X0001.HK.Close         101.129  244.8264 15.6469  -0.1124   0.0243
## X0002.HK.Close          60.269   43.5512  6.5993   0.1757  -1.3774
## X0003.HK.Close          17.889    4.2947  2.0724  -1.6369   2.2858
## X0004.HK.Close          42.696  112.6221 10.6124  -0.5406   0.0606
## X0005.HK.Close          75.005  132.0166 11.4898  -0.6317   0.1106
## X0006.HK.Close          50.163   39.4020  6.2771   0.3925  -1.2046
## X0011.HK.Close         109.723  148.7275 12.1954  -0.4133   0.0793
## X0012.HK.Close          47.160   63.2297  7.9517  -0.7993   0.2743
## X0013.HK.Close          65.927  243.2588 15.5968   0.2200  -1.0346
## X0016.HK.Close         108.643  316.4590 17.7893  -0.7417   0.4730
```

```
## X0017.HK.Close          12.621   11.0026  3.3170  -0.3024  -1.1641
## X0019.HK.Close          93.334  366.1213 19.1343  -0.3932   0.2073
## X0023.HK.Close          28.565   23.6841  4.8666  -1.2783   1.3906
## X0066.HK.Close          26.302    9.7888  3.1287  -1.4623   1.6395
## X0083.HK.Close          13.189    5.7882  2.4059  -1.0020   0.8738
## X0101.HK.Close          28.864   28.8021  5.3668  -0.4926   0.1897
## X0144.HK.Close          26.197   23.7066  4.8689  -0.4936   0.5109
## X0151.HK.Close           6.203    2.4693  1.5714  -0.1494  -0.4789
## X0267.HK.Close          16.953   15.9943  3.9993  -0.2304  -0.8475
## X0291.HK.Close          26.610   39.5692  6.2904  -1.0938   0.1834
## X0293.HK.Close          15.298   15.2584  3.9062   0.2125  -0.5884
## X0322.HK.Close          18.758   19.4547  4.4107  -0.9073   0.0415
## X0330.HK.Close          38.028  245.3442 15.6635  -0.4396  -1.0697
## X0386.HK.Close           7.014    1.2752  1.1292  -0.3955   0.3264
## X0388.HK.Close         137.567  843.8095 29.0484  -0.4934   0.4047
## X0494.HK.Close          28.724  134.7165 11.6067   0.1840  -1.4522
## X0688.HK.Close          15.392    3.5594  1.8866  -0.8230   0.3629
## X0700.HK.Close         157.459 2447.5712 49.4729  -0.6631  -0.2578
## X0762.HK.Close          12.145    5.9772  2.4448   0.6225  -0.9580
## X0836.HK.Close          15.445    2.6608  1.6312   0.2843  -0.2374
## X0857.HK.Close           9.554    2.0486  1.4313  -0.7431   0.6421
## X0883.HK.Close          14.002   11.4289  3.3807  -0.2050  -0.6794
## X0939.HK.Close           6.157    0.8172  0.9040  -0.6939   0.1539
## X0941.HK.Close          76.628   20.0086  4.4731   0.1689   0.3558
## X1044.HK.Close          58.938  220.6939 14.8558  -0.7312  -0.4690
## X1088.HK.Close          32.072   31.8005  5.6392  -1.4128   1.6302
## X1109.HK.Close          14.546    6.1893  2.4878  -0.4194   0.0402
## X1199.HK.Close          11.249    5.1470  2.2687   0.0935  -0.3611
## X1299.HK.Close          25.154    4.5951  2.1436   0.0468  -1.1576
## X1398.HK.Close           5.480    0.6979  0.8354  -0.8479   0.3091
## X1880.HK.Close          11.530   14.1218  3.7579  -0.5875  -0.7553
## X1898.HK.Close          10.418    4.7229  2.1732  -0.3570   0.0863
## X1928.HK.Close          18.936   38.3575  6.1933   0.3650  -0.8705
## X2318.HK.Close          65.897  166.7997 12.9151  -0.1364  -0.1528
## X2388.HK.Close          19.373   24.8496  4.9849  -0.5643  -0.0714
## X2600.HK.Close           6.519    3.5049  1.8721  -0.2459  -1.1181
## X2628.HK.Close          29.230   39.6872  6.2998  -0.2011  -1.2187
## X3328.HK.Close           7.526    2.4772  1.5739  -0.2525  -1.1732
## X3988.HK.Close           3.660    0.4851  0.6965  -0.6127  -0.5437
```

4.1 Higher Moments - Combined

```
##                 HSI Components to HSI Combined
## CoSkewness                              0.0000
## CoKurtosis                              0.0000
## Beta CoVariance                         0.0799
## Beta CoSkewness                         1.2139
## Beta CoKurtosis                        -0.0340
```

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     4.8684 1.41249 1.20701 1.17485 1.04658 1.01421
## Proportion of Variance 0.4837 0.04072 0.02973 0.02817 0.02235 0.02099
## Cumulative Proportion  0.4837 0.52441 0.55415 0.58231 0.60467 0.62566
##                         Comp.7  Comp.8 Comp.9 Comp.10 Comp.11 Comp.12
## Standard deviation     0.96563 0.96289 0.9286 0.90876 0.87492 0.85060
## Proportion of Variance 0.01903 0.01892 0.0176 0.01685 0.01562 0.01477
## Cumulative Proportion  0.64469 0.66361 0.6812 0.69806 0.71368 0.72845
##                        Comp.13 Comp.14 Comp.15 Comp.16 Comp.17 Comp.18
## Standard deviation     0.82865 0.81384 0.78359 0.77827 0.76236 0.75368
## Proportion of Variance 0.01401 0.01352 0.01253 0.01236 0.01186 0.01159
## Cumulative Proportion  0.74246 0.75598 0.76851 0.78087 0.79273 0.80433
##                        Comp.19 Comp.20 Comp.21  Comp.22  Comp.23  Comp.24
## Standard deviation      0.7375 0.72726 0.70375 0.683730 0.679904 0.672256
## Proportion of Variance  0.0111 0.01079 0.01011 0.009541 0.009434 0.009223
## Cumulative Proportion   0.8154 0.82622 0.83633 0.845870 0.855304 0.864527
##                         Comp.25  Comp.26  Comp.27  Comp.28  Comp.29
## Standard deviation     0.658106 0.652804 0.631032 0.621745 0.613120
## Proportion of Variance 0.008839 0.008697 0.008127 0.007889 0.007672
## Cumulative Proportion  0.873366 0.882063 0.890190 0.898079 0.905751
##                         Comp.30  Comp.31  Comp.32  Comp.33  Comp.34
## Standard deviation     0.594246 0.590090 0.583068 0.562681 0.543170
## Proportion of Variance 0.007207 0.007106 0.006938 0.006461 0.006021
## Cumulative Proportion  0.912957 0.920064 0.927002 0.933463 0.939484
##                         Comp.35  Comp.36 Comp.37  Comp.38  Comp.39 Comp.40
## Standard deviation     0.530294 0.514941 0.51342 0.509155 0.488151 0.47783
## Proportion of Variance 0.005739 0.005412 0.00538 0.005291 0.004863 0.00466
## Cumulative Proportion  0.945223 0.950635 0.95601 0.961305 0.966168 0.97083
##                         Comp.41  Comp.42  Comp.43  Comp.44  Comp.45
## Standard deviation     0.459817 0.443309 0.432483 0.414601 0.396481
## Proportion of Variance 0.004315 0.004011 0.003817 0.003508 0.003208
## Cumulative Proportion  0.975142 0.979153 0.982970 0.986478 0.989686
##                         Comp.46  Comp.47  Comp.48 Comp.49
## Standard deviation     0.383091 0.360068 0.346630 0.32985
## Proportion of Variance 0.002995 0.002646 0.002452 0.00222
## Cumulative Proportion  0.992682 0.995327 0.997780 1.00000
##
## Loadings:
##         Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8 Comp.9
## 0001.HK -0.174        -0.193  0.124
## 0002.HK        -0.475         0.103  0.216        -0.212
## 0003.HK        -0.348         0.259 -0.145 -0.150 -0.122        -0.229
## 0004.HK -0.161        -0.150
## 0005.HK -0.165
## 0006.HK        -0.486        -0.106  0.156  0.109 -0.343        -0.112
## 0011.HK -0.152        -0.145  0.207  0.171                 0.167  0.168
## 0012.HK -0.159        -0.213                              -0.129 -0.219
## 0013.HK -0.165        -0.135                0.101                 0.135
## 0016.HK -0.159        -0.255                              -0.178 -0.161
## 0017.HK -0.145        -0.258                              -0.193 -0.120
## 0019.HK -0.127                0.257        -0.174  0.157 -0.195  0.225
## 0023.HK -0.151                0.148  0.226                 0.194  0.137
## 0066.HK -0.138 -0.175         0.141                              0.252
## 0083.HK -0.154        -0.234                              -0.127 -0.267
```

```
## 0101.HK -0.153        -0.157                0.120         0.123
## 0144.HK -0.151               -0.116         0.224        -0.133
## 0151.HK                0.388  0.333 -0.221 -0.243        -0.209 -0.131
## 0267.HK -0.157                      -0.111                       0.128
## 0291.HK -0.128                                0.197        -0.216 -0.145
## 0293.HK -0.124                0.140         0.240  0.121 -0.172  0.327
## 0322.HK                0.353  0.453                -0.137  0.189 -0.169
## 0330.HK                             -0.437        -0.594 -0.106  0.272
## 0386.HK -0.139 -0.223  0.121 -0.203 -0.198         0.291
## 0388.HK -0.173                              -0.116
## 0494.HK                      -0.129        -0.180 -0.230         0.322
## 0688.HK -0.153  0.221        -0.110                -0.172        -0.256
## 0700.HK -0.134         0.144         0.206  0.139        -0.234  0.101
## 0762.HK -0.127 -0.127  0.278 -0.135                 0.178
## 0836.HK                       0.140 -0.573  0.392         0.290
## 0857.HK -0.157 -0.150        -0.176 -0.139         0.185
## 0883.HK -0.168               -0.139
## 0939.HK -0.173                                             0.119 -0.105
## 0941.HK -0.120 -0.284  0.138                          0.114 -0.135
## 1044.HK -0.102         0.331  0.215  0.141  0.145         -0.295
## 1088.HK -0.165         0.104
## 1109.HK -0.150  0.248                                -0.149        -0.182
## 1199.HK -0.155               -0.211         0.150
## 1299.HK -0.129                                0.324         0.330
## 1398.HK -0.176                               -0.127         0.219
## 1880.HK -0.127         0.154                 0.243 -0.144 -0.136 -0.108
## 1898.HK -0.162                               -0.148 -0.118  0.102  0.126
## 1928.HK -0.133  0.152  0.112         0.194  0.242 -0.106  0.153
## 2318.HK -0.169               -0.108        -0.155
## 2388.HK -0.159                      0.172                        0.161
## 2600.HK -0.159               -0.131        -0.105 -0.104
## 2628.HK -0.161               -0.134        -0.202
## 3328.HK -0.173                              -0.109         0.137
## 3988.HK -0.170                              -0.154         0.234
##         Comp.10 Comp.11 Comp.12 Comp.13 Comp.14 Comp.15 Comp.16 Comp.17
## 0001.HK                                                          -0.126
## 0002.HK                                  0.213
## 0003.HK          0.361                  -0.354   0.121   0.154   0.165
## 0004.HK                        -0.137   0.233                   -0.132
## 0005.HK                 0.195
## 0006.HK         -0.392  -0.245          -0.134          -0.136
## 0011.HK          0.113          -0.103          -0.106
## 0012.HK                                  0.119  -0.148
## 0013.HK                        -0.112           0.122          -0.125
## 0016.HK                                        -0.109
## 0017.HK  0.134  -0.137   0.179  -0.135           0.103  -0.147   0.158
## 0019.HK -0.157  -0.117  -0.272                   0.281  -0.220
## 0023.HK -0.122   0.108  -0.143   0.126                   0.144
## 0066.HK          0.151   0.175   0.110   0.197                   -0.159
## 0083.HK                  0.104           0.130  -0.215           0.115
## 0101.HK  0.169   0.124                  -0.173  -0.160  -0.136  -0.130
## 0144.HK  0.137           0.112                   0.176   0.196   0.275
## 0151.HK                        -0.262  -0.156  -0.204           0.118
## 0267.HK -0.102                 -0.114   0.205   0.200   0.194   0.126
## 0291.HK                         0.643           0.293           0.111
## 0293.HK -0.226  -0.139                  -0.317  -0.103   0.162
## 0322.HK  0.152  -0.345   0.153           0.149   0.237   0.193  -0.291
```

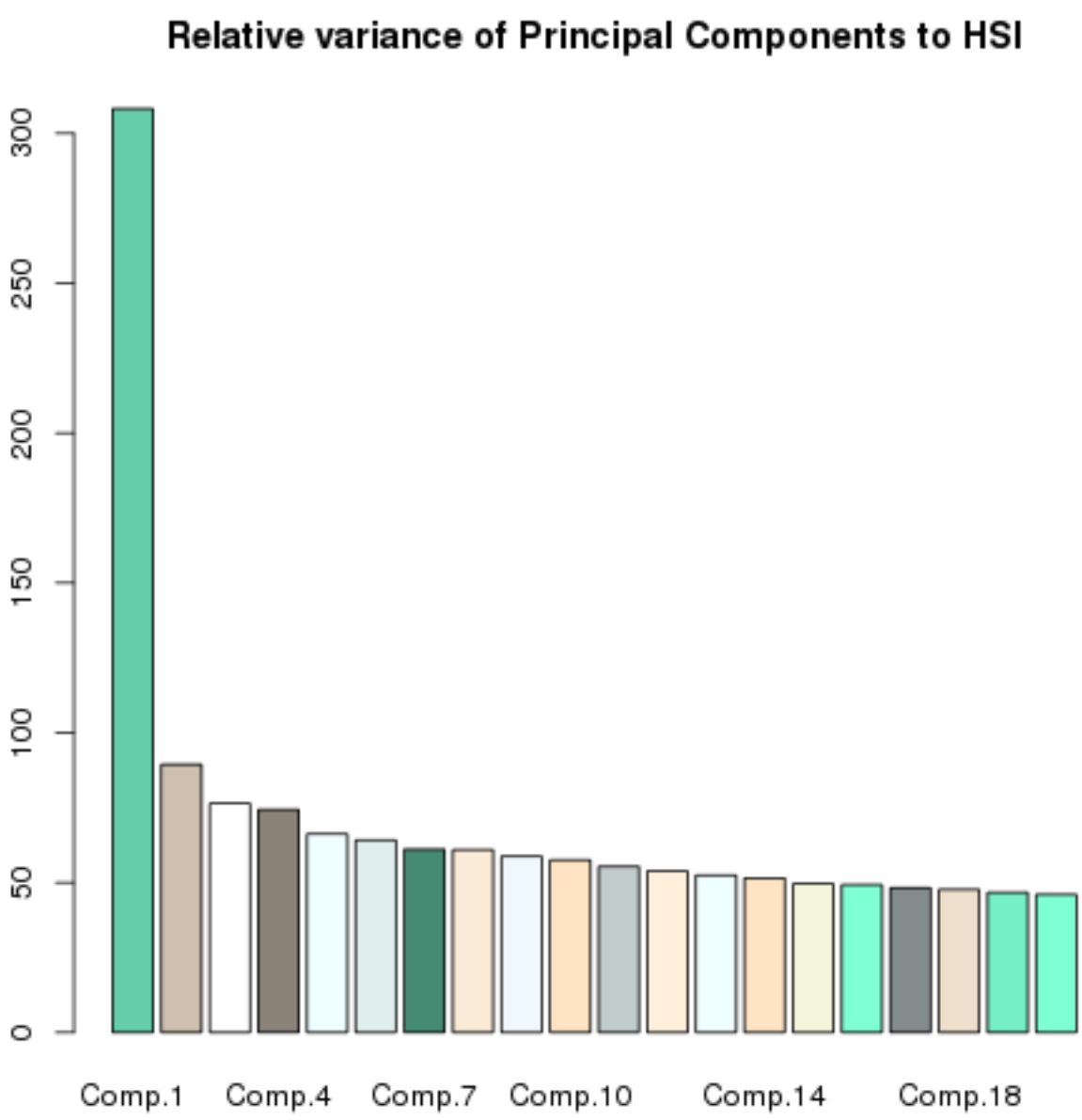
```
## 0330.HK -0.253   0.118   0.252                  -0.238
## 0386.HK
## 0388.HK                  0.110                   0.126
## 0494.HK  0.722          -0.211   0.155                  0.142
## 0688.HK -0.130   0.106  -0.269                                -0.126
## 0700.HK                         -0.216          -0.204   0.290
## 0762.HK          0.143  -0.107  -0.104   0.319                  0.392
## 0836.HK         -0.239  -0.277           0.109  -0.139
## 0857.HK                                                        -0.218
## 0883.HK                                                        -0.157
## 0939.HK         -0.151   0.173   0.106  -0.159  -0.149
## 0941.HK -0.167   0.255   0.112   0.214   0.131          0.183  -0.196
## 1044.HK  0.119                   0.238   0.105  -0.198  -0.532
## 1088.HK                 -0.179                   0.130           0.146
## 1109.HK -0.124   0.107  -0.355           0.124
## 1199.HK         -0.164   0.272                   0.119
## 1299.HK          0.249   0.234  -0.213           0.218  -0.324
## 1398.HK         -0.154                  -0.150  -0.117
## 1880.HK          0.233          -0.164  -0.320   0.190          -0.363
## 1898.HK                                         0.145           0.110
## 1928.HK                                        -0.128   0.258   0.274
## 2318.HK                 -0.136
## 2388.HK                                 -0.101                  0.155
## 2600.HK                                          0.152           0.142
## 2628.HK                                  0.102   0.132          -0.169
## 3328.HK                                 -0.185  -0.111  -0.139
## 3988.HK         -0.108   0.139   0.227  -0.131  -0.200
##         Comp.18 Comp.19 Comp.20 Comp.21 Comp.22 Comp.23 Comp.24 Comp.25
## 0001.HK  0.101                                   0.152
## 0002.HK                  0.185          -0.146  -0.186
## 0003.HK -0.148   0.214  -0.313  -0.156                  0.179  -0.110
## 0004.HK                  0.204                          -0.116   0.232
## 0005.HK                 -0.177          -0.138                  0.133
## 0006.HK  0.136          -0.103                                  0.104
## 0011.HK          0.156                  -0.135           0.137
## 0012.HK -0.131  -0.147   0.126           0.103  -0.109          -0.158
## 0013.HK  0.149                  -0.137           0.168  -0.227  -0.116
## 0016.HK                          0.175           0.185
## 0017.HK         -0.119                  -0.160  -0.197  -0.151
## 0019.HK         -0.212  -0.138   0.273   0.145   0.171   0.148   0.166
## 0023.HK  0.163                                   0.343   0.202   0.162
## 0066.HK  0.339   0.130           0.171          -0.409   0.178
## 0083.HK                                  0.144           0.206
## 0101.HK -0.243   0.160   0.196           0.156  -0.115  -0.129   0.163
## 0144.HK  0.187                          -0.129   0.159          -0.174
## 0151.HK  0.290   0.131   0.224          -0.123          -0.123   0.301
## 0267.HK                                  0.193  -0.145   0.160  -0.149
## 0291.HK                  0.267  -0.258                                  0.240
## 0293.HK -0.348          -0.121          -0.365  -0.115
## 0322.HK -0.291
## 0330.HK -0.207                                   0.188
## 0386.HK -0.170   0.111           0.219
## 0388.HK                         -0.157  -0.141  -0.108
## 0494.HK         -0.215
## 0688.HK                 -0.149          -0.261
## 0700.HK          0.106  -0.241  -0.421   0.316
## 0762.HK -0.226  -0.334          -0.199  -0.133           0.195
```

