CAPM and other Statistics for HSI Components Version 1.1

QQtop*
Department of R Dabbling
QQtop Laboratory Hong Kong
noemail.address@gmail.com

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Contents

1 Introduction **3**

2 CAPM Analysis **4**
2.1 HSI Components CAPM with HSI as benchmark 4

3 HSI Components Risk **9**
3.1 Correlation 9
3.2 Autocorrelation Coefficients - Combined 12
3.3 Downside Risk - Combined 13
3.4 Drawdowns - Combined 14
3.5 Downside Deviation - Combined 15
3.6 Autocorrelation Coefficients - Distinct 15
3.7 Downside Deviation - Distinct 16

4 General Statistics **17**
4.1 Higher Moments - Combined 20

5 Principal Components Analysis **21**
5.1 PCA with stats package princomp function 22
5.2 PCA with psyche package principal Function 31
5.2.1 Rotation : none 32
5.2.2 Rotation : varimax 35
5.2.3 Rotation : quatimax 38
5.2.4 Rotation : simplimax 41
5.2.5 Rotation : oblimin 45
5.2.6 Rotation : promax 49

6 HSI Components Performance **53**
6.1 Performance Chart 53
6.2 Performance SnailTrail Chart 54
6.3 HSI Components Frontier 55

7 HSI Components Ratios **58**
7.1 Sharpe Ratio - Combined 58
7.2 Sharpe - Distinct 59
7.3 Information Ratio - Combined 59
7.4 Information Ratio - Distinct 60

8 HSI Components Table Latest Quotes **61**

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†Itself

9 Hang Seng Index **62**
9.1 Hang Seng Index - Momentum 63
9.2 HSI Performance 64
9.3 HSI Ratios 65
9.4 HSI Volatility 67
9.5 HSI Statistics 68

10 Dataset First and Last Rows Info **69**

11 Notes **72**

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

```
##                      HSI Components to HSI
## Alpha                              -0.0002
## Beta                               -0.0230
## Beta+                              -0.4626
## Beta-                               0.3870
## R-squared                           0.0002
## Annualized Alpha                   -0.0540
## Correlation                        -0.0152
## Correlation p-value                 0.8546
## Tracking Error                      0.4980
## Active Premium                     -0.0308
## Information Ratio                  -0.0619
## Treynor Ratio                       5.6121
```

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

CAPM - Distinct for each stock

	X0001.HK to HSI	X0002.HK to HSI	X0003.HK to HSI
Alpha	0.000	0.000	0.001
Beta	1.032	0.220	0.298
Beta+	1.076	0.006	-0.087
Beta-	1.037	0.257	0.511
R-squared	0.768	0.130	0.189
Annualized Alpha	0.031	0.091	0.183
Correlation	0.876	0.360	0.434
Correlation p-value	0.000	0.000	0.000
Tracking Error	0.160	0.273	0.264
Active Premium	0.010	0.196	0.269
Information Ratio	0.062	0.720	1.020
Treynor Ratio	-0.135	0.213	0.403
	X0004.HK to HSI	X0005.HK to HSI	X0006.HK to HSI
Alpha	0.000	0.000	0.000
Beta	1.192	1.013	0.130
Beta+	1.268	0.914	-0.136
Beta-	1.190	1.118	0.204
R-squared	0.633	0.809	0.030
Annualized Alpha	-0.091	-0.069	0.103
Correlation	0.796	0.899	0.173
Correlation p-value	0.000	0.000	0.016
Tracking Error	0.262	0.139	0.322
Active Premium	-0.131	-0.068	0.211
Information Ratio	-0.502	-0.493	0.654
Treynor Ratio	-0.236	-0.215	0.473
	X0011.HK to HSI	X0012.HK to HSI	X0013.HK to HSI
Alpha	0.000	0.000	0.000
Beta	0.670	1.008	1.041
Beta+	0.637	0.980	1.031
Beta-	0.759	0.994	1.163
R-squared	0.596	0.623	0.709
Annualized Alpha	-0.058	0.028	-0.026
Correlation	0.772	0.789	0.842
Correlation p-value	0.000	0.000	0.000
Tracking Error	0.181	0.221	0.189
Active Premium	-0.008	0.002	-0.044
Information Ratio	-0.047	0.008	-0.231
Treynor Ratio	-0.235	-0.146	-0.185
	X0016.HK to HSI	X0017.HK to HSI	X0019.HK to HSI
Alpha	0.000	-0.001	-0.001
Beta	0.929	1.081	0.690
Beta+	0.992	0.662	0.733
Beta-	0.876	1.413	0.609
R-squared	0.738	0.463	0.330
Annualized Alpha	0.123	-0.170	-0.235
Correlation	0.859	0.680	0.574
Correlation p-value	0.000	0.000	0.000
Tracking Error	0.158	0.329	0.291
Active Premium	0.107	-0.195	-0.188
Information Ratio	0.677	-0.591	-0.644
Treynor Ratio	-0.046	-0.318	-0.488
	X0023.HK to HSI	X0066.HK to HSI	X0083.HK to HSI
Alpha	0.000	0.000	0.001
Beta	0.887	0.516	1.157

```
## Beta+                          1.051           0.486           1.281
## Beta-                          0.802           0.554           1.333
## R-squared                      0.537           0.445           0.594
## Annualized Alpha               0.031           0.028           0.251
## Correlation                    0.733           0.667           0.771
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.235           0.212           0.273
## Active Premium                 0.023           0.092           0.142
## Information Ratio              0.096           0.434           0.518
## Treynor Ratio                 -0.143          -0.111          -0.007
##                      X0101.HK to HSI X0144.HK to HSI X0151.HK to HSI
## Alpha                          0.000           0.000           0.002
## Beta                           1.068           1.173           0.660
## Beta+                          1.113           1.249           0.563
## Beta-                          1.077           1.150           0.805
## R-squared                      0.585           0.574           0.220
## Annualized Alpha              -0.013          -0.075           0.480
## Correlation                    0.765           0.758           0.470
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.254           0.289           0.363
## Active Premium                -0.049          -0.122           0.412
## Information Ratio             -0.192          -0.420           1.136
## Treynor Ratio                 -0.186          -0.231           0.399
##                      X0267.HK to HSI X0291.HK to HSI X0293.HK to HSI
## Alpha                         -0.002           0.000           0.000
## Beta                           1.214           0.708           0.746
## Beta+                          1.469           0.687           0.965
## Beta-                          1.005           0.858           0.664
## R-squared                      0.582           0.374           0.405
## Annualized Alpha              -0.338           0.032          -0.125
## Correlation                    0.763           0.611           0.637
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.297           0.271           0.265
## Active Premium                -0.335           0.047          -0.094
## Information Ratio             -1.129           0.173          -0.355
## Treynor Ratio                 -0.399          -0.145          -0.326
##                      X0322.HK to HSI X0330.HK to HSI X0386.HK to HSI
## Alpha                          0.000           0.000           0.001
## Beta                           0.449           1.107           0.784
## Beta+                          0.641           1.060           0.701
## Beta-                          0.418           1.246           0.610
## R-squared                      0.132           0.149           0.477
## Annualized Alpha               0.076          -0.105           0.378
## Correlation                    0.364           0.386           0.691
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.360           0.748           0.239
## Active Premium                 0.108          -0.288           0.340
## Information Ratio              0.300          -0.385           1.420
## Treynor Ratio                 -0.092          -0.395           0.243
##                      X0388.HK to HSI X0494.HK to HSI X0688.HK to HSI
## Alpha                          0.000           0.001           0.001
## Beta                           1.102           1.225           1.619
## Beta+                          1.141           1.126           2.323
## Beta-                          1.095           0.937           1.335
## R-squared                      0.698           0.444           0.590
## Annualized Alpha              -0.103           0.278           0.387
## Correlation                    0.835           0.666           0.768
```

```
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.207           0.392           0.419
## Active Premium               -0.118           0.113           0.107
## Information Ratio            -0.572           0.287           0.255
## Treynor Ratio                -0.243          -0.030          -0.026
##                      X0700.HK to HSI X0762.HK to HSI X0836.HK to HSI
## Alpha                         0.000           0.000           0.000
## Beta                          1.070           0.953           0.467
## Beta+                         1.347           1.042           0.269
## Beta-                         0.919           0.940           0.633
## R-squared                     0.551           0.453           0.130
## Annualized Alpha              0.045          -0.052           0.110
## Correlation                   0.742           0.673           0.360
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.274           0.296           0.373
## Active Premium               -0.006          -0.071           0.130
## Information Ratio            -0.021          -0.239           0.349
## Treynor Ratio                -0.145          -0.231          -0.041
##                      X0857.HK to HSI X0883.HK to HSI X0939.HK to HSI
## Alpha                         0.001           0.000           0.000
## Beta                          0.930           1.405           1.099
## Beta+                         0.857           1.680           1.121
## Beta-                         0.948           1.429           1.092
## R-squared                     0.675           0.767           0.794
## Annualized Alpha              0.195           0.082          -0.002
## Correlation                   0.822           0.876           0.891
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.183           0.246           0.160
## Active Premium                0.163          -0.028          -0.030
## Information Ratio             0.892          -0.112          -0.184
## Treynor Ratio                 0.015          -0.126          -0.163
##                      X0941.HK to HSI X1044.HK to HSI X1088.HK to HSI
## Alpha                         0.001           0.001           0.000
## Beta                          0.504           0.618           1.196
## Beta+                         0.323           0.798           1.158
## Beta-                         0.497           0.577           1.228
## R-squared                     0.399           0.313           0.715
## Annualized Alpha              0.286           0.242           0.062
## Correlation                   0.632           0.560           0.846
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.224           0.280           0.220
## Active Premium                0.328           0.247          -0.003
## Information Ratio             1.467           0.884          -0.014
## Treynor Ratio                 0.355           0.158          -0.128
##                      X1109.HK to HSI X1199.HK to HSI X1299.HK to HSI
## Alpha                         0.001           0.000           0.001
## Beta                          1.571           1.407           0.888
## Beta+                         2.157           1.350           0.774
## Beta-                         1.214           1.561           1.177
## R-squared                     0.536           0.655           0.457
## Annualized Alpha              0.415          -0.108           0.200
## Correlation                   0.732           0.809           0.676
## Correlation p-value           0.000           0.000           0.000
## Tracking Error                0.443           0.310           0.275
## Active Premium                0.124          -0.185           0.154
## Information Ratio             0.281          -0.595           0.560
## Treynor Ratio                -0.016          -0.237           0.005
```

```
##                      X1398.HK to HSI X1880.HK to HSI X1898.HK to HSI
## Alpha                          0.000           0.000           0.001
## Beta                           1.423           1.098           1.489
## Beta+                          1.636           1.300           1.497
## Beta-                          1.250           0.907           1.378
## R-squared                      0.833           0.412           0.685
## Annualized Alpha              -0.012           0.010           0.185
## Correlation                    0.913           0.642           0.828
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.216           0.371           0.317
## Active Premium                -0.096          -0.064           0.017
## Information Ratio             -0.446          -0.173           0.053
## Treynor Ratio                 -0.172          -0.195          -0.089
##                      X2318.HK to HSI X2388.HK to HSI X2600.HK to HSI
## Alpha                          0.000           0.000          -0.002
## Beta                           1.693           1.035           1.515
## Beta+                          1.964           1.028           1.636
## Beta-                          1.353           1.072           1.280
## R-squared                      0.709           0.688           0.601
## Annualized Alpha              -0.013           0.016          -0.318
## Correlation                    0.842           0.830           0.775
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.363           0.197           0.378
## Active Premium                -0.166          -0.009          -0.364
## Information Ratio             -0.459          -0.045          -0.963
## Treynor Ratio                 -0.187          -0.153          -0.339
##                      X2628.HK to HSI X3328.HK to HSI X3988.HK to HSI
## Alpha                          0.000           0.000          -0.001
## Beta                           1.367           1.385           1.178
## Beta+                          1.368           1.335           1.164
## Beta-                          1.195           1.361           1.115
## R-squared                      0.649           0.795           0.770
## Annualized Alpha              -0.058          -0.091          -0.149
## Correlation                    0.805           0.892           0.877
## Correlation p-value            0.000           0.000           0.000
## Tracking Error                 0.302           0.226           0.189
## Active Premium                -0.140          -0.153          -0.164
## Information Ratio             -0.464          -0.678          -0.871
## Treynor Ratio                 -0.212          -0.218          -0.266
```