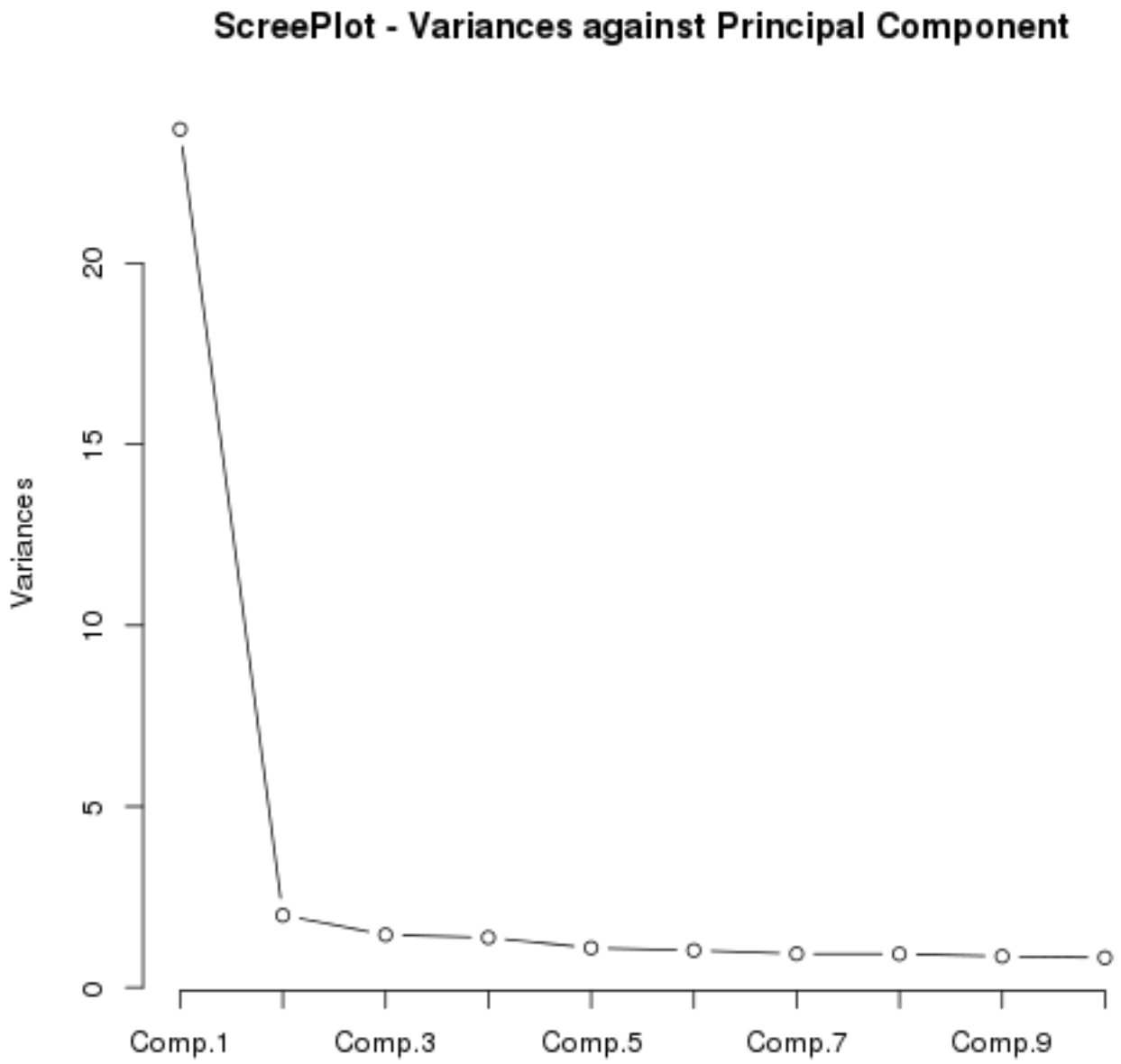
```
## 0836.HK  0.192          -0.142  -0.208
## 0857.HK -0.190   0.255   0.210   0.162           0.119          -0.137
## 0883.HK                  0.181                   0.197   0.231  -0.216
## 0939.HK         -0.186
## 0941.HK  0.130  -0.319  -0.218   0.103                  -0.429
## 1044.HK          0.230  -0.221                                 -0.284
## 1088.HK          0.130   0.184                   0.174  -0.194  -0.106
## 1109.HK                 -0.164   0.106  -0.280
## 1199.HK  0.221   0.117  -0.131   0.120  -0.113           0.105   0.101
## 1299.HK                 -0.179   0.109           0.195  -0.132   0.288
## 1398.HK         -0.101
## 1880.HK  0.183  -0.322   0.145                  -0.259   0.368
## 1898.HK                                  0.224          -0.150  -0.222
## 1928.HK                          0.345   0.342  -0.271  -0.178
## 2318.HK                 -0.156  -0.129   0.273
## 2388.HK                          -0.253  -0.142          -0.216  -0.352
## 2600.HK -0.110   0.198                           -0.159           0.240
## 2628.HK          0.248  -0.245  -0.158   0.113  -0.149  -0.105   0.111
## 3328.HK
## 3988.HK         -0.108
##         Comp.26 Comp.27 Comp.28 Comp.29 Comp.30 Comp.31 Comp.32 Comp.33
## 0001.HK          0.115          -0.140
## 0002.HK                  0.155   0.192  -0.227  -0.187  -0.124   0.228
## 0003.HK          0.107   0.192
## 0004.HK  0.142           0.432           0.228           0.126
## 0005.HK  0.361          -0.161   0.199                  -0.234
## 0006.HK                          -0.150           0.175   0.122  -0.226
## 0011.HK         -0.226  -0.241                   0.419   0.268
## 0012.HK                  0.104  -0.245                  -0.118   0.157
## 0013.HK          0.188          -0.326          -0.183  -0.202  -0.291
## 0016.HK                 -0.186                                   0.341
## 0017.HK -0.149  -0.195  -0.144   0.315          -0.226   0.143  -0.434
## 0019.HK -0.138   0.236           0.271                  -0.133
## 0023.HK         -0.147           0.123   0.279  -0.193          -0.190
## 0066.HK -0.178   0.105  -0.131  -0.125  -0.218          -0.190  -0.178
## 0083.HK                 -0.264
## 0101.HK -0.177  -0.231   0.230   0.322                  -0.227
## 0144.HK -0.157  -0.220   0.247                   0.339  -0.181
## 0151.HK                                  -0.212           0.135
## 0267.HK         -0.319   0.248          -0.197           0.362
## 0291.HK          0.130  -0.128          -0.169           0.161
## 0293.HK  0.273  -0.142          -0.230  -0.154  -0.106
## 0322.HK                 -0.107                           -0.149
## 0330.HK
## 0386.HK -0.210   0.154  -0.183           0.157   0.213
## 0388.HK          0.129          -0.174   0.246
## 0494.HK                                                  0.130
## 0688.HK -0.169                           -0.171
## 0700.HK -0.405                                   -0.121
## 0762.HK  0.122                                           -0.165  -0.140
## 0836.HK                          0.100           -0.126           0.143
## 0857.HK          0.126                                   0.155  -0.182
## 0883.HK  0.170   0.103           0.125           -0.221   0.246  -0.101
## 0939.HK -0.124           0.154                           0.116
## 0941.HK         -0.206           0.109   0.220           0.149
## 1044.HK                  0.101           0.125
## 1088.HK         -0.278                   -0.133          -0.362
```

```
## 1109.HK -0.114   0.113
## 1199.HK          0.155   0.158   0.172                          0.303
## 1299.HK                         -0.164  -0.294           0.179
## 1398.HK
## 1880.HK         -0.150                   0.127
## 1898.HK         -0.206  -0.285                   -0.354          0.302
## 1928.HK  0.237   0.279           0.164   0.161                  -0.128
## 2318.HK  0.166           0.132                    0.150
## 2388.HK          0.285  -0.124   0.198   0.128   0.213   0.127   0.119
## 2600.HK -0.263          -0.108  -0.282   0.415  -0.284           0.113
## 2628.HK  0.302                                   0.177
## 3328.HK
## 3988.HK -0.103           0.149          -0.143          -0.108
##         Comp.34 Comp.35 Comp.36 Comp.37 Comp.38 Comp.39 Comp.40 Comp.41
## 0001.HK                         -0.262  -0.230           0.110
## 0002.HK  0.271  -0.140          -0.322
## 0003.HK                 -0.135
## 0004.HK -0.110          -0.429   0.124   0.175                  -0.262
## 0005.HK  0.179  -0.441   0.109   0.200  -0.394           0.139  -0.207
## 0006.HK -0.152                   0.257  -0.118
## 0011.HK  0.196   0.119  -0.185          -0.262  -0.109  -0.220   0.212
## 0012.HK  0.192                   0.240           0.372           0.178
## 0013.HK                                  -0.166  -0.160  -0.110   0.243
## 0016.HK -0.404   0.114          -0.194           0.134  -0.152  -0.295
## 0017.HK -0.102          -0.148                   0.210
## 0019.HK  0.153
## 0023.HK -0.144           0.218           0.272   0.186   0.190   0.163
## 0066.HK          0.153           0.207                          -0.173
## 0083.HK  0.215  -0.119           0.121   0.455  -0.371   0.105
## 0101.HK -0.178           0.186   0.105  -0.159  -0.318   0.158
## 0144.HK  0.244   0.171          -0.152                   0.278  -0.250
## 0151.HK                  0.127                            0.130
## 0267.HK -0.148  -0.339   0.189          -0.171
## 0291.HK
## 0293.HK                                  0.112
## 0322.HK                 -0.107
## 0330.HK
## 0386.HK -0.115  -0.325  -0.153  -0.194   0.102           0.176   0.199
## 0388.HK         -0.208                   0.196  -0.313  -0.139
## 0494.HK
## 0688.HK                 -0.174          -0.116  -0.120   0.112
## 0700.HK                          0.102
## 0762.HK -0.272   0.194                  -0.145  -0.157
## 0836.HK
## 0857.HK                  0.121   0.107   0.107   0.116
## 0883.HK  0.265   0.257                           -0.163  -0.153
## 0939.HK         -0.208                           -0.202  -0.191
## 0941.HK                                          -0.107  -0.118
## 1044.HK
## 1088.HK         -0.108  -0.150   0.202   0.206   0.119  -0.518
## 1109.HK         -0.117
## 1199.HK -0.247   0.166           0.114                   -0.104   0.539
## 1299.HK                                  0.126   0.105
## 1398.HK                                          0.104          -0.147
## 1880.HK
## 1898.HK                 -0.200                   -0.229   0.357
## 1928.HK                          -0.114                  -0.108
```

```
## 2318.HK  0.145   0.252   0.173           0.134                   0.192
## 2388.HK                  0.240   0.302   0.130   0.108   0.177
## 2600.HK  0.193   0.170   0.289          -0.125          -0.126
## 2628.HK          0.182   0.109  -0.436   0.133
## 3328.HK  0.153          -0.418                  0.297   0.205   0.201
## 3988.HK                                                         -0.104
##          Comp.42 Comp.43 Comp.44 Comp.45 Comp.46 Comp.47 Comp.48 Comp.49
## 0001.HK  0.204   0.225   0.119           0.453           0.529
## 0002.HK
## 0003.HK
## 0004.HK  0.221  -0.132          -0.171
## 0005.HK         -0.193
## 0006.HK          0.103
## 0011.HK         -0.135   0.190
## 0012.HK -0.383   0.122   0.151  -0.252                   -0.160
## 0013.HK  0.117                          -0.343          -0.310  -0.153
## 0016.HK         -0.138  -0.263   0.169  -0.198   0.145  -0.131
## 0017.HK -0.118  -0.169
## 0019.HK          0.125   0.145
## 0023.HK -0.180                                          -0.124
## 0066.HK                                  0.111
## 0083.HK  0.304   0.101
## 0101.HK                  -0.158
## 0144.HK                                          0.105
## 0151.HK
## 0267.HK  0.173   0.159           0.108
## 0291.HK
## 0293.HK
## 0322.HK
## 0330.HK
## 0386.HK         -0.171  -0.234  -0.212          -0.178
## 0388.HK -0.512   0.248           0.369          -0.108           0.124
## 0494.HK
## 0688.HK                                  0.217  -0.356  -0.409   0.277
## 0700.HK                  0.110
## 0762.HK
## 0836.HK
## 0857.HK                  0.508   0.338           0.183  -0.162
## 0883.HK -0.190   0.113  -0.411  -0.244                   0.179
## 0939.HK                         -0.296   0.330   0.553  -0.201   0.140
## 0941.HK                          0.103  -0.107
## 1044.HK
## 1088.HK                                  0.216
## 1109.HK -0.117                          -0.272   0.386   0.374  -0.290
## 1199.HK                  0.130
## 1299.HK          0.105
## 1398.HK         -0.107           0.149   0.163  -0.286  -0.125  -0.728
## 1880.HK                  0.108
## 1898.HK -0.162  -0.115   0.227
## 1928.HK -0.103
## 2318.HK         -0.571  -0.139   0.235   0.151                   0.170
## 2388.HK  0.238   0.135  -0.125  -0.127
## 2600.HK  0.264
## 2628.HK          0.272          -0.305                   -0.158  -0.100
## 3328.HK  0.142   0.323  -0.264   0.368  -0.178   0.198
## 3988.HK         -0.129   0.249  -0.140  -0.434  -0.333   0.254   0.369
##
```

```
##                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)

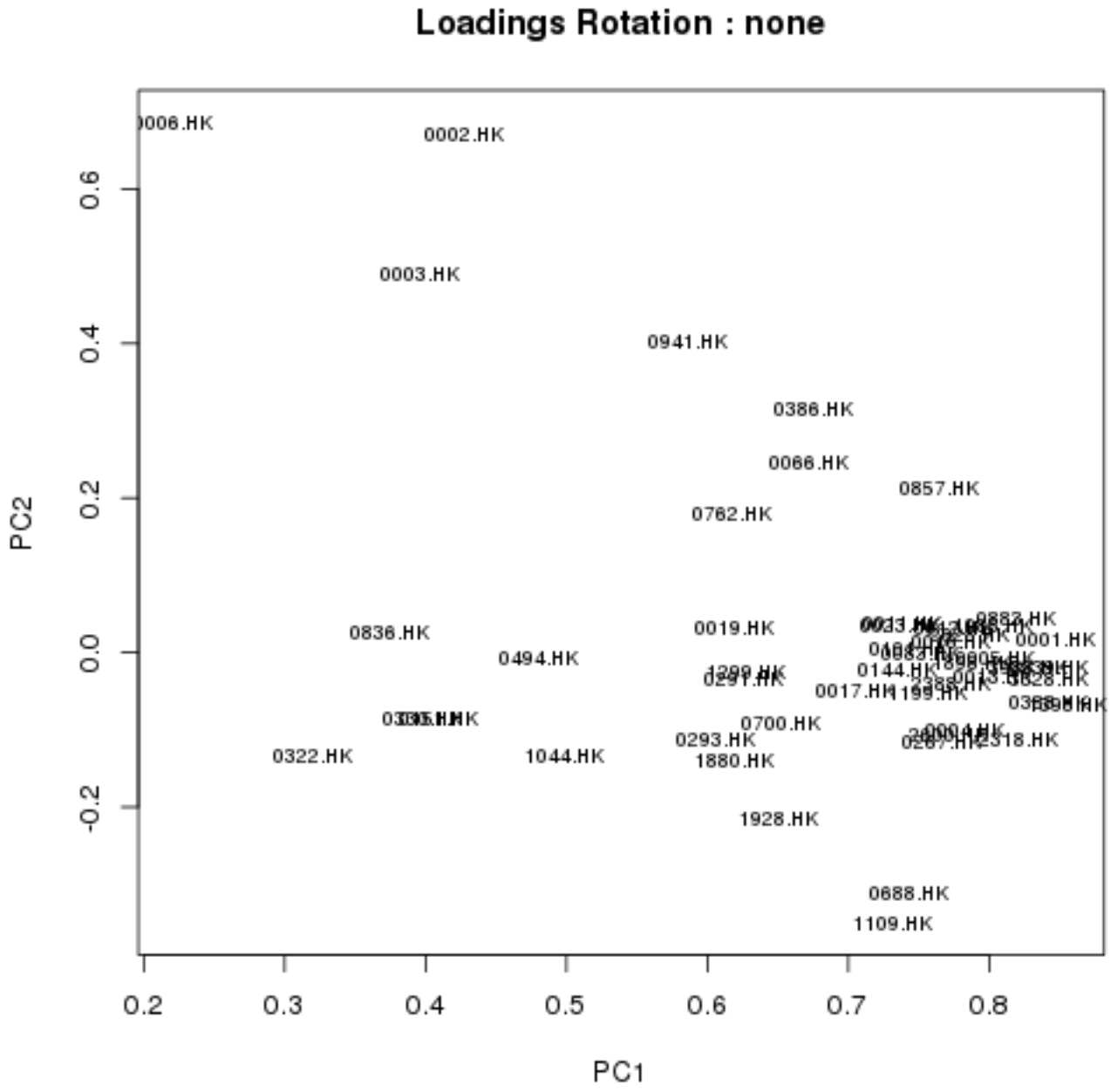
[7] http://en.wikipedia.org/wiki/Factoranalysis

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
## 1398.HK   40 0.86 -0.07  0.07 -0.08 -0.07 0.75 0.25
## 0001.HK    1 0.85  0.02 -0.23  0.15 -0.03 0.79 0.21
## 0388.HK   25 0.84 -0.07 -0.11  0.03 -0.02 0.73 0.27
## 0939.HK   33 0.84 -0.02  0.10 -0.05 -0.01 0.72 0.28
## 3328.HK   48 0.84 -0.03  0.04 -0.10  0.01 0.72 0.28
## 3988.HK   49 0.83 -0.02  0.07 -0.06 -0.01 0.69 0.31
## 2318.HK   44 0.82 -0.11  0.00 -0.13 -0.03 0.70 0.30
## 0883.HK   32 0.82  0.04  0.10 -0.16 -0.01 0.71 0.29
## 0005.HK    5 0.80 -0.01 -0.02 -0.12 -0.02 0.66 0.34
## 1088.HK   36 0.80  0.04  0.13 -0.09  0.05 0.67 0.33
## 0013.HK    9 0.80 -0.03 -0.16  0.11 -0.03 0.68 0.32
## 1898.HK   42 0.79 -0.01  0.05 -0.11 -0.01 0.64 0.36
## 2628.HK   47 0.79  0.02  0.03 -0.16  0.01 0.64 0.36
## 0004.HK    4 0.78 -0.10 -0.18  0.04 -0.02 0.66 0.34
## 0012.HK    8 0.77  0.03 -0.26  0.11  0.05 0.68 0.32
## 2388.HK   45 0.77 -0.04 -0.02  0.06 -0.18 0.64 0.36
## 0016.HK   10 0.77  0.01 -0.31  0.08 -0.05 0.70 0.30
## 2600.HK   46 0.77 -0.11  0.04 -0.15  0.02 0.63 0.37
## 0267.HK   19 0.77 -0.12  0.03  0.05  0.12 0.62 0.38
## 0857.HK   31 0.76  0.21  0.11 -0.21  0.15 0.70 0.30
## 1199.HK   38 0.76 -0.05  0.01 -0.25  0.02 0.64 0.36
## 0083.HK   15 0.75  0.00 -0.28  0.06  0.00 0.65 0.35
## 0101.HK   16 0.74  0.00 -0.19  0.04  0.01 0.59 0.41
## 0688.HK   27 0.74 -0.31  0.01 -0.13 -0.05 0.67 0.33
## 0011.HK    7 0.74  0.04 -0.17  0.24 -0.18 0.67 0.33
## 0023.HK   13 0.74  0.04  0.00  0.17 -0.24 0.63 0.37
## 0144.HK   17 0.74 -0.02  0.07 -0.14  0.09 0.57 0.43
## 1109.HK   37 0.73 -0.35 -0.03 -0.10  0.03 0.67 0.33
## 0017.HK   11 0.71 -0.05 -0.31  0.05  0.07 0.60 0.40
## 0386.HK   24 0.68  0.31  0.15 -0.24  0.21 0.68 0.32
## 0066.HK   14 0.67  0.25 -0.09  0.17  0.02 0.55 0.45
## 0700.HK   28 0.65 -0.09  0.17 -0.09 -0.22 0.52 0.48
## 1928.HK   43 0.65 -0.21  0.14  0.08 -0.20 0.53 0.47
## 1299.HK   39 0.63 -0.02  0.02  0.05 -0.06 0.40 0.60
## 0291.HK   20 0.63 -0.03  0.00  0.01  0.02 0.39 0.61
## 0019.HK   12 0.62  0.03 -0.09  0.30  0.08 0.49 0.51
## 1880.HK   41 0.62 -0.14  0.19 -0.05  0.00 0.44 0.56
## 0762.HK   29 0.62  0.18  0.34 -0.16  0.03 0.55 0.45
## 0293.HK   21 0.61 -0.11 -0.07  0.16 -0.07 0.42 0.58
## 0941.HK   34 0.59  0.40  0.17 -0.06  0.10 0.55 0.45
## 1044.HK   35 0.50 -0.13  0.40  0.25 -0.15 0.51 0.49
## 0494.HK   26 0.48 -0.01  0.05 -0.15 -0.05 0.26 0.74
## 0006.HK    6 0.22  0.69  0.06 -0.12 -0.16 0.57 0.43
## 0002.HK    2 0.43  0.67  0.05  0.12 -0.23 0.70 0.30
## 0003.HK    3 0.40  0.49 -0.10  0.30  0.15 0.52 0.48
## 0151.HK   18 0.41 -0.08  0.47  0.39  0.23 0.60 0.40
## 0322.HK   22 0.32 -0.13  0.43  0.53  0.00 0.58 0.42
## 0836.HK   30 0.38  0.03 -0.10  0.16  0.60 0.54 0.46
## 0330.HK   23 0.40 -0.08  0.01 -0.06  0.46 0.38 0.62
##
##                 PC1  PC2  PC3  PC4  PC5
```

```
## SS loadings    23.70 2.00 1.46 1.38 1.10
## Proportion Var  0.48 0.04 0.03 0.03 0.02
## Cumulative Var  0.48 0.52 0.55 0.58 0.60
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  38.6 0.3
## The degrees of freedom for the model are 941  and the objective function was  5.67
##  0.3The number of observations was  390  with Chi Square =  2090  with prob <  5.7e-89
##  0.3
## Fit based upon off diagonal values = 0.99
##            PC1       PC2
## 0001.HK 0.8468  0.016505
## 0002.HK 0.4271  0.671126
## 0003.HK 0.3969  0.491235
## 0004.HK 0.7836 -0.101833
## 0005.HK 0.8043 -0.007180
## 0006.HK 0.2216  0.686272
## 0011.HK 0.7377  0.039066
## 0012.HK 0.7744  0.031138
## 0013.HK 0.8026 -0.032335
## 0016.HK 0.7724  0.012892
## 0017.HK 0.7057 -0.049973
## 0019.HK 0.6200  0.030849
## 0023.HK 0.7362  0.035023
## 0066.HK 0.6715  0.247393
## 0083.HK 0.7517 -0.001719
## 0101.HK 0.7431  0.003784
## 0144.HK 0.7356 -0.021536
## 0151.HK 0.4092 -0.084482
## 0267.HK 0.7664 -0.116851
## 0291.HK 0.6251 -0.033102
## 0293.HK 0.6059 -0.112756
## 0322.HK 0.3205 -0.133710
## 0330.HK 0.3970 -0.084186
## 0386.HK 0.6754  0.314743
## 0388.HK 0.8431 -0.065213
## 0494.HK 0.4810 -0.006798
## 0688.HK 0.7429 -0.311577
## 0700.HK 0.6531 -0.089976
## 0762.HK 0.6183  0.179914
## 0836.HK 0.3750  0.026052
## 0857.HK 0.7643  0.211637
## 0883.HK 0.8184  0.043401
## 0939.HK 0.8429 -0.018572
## 0941.HK 0.5861  0.401683
## 1044.HK 0.4984 -0.132198
## 1088.HK 0.8027  0.035554
## 1109.HK 0.7320 -0.349889
## 1199.HK 0.7563 -0.053356
## 1299.HK 0.6278 -0.024972
## 1398.HK 0.8562 -0.067685
## 1880.HK 0.6192 -0.138378
## 1898.HK 0.7882 -0.012053
## 1928.HK 0.6499 -0.214961
## 2318.HK 0.8216 -0.112734
## 2388.HK 0.7727 -0.040495
```

```
## 2600.HK 0.7719 -0.105234
## 2628.HK 0.7862  0.023151
## 3328.HK 0.8423 -0.033760
## 3988.HK 0.8276 -0.018692
```