3 HSI Components Risk

3.1 Correlation

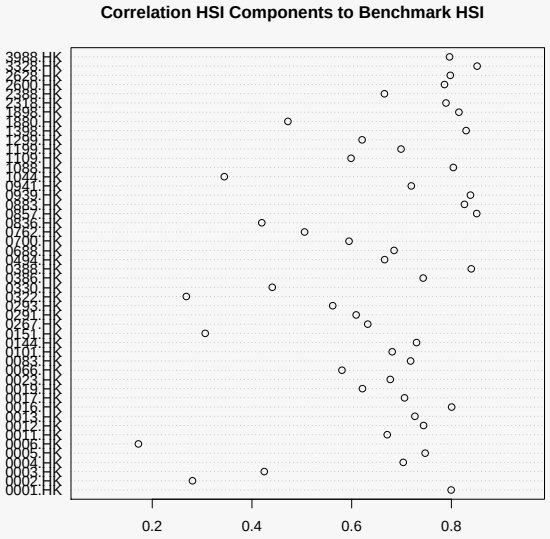
Correlation Combined

```
##                       Correlation p-value Lower CI Upper CI
## HSI Components to HSI     -0.0152  0.8546  -0.2252   0.1961
```

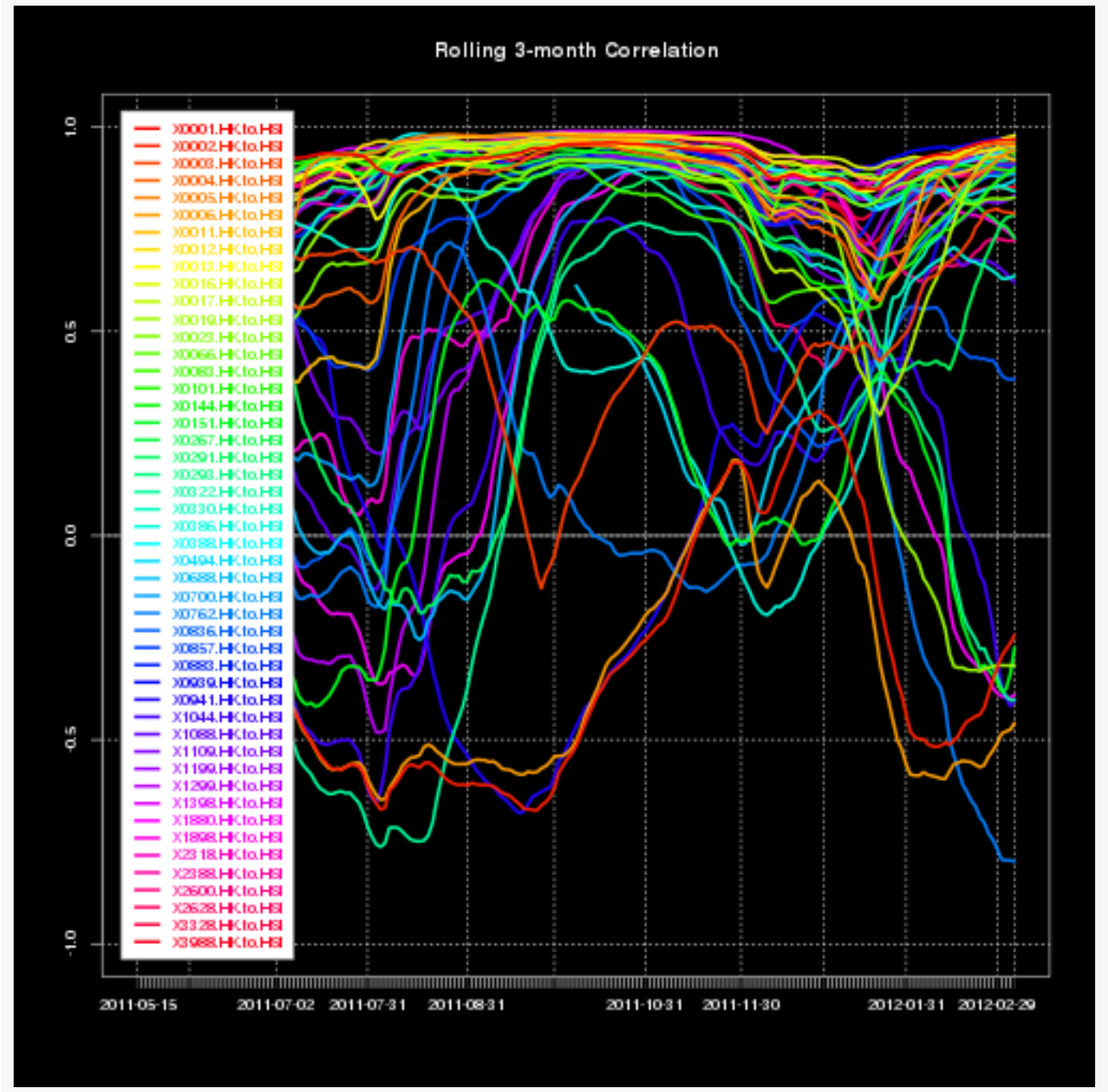
Correlation - Distinct

```
##         Correlation p-value Lower CI Upper CI
## 0001.HK      0.7995       0   0.7638   0.8303
## 0002.HK      0.2807       0   0.1941   0.3629
## 0003.HK      0.4247       0   0.3466   0.4969
## 0004.HK      0.7034       0   0.6539   0.7469
## 0005.HK      0.7474       0   0.7040   0.7852
## 0006.HK      0.1722       0   0.0819   0.2596
## 0011.HK      0.6713       0   0.6177   0.7187
## 0012.HK      0.7442       0   0.7004   0.7825
## 0013.HK      0.7268       0   0.6805   0.7673
## 0016.HK      0.8005       0   0.7650   0.8312
## 0017.HK      0.7060       0   0.6569   0.7491
## 0019.HK      0.6216       0   0.5620   0.6748
## 0023.HK      0.6774       0   0.6246   0.7241
## 0066.HK      0.5805       0   0.5163   0.6381
## 0083.HK      0.7182       0   0.6708   0.7598
## 0101.HK      0.6813       0   0.6289   0.7274
## 0144.HK      0.7301       0   0.6843   0.7702
## 0151.HK      0.3062       0   0.2209   0.3869
## 0267.HK      0.6322       0   0.5738   0.6841
## 0291.HK      0.6090       0   0.5480   0.6636
## 0293.HK      0.5620       0   0.4960   0.6216
## 0322.HK      0.2683       0   0.1812   0.3512
## 0330.HK      0.4407       0   0.3638   0.5116
## 0386.HK      0.7434       0   0.6995   0.7818
## 0388.HK      0.8399       0   0.8107   0.8650
## 0494.HK      0.6661       0   0.5482   0.7580
## 0688.HK      0.6850       0   0.6332   0.7308
## 0700.HK      0.5947       0   0.5322   0.6507
## 0762.HK      0.5055       0   0.4341   0.5706
## 0836.HK      0.4197       0   0.3412   0.4923
## 0857.HK      0.8508       0   0.8233   0.8742
## 0883.HK      0.8262       0   0.7948   0.8532
## 0939.HK      0.8382       0   0.8087   0.8635
## 0941.HK      0.7196       0   0.6724   0.7610
## 1044.HK      0.3445       0   0.2614   0.4225
## 1088.HK      0.8039       0   0.7689   0.8340
## 1109.HK      0.5988       0   0.5366   0.6545
## 1199.HK      0.6990       0   0.6489   0.7430
## 1299.HK      0.6209       0   0.5267   0.7001
## 1398.HK      0.8295       0   0.7986   0.8560
## 1880.HK      0.4721       0   0.3977   0.5403
## 1898.HK      0.8151       0   0.7819   0.8437
## 2318.HK      0.7892       0   0.7520   0.8214
## 2388.HK      0.6657       0   0.6114   0.7137
## 2600.HK      0.7862       0   0.7486   0.8189
## 2628.HK      0.7978       0   0.7618   0.8288
```

```
## 3328.HK      0.8516        0   0.8243   0.8750
## 3988.HK      0.7963        0   0.7602   0.8275
```



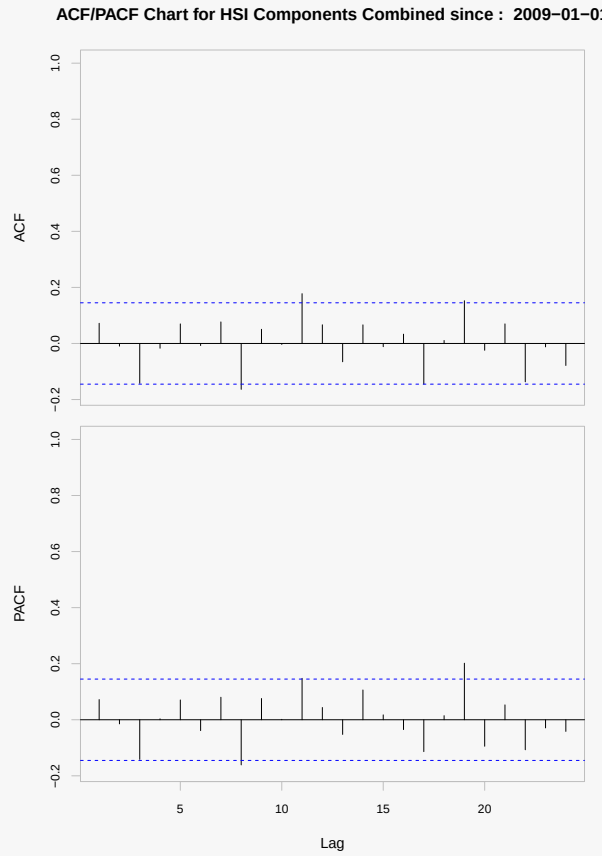
3 Month Rolling Correlation



3.2 Autocorrelation Coefficients - Combined

Autocorrelation Combined

```
##                rho1    rho2    rho3   rho4   rho5    rho6 Q(6) p-value
## daily.returns 0.072 -0.0095 -0.1423 -0.017 0.0698 -0.0075       0.4231
```



3.3 Downside Risk - Combined

Downside Risk Combined

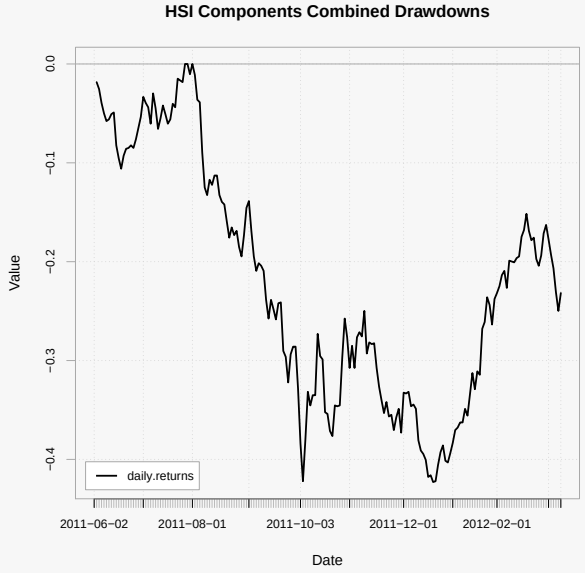
```
##                                HSI Components dailyReturn
## Semi Deviation                                      0.0252
## Gain Deviation                                      0.0194
## Loss Deviation                                      0.0168
## Downside Deviation (MAR=210%)                       0.0289
## Downside Deviation (Rf=0%)                          0.0259
## Downside Deviation (0%)                             0.0259
## Maximum Drawdown                                    0.4229
## Historical VaR (95%)                               -0.0380
## Historical ES (95%)                                -0.0586
## Modified VaR (95%)                                 -0.0417
## Modified ES (95%)                                  -0.0536
```

3.4 Drawdowns - Combined

Drawdowns Combined

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

```
##         From     Trough         To   Depth Length To Trough Recovery
## 1 2011-08-02 2011-12-19       <NA> -0.4229    151        98       NA
## 2 2011-06-03 2011-06-20 2011-07-28 -0.1060     38        11       27
## 3 2011-07-29 2011-07-29 2011-08-01 -0.0104      2         1        1
```



3.5 Downside Deviation - Combined

Downside Deviation Combined

```
##                                 HSI Components
## Downside Deviation (MAR = 0%)          0.02588
```