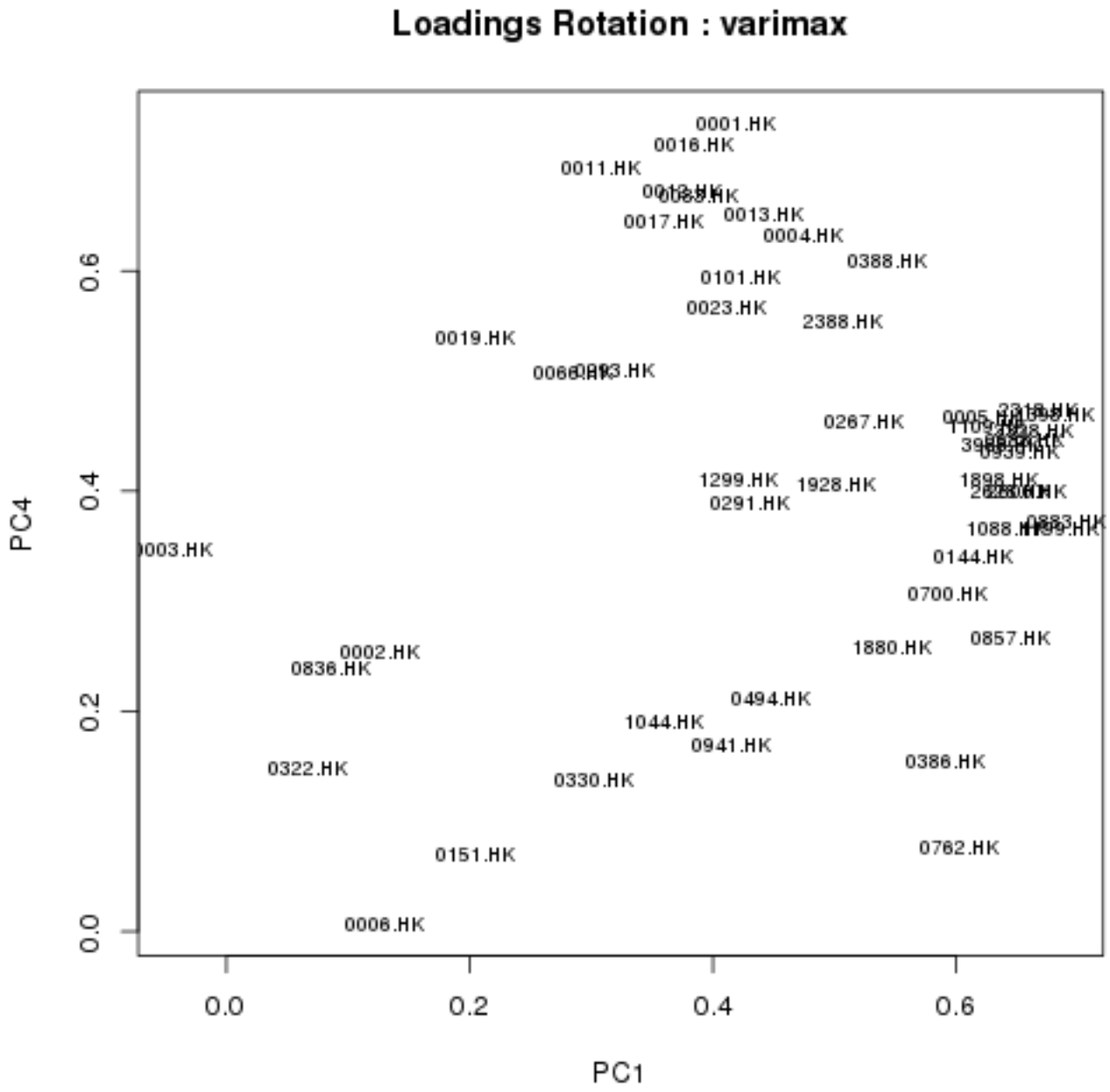
5.2.2 Rotation : varimax

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
## 0883.HK   32  0.69 0.37  0.24  0.13  0.13 0.71 0.29
## 1199.HK   38  0.69 0.37  0.11  0.02  0.14 0.64 0.36
## 1398.HK   40  0.68 0.47  0.14  0.20  0.08 0.75 0.25
## 2318.HK   44  0.67 0.47  0.08  0.12  0.12 0.70 0.30
## 3328.HK   48  0.66 0.46  0.16  0.15  0.16 0.72 0.28
## 2600.HK   46  0.66 0.40  0.07  0.11  0.15 0.63 0.37
## 0688.HK   27  0.66 0.45 -0.13  0.14  0.06 0.67 0.33
## 0939.HK   33  0.65 0.44  0.19  0.23  0.14 0.72 0.28
## 2628.HK   47  0.65 0.40  0.20  0.09  0.15 0.64 0.36
## 0857.HK   31  0.64 0.27  0.37  0.07  0.28 0.70 0.30
## 1088.HK   36  0.64 0.37  0.23  0.20  0.18 0.67 0.33
## 3988.HK   49  0.64 0.44  0.18  0.20  0.14 0.69 0.31
## 1898.HK   42  0.64 0.41  0.17  0.14  0.13 0.64 0.36
## 1109.HK   37  0.62 0.46 -0.18  0.14  0.14 0.67 0.33
## 0005.HK    5  0.62 0.47  0.17  0.09  0.13 0.66 0.34
## 0144.HK   17  0.61 0.34  0.14  0.12  0.22 0.57 0.43
## 0762.HK   29  0.60 0.08  0.35  0.23  0.12 0.55 0.45
## 0700.HK   28  0.59 0.31  0.10  0.23 -0.11 0.52 0.48
## 0386.HK   24  0.59 0.15  0.45  0.03  0.32 0.68 0.32
## 1880.HK   41  0.55 0.26  0.03  0.26  0.09 0.44 0.56
## 0267.HK   19  0.52 0.46  0.06  0.25  0.25 0.62 0.38
## 1928.HK   43  0.50 0.41 -0.02  0.33 -0.09 0.53 0.47
## 0494.HK   26  0.45 0.21  0.11  0.04  0.03 0.26 0.74
## 0291.HK   20  0.43 0.39  0.11  0.15  0.13 0.39 0.61
## 1299.HK   39  0.42 0.41  0.13  0.19  0.06 0.40 0.60
## 0001.HK    1  0.42 0.73  0.19  0.13  0.16 0.79 0.21
## 0016.HK   10  0.38 0.71  0.16  0.02  0.13 0.70 0.30
## 0011.HK    7  0.31 0.69  0.22  0.21  0.00 0.67 0.33
## 0012.HK    8  0.38 0.67  0.18  0.07  0.23 0.68 0.32
## 0083.HK   15  0.39 0.67  0.14  0.02  0.17 0.65 0.35
## 0013.HK    9  0.44 0.65  0.14  0.16  0.14 0.68 0.32
## 0017.HK   11  0.36 0.65  0.08 -0.01  0.23 0.60 0.40
## 0004.HK    4  0.47 0.63  0.07  0.10  0.14 0.66 0.34
## 0388.HK   25  0.54 0.61  0.12  0.15  0.15 0.73 0.27
## 0101.HK   16  0.42 0.59  0.15  0.07  0.17 0.59 0.41
## 0023.HK   13  0.41 0.57  0.23  0.28 -0.08 0.63 0.37
## 2388.HK   45  0.51 0.55  0.16  0.21 -0.03 0.64 0.36
## 0019.HK   12  0.21 0.54  0.17  0.28  0.23 0.49 0.51
## 0293.HK   21  0.32 0.51  0.04  0.22  0.06 0.42 0.58
## 0066.HK   14  0.29 0.51  0.39  0.16  0.18 0.55 0.45
## 0002.HK    2  0.13 0.25  0.77  0.10 -0.10 0.70 0.30
## 0006.HK    6  0.13 0.01  0.73 -0.11 -0.09 0.57 0.43
## 0003.HK    3 -0.04 0.35  0.55  0.15  0.28 0.52 0.48
## 0941.HK   34  0.42 0.17  0.53  0.14  0.21 0.55 0.45
## 0322.HK   22  0.07 0.15  0.02  0.75  0.05 0.58 0.42
## 0151.HK   18  0.21 0.07  0.06  0.68  0.29 0.60 0.40
```

```
## 1044.HK   35  0.36 0.19  0.06  0.58 -0.07 0.51 0.49
## 0836.HK   30  0.09 0.24  0.05  0.12  0.68 0.54 0.46
## 0330.HK   23  0.30 0.14 -0.03  0.06  0.51 0.38 0.62
##
##                  PC1  PC4  PC2  PC3  PC5
## SS loadings    12.12 9.87 3.15 2.58 1.92
## Proportion Var  0.25 0.20 0.06 0.05 0.04
## Cumulative Var  0.25 0.45 0.51 0.57 0.60
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  38.6 0.3
## The degrees of freedom for the model are 941  and the objective function was  5.67
##  0.3The number of observations was  390  with Chi Square =  2090  with prob <  5.7e-89
##  0.3
## Fit based upon off diagonal values = 0.99
##              PC1     PC4
## 0001.HK  0.41837 0.73419
## 0002.HK  0.12657 0.25319
## 0003.HK -0.04313 0.34675
## 0004.HK  0.47456 0.63210
## 0005.HK  0.62244 0.46722
## 0006.HK  0.13114 0.00694
## 0011.HK  0.30768 0.69323
## 0012.HK  0.37542 0.67233
## 0013.HK  0.44108 0.65204
## 0016.HK  0.38375 0.71458
## 0017.HK  0.36036 0.64582
## 0019.HK  0.20523 0.54006
## 0023.HK  0.41058 0.56579
## 0066.HK  0.28581 0.50780
## 0083.HK  0.38892 0.66927
## 0101.HK  0.42228 0.59467
## 0144.HK  0.61343 0.34021
## 0151.HK  0.20575 0.06901
## 0267.HK  0.52386 0.46230
## 0291.HK  0.43097 0.38987
## 0293.HK  0.31998 0.51027
## 0322.HK  0.06690 0.14718
## 0330.HK  0.30196 0.13844
## 0386.HK  0.59100 0.15386
## 0388.HK  0.54382 0.61000
## 0494.HK  0.44810 0.21192
## 0688.HK  0.65572 0.44626
## 0700.HK  0.59243 0.30720
## 0762.HK  0.60283 0.07674
## 0836.HK  0.08709 0.23998
## 0857.HK  0.64409 0.26718
## 0883.HK  0.69148 0.37314
## 0939.HK  0.65297 0.43656
## 0941.HK  0.41601 0.16944
## 1044.HK  0.35979 0.19144
## 1088.HK  0.64153 0.36605
## 1109.HK  0.62500 0.45895
## 1199.HK  0.68512 0.36595
## 1299.HK  0.42053 0.40978
## 1398.HK  0.68160 0.47051
```

```
## 1880.HK  0.54653 0.25742
## 1898.HK  0.63507 0.40987
## 1928.HK  0.50045 0.40547
## 2318.HK  0.66833 0.47365
## 2388.HK  0.50740 0.55448
## 2600.HK  0.65854 0.39902
## 2628.HK  0.64541 0.39893
## 3328.HK  0.66380 0.45566
## 3988.HK  0.63747 0.44308
```



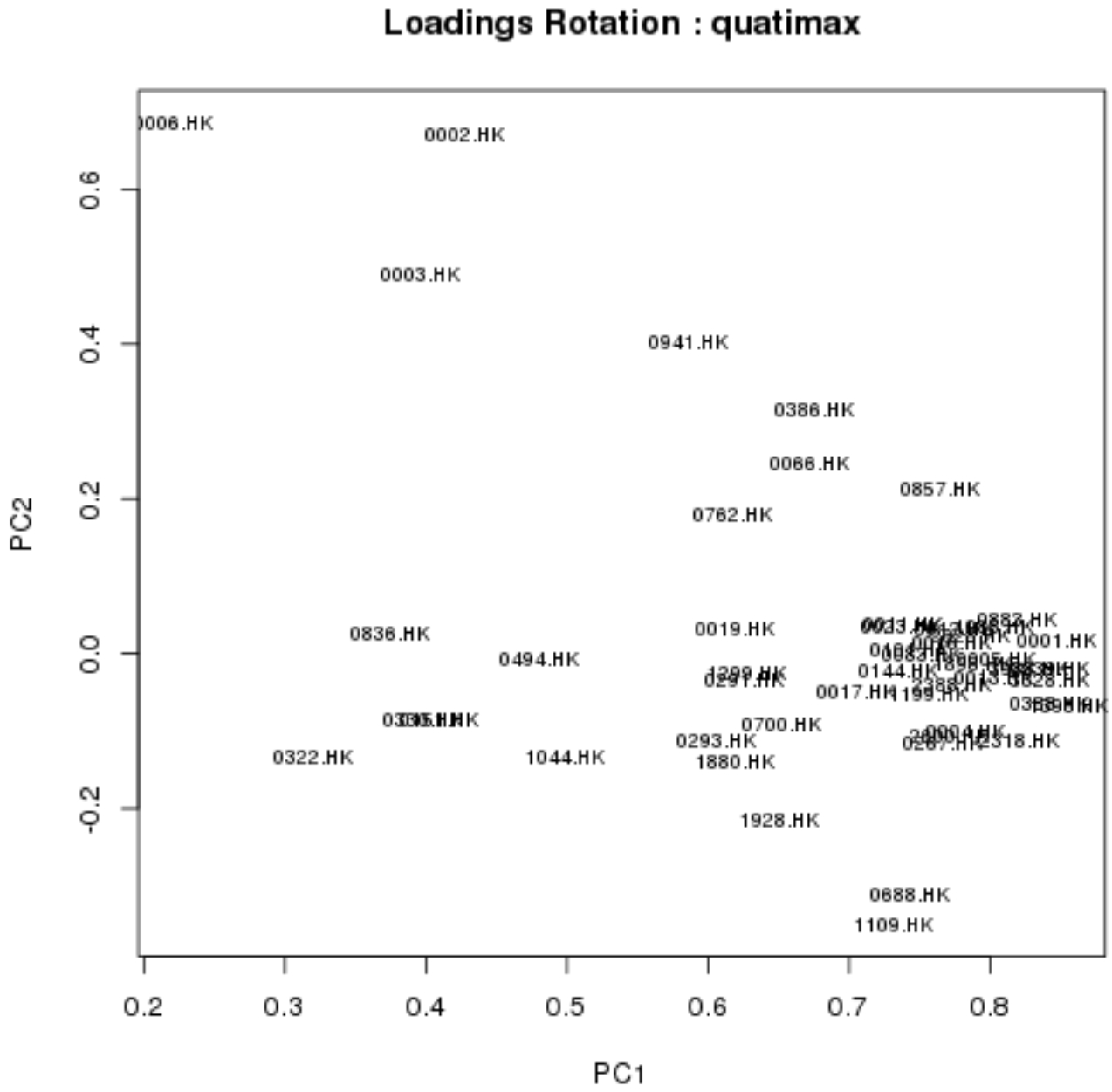
5.2.3 Rotation : quatimax

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

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "quatimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item  PC1   PC2   PC3   PC4   PC5   h2   u2
## 1398.HK   40 0.86 -0.07  0.07 -0.08 -0.07 0.75 0.25
## 0001.HK    1 0.85  0.02 -0.23  0.15 -0.03 0.79 0.21
## 0388.HK   25 0.84 -0.07 -0.11  0.03 -0.02 0.73 0.27
## 0939.HK   33 0.84 -0.02  0.10 -0.05 -0.01 0.72 0.28
## 3328.HK   48 0.84 -0.03  0.04 -0.10  0.01 0.72 0.28
## 3988.HK   49 0.83 -0.02  0.07 -0.06 -0.01 0.69 0.31
## 2318.HK   44 0.82 -0.11  0.00 -0.13 -0.03 0.70 0.30
## 0883.HK   32 0.82  0.04  0.10 -0.16 -0.01 0.71 0.29
## 0005.HK    5 0.80 -0.01 -0.02 -0.12 -0.02 0.66 0.34
## 1088.HK   36 0.80  0.04  0.13 -0.09  0.05 0.67 0.33
## 0013.HK    9 0.80 -0.03 -0.16  0.11 -0.03 0.68 0.32
## 1898.HK   42 0.79 -0.01  0.05 -0.11 -0.01 0.64 0.36
## 2628.HK   47 0.79  0.02  0.03 -0.16  0.01 0.64 0.36
## 0004.HK    4 0.78 -0.10 -0.18  0.04 -0.02 0.66 0.34
## 0012.HK    8 0.77  0.03 -0.26  0.11  0.05 0.68 0.32
## 2388.HK   45 0.77 -0.04 -0.02  0.06 -0.18 0.64 0.36
## 0016.HK   10 0.77  0.01 -0.31  0.08 -0.05 0.70 0.30
## 2600.HK   46 0.77 -0.11  0.04 -0.15  0.02 0.63 0.37
## 0267.HK   19 0.77 -0.12  0.03  0.05  0.12 0.62 0.38
## 0857.HK   31 0.76  0.21  0.11 -0.21  0.15 0.70 0.30
## 1199.HK   38 0.76 -0.05  0.01 -0.25  0.02 0.64 0.36
## 0083.HK   15 0.75  0.00 -0.28  0.06  0.00 0.65 0.35
## 0101.HK   16 0.74  0.00 -0.19  0.04  0.01 0.59 0.41
## 0688.HK   27 0.74 -0.31  0.01 -0.13 -0.05 0.67 0.33
## 0011.HK    7 0.74  0.04 -0.17  0.24 -0.18 0.67 0.33
## 0023.HK   13 0.74  0.04  0.00  0.17 -0.24 0.63 0.37
## 0144.HK   17 0.74 -0.02  0.07 -0.14  0.09 0.57 0.43
## 1109.HK   37 0.73 -0.35 -0.03 -0.10  0.03 0.67 0.33
## 0017.HK   11 0.71 -0.05 -0.31  0.05  0.07 0.60 0.40
## 0386.HK   24 0.68  0.31  0.15 -0.24  0.21 0.68 0.32
## 0066.HK   14 0.67  0.25 -0.09  0.17  0.02 0.55 0.45
## 0700.HK   28 0.65 -0.09  0.17 -0.09 -0.22 0.52 0.48
## 1928.HK   43 0.65 -0.21  0.14  0.08 -0.20 0.53 0.47
## 1299.HK   39 0.63 -0.02  0.02  0.05 -0.06 0.40 0.60
## 0291.HK   20 0.63 -0.03  0.00  0.01  0.02 0.39 0.61
## 0019.HK   12 0.62  0.03 -0.09  0.30  0.08 0.49 0.51
## 1880.HK   41 0.62 -0.14  0.19 -0.05  0.00 0.44 0.56
## 0762.HK   29 0.62  0.18  0.34 -0.16  0.03 0.55 0.45
## 0293.HK   21 0.61 -0.11 -0.07  0.16 -0.07 0.42 0.58
## 0941.HK   34 0.59  0.40  0.17 -0.06  0.10 0.55 0.45
## 1044.HK   35 0.50 -0.13  0.40  0.25 -0.15 0.51 0.49
## 0494.HK   26 0.48 -0.01  0.05 -0.15 -0.05 0.26 0.74
## 0006.HK    6 0.22  0.69  0.06 -0.12 -0.16 0.57 0.43
## 0002.HK    2 0.43  0.67  0.05  0.12 -0.23 0.70 0.30
## 0003.HK    3 0.40  0.49 -0.10  0.30  0.15 0.52 0.48
## 0151.HK   18 0.41 -0.08  0.47  0.39  0.23 0.60 0.40
## 0322.HK   22 0.32 -0.13  0.43  0.53  0.00 0.58 0.42
## 0836.HK   30 0.38  0.03 -0.10  0.16  0.60 0.54 0.46
```

```
## 0330.HK   23 0.40 -0.08  0.01 -0.06  0.46 0.38 0.62
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    23.70 2.00 1.46 1.38 1.10
## Proportion Var  0.48 0.04 0.03 0.03 0.02
## Cumulative Var  0.48 0.52 0.55 0.58 0.60
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1176  and the objective function was  38.6 0.3
## The degrees of freedom for the model are 941  and the objective function was  5.67
##  0.3The number of observations was  390  with Chi Square =  2090  with prob <  5.7e-89
##  0.3
## Fit based upon off diagonal values = 0.99
##            PC1       PC2
## 0001.HK 0.8468  0.016505
## 0002.HK 0.4271  0.671126
## 0003.HK 0.3969  0.491235
## 0004.HK 0.7836 -0.101833
## 0005.HK 0.8043 -0.007180
## 0006.HK 0.2216  0.686272
## 0011.HK 0.7377  0.039066
## 0012.HK 0.7744  0.031138
## 0013.HK 0.8026 -0.032335
## 0016.HK 0.7724  0.012892
## 0017.HK 0.7057 -0.049973
## 0019.HK 0.6200  0.030849
## 0023.HK 0.7362  0.035023
## 0066.HK 0.6715  0.247393
## 0083.HK 0.7517 -0.001719
## 0101.HK 0.7431  0.003784
## 0144.HK 0.7356 -0.021536
## 0151.HK 0.4092 -0.084482
## 0267.HK 0.7664 -0.116851
## 0291.HK 0.6251 -0.033102
## 0293.HK 0.6059 -0.112756
## 0322.HK 0.3205 -0.133710
## 0330.HK 0.3970 -0.084186
## 0386.HK 0.6754  0.314743
## 0388.HK 0.8431 -0.065213
## 0494.HK 0.4810 -0.006798
## 0688.HK 0.7429 -0.311577
## 0700.HK 0.6531 -0.089976
## 0762.HK 0.6183  0.179914
## 0836.HK 0.3750  0.026052
## 0857.HK 0.7643  0.211637
## 0883.HK 0.8184  0.043401
## 0939.HK 0.8429 -0.018572
## 0941.HK 0.5861  0.401683
## 1044.HK 0.4984 -0.132198
## 1088.HK 0.8027  0.035554
## 1109.HK 0.7320 -0.349889
## 1199.HK 0.7563 -0.053356
## 1299.HK 0.6278 -0.024972
## 1398.HK 0.8562 -0.067685
## 1880.HK 0.6192 -0.138378
## 1898.HK 0.7882 -0.012053
```

```
## 1928.HK 0.6499 -0.214961
## 2318.HK 0.8216 -0.112734
## 2388.HK 0.7727 -0.040495
## 2600.HK 0.7719 -0.105234
## 2628.HK 0.7862  0.023151
## 3328.HK 0.8423 -0.033760
## 3988.HK 0.8276 -0.018692
```



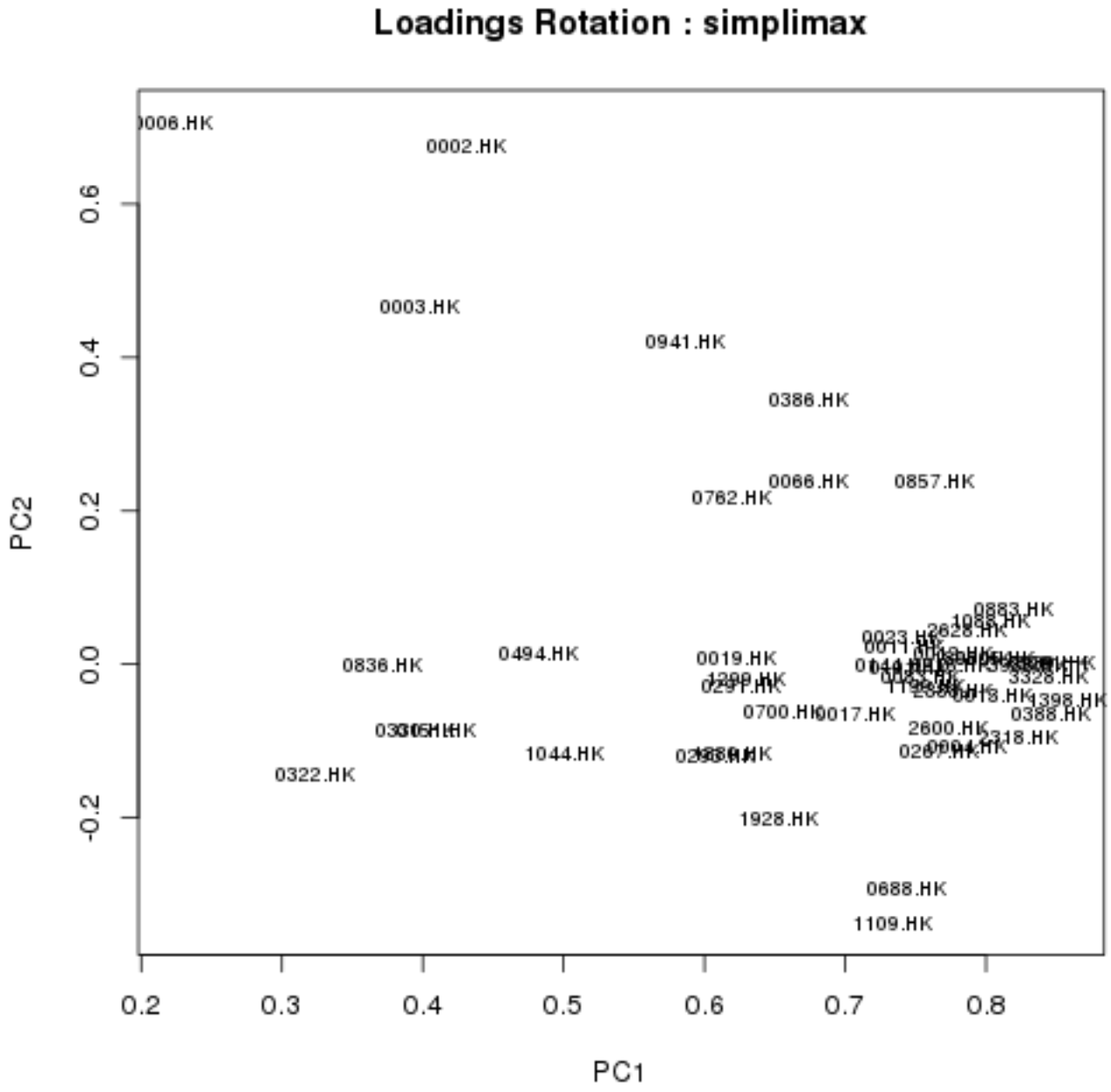
5.2.4 Rotation : simplimax

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   PC4   PC3   PC5   h2   u2
## 1398.HK   40 0.86 -0.05  0.14  0.08 -0.06 0.75 0.25
## 0001.HK    1 0.85  0.00 -0.09 -0.23  0.00 0.79 0.21
## 0388.HK   25 0.85 -0.06  0.03 -0.10  0.00 0.73 0.27
## 0939.HK   33 0.84  0.00  0.12  0.10  0.00 0.72 0.28
## 3328.HK   48 0.84 -0.02  0.17  0.04  0.02 0.72 0.28
## 3988.HK   49 0.83  0.00  0.12  0.08  0.00 0.69 0.31
## 2318.HK   44 0.82 -0.09  0.19  0.00 -0.02 0.70 0.30
## 0883.HK   32 0.82  0.07  0.23  0.10 -0.01 0.71 0.29
## 0005.HK    5 0.81  0.01  0.18 -0.02 -0.01 0.66 0.34
## 0013.HK    9 0.81 -0.04 -0.06 -0.16  0.00 0.68 0.32
## 1088.HK   36 0.80  0.06  0.15  0.13  0.05 0.67 0.33
## 1898.HK   42 0.79  0.01  0.17  0.06 -0.01 0.64 0.36
## 2628.HK   47 0.79  0.04  0.22  0.03  0.01 0.64 0.36
## 0004.HK    4 0.79 -0.11  0.01 -0.18  0.01 0.66 0.34
## 0012.HK    8 0.78  0.02 -0.05 -0.26  0.09 0.68 0.32
## 2388.HK   45 0.78 -0.03  0.00 -0.02 -0.16 0.64 0.36
## 0016.HK   10 0.78  0.00 -0.02 -0.31 -0.01 0.70 0.30
## 2600.HK   46 0.77 -0.08  0.21  0.04  0.02 0.63 0.37
## 0267.HK   19 0.77 -0.11  0.00  0.04  0.13 0.62 0.38
## 0857.HK   31 0.76  0.24  0.27  0.10  0.14 0.70 0.30
## 1199.HK   38 0.76 -0.03  0.30  0.01  0.02 0.64 0.36
## 0083.HK   15 0.75 -0.01 -0.01 -0.28  0.04 0.65 0.35
## 0101.HK   16 0.75  0.00  0.01 -0.19  0.04 0.59 0.41
## 0688.HK   27 0.74 -0.29  0.18  0.02 -0.04 0.67 0.33
## 0011.HK    7 0.74  0.02 -0.19 -0.17 -0.14 0.67 0.33
## 0023.HK   13 0.74  0.04 -0.12  0.00 -0.22 0.63 0.37
## 0144.HK   17 0.74  0.00  0.19  0.07  0.09 0.57 0.43
## 1109.HK   37 0.73 -0.34  0.15 -0.02  0.04 0.67 0.33
## 0017.HK   11 0.71 -0.07  0.00 -0.31  0.11 0.60 0.40
## 0386.HK   24 0.67  0.34  0.30  0.13  0.19 0.68 0.32
## 0066.HK   14 0.67  0.24 -0.11 -0.10  0.05 0.55 0.45
## 0700.HK   28 0.66 -0.06  0.14  0.18 -0.22 0.52 0.48
## 1928.HK   43 0.65 -0.20 -0.03  0.15 -0.20 0.53 0.47
## 1299.HK   39 0.63 -0.02  0.00  0.02 -0.05 0.40 0.60
## 0291.HK   20 0.63 -0.03  0.03  0.00  0.03 0.39 0.61
## 0019.HK   12 0.62  0.01 -0.26 -0.09  0.11 0.49 0.51
## 1880.HK   41 0.62 -0.12  0.09  0.19 -0.01 0.44 0.56
## 0762.HK   29 0.62  0.22  0.22  0.33  0.00 0.55 0.45
## 0293.HK   21 0.61 -0.12 -0.12 -0.07 -0.04 0.42 0.58
## 0941.HK   34 0.59  0.42  0.11  0.16  0.09 0.55 0.45
## 1044.HK   35 0.50 -0.12 -0.21  0.41 -0.16 0.51 0.49
## 0494.HK   26 0.48  0.01  0.19  0.06 -0.06 0.26 0.74
## 0006.HK    6 0.22  0.71  0.17  0.04 -0.18 0.57 0.43
## 0002.HK    2 0.43  0.68 -0.06  0.03 -0.22 0.70 0.30
## 0003.HK    3 0.40  0.47 -0.26 -0.11  0.18 0.52 0.48
## 0322.HK   22 0.32 -0.14 -0.51  0.44  0.00 0.58 0.42
## 0151.HK   18 0.41 -0.09 -0.36  0.48  0.22 0.60 0.40
## 0836.HK   30 0.37  0.00 -0.15 -0.10  0.62 0.54 0.46
## 0330.HK   23 0.39 -0.09  0.08  0.00  0.46 0.38 0.62
```