3.6 Autocorrelation Coefficients - Distinct

```
##            rho1    rho2    rho3    rho4    rho5    rho6 Q(6) p-value
## 0001.HK  0.0521 -0.0645  0.0166 -0.0348  0.0106  0.0099       0.3389
## 0002.HK -0.1147 -0.0491 -0.0150  0.0178  0.0215 -0.0163       0.0377
## 0003.HK -0.0989 -0.0194 -0.0144  0.0446  0.0093  0.0324       0.0979
## 0004.HK  0.0106 -0.0331 -0.0304 -0.0326  0.0863 -0.0383       0.1406
## 0005.HK -0.0249 -0.0216  0.0594  0.0324 -0.0473  0.0285       0.3270
## 0006.HK -0.0804 -0.0658  0.0136 -0.0229  0.0042 -0.0693       0.0433
## 0011.HK  0.1120  0.0156 -0.0209  0.0024 -0.0463 -0.0789       0.0087
## 0012.HK  0.0716 -0.0282 -0.0489 -0.0106  0.0459  0.0006       0.2128
## 0013.HK -0.0001  0.0295  0.0128 -0.0130  0.0223 -0.0261       0.9287
## 0016.HK  0.0478 -0.0591  0.0259 -0.0055  0.0392  0.0156       0.3635
## 0017.HK  0.0774  0.0204  0.0147  0.0308  0.0485 -0.0181       0.2274
## 0019.HK  0.0405  0.0462 -0.0268 -0.1058 -0.0072  0.0165       0.0476
## 0023.HK  0.0872 -0.0095 -0.0061 -0.0078 -0.0508 -0.0364       0.1581
## 0066.HK -0.0759  0.0001  0.0505 -0.0210 -0.0071 -0.0174       0.3001
## 0083.HK  0.0977 -0.0618 -0.0326  0.0081  0.0396  0.0022       0.0474
## 0101.HK -0.0729 -0.0199  0.0165 -0.0436 -0.0603  0.0223       0.1452
## 0144.HK  0.0592 -0.0071  0.0006 -0.0483 -0.1048  0.0037       0.0364
## 0151.HK -0.0045 -0.0242 -0.0870 -0.1061  0.0134  0.0094       0.0156
## 0267.HK  0.1250  0.0371 -0.0543 -0.0208  0.0436  0.0422       0.0040
## 0291.HK -0.0363 -0.0207  0.0064 -0.0439  0.0102 -0.0058       0.8011
## 0293.HK  0.0203 -0.0438 -0.0675 -0.0598  0.0765  0.0606       0.0143
## 0322.HK -0.0119  0.0339 -0.0890 -0.0020 -0.0171 -0.0235       0.2381
## 0330.HK  0.0345  0.1065 -0.0297  0.0580  0.0088  0.0013       0.0373
## 0386.HK -0.0265 -0.0236 -0.0410 -0.0121 -0.0077  0.0295       0.7841
## 0388.HK  0.0961 -0.0119  0.0327 -0.0098  0.0061 -0.0153       0.1985
## 0494.HK  0.0612 -0.0265 -0.0115 -0.0359 -0.1510 -0.0282       0.4439
## 0688.HK  0.0743 -0.0618 -0.0481 -0.0436 -0.0062  0.0058       0.0940
## 0700.HK  0.0226 -0.0993 -0.0004 -0.0886  0.0074  0.0374       0.0148
## 0762.HK -0.0486 -0.0752 -0.0339 -0.0607  0.0355 -0.0289       0.0624
## 0836.HK -0.0568 -0.0369 -0.0090  0.0025 -0.0072 -0.0201       0.6657
## 0857.HK  0.0432 -0.0167  0.0374 -0.0030 -0.0077  0.0034       0.8240
## 0883.HK  0.0436 -0.0512 -0.0122 -0.0257 -0.0579 -0.0012       0.3303
## 0939.HK  0.0008  0.0032  0.0182 -0.0570 -0.0316 -0.0349       0.5930
## 0941.HK -0.0182 -0.0176  0.0046 -0.0925  0.0025 -0.0252       0.2497
## 1044.HK -0.0309 -0.0508 -0.0976 -0.0588 -0.0412  0.0170       0.0208
## 1088.HK  0.0471 -0.0028 -0.0260 -0.0343  0.0280 -0.0365       0.5533
## 1109.HK  0.0238 -0.0272 -0.0480 -0.0854  0.0111 -0.0014       0.1870
## 1199.HK  0.0704  0.0482 -0.0037 -0.0664  0.0082  0.0297       0.1224
## 1299.HK -0.0284 -0.0649  0.0162 -0.0637 -0.1048 -0.0263       0.3021
## 1398.HK  0.0225 -0.0040  0.0599 -0.0226 -0.0195 -0.0411       0.5021
## 1880.HK  0.0078 -0.0913 -0.0813 -0.0187 -0.0390 -0.0381       0.0239
## 1898.HK  0.0928  0.0160 -0.0007  0.0068 -0.0465 -0.0206       0.1665
## 2318.HK  0.0643 -0.0454 -0.0703 -0.0363  0.0668  0.0065       0.0359
## 2388.HK  0.0704  0.0278  0.0542 -0.0009 -0.0407 -0.0139       0.2129
## 2600.HK  0.0639 -0.0332 -0.0309  0.0041  0.0063 -0.0024       0.5533
## 2628.HK  0.0012 -0.0122  0.0362 -0.0541 -0.0087 -0.0096       0.7275
```

```
## 3328.HK  0.0208  0.0301 -0.0063 -0.0601 -0.0026 -0.0227       0.6252
## 3988.HK  0.0375 -0.0223  0.0386 -0.0431 -0.0083 -0.0700       0.2278
```

3.7 Downside Deviation - Distinct

```
##                                0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## Downside Deviation (MAR = 0%)  0.0192  0.0088  0.0154  0.0241  0.0253
##                                0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## Downside Deviation (MAR = 0%)   0.011   0.015  0.0214  0.0191  0.0196
##                                0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## Downside Deviation (MAR = 0%)  0.0248  0.0208  0.0206  0.0132  0.0255
##                                0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## Downside Deviation (MAR = 0%)  0.0251  0.0268  0.0217  0.0254  0.0226
##                                0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## Downside Deviation (MAR = 0%)  0.0214  0.0199  0.0355  0.0207  0.0198
##                                0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Downside Deviation (MAR = 0%)   0.033   0.026  0.0244  0.0226  0.0205
##                                0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## Downside Deviation (MAR = 0%)  0.0209  0.0239  0.0209  0.0159  0.0203
##                                1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## Downside Deviation (MAR = 0%)  0.0243  0.0291   0.029  0.0207  0.0217
##                                1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## Downside Deviation (MAR = 0%)  0.0272  0.0298  0.0269  0.0199  0.0298
##                                2628.HK 3328.HK 3988.HK
## Downside Deviation (MAR = 0%)  0.0222  0.0225  0.0217
```