```
##
##                  PC1  PC2  PC4  PC3  PC5
## SS loadings    23.69 2.00 1.39 1.46 1.10
## Proportion Var  0.48 0.04 0.03 0.03 0.02
## Cumulative Var  0.48 0.52 0.55 0.58 0.60
##
##  With component correlations of
##       PC1   PC2   PC4   PC3   PC5
## PC1  1.00  0.00 -0.07  0.00 -0.01
## PC2  0.00  1.00 -0.10 -0.03  0.03
## PC4 -0.07 -0.10  1.00  0.01  0.06
## PC3  0.00 -0.03  0.01  1.00  0.09
## PC5 -0.01  0.03  0.06  0.09  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  38.6 0.3
## The degrees of freedom for the model are 941  and the objective function was  5.67
##  0.3The number of observations was  390  with Chi Square =  2090  with prob <  5.7e-89
##  0.3
## Fit based upon off diagonal values = 0.99
##            PC1        PC2
## 0001.HK 0.8500  0.0024747
## 0002.HK 0.4309  0.6771325
## 0003.HK 0.3983  0.4653763
## 0004.HK 0.7860 -0.1068368
## 0005.HK 0.8060  0.0092792
## 0006.HK 0.2234  0.7066836
## 0011.HK 0.7422  0.0240635
## 0012.HK 0.7766  0.0154526
## 0013.HK 0.8054 -0.0403815
## 0016.HK 0.7754 -0.0013057
## 0017.HK 0.7074 -0.0660468
## 0019.HK 0.6222  0.0089571
## 0023.HK 0.7407  0.0367238
## 0066.HK 0.6738  0.2374906
## 0083.HK 0.7541 -0.0146296
## 0101.HK 0.7452 -0.0027500
## 0144.HK 0.7360 -0.0018141
## 0151.HK 0.4093 -0.0852901
## 0267.HK 0.7675 -0.1132002
## 0291.HK 0.6265 -0.0273812
## 0293.HK 0.6086 -0.1206303
## 0322.HK 0.3229 -0.1425519
## 0330.HK 0.3939 -0.0866283
## 0386.HK 0.6746  0.3436723
## 0388.HK 0.8456 -0.0638467
## 0494.HK 0.4820  0.0140522
## 0688.HK 0.7444 -0.2930148
## 0700.HK 0.6559 -0.0608122
## 0762.HK 0.6189  0.2182135
## 0836.HK 0.3718 -0.0020741
## 0857.HK 0.7642  0.2384636
## 0883.HK 0.8199  0.0705370
## 0939.HK 0.8447  0.0008355
## 0941.HK 0.5867  0.4207919
## 1044.HK 0.5014 -0.1169789
```

```
## 1088.HK 0.8039  0.0573159
## 1109.HK 0.7330 -0.3371470
## 1199.HK 0.7570 -0.0273540
## 1299.HK 0.6300 -0.0186769
## 1398.HK 0.8585 -0.0464807
## 1880.HK 0.6203 -0.1169575
## 1898.HK 0.7898  0.0083185
## 1928.HK 0.6532 -0.2003741
## 2318.HK 0.8233 -0.0940327
## 2388.HK 0.7763 -0.0332520
## 2600.HK 0.7730 -0.0840861
## 2628.HK 0.7875  0.0449049
## 3328.HK 0.8439 -0.0150827
## 3988.HK 0.8295 -0.0006087
```



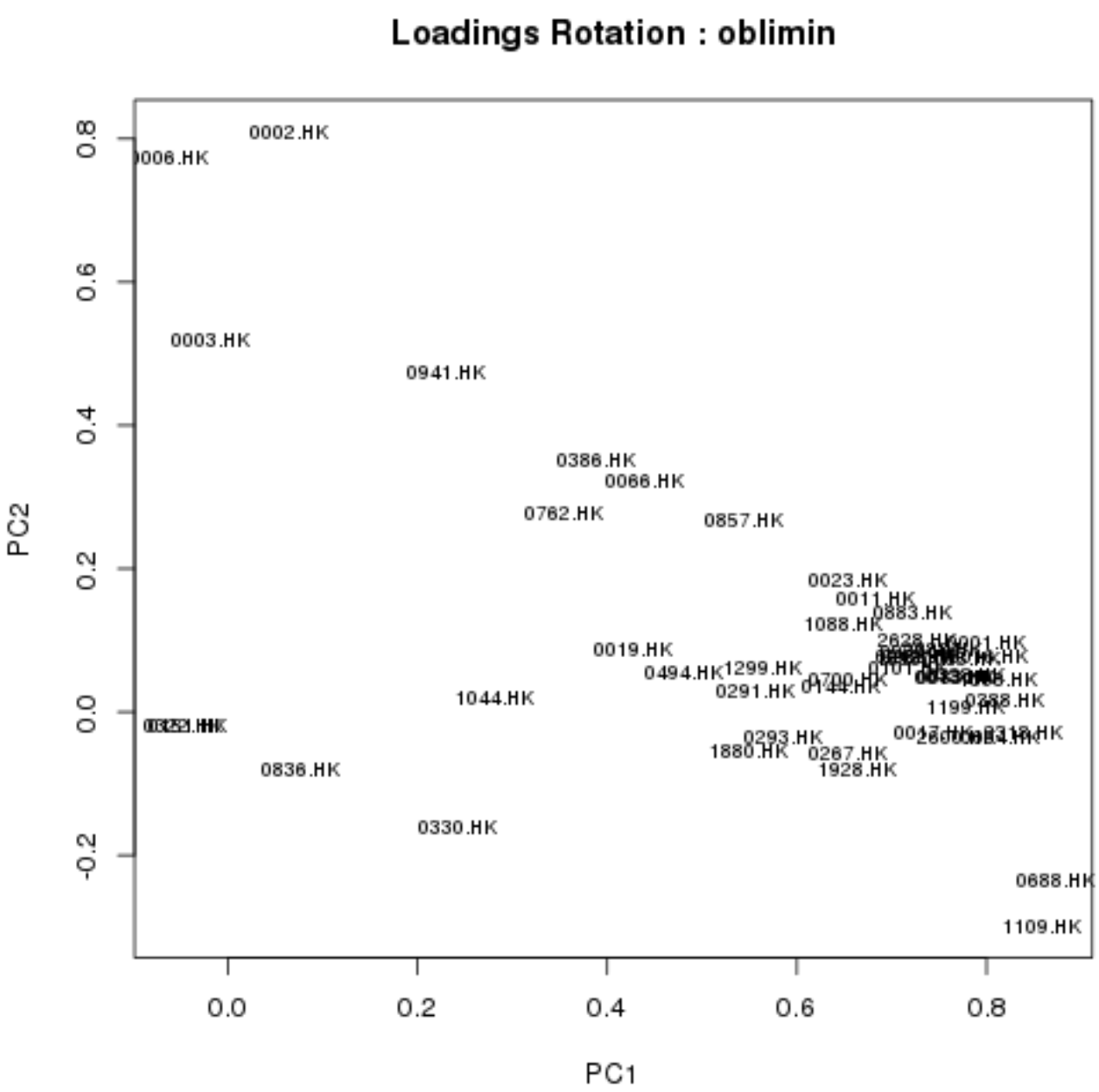
5.2.5 Rotation : oblimin

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   PC4   PC3   PC5   h2   u2
## 0688.HK   27  0.87 -0.24  0.01  0.09 -0.08 0.67 0.33
## 1109.HK   37  0.86 -0.30  0.02  0.07  0.00 0.67 0.33
## 2318.HK   44  0.84 -0.03  0.00  0.10 -0.02 0.70 0.30
## 0388.HK   25  0.82  0.02  0.03 -0.07  0.05 0.73 0.27
## 0004.HK    4  0.81 -0.04 -0.02 -0.13  0.06 0.66 0.34
## 1398.HK   40  0.81  0.04  0.08  0.10 -0.06 0.75 0.25
## 0016.HK   10  0.80  0.08 -0.11 -0.24  0.08 0.70 0.30
## 0001.HK    1  0.80  0.10  0.01 -0.23  0.10 0.79 0.21
## 1199.HK   38  0.78  0.01 -0.10  0.21  0.01 0.64 0.36
## 3328.HK   48  0.78  0.05  0.04  0.13  0.04 0.72 0.28
## 0005.HK    5  0.77  0.07 -0.02  0.09  0.02 0.66 0.34
## 0083.HK   15  0.77  0.05 -0.10 -0.19  0.12 0.65 0.35
## 2600.HK   46  0.77 -0.03  0.01  0.16  0.02 0.63 0.37
## 0013.HK    9  0.76  0.05  0.04 -0.17  0.07 0.68 0.32
## 2388.HK   45  0.75  0.09  0.09 -0.10 -0.12 0.64 0.36
## 0017.HK   11  0.74 -0.03 -0.12 -0.18  0.19 0.60 0.40
## 3988.HK   49  0.73  0.08  0.10  0.11  0.02 0.69 0.31
## 0939.HK   33  0.73  0.08  0.13  0.12  0.01 0.72 0.28
## 2628.HK   47  0.73  0.10 -0.02  0.16  0.03 0.64 0.36
## 0012.HK    8  0.72  0.08 -0.04 -0.19  0.18 0.68 0.32
## 1898.HK   42  0.72  0.08  0.04  0.14  0.01 0.64 0.36
## 0883.HK   32  0.72  0.14  0.03  0.20  0.00 0.71 0.29
## 0101.HK   16  0.72  0.06 -0.04 -0.12  0.11 0.59 0.41
## 0011.HK    7  0.68  0.16  0.09 -0.32 -0.04 0.67 0.33
## 1928.HK   43  0.66 -0.08  0.23 -0.03 -0.21 0.53 0.47
## 0267.HK   19  0.65 -0.06  0.17  0.04  0.15 0.62 0.38
## 0023.HK   13  0.65  0.18  0.17 -0.18 -0.15 0.63 0.37
## 0700.HK   28  0.65  0.05  0.12  0.11 -0.24 0.52 0.48
## 1088.HK   36  0.65  0.12  0.12  0.18  0.06 0.67 0.33
## 0144.HK   17  0.65  0.03  0.04  0.19  0.10 0.57 0.43
## 0293.HK   21  0.58 -0.03  0.13 -0.17  0.00 0.42 0.58
## 1299.HK   39  0.57  0.06  0.11 -0.03 -0.02 0.40 0.60
## 0291.HK   20  0.56  0.03  0.08  0.02  0.05 0.39 0.61
## 1880.HK   41  0.55 -0.06  0.19  0.16 -0.03 0.44 0.56
## 0857.HK   31  0.55  0.27  0.00  0.30  0.17 0.70 0.30
## 0494.HK   26  0.48  0.06 -0.03  0.14 -0.06 0.26 0.74
## 0066.HK   14  0.44  0.32  0.09 -0.13  0.16 0.55 0.45
## 0019.HK   12  0.43  0.09  0.23 -0.23  0.20 0.49 0.51
## 0386.HK   24  0.39  0.35 -0.01  0.37  0.23 0.68 0.32
## 0002.HK    2  0.06  0.81  0.06 -0.08 -0.08 0.70 0.30
## 0006.HK    6 -0.06  0.77 -0.13  0.12 -0.07 0.57 0.43
## 0003.HK    3 -0.02  0.52  0.15 -0.19  0.33 0.52 0.48
## 0941.HK   34  0.23  0.47  0.11  0.22  0.16 0.55 0.45
## 0322.HK   22 -0.05 -0.02  0.78 -0.12  0.00 0.58 0.42
## 0151.HK   18 -0.04 -0.02  0.74  0.09  0.21 0.60 0.40
## 1044.HK   35  0.28  0.02  0.55  0.02 -0.18 0.51 0.49
## 0762.HK   29  0.36  0.28  0.19  0.36 -0.01 0.55 0.45
## 0836.HK   30  0.08 -0.08  0.16  0.03  0.68 0.54 0.46
```

```
## 0330.HK   23  0.24 -0.16  0.07  0.21  0.46 0.38 0.62
##
##                  PC1  PC2  PC4  PC3  PC5
## SS loadings    20.85 3.04 2.56 1.48 1.70
## Proportion Var  0.43 0.06 0.05 0.03 0.03
## Cumulative Var  0.43 0.49 0.54 0.57 0.60
##
##  With component correlations of
##      PC1  PC2  PC4   PC3   PC5
## PC1 1.00 0.37 0.42  0.10  0.31
## PC2 0.37 1.00 0.15  0.02  0.18
## PC4 0.42 0.15 1.00  0.07  0.08
## PC3 0.10 0.02 0.07  1.00 -0.04
## PC5 0.31 0.18 0.08 -0.04  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  38.6 0.3
## The degrees of freedom for the model are 941  and the objective function was  5.67
##  0.3The number of observations was  390  with Chi Square =  2090  with prob <  5.7e-89
##  0.3
## Fit based upon off diagonal values = 0.99
##              PC1      PC2
## 0001.HK  0.80086  0.09725
## 0002.HK  0.06430  0.80977
## 0003.HK -0.01804  0.52070
## 0004.HK  0.81343 -0.03512
## 0005.HK  0.77239  0.07460
## 0006.HK -0.06093  0.77433
## 0011.HK  0.68355  0.15768
## 0012.HK  0.72397  0.07834
## 0013.HK  0.76499  0.04734
## 0016.HK  0.80334  0.07691
## 0017.HK  0.74342 -0.02831
## 0019.HK  0.42696  0.08625
## 0023.HK  0.65427  0.18458
## 0066.HK  0.44063  0.32162
## 0083.HK  0.76818  0.04844
## 0101.HK  0.71739  0.06079
## 0144.HK  0.64647  0.03471
## 0151.HK -0.04359 -0.01803
## 0267.HK  0.65475 -0.05912
## 0291.HK  0.55677  0.02991
## 0293.HK  0.58479 -0.03379
## 0322.HK -0.04723 -0.01895
## 0330.HK  0.24317 -0.15939
## 0386.HK  0.38885  0.35192
## 0388.HK  0.81975  0.01715
## 0494.HK  0.48016  0.05585
## 0688.HK  0.87401 -0.23630
## 0700.HK  0.65376  0.04703
## 0762.HK  0.35527  0.27873
## 0836.HK  0.07713 -0.08139
## 0857.HK  0.54502  0.26731
## 0883.HK  0.72117  0.13853
## 0939.HK  0.72847  0.08300
## 0941.HK  0.22977  0.47253
```

```
## 1044.HK  0.28227  0.01835
## 1088.HK  0.64901  0.12290
## 1109.HK  0.85936 -0.29873
## 1199.HK  0.77766  0.00829
## 1299.HK  0.56501  0.06271
## 1398.HK  0.81135  0.04419
## 1880.HK  0.54877 -0.05549
## 1898.HK  0.72360  0.07541
## 1928.HK  0.66263 -0.08076
## 2318.HK  0.83853 -0.02866
## 2388.HK  0.75424  0.08700
## 2600.HK  0.76764 -0.03473
## 2628.HK  0.72575  0.10166
## 3328.HK  0.77742  0.05167
## 3988.HK  0.73164  0.07766
```


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
0002.HK
0003.HK
0941.HK
0386.HK
0066.HK
0762.HK
0857.HK
0023.HK
0011.HK
0883.HK
1088.HK
0019.HK
0494.HK
1299.HK
0291.HK
1044.HK
0293.HK
1880.HK
0267.HK
1928.HK
0836.HK
0330.HK
0688.HK
1109.HK

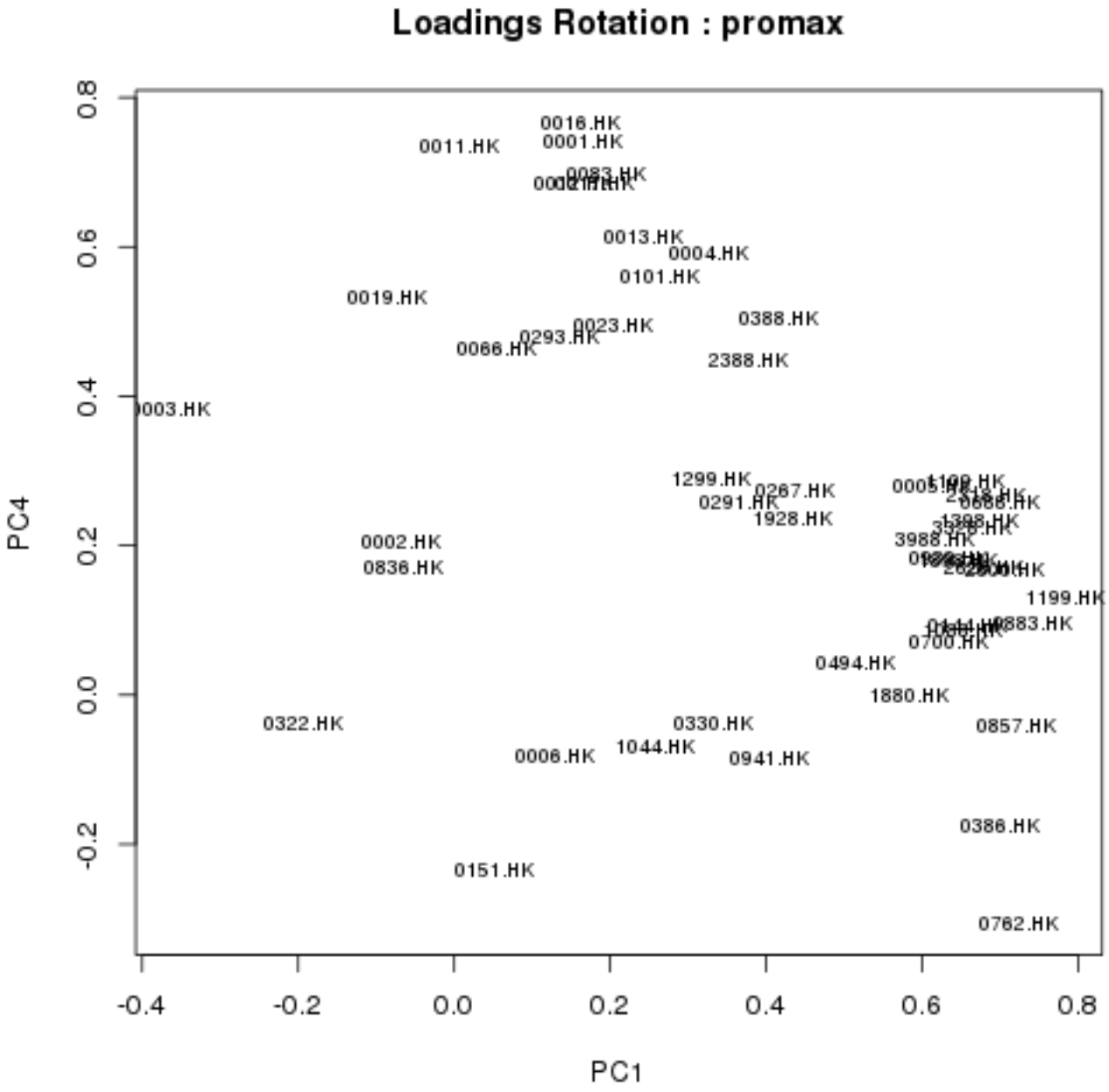
5.2.6 Rotation : promax

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
## 1199.HK   38  0.78  0.13 -0.03 -0.16  0.01 0.64 0.36
## 0883.HK   32  0.74  0.10  0.10 -0.03 -0.01 0.71 0.29
## 0762.HK   29  0.72 -0.31  0.25  0.15  0.01 0.55 0.45
## 0857.HK   31  0.72 -0.04  0.22 -0.07  0.15 0.70 0.30
## 2600.HK   46  0.71  0.17 -0.07 -0.05  0.02 0.63 0.37
## 0688.HK   27  0.70  0.26 -0.27 -0.02 -0.05 0.67 0.33
## 0386.HK   24  0.70 -0.17  0.31 -0.08  0.21 0.68 0.32
## 2318.HK   44  0.68  0.27 -0.07 -0.05 -0.02 0.70 0.30
## 2628.HK   47  0.68  0.17  0.07 -0.08  0.01 0.64 0.36
## 1398.HK   40  0.67  0.23  0.01  0.04 -0.06 0.75 0.25
## 3328.HK   48  0.66  0.22  0.01 -0.01  0.03 0.72 0.28
## 0144.HK   17  0.66  0.09 -0.01 -0.01  0.10 0.57 0.43
## 1109.HK   37  0.65  0.29 -0.34 -0.01  0.04 0.67 0.33
## 1088.HK   36  0.65  0.09  0.08  0.07  0.06 0.67 0.33
## 1898.HK   42  0.65  0.18  0.04 -0.01  0.00 0.64 0.36
## 0700.HK   28  0.63  0.07  0.04  0.09 -0.24 0.52 0.48
## 0939.HK   33  0.63  0.18  0.05  0.09  0.01 0.72 0.28
## 3988.HK   49  0.62  0.21  0.04  0.05  0.01 0.69 0.31
## 0005.HK    5  0.61  0.28  0.04 -0.08  0.00 0.66 0.34
## 1880.HK   41  0.58  0.00 -0.09  0.17  0.00 0.44 0.56
## 0494.HK   26  0.52  0.04  0.04 -0.07 -0.07 0.26 0.74
## 0267.HK   19  0.44  0.28 -0.11  0.15  0.16 0.62 0.38
## 1928.HK   43  0.43  0.24 -0.10  0.23 -0.20 0.53 0.47
## 0291.HK   20  0.36  0.26  0.00  0.05  0.05 0.39 0.61
## 1299.HK   39  0.33  0.29  0.04  0.08 -0.04 0.40 0.60
## 0016.HK   10  0.16  0.77  0.05 -0.16  0.01 0.70 0.30
## 0001.HK    1  0.17  0.74  0.06 -0.03  0.04 0.79 0.21
## 0011.HK    7  0.01  0.74  0.14  0.08 -0.11 0.67 0.33
## 0083.HK   15  0.19  0.70  0.01 -0.14  0.07 0.65 0.35
## 0017.HK   11  0.18  0.69 -0.07 -0.17  0.14 0.60 0.40
## 0012.HK    8  0.15  0.68  0.04 -0.08  0.13 0.68 0.32
## 0013.HK    9  0.24  0.61  0.01  0.01  0.04 0.68 0.32
## 0004.HK    4  0.33  0.59 -0.07 -0.06  0.03 0.66 0.34
## 0101.HK   16  0.26  0.56  0.03 -0.08  0.07 0.59 0.41
## 0019.HK   12 -0.09  0.53  0.05  0.23  0.18 0.49 0.51
## 0388.HK   25  0.42  0.51 -0.02 -0.01  0.03 0.73 0.27
## 0023.HK   13  0.20  0.49  0.17  0.16 -0.20 0.63 0.37
## 0293.HK   21  0.14  0.48 -0.06  0.13 -0.02 0.42 0.58
## 0066.HK   14  0.05  0.46  0.29  0.06  0.10 0.55 0.45
## 2388.HK   45  0.38  0.45  0.07  0.06 -0.15 0.64 0.36
## 0002.HK    2 -0.07  0.20  0.83  0.03 -0.20 0.70 0.30
## 0006.HK    6  0.13 -0.08  0.80 -0.19 -0.18 0.57 0.43
## 0003.HK    3 -0.36  0.38  0.50  0.14  0.25 0.52 0.48
## 0941.HK   34  0.40 -0.09  0.45  0.06  0.12 0.55 0.45
## 0322.HK   22 -0.19 -0.04 -0.04  0.87  0.07 0.58 0.42
## 0151.HK   18  0.05 -0.23 -0.06  0.80  0.30 0.60 0.40
## 1044.HK   35  0.26 -0.07  0.01  0.59 -0.13 0.51 0.49
## 0836.HK   30 -0.06  0.17 -0.15  0.15  0.71 0.54 0.46
## 0330.HK   23  0.33 -0.04 -0.22  0.04  0.50 0.38 0.62
```

```
##
##                  PC1  PC4  PC2  PC3  PC5
## SS loadings    13.98 9.45 2.58 2.14 1.47
## Proportion Var  0.29 0.19 0.05 0.04 0.03
## Cumulative Var  0.29 0.48 0.53 0.57 0.60
##
##  With component correlations of
##      PC1  PC4  PC2  PC3  PC5
## PC1 1.00 0.73 0.37 0.54 0.31
## PC4 0.73 1.00 0.32 0.53 0.28
## PC2 0.37 0.32 1.00 0.22 0.36
## PC3 0.54 0.53 0.22 1.00 0.07
## PC5 0.31 0.28 0.36 0.07 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  38.6 0.3
## The degrees of freedom for the model are 941  and the objective function was  5.67
##  0.3The number of observations was  390  with Chi Square =  2090  with prob <  5.7e-89
##  0.3
## Fit based upon off diagonal values = 0.99
##               PC1        PC4
## 0001.HK  0.166455  0.7398882
## 0002.HK -0.067966  0.2049652
## 0003.HK -0.362294  0.3825874
## 0004.HK  0.325082  0.5901763
## 0005.HK  0.613731  0.2802408
## 0006.HK  0.127983 -0.0815173
## 0011.HK  0.008138  0.7352622
## 0012.HK  0.152024  0.6849609
## 0013.HK  0.241941  0.6140038
## 0016.HK  0.162840  0.7668412
## 0017.HK  0.179422  0.6862393
## 0019.HK -0.085846  0.5310640
## 0023.HK  0.203572  0.4942010
## 0066.HK  0.054844  0.4630215
## 0083.HK  0.193871  0.6971277
## 0101.HK  0.264771  0.5616220
## 0144.HK  0.656938  0.0916850
## 0151.HK  0.050280 -0.2340645
## 0267.HK  0.437293  0.2751080
## 0291.HK  0.364666  0.2571842
## 0293.HK  0.136760  0.4797238
## 0322.HK -0.191999 -0.0378152
## 0330.HK  0.333881 -0.0365402
## 0386.HK  0.700107 -0.1736259
## 0388.HK  0.416169  0.5056192
## 0494.HK  0.515882  0.0437388
## 0688.HK  0.701224  0.2568224
## 0700.HK  0.633248  0.0723888
## 0762.HK  0.723332 -0.3053203
## 0836.HK -0.064683  0.1699840
## 0857.HK  0.721413 -0.0396991
## 0883.HK  0.741604  0.0967477
## 0939.HK  0.633100  0.1825782
## 0941.HK  0.402752 -0.0851471
## 1044.HK  0.258069 -0.0675952
```

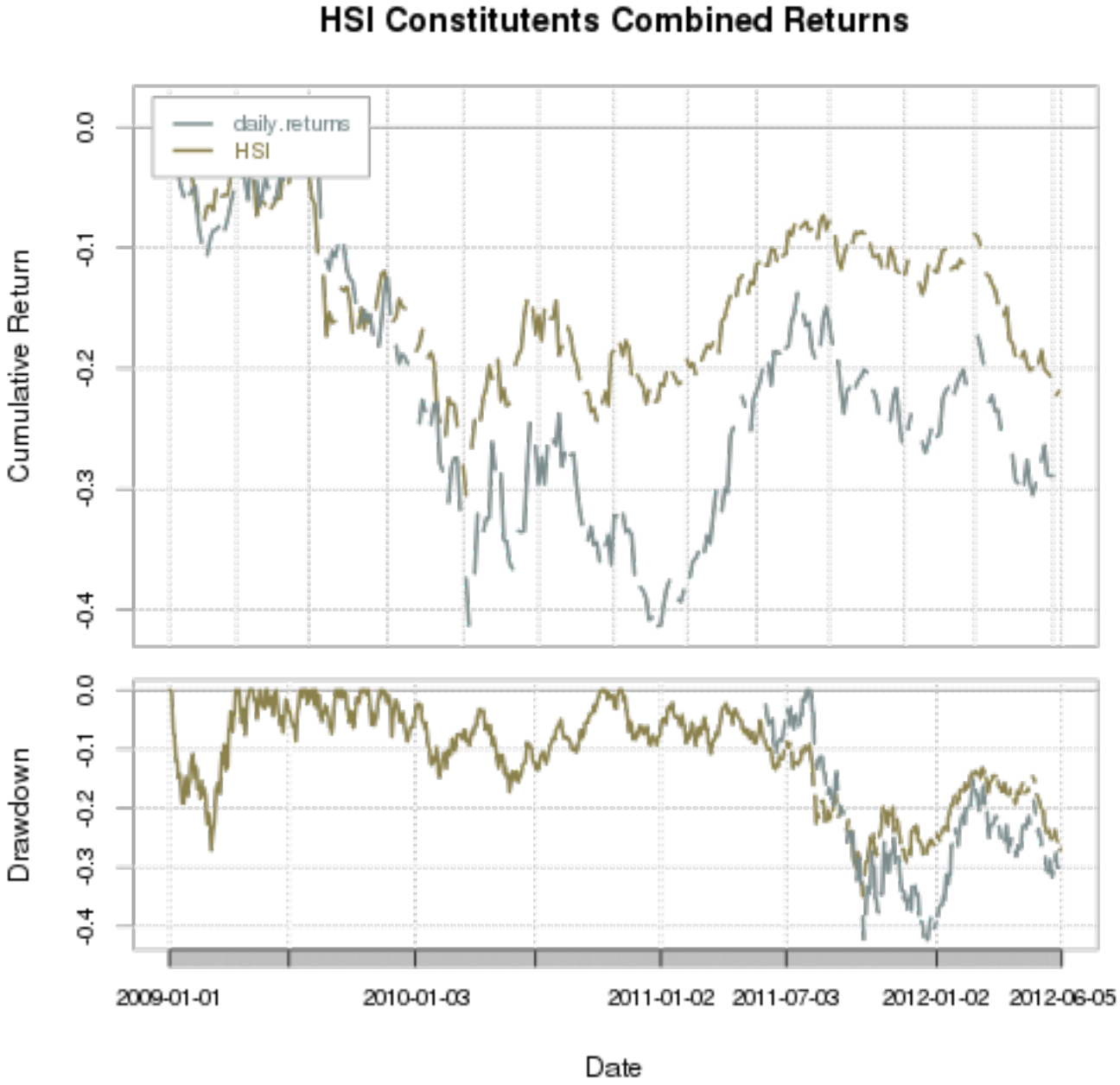
```
## 1088.HK  0.652628  0.0881967
## 1109.HK  0.653650  0.2855021
## 1199.HK  0.784753  0.1315013
## 1299.HK  0.330507  0.2888212
## 1398.HK  0.672794  0.2338700
## 1880.HK  0.583493 -0.0007914
## 1898.HK  0.647604  0.1810070
## 1928.HK  0.434505  0.2359785
## 2318.HK  0.682230  0.2688709
## 2388.HK  0.377219  0.4484986
## 2600.HK  0.707167  0.1681422
## 2628.HK  0.678916  0.1701889
## 3328.HK  0.663175  0.2243411
## 3988.HK  0.616169  0.2080731
```



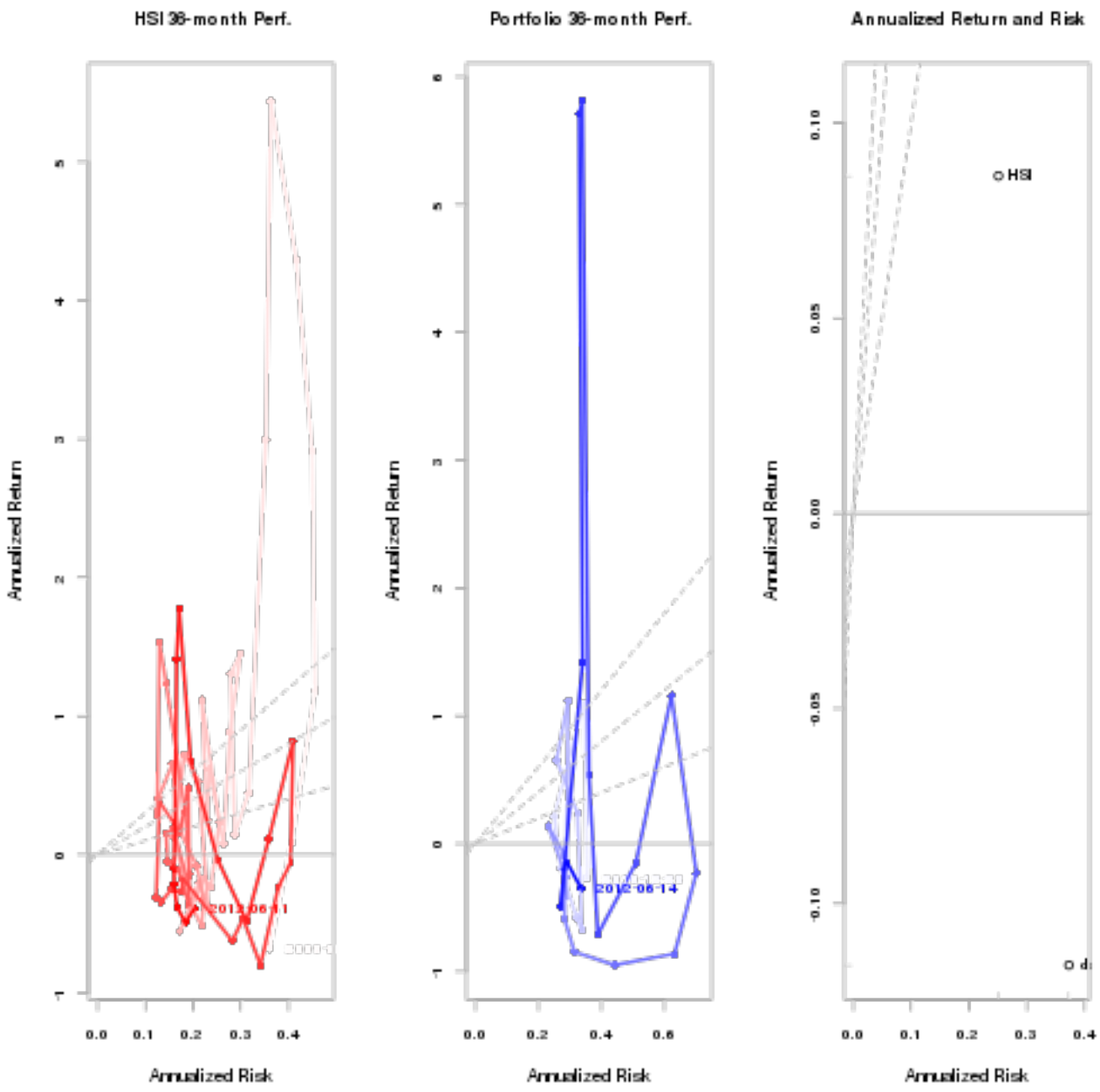
PCA is a science in itself and can not be fully covered and even less interpreted in this paper. The factors produced by principal component analysis are conceptualized as being linear combinations of the variables whereas the factors produced by common factor analysis are conceptualized as being latent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

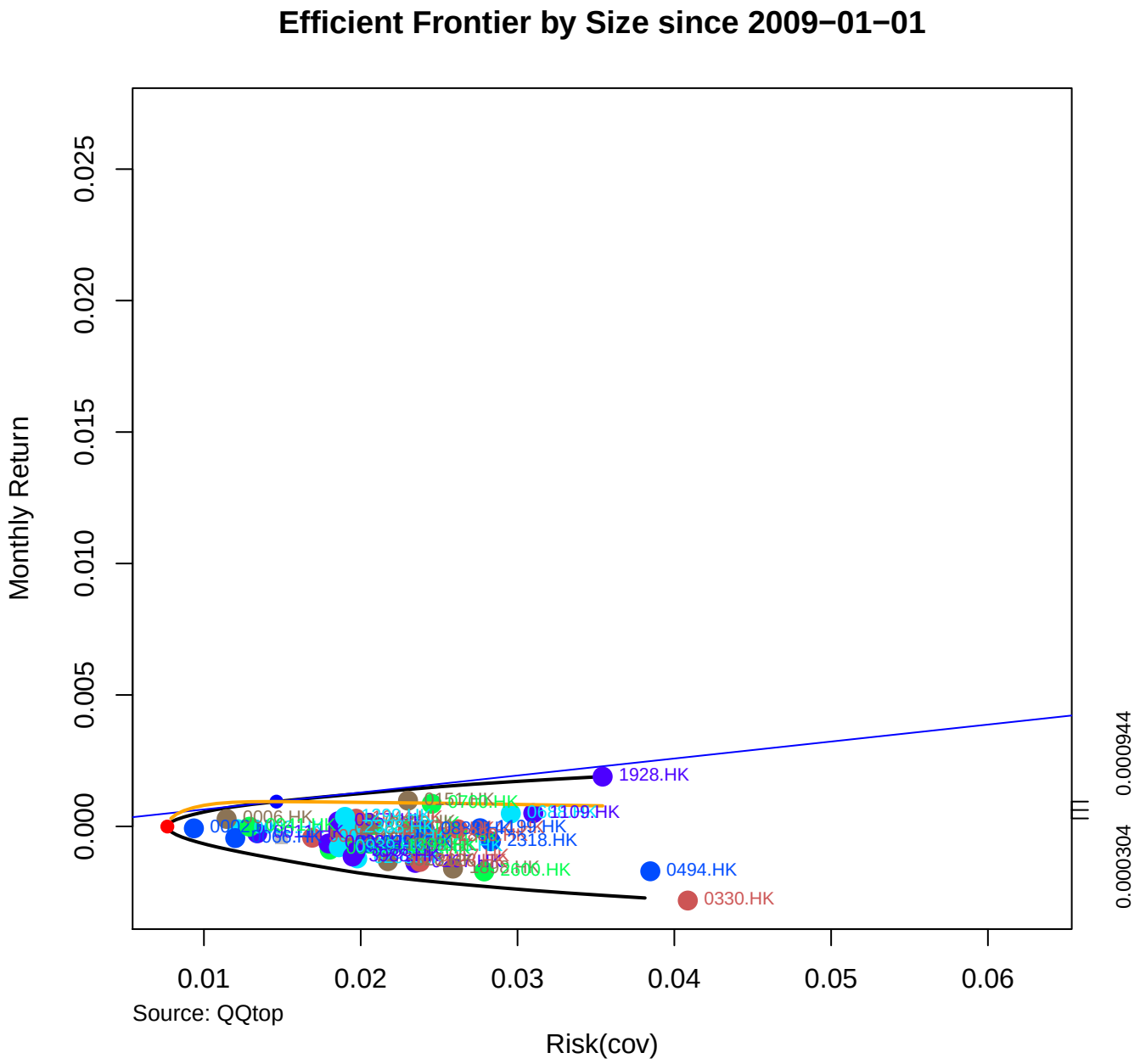
6.1 Performance Chart



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  0.0493  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
```

```
## 25  0.0000  0.3491  0.1417  0.0000  0.0000  0.0918  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.5462  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  0.0177  0.0000  0.0000  0.0000  0.0205  0.0000  0.0000  0.0000  0.0000
## 25  0.0136  0.0000  0.0000  0.0000  0.1784  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  0.2369
## 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   0.0000  0.0000  0.0000  0.0000  0.9133  0.0000  0.0000  0.0530  0.0000
## 13  0.0358  0.0000  0.3473  0.0000  0.2064  0.0000  0.0000  0.0690  0.0000
## 25  0.0000  0.0000  0.1319  0.0360  0.0465  0.0000  0.0000  0.0110  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  0.0000  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  0.0527  0.0000  0.0022  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
##    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  0.0325  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  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1621  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   0.0337  0.0000  0.0000  0.0000
## 13  0.0786  0.0450  0.0467  0.0512
## 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  0.0084  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.2874  0.1189  0.0000  0.0000  0.0585  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.3057  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  0.0109  0.0000  0.0000  0.0000  0.0077  0.0000  0.0000  0.0000  0.0000
## 25  0.0169  0.0000  0.0000  0.0000  0.1812  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  0.2919
## 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   0.0000  0.0000  0.0000  0.0000  0.9767  0.0000  0.0000  0.0141  0.0000
## 13  0.0322  0.0000  0.2795  0.0000  0.3498  0.0000  0.0000  0.0743  0.0000
## 25  0.0000  0.0000  0.1869  0.0273  0.1045  0.0000  0.0000  0.0184  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  0.0000  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  0.0588  0.0000  0.0009  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
##    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  0.0332  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  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.3427  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   0.0092  0.0000  0.0000  0.0000
## 13  0.0849  0.0396  0.0403  0.0392
## 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  -0.0027 -0.0027  0.0381  0.0381  0.0983  0.0573
## 13 -0.0016 -0.0016  0.0178  0.0178  0.0418  0.0305
## 25 -0.0004 -0.0004  0.0086  0.0086  0.0199  0.0153
## 37  0.0007  0.0007  0.0118  0.0118  0.0258  0.0169
## 49  0.0019  0.0019  0.0354  0.0354  0.0724  0.0508
##
## Description:
##  Sat Jun 16 16:25:51 2012 by user:
```