4 General Statistics

Statistics Distinct

	Observations	NAs	Minimum	Quartile 1	Median	Arithmetic Mean
X0001.HK.Close	790	12	56.00	91.463	98.250	100.193
X0002.HK.Close	790	12	51.10	52.600	57.500	59.370
X0003.HK.Close	790	12	10.78	17.220	18.180	17.631
X0004.HK.Close	790	12	15.20	37.013	41.850	41.886
X0005.HK.Close	790	12	33.00	66.025	78.300	74.800
X0006.HK.Close	790	12	41.10	43.550	47.325	49.147
X0011.HK.Close	790	12	67.00	102.500	110.200	109.351
X0012.HK.Close	790	12	23.75	42.875	48.350	46.938
X0013.HK.Close	790	12	36.40	52.663	58.300	64.259
X0016.HK.Close	790	12	55.80	100.650	111.600	108.343
X0017.HK.Close	790	12	6.20	9.682	13.430	12.666
X0019.HK.Close	790	12	42.90	84.763	92.200	92.458
X0023.HK.Close	790	12	12.34	26.800	29.000	28.242
X0066.HK.Close	790	12	16.14	25.200	26.850	26.051
X0083.HK.Close	790	12	5.60	11.900	13.620	13.083
X0101.HK.Close	790	12	13.66	25.712	29.000	28.610
X0144.HK.Close	790	12	12.20	23.100	26.400	25.974
X0151.HK.Close	790	12	2.77	4.673	6.200	5.861
X0267.HK.Close	790	12	7.18	14.220	17.180	17.025
X0291.HK.Close	790	12	10.66	24.350	27.950	26.128
X0293.HK.Close	790	12	6.98	12.665	14.990	15.170
X0322.HK.Close	790	12	8.27	16.585	19.280	18.267
X0330.HK.Close	790	12	7.93	29.350	42.200	38.735
X0386.HK.Close	790	12	3.65	6.192	6.800	6.857
X0388.HK.Close	790	12	54.60	123.125	136.800	136.652
X0494.HK.Close	191	611	11.60	13.780	14.720	14.989
X0688.HK.Close	790	12	9.41	14.285	15.470	15.216
X0700.HK.Close	799	3	41.80	128.000	156.000	148.778
X0762.HK.Close	797	5	8.31	9.640	11.020	11.937
X0836.HK.Close	790	12	11.10	14.245	15.330	15.431
X0857.HK.Close	790	12	5.10	8.700	9.390	9.350
X0883.HK.Close	790	12	6.08	11.275	13.320	13.636
X0939.HK.Close	790	12	3.66	5.622	6.270	6.122
X0941.HK.Close	790	12	63.00	73.350	76.000	75.751
X1044.HK.Close	802	0	24.25	48.112	59.175	56.415
X1088.HK.Close	790	12	13.90	30.262	33.325	31.709
X1109.HK.Close	790	12	7.50	12.930	14.570	14.401
X1199.HK.Close	790	12	5.40	9.432	11.040	11.133
X1299.HK.Close	337	465	19.86	22.750	24.100	24.564
X1398.HK.Close	790	12	3.03	4.995	5.715	5.463
X1880.HK.Close	790	12	2.98	8.012	12.070	11.062
X1898.HK.Close	790	12	4.43	9.480	10.530	10.434
X2318.HK.Close	790	12	30.35	58.050	64.350	65.396
X2388.HK.Close	790	12	6.30	16.720	18.500	18.772
X2600.HK.Close	790	12	3.20	5.300	7.005	6.622
X2628.HK.Close	790	12	17.24	24.762	30.275	29.527
X3328.HK.Close	790	12	4.17	6.213	7.970	7.567
X3988.HK.Close	790	12	1.84	3.107	3.910	3.656