7 HSI Components Ratios

7.1 Sharpe Ratio - Combined

```
##                                daily.returns
## StdDev Sharpe (Rf=0%, p=95%):       -0.0091
## VaR Sharpe (Rf=0%, p=95%):          -0.0060
## ES Sharpe (Rf=0%, p=95%):           -0.0047
```

7.2 Sharpe - Distinct

```
##                                0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0188  0.0299  0.0310  0.0426  0.0039
## VaR Sharpe (Rf=0%, p=95%):     0.0125  0.0189  0.0181  0.0293  0.0026
## ES Sharpe (Rf=0%, p=95%):      0.0097  0.0134  0.0071  0.0230  0.0014
##                                0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0332  0.0062  0.0257  0.0364  0.0262
## VaR Sharpe (Rf=0%, p=95%):     0.0213  0.0045  0.0179  0.0250  0.0169
## ES Sharpe (Rf=0%, p=95%):      0.0149  0.0045  0.0144  0.0195  0.0114
##                                0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0170  0.0356  0.0332  0.0339  0.0249
## VaR Sharpe (Rf=0%, p=95%):     0.0112  0.0223  0.0258  0.0250  0.0165
## ES Sharpe (Rf=0%, p=95%):      0.0079  0.0132  0.0258  0.0215  0.0121
##                                0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0273  0.0290  0.0663  0.0167  0.0358
## VaR Sharpe (Rf=0%, p=95%):     0.0188  0.0193  0.0448  0.0122  0.0238
## ES Sharpe (Rf=0%, p=95%):      0.0150  0.0151  0.0340  0.0106  0.0186
##                                0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0264  0.0513 -0.0348  0.0290  0.0299
## VaR Sharpe (Rf=0%, p=95%):     0.0172  0.0428 -0.0218  0.0187  0.0214
## ES Sharpe (Rf=0%, p=95%):      0.0129  0.0428 -0.0122  0.0140  0.0177
##                                0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0216  0.0318  0.0823  0.0170  0.0079
## VaR Sharpe (Rf=0%, p=95%):     0.0183  0.0230  0.0549  0.0116  0.0051
## ES Sharpe (Rf=0%, p=95%):      0.0183  0.0194  0.0406  0.0091  0.0040
##                                0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0306  0.0435  0.0176  0.0054  0.0719
## VaR Sharpe (Rf=0%, p=95%):     0.0193  0.0286  0.0109  0.0036  0.0497
## ES Sharpe (Rf=0%, p=95%):      0.0146  0.0215  0.0076  0.0028  0.0384
##                                1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0326  0.0321  0.0223  0.0243  0.0109
## VaR Sharpe (Rf=0%, p=95%):     0.0206  0.0236  0.0153  0.0154  0.0077
## ES Sharpe (Rf=0%, p=95%):      0.0158  0.0202  0.0121  0.0089  0.0063
##                                1880.HK 1898.HK 1928.HK 2318.HK 2388.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0652  0.0162  0.0653  0.0314  0.0606
## VaR Sharpe (Rf=0%, p=95%):     0.0466  0.0100  0.0533  0.0210  0.0437
## ES Sharpe (Rf=0%, p=95%):      0.0370  0.0067  0.0533  0.0150  0.0353
##                                2600.HK 2628.HK 3328.HK 3988.HK
## StdDev Sharpe (Rf=0%, p=95%):  0.0021 -0.0031  0.0025  0.0249
## VaR Sharpe (Rf=0%, p=95%):     0.0014 -0.0019  0.0016  0.0164
## ES Sharpe (Rf=0%, p=95%):      0.0011 -0.0013  0.0012  0.0118
```

7.3 Information Ratio - Combined

```
## [1] "Information Ratio :  0.0042"
```

7.4 Information Ratio - Distinct

```
##                        0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK
## Information Ratio: HSI -0.0962 -0.1004  0.0208  0.2729 -0.2839 -0.0171
##                        0011.HK 0012.HK 0013.HK 0016.HK 0017.HK 0019.HK
## Information Ratio: HSI -0.2736  0.0036   0.154  0.0044   -0.12  0.1357
```

```
##                         0023.HK 0066.HK 0083.HK 0101.HK 0144.HK 0151.HK
## Information Ratio: HSI  0.1087  0.0467 -0.0071   0.029  0.0529  0.6456
##                         0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK
## Information Ratio: HSI -0.1242  0.1496    0.01  0.3869 -0.7482  0.0431
##                         0388.HK 0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Information Ratio: HSI  0.0613 -0.1015  0.0986   1.005 -0.1128 -0.2352
##                         0857.HK 0883.HK 0939.HK 0941.HK 1044.HK 1088.HK
## Information Ratio: HSI   0.065   0.277 -0.1154 -0.2654  0.7686  0.1063
##                         1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK
## Information Ratio: HSI  0.1048 -0.0513  0.5439 -0.1996  0.7071 -0.1361
##                         1928.HK 2318.HK 2388.HK 2600.HK 2628.HK 3328.HK
## Information Ratio: HSI  0.9609   0.092  0.5481 -0.3296 -0.3647  -0.315
##                         3988.HK
## Information Ratio: HSI -0.0123
```

8 HSI Components Table Latest Quotes

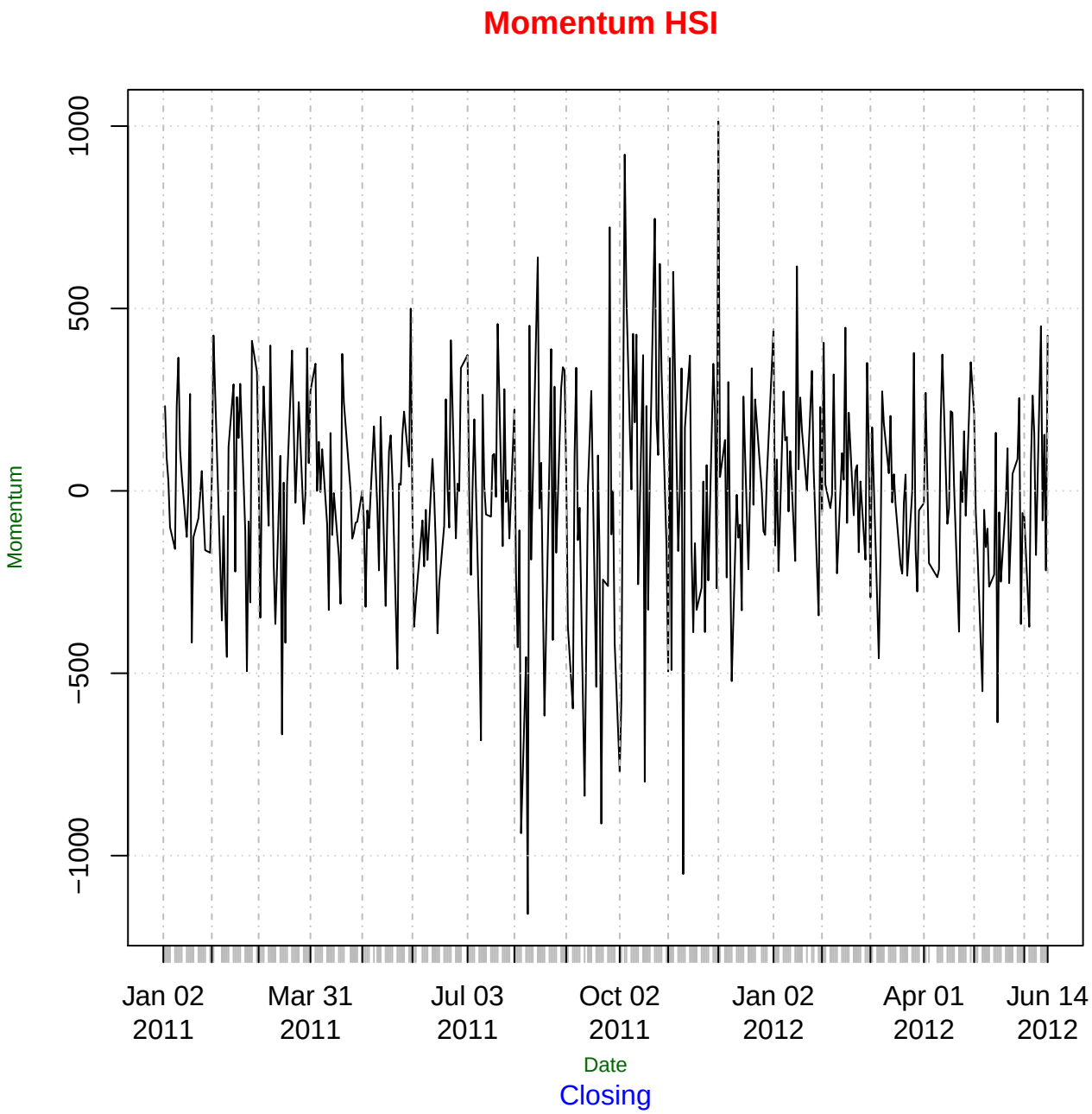
```
## [1] "Date :  2012-06-15 03:59:00"
##                    Name    Bid    Ask Change   52-week Range
## 0001.HK     CHEUNG KONG  92.30  92.50   2.80  79.10 - 122.40
## 0002.HK    CLP HOLDINGS  63.65  63.75   0.75   62.10 - 75.20
## 0003.HK  HK & CHINA GAS  16.42  16.46   0.28   16.02 - 20.65
## 0004.HK  WHARF HOLDINGS  41.80  42.10   0.00   33.15 - 59.00
## 0005.HK   HSBC HOLDINGS  66.70  66.75   1.55   56.00 - 78.85
## 0006.HK    POWER ASSETS  55.65  56.00   0.55   52.55 - 64.80
## 0011.HK  HANG SENG BANK 103.50 104.00   1.10  84.40 - 125.00
## 0012.HK  HENDERSON LAND  40.95  41.15   0.90   33.20 - 51.05
## 0013.HK       HUTCHISON  65.85  65.90   2.45   53.60 - 93.10
## 0016.HK         SHK PPT  90.05  90.45   1.20  85.30 - 122.00
## 0017.HK   NEW WORLD DEV   8.97   9.00  -0.04    6.13 - 12.30
## 0019.HK SWIRE PACIFIC A  88.15  88.40   1.90  75.10 - 116.00
## 0023.HK  BANK OF E ASIA  26.00  26.15   0.70   21.85 - 32.70
## 0066.HK MTR CORPORATION  25.15  25.25   0.35   22.45 - 28.00
## 0083.HK       SINO LAND  11.08  11.14   0.16    9.28 - 14.16
## 0101.HK   HANG LUNG PPT  25.40  25.50   0.25   20.85 - 32.95
## 0144.HK  CHINA MER HOLD  22.10  22.20   0.05   19.00 - 30.85
## 0151.HK WANT WANT CHINA   9.57   9.68   0.50    6.03 - 10.24
## 0267.HK   CITIC PACIFIC  11.10  11.12   0.10   10.26 - 20.10
## 0291.HK CHINA RESOURCES  23.00  23.25   0.40   22.20 - 35.50
## 0293.HK  CATHAY PAC AIR  12.06  12.20   0.20   11.76 - 18.88
## 0322.HK          TINGYI  19.04  19.10   0.32   17.84 - 26.00
## 0330.HK ESPRIT HOLDINGS  10.10  10.12   0.91    7.55 - 25.75
## 0386.HK    SINOPEC CORP   7.06   7.10   0.16     6.22 - 9.67
## 0388.HK            HKEX 112.40 112.50   2.90  99.15 - 170.00
## 0494.HK       LI & FUNG  15.06  15.22   0.38   10.82 - 20.15
## 0688.HK  CHINA OVERSEAS  17.68  17.70   0.50    9.99 - 17.86
## 0700.HK         TENCENT 229.40 230.80   5.20 139.80 - 248.80
## 0762.HK    CHINA UNICOM  10.90  10.98   0.18    9.95 - 17.64
## 0836.HK CHINA RES POWER  14.36  14.38   0.06   10.82 - 16.20
## 0857.HK      PETROCHINA  10.48  10.56   0.24    8.59 - 11.92
## 0883.HK           CNOOC  15.16  15.18   0.56   11.20 - 18.64
## 0939.HK             CCB   5.27   5.30   0.14     4.41 - 6.71
## 0941.HK    CHINA MOBILE  79.80  80.10   1.50   68.20 - 89.85
## 1044.HK    HENGAN INT'L  78.30  78.90   0.40   56.80 - 83.45
## 1088.HK   CHINA SHENHUA  27.35  27.50   0.85   24.15 - 40.20
## 1109.HK  CHINA RES LAND  15.64  15.76   0.28    7.28 - 15.76
## 1199.HK   COSCO PACIFIC   9.90   9.96   0.22    7.52 - 14.58
## 1299.HK             AIA  25.90  26.05   0.15   19.84 - 29.90
## 1398.HK            ICBC   4.44   4.45   0.14     3.46 - 6.06
## 1880.HK     BELLE INT'L  12.24  12.26   0.26   11.38 - 17.54
## 1898.HK      CHINA COAL   6.83   6.86   0.02    6.50 - 11.66
## 1928.HK SANDS CHINA LTD  24.95  25.05  -0.50   14.90 - 33.05
## 2318.HK         PING AN  61.00  61.20   1.00   37.35 - 83.75
## 2388.HK   BOC HONG KONG  23.30  23.40   1.10   14.24 - 24.45
## 2600.HK          CHALCO   3.24   3.25   0.06     3.07 - 6.83
## 2628.HK      CHINA LIFE  19.22  19.28   0.40   17.04 - 28.10
## 3328.HK        BANKCOMM   5.17   5.18   0.18     4.15 - 7.61
## 3988.HK   BANK OF CHINA   2.86   2.87   0.07     2.20 - 3.88
```