	Geometric Mean	Quartile 3	Maximum	SE Mean	LCL Mean (0.95)
X0001.HK.Close	98.843	113.800	135.70	0.5746	99.065
X0002.HK.Close	59.012	64.200	75.00	0.2361	58.906
X0003.HK.Close	17.496	19.000	21.00	0.0741	17.485
X0004.HK.Close	40.186	50.987	62.00	0.3917	41.117

```
## X0005.HK.Close          73.782     82.950   98.00  0.4171           73.981
## X0006.HK.Close          48.785     54.200   64.80  0.2185           48.718
## X0011.HK.Close         108.595    117.375  134.00  0.4469          108.473
## X0012.HK.Close          46.136     53.000   60.50  0.2898           46.369
## X0013.HK.Close          62.326     77.725   95.90  0.5679           63.144
## X0016.HK.Close         106.638    118.800  146.30  0.6392          107.088
## X0017.HK.Close          12.212     15.300   18.54  0.1175           12.435
## X0019.HK.Close          90.065    108.600  136.40  0.7049           91.075
## X0023.HK.Close          27.711     32.100   35.90  0.1792           27.890
## X0066.HK.Close          25.829     28.250   31.15  0.1150           25.825
## X0083.HK.Close          12.823     14.780   18.56  0.0880           12.910
## X0101.HK.Close          28.026     32.188   40.30  0.1972           28.223
## X0144.HK.Close          25.443     28.850   37.55  0.1788           25.623
## X0151.HK.Close           5.706      7.000    8.75  0.0491            5.765
## X0267.HK.Close          16.539     20.550   24.40  0.1407           16.749
## X0291.HK.Close          25.129     30.738   35.25  0.2316           25.674
## X0293.HK.Close          14.652     18.240   24.05  0.1430           14.890
## X0322.HK.Close          17.623     21.300   25.95  0.1603           17.953
## X0330.HK.Close          34.762     49.900   64.30  0.5308           37.693
## X0386.HK.Close           6.772      7.650    9.64  0.0398            6.779
## X0388.HK.Close         132.831    160.100  197.50  1.0606          134.570
## X0494.HK.Close          14.903     16.130   18.42  0.1212           14.750
## X0688.HK.Close          15.090     16.620   19.44  0.0691           15.080
## X0700.HK.Close         138.600    182.300  225.00  1.6730          145.494
## X0762.HK.Close          11.708     14.300   17.40  0.0890           11.762
## X0836.HK.Close          15.348     16.615   20.15  0.0588           15.315
## X0857.HK.Close           9.243     10.260   12.36  0.0507            9.251
## X0883.HK.Close          13.195     16.860   20.95  0.1232           13.394
## X0939.HK.Close           6.056      6.790    8.28  0.0330            6.058
## X0941.HK.Close          75.644     78.350   91.45  0.1438           75.468
## X1044.HK.Close          54.235     68.300   78.25  0.5056           55.422
## X1088.HK.Close          31.061     35.350   40.80  0.2061           31.304
## X1109.HK.Close          14.167     16.260   20.00  0.0916           14.221
## X1199.HK.Close          10.900     12.680   16.76  0.0832           10.970
## X1299.HK.Close          24.480     26.400   29.65  0.1134           24.341
## X1398.HK.Close           5.401      5.970    7.03  0.0303            5.404
## X1880.HK.Close          10.314     14.220   17.54  0.1359           10.795
## X1898.HK.Close          10.202     11.740   15.86  0.0770           10.283
## X2318.HK.Close          63.946     75.888   94.30  0.4742           64.465
## X2388.HK.Close          17.994     22.800   28.95  0.1809           18.417
## X2600.HK.Close           6.398      7.850   10.66  0.0625            6.499
## X2628.HK.Close          28.898     34.400   41.00  0.2126           29.109
## X3328.HK.Close           7.417      8.668   10.56  0.0548            7.459
## X3988.HK.Close           3.597      4.140    5.00  0.0251            3.607
##                 UCL Mean (0.95)  Variance   Stdev Skewness Kurtosis
## X0001.HK.Close          101.321  260.8651 16.1513  -0.1276  -0.1253
## X0002.HK.Close           59.833   44.0303  6.6355   0.3316  -1.2848
## X0003.HK.Close           17.776    4.3372  2.0826  -1.6375   2.1302
## X0004.HK.Close           42.655  121.2132 11.0097  -0.4973  -0.1654
## X0005.HK.Close           75.619  137.4497 11.7239  -0.7585   0.2053
## X0006.HK.Close           49.576   37.7119  6.1410   0.5912  -0.9079
## X0011.HK.Close          110.228  157.7567 12.5601  -0.5056   0.0171
## X0012.HK.Close           47.506   66.3525  8.1457  -0.8950   0.3191
## X0013.HK.Close           65.374  254.7837 15.9619   0.3147  -1.0453
## X0016.HK.Close          109.597  322.7877 17.9663  -0.8764   0.7112
## X0017.HK.Close           12.897   10.9153  3.3038  -0.4876  -0.9577
## X0019.HK.Close           93.842  392.4976 19.8116  -0.4419   0.0462
```

```
## X0023.HK.Close          28.594   25.3776  5.0376  -1.2455   1.1320
## X0066.HK.Close          26.276   10.4556  3.2335  -1.3958   1.3174
## X0083.HK.Close          13.256    6.1187  2.4736  -1.0451   0.8211
## X0101.HK.Close          28.998   30.7362  5.5440  -0.5328   0.0614
## X0144.HK.Close          26.325   25.2641  5.0263  -0.5391   0.3780
## X0151.HK.Close           5.957    1.9010  1.3788  -0.5437  -0.7951
## X0267.HK.Close          17.302   15.6438  3.9552  -0.4039  -0.6101
## X0291.HK.Close          26.582   42.3567  6.5082  -1.0417  -0.0377
## X0293.HK.Close          15.451   16.1466  4.0183   0.1233  -0.7038
## X0322.HK.Close          18.582   20.3084  4.5065  -0.8214  -0.1678
## X0330.HK.Close          39.777  222.6231 14.9206  -0.6394  -0.6521
## X0386.HK.Close           6.935    1.2509  1.1184  -0.3614   0.3872
## X0388.HK.Close         138.734  888.6074 29.8095  -0.5772   0.3744
## X0494.HK.Close          15.228    2.8047  1.6747   0.2709  -0.8120
## X0688.HK.Close          15.351    3.7689  1.9414  -0.7549   0.1487
## X0700.HK.Close         152.062 2236.3640 47.2902  -0.7303  -0.2561
## X0762.HK.Close          12.112    6.3191  2.5138   0.6641  -0.9912
## X0836.HK.Close          15.546    2.7323  1.6530   0.1655  -0.2682
## X0857.HK.Close           9.450    2.0297  1.4247  -0.6913   0.6308
## X0883.HK.Close          13.877   11.9923  3.4630  -0.1060  -0.7673
## X0939.HK.Close           6.187    0.8626  0.9287  -0.7561   0.1222
## X0941.HK.Close          76.033   16.3255  4.0405  -0.0209   0.6055
## X1044.HK.Close          57.407  205.0235 14.3186  -0.7726  -0.5476
## X1088.HK.Close          32.114   33.5580  5.7929  -1.4055   1.4934
## X1109.HK.Close          14.581    6.6295  2.5748  -0.4325  -0.1259
## X1199.HK.Close          11.296    5.4706  2.3389   0.0567  -0.4882
## X1299.HK.Close          24.787    4.3307  2.0810   0.3029  -0.9445
## X1398.HK.Close           5.523    0.7258  0.8519  -0.9666   0.4323
## X1880.HK.Close          11.328   14.5799  3.8184  -0.4722  -0.8809
## X1898.HK.Close          10.585    4.6779  2.1628  -0.5078   0.3640
## X2318.HK.Close          66.327  177.6710 13.3293  -0.2098  -0.2757
## X2388.HK.Close          19.127   25.8514  5.0844  -0.4451  -0.2062
## X2600.HK.Close           6.744    3.0835  1.7560  -0.3676  -0.8570
## X2628.HK.Close          29.944   35.7140  5.9761  -0.3269  -1.0174
## X3328.HK.Close           7.675    2.3764  1.5415  -0.4235  -0.9544
## X3988.HK.Close           3.705    0.4968  0.7048  -0.7739  -0.3503
```

4.1 Higher Moments - Combined

```
##                 HSI Components to HSI Combined
## CoSkewness                               0.000
## CoKurtosis                               0.000
## Beta CoVariance                         -0.023
## Beta CoSkewness                          1.245
## Beta CoKurtosis                         -0.065
```