9 Hang Seng Index

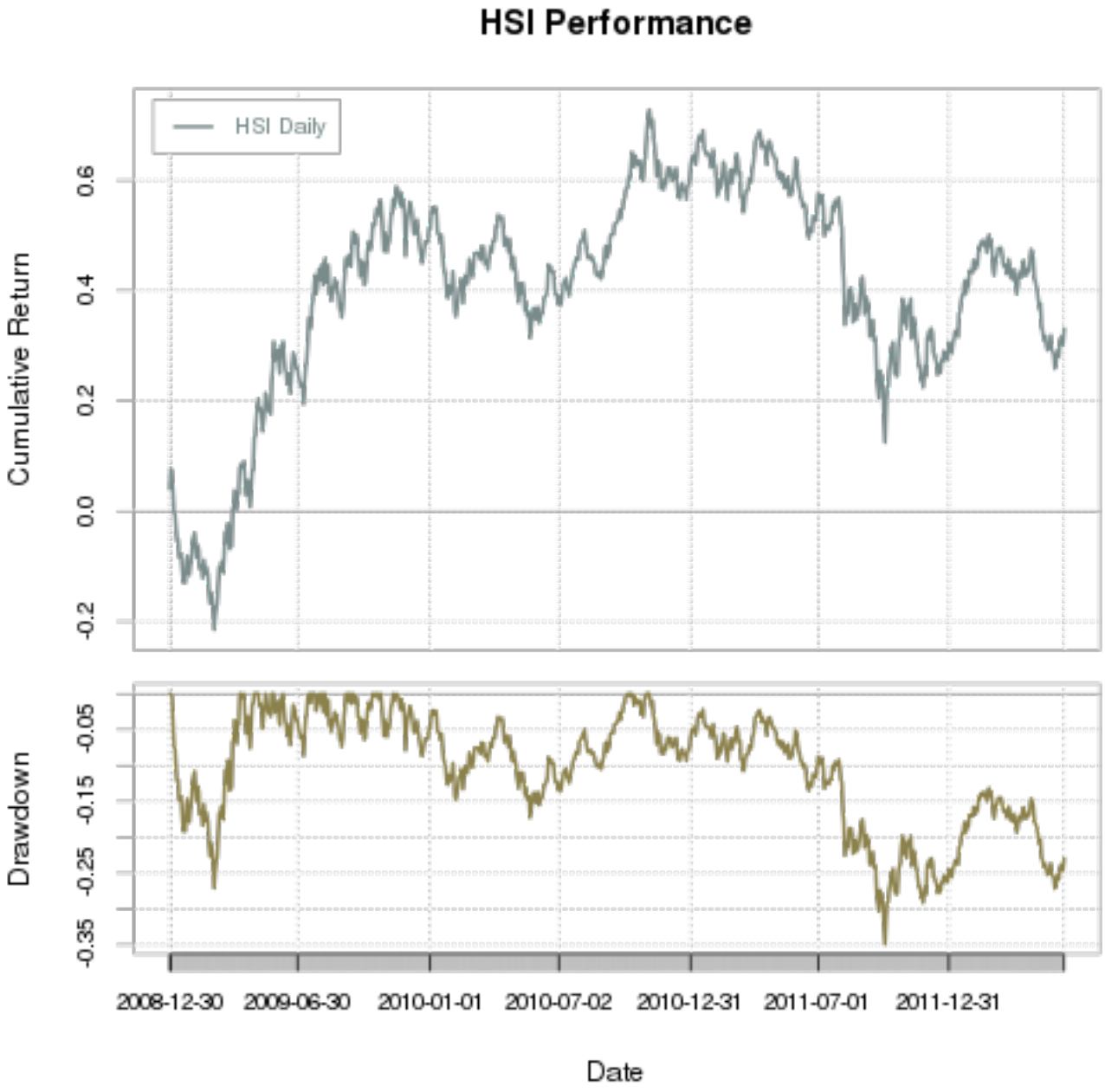
Latest Hang Seng Index

	Trade Time	Name	Last	Change	Days Range	52−week Range
^HSI	2012−06−15 04:01:00	HANG SENG INDEX	19234	425.5	18919.17 − 19254.561	16170.30 − 22835.00

9.1 Hang Seng Index - Momentum

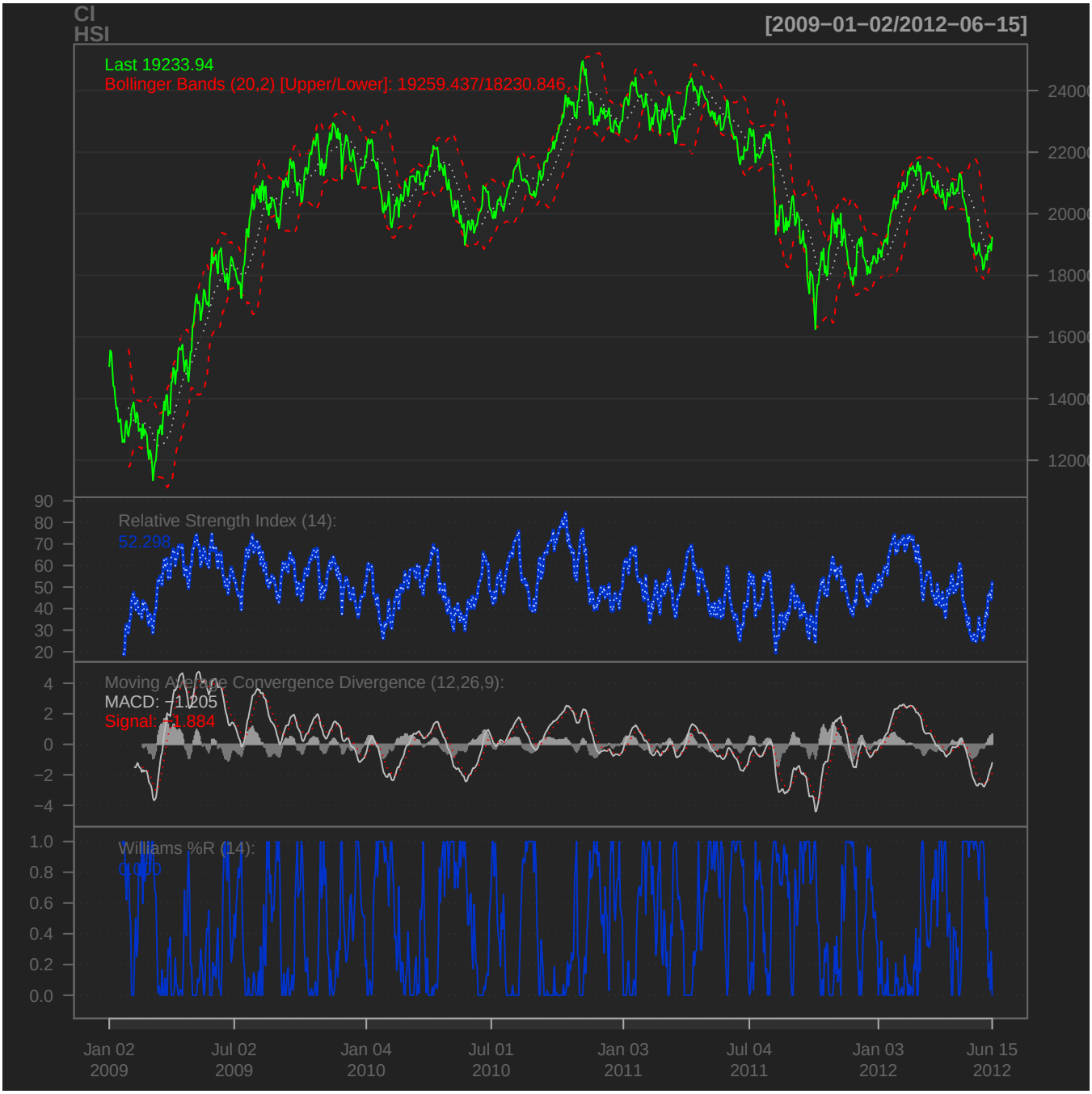


9.2 HSI Performance

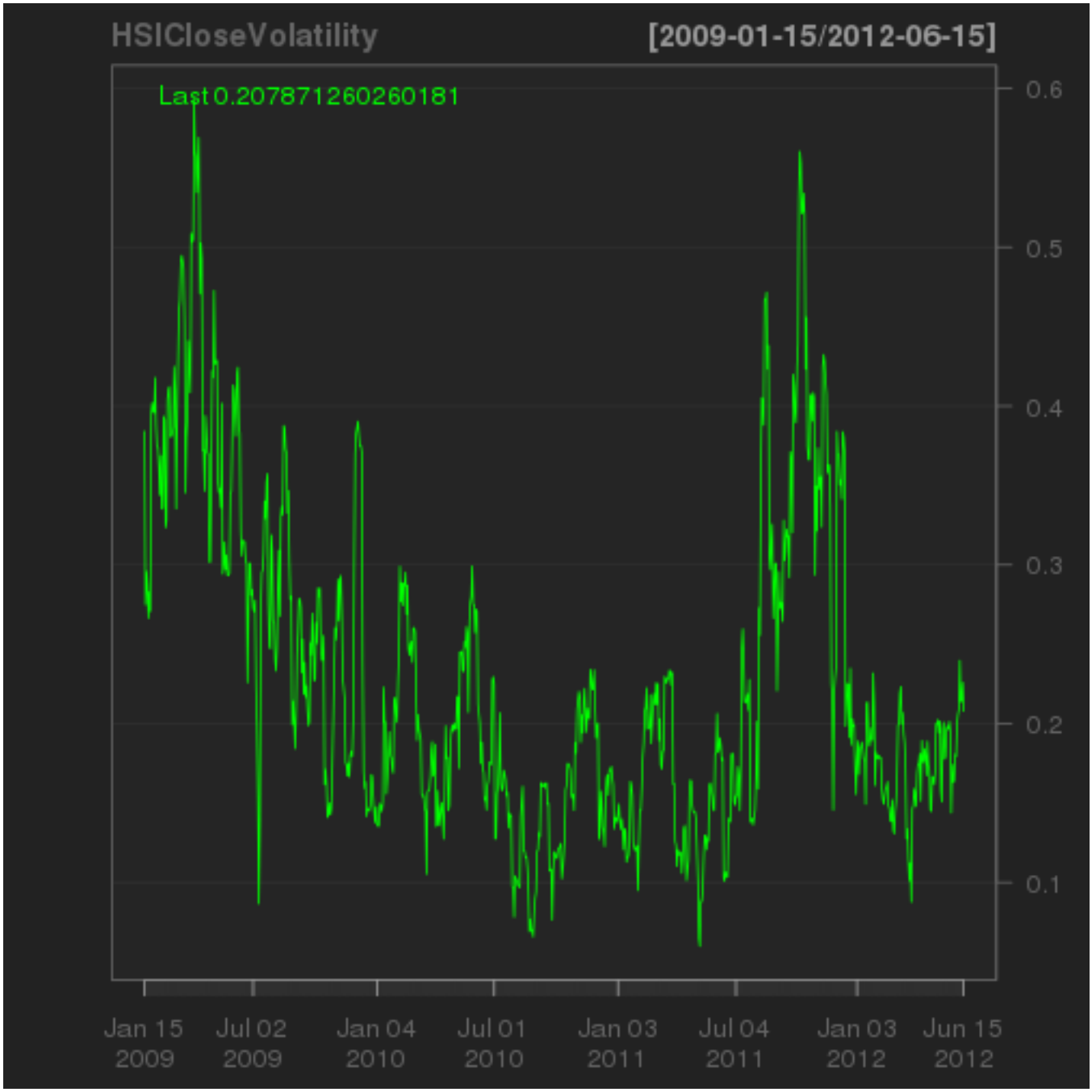


9.3 HSI Ratios

```
##                RSI
## 2012-06-03 25.28
## 2012-06-04 27.46
## 2012-06-05 34.76
## 2012-06-06 38.77
## 2012-06-07 36.11
## 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
##                macd signal
## 2012-06-03 -2.734 -2.482
## 2012-06-04 -2.780 -2.542
## 2012-06-05 -2.675 -2.568
## 2012-06-06 -2.496 -2.554
## 2012-06-07 -2.402 -2.523
## 2012-06-10 -2.110 -2.441
## 2012-06-11 -1.891 -2.331
## 2012-06-12 -1.632 -2.191
## 2012-06-13 -1.503 -2.053
## 2012-06-14 -1.205 -1.884
## [1] "BBands"
##                 dn  mavg    up   pctB
## 2012-06-03 17908 19205 20501 0.1069
## 2012-06-04 17876 19094 20311 0.1573
## 2012-06-05 17903 19003 20103 0.2806
## 2012-06-06 17973 18926 19878 0.3701
## 2012-06-07 18013 18852 19692 0.2915
## 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
##               WPR %
## 2012-06-03 100.00
## 2012-06-04  92.77
## 2012-06-05  61.50
## 2012-06-06  43.36
## 2012-06-07  63.59
## 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
```


CI
HSI
[2009−01−02/2012−06−15]
Last 19233.94
Bollinger Bands (20,2) [Upper/Lower]: 19259.437/18230.846
Relative Strength Index (14):
52.298
Moving Average Convergence Divergence (12,26,9):
MACD: −1.205
Signal: −1.884
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 15 2012

9.4 HSI Volatility



9.5 HSI Statistics

```
##                                HSI-Daily HSI-Monthly
## StdDev Sharpe (Rf=0%, p=95%):   0.02870     0.11777
## VaR Sharpe (Rf=0%, p=95%):      0.01852     0.07904
## ES Sharpe (Rf=0%, p=95%):       0.01365     0.06252
##          HSI-Daily HSI-Monthly
## Skewness     0.125     0.06005
##          HSI-Daily HSI-Monthly
## Kurtosis     1.494     -0.1475
```

```
##      Index              HSI Daily
##  Min.   :2008-12-31   Min.   :-5.66e-02
##  1st Qu.:2009-11-09   1st Qu.:-8.12e-03
##  Median :2010-09-19   Median : 6.01e-05
##  Mean   :2010-09-21   Mean   : 4.53e-04
##  3rd Qu.:2011-07-31   3rd Qu.: 9.94e-03
##  Max.   :2012-06-13   Max.   : 7.41e-02
##      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   : 0.00825
##  3rd Qu.:2011-08-20   3rd Qu.: 0.03680
##  Max.   :2012-06-13   Max.   : 0.17074
```

10 Dataset First and Last Rows Info

```
##            X0001.HK.Close
## 2009-01-02           76.9
## 2012-06-14           89.5
##            X0002.HK.Close
## 2009-01-02          52.40
## 2012-06-14          63.15
##            X0003.HK.Close
## 2009-01-02          12.08
## 2012-06-14          16.26
##            X0004.HK.Close
## 2009-01-02           22.0
## 2012-06-14           42.1
##            X0005.HK.Close
## 2009-01-02          77.00
## 2012-06-14          65.25
##            X0006.HK.Close
## 2009-01-02          42.75
## 2012-06-14          55.45
##            X0011.HK.Close
## 2009-01-02          104.7
## 2012-06-14          102.9
##            X0012.HK.Close
## 2009-01-02          30.35
## 2012-06-14          40.10
##            X0013.HK.Close
## 2009-01-02          39.85
## 2012-06-14          63.35
##            X0016.HK.Close
## 2009-01-02           67.3
## 2012-06-14           89.0
##            X0017.HK.Close
## 2009-01-02           8.18
## 2012-06-14           8.94
##            X0019.HK.Close
## 2009-01-02          55.75
## 2012-06-14          86.40
##            X0023.HK.Close
## 2009-01-02          16.68
## 2012-06-14          25.35
##            X0066.HK.Close
## 2009-01-02          18.08
## 2012-06-14          24.90
##            X0083.HK.Close
## 2009-01-02           8.36
## 2012-06-14          10.90
##            X0101.HK.Close
## 2009-01-02          18.36
## 2012-06-14          25.25
##            X0144.HK.Close
## 2009-01-02           15.4
## 2012-06-14           22.1
##            X0151.HK.Close
## 2009-01-02           3.17
## 2012-06-14           9.17
##            X0267.HK.Close
```

```
## 2009-01-02          10.20
## 2012-06-14          11.02
##            X0291.HK.Close
## 2009-01-02           14.0
## 2012-06-14           22.7
##            X0293.HK.Close
## 2009-01-02           8.91
## 2012-06-14          11.90
##            X0322.HK.Close
## 2009-01-02           8.98
## 2012-06-14          18.72
##            X0330.HK.Close
## 2009-01-02          44.80
## 2012-06-14           9.23
##            X0386.HK.Close
## 2009-01-02           4.96
## 2012-06-14           6.89
##            X0388.HK.Close
## 2009-01-02           76.6
## 2012-06-14          109.5
##            X0494.HK.Close
## 2009-01-02          14.04
## 2012-06-14          14.82
##            X0688.HK.Close
## 2009-01-02          11.22
## 2012-06-14          17.20
##            X0700.HK.Close
## 2009-01-01             50
## 2012-06-14            225
##            X0762.HK.Close
## 2009-01-01           9.63
## 2012-06-14          10.76
##            X0836.HK.Close
## 2009-01-02          15.12
## 2012-06-14          14.40
##            X0857.HK.Close
## 2009-01-02           7.20
## 2012-06-14          10.28
##            X0883.HK.Close
## 2009-01-02           7.59
## 2012-06-14          14.64
##            X0939.HK.Close
## 2009-01-02           4.52
## 2012-06-14           5.14
##            X0941.HK.Close
## 2009-01-02          81.20
## 2012-06-14          78.45
##            X1044.HK.Close
## 2009-01-01           24.9
## 2012-06-14           78.2
##            X1088.HK.Close
## 2009-01-02          17.40
## 2012-06-14          26.55
##            X1109.HK.Close
## 2009-01-02           9.90
## 2012-06-14          15.46
##            X1199.HK.Close
```

```
## 2009-01-02           8.07
## 2012-06-14           9.72
##            X1299.HK.Close
## 2010-10-29          23.10
## 2012-06-14          25.85
##            X1398.HK.Close
## 2009-01-02           4.30
## 2012-06-14           4.31
##            X1880.HK.Close
## 2009-01-02           3.50
## 2012-06-14          11.96
##            X1898.HK.Close
## 2009-01-02           6.55
## 2012-06-14           6.82
##            X1928.HK.Close
## 2009-11-30           9.31
## 2012-06-14          25.50
##            X2318.HK.Close
## 2009-01-02           39.6
## 2012-06-14           59.9
##            X2388.HK.Close
## 2009-01-02           9.06
## 2012-06-14          22.20
##            X2600.HK.Close
## 2009-01-02           4.55
## 2012-06-14           3.18
##            X2628.HK.Close
## 2009-01-02          24.75
## 2012-06-14          18.88
##            X3328.HK.Close
## 2009-01-02           5.91
## 2012-06-14           5.00
##            X3988.HK.Close
## 2009-01-02           2.17
## 2012-06-14           2.81
```

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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