5 Principal Components Analysis

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.1 PCA with stats package princomp function

```
## Importance of components:
##                         Comp.1  Comp.2  Comp.3  Comp.4  Comp.5  Comp.6
## Standard deviation     5.0896 1.51612 1.21619 1.12249 1.06175 1.02183
## Proportion of Variance 0.5397 0.04789 0.03081 0.02625 0.02349 0.02175
## Cumulative Proportion  0.5397 0.58755 0.61836 0.64461 0.66810 0.68985
##                         Comp.7  Comp.8  Comp.9 Comp.10 Comp.11 Comp.12
## Standard deviation     0.96963 0.95180 0.90143 0.86441 0.82650 0.81493
## Proportion of Variance 0.01959 0.01887 0.01693 0.01557 0.01423 0.01384
## Cumulative Proportion  0.70944 0.72831 0.74524 0.76080 0.77504 0.78887
##                        Comp.13 Comp.14 Comp.15 Comp.16 Comp.17  Comp.18
## Standard deviation     0.79038 0.77542 0.75924 0.73434 0.72512 0.691201
## Proportion of Variance 0.01301 0.01253 0.01201 0.01123 0.01095 0.009953
## Cumulative Proportion  0.80189 0.81441 0.82642 0.83766 0.84861 0.858564
##                         Comp.19  Comp.20 Comp.21  Comp.22  Comp.23 Comp.24
## Standard deviation     0.686317 0.656687 0.63798 0.625041 0.601860 0.59637
## Proportion of Variance 0.009813 0.008984 0.00848 0.008139 0.007547 0.00741
## Cumulative Proportion  0.868377 0.877361 0.88584 0.893980 0.901527 0.90894
##                         Comp.25  Comp.26  Comp.27  Comp.28  Comp.29
## Standard deviation     0.576776 0.561494 0.555673 0.541058 0.503456
## Proportion of Variance 0.006931 0.006568 0.006433 0.006099 0.005281
## Cumulative Proportion  0.915867 0.922435 0.928868 0.934967 0.940247
##                         Comp.30  Comp.31  Comp.32  Comp.33  Comp.34
## Standard deviation     0.495084 0.489606 0.475344 0.462034 0.448924
## Proportion of Variance 0.005106 0.004994 0.004707 0.004447 0.004199
## Cumulative Proportion  0.945354 0.950348 0.955055 0.959502 0.963701
##                         Comp.35  Comp.36  Comp.37  Comp.38  Comp.39
## Standard deviation     0.442657 0.429279 0.412077 0.395233 0.386491
## Proportion of Variance 0.004082 0.003839 0.003538 0.003254 0.003112
## Cumulative Proportion  0.967783 0.971622 0.975160 0.978414 0.981526
##                         Comp.40  Comp.41  Comp.42  Comp.43  Comp.44
## Standard deviation     0.384198 0.359493 0.342289 0.331082 0.316199
## Proportion of Variance 0.003075 0.002692 0.002441 0.002284 0.002083
## Cumulative Proportion  0.984602 0.987294 0.989735 0.992018 0.994101
##                         Comp.45  Comp.46  Comp.47 Comp.48
## Standard deviation     0.290716 0.279775 0.252439 0.23794
## Proportion of Variance 0.001761 0.001631 0.001328 0.00118
## Cumulative Proportion  0.995862 0.997493 0.998820 1.00000

##
## Loadings:
##         Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8 Comp.9
## 0001.HK -0.175                -0.180        -0.112  0.111
## 0002.HK         0.475         -0.116  0.121 -0.162 -0.307 -0.111
## 0003.HK         0.362         -0.272 -0.111                 0.270  0.104
## 0004.HK -0.162 -0.101         -0.118                               -0.107
## 0005.HK -0.170
## 0006.HK         0.470 -0.135  0.107  0.141 -0.115 -0.387
## 0011.HK -0.158                -0.267        -0.110                -0.185
## 0012.HK -0.159                -0.193                0.137  0.134  0.122
## 0013.HK -0.170                -0.127        -0.142
## 0016.HK -0.171                -0.164                       0.179
## 0017.HK -0.138        -0.147  -0.190                       0.222  0.309
## 0019.HK -0.118         0.154  -0.179         0.184        -0.437  0.326
## 0023.HK -0.147         0.113  -0.122  0.158                -0.309 -0.240
## 0066.HK -0.133  0.148  0.124  -0.206         0.184        -0.113 -0.186
```

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## 0083.HK -0.155        -0.140 -0.135        -0.113         0.170
## 0101.HK -0.153        -0.158 -0.126        -0.159         0.104 -0.119
## 0144.HK -0.152                0.179               -0.149
## 0151.HK                0.490  0.107         0.172         0.273  0.307
## 0267.HK -0.158                              0.115        -0.157
## 0291.HK -0.124                                     -0.111         0.354
## 0293.HK -0.132 -0.112                       -0.146 -0.128 -0.321  0.297
## 0322.HK                0.527 -0.146  0.131        -0.120  0.116
## 0330.HK                             -0.454  0.367 -0.527
## 0386.HK -0.129  0.236         0.310 -0.193         0.271
## 0388.HK -0.168               -0.142         0.131
## 0494.HK -0.132                              0.254 -0.150  0.238 -0.309
## 0688.HK -0.155 -0.172 -0.101                -0.134
## 0700.HK -0.145                0.236  0.171 -0.156
## 0762.HK -0.130  0.159  0.161  0.257                0.159
## 0836.HK                0.155        -0.677 -0.295        -0.139
## 0857.HK -0.157  0.142         0.178 -0.121         0.182  0.100
## 0883.HK -0.169                0.167
## 0939.HK -0.172
## 0941.HK -0.116  0.341                       0.133  0.141         0.118
## 1044.HK -0.114         0.371  0.192  0.109
## 1088.HK -0.167                0.103
## 1109.HK -0.151 -0.230                                     -0.112
## 1199.HK -0.160        -0.131  0.137                       0.139
## 1299.HK -0.134                            -0.376         0.119 -0.252
## 1398.HK -0.178                      0.122
## 1880.HK -0.129         0.110  0.211        -0.264 -0.204         0.173
## 1898.HK -0.165                              0.154        -0.134 -0.143
## 2318.HK -0.167                              0.119        -0.127
## 2388.HK -0.166                      0.147                -0.149
## 2600.HK -0.156        -0.122         0.101
## 2628.HK -0.154                             0.210  0.121
## 3328.HK -0.174
## 3988.HK -0.170                             0.123  0.109
##         Comp.10 Comp.11 Comp.12 Comp.13 Comp.14 Comp.15 Comp.16 Comp.17
## 0001.HK
## 0002.HK -0.114                           0.278          -0.124
## 0003.HK  0.116  -0.222                  -0.400           0.242   0.167
## 0004.HK -0.118   0.170
## 0005.HK                                                          0.132
## 0006.HK -0.141   0.289  -0.234          -0.249           0.128  -0.100
## 0011.HK
## 0012.HK          0.173   0.146                  0.150          -0.151
## 0013.HK  0.186
## 0016.HK                  0.108                          -0.138
## 0017.HK  0.179          -0.226  -0.253   0.158  -0.113
## 0019.HK  0.300   0.153          -0.109  -0.200   0.187  -0.225
## 0023.HK         -0.158                                           0.320
## 0066.HK                  0.264           0.202  -0.316   0.222  -0.111
## 0083.HK -0.131   0.123   0.184           0.152
## 0101.HK                 -0.122          -0.128          -0.301
## 0144.HK  0.209          -0.126                                   0.311
## 0151.HK          0.190          -0.102                  0.150   0.259
## 0267.HK          0.168                  0.128  -0.118  -0.160
## 0291.HK -0.125  -0.389   0.130   0.503   0.214   0.360
## 0293.HK                          0.349   0.127  -0.227
## 0322.HK -0.310  -0.209  -0.391                 -0.141  -0.326  -0.172
```

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## 0330.HK          -0.195   0.178  -0.259                                -0.155
## 0386.HK  0.104                           -0.134          -0.160  -0.200
## 0388.HK                                                   0.133
## 0494.HK  0.159   0.191           0.376  -0.121   0.121  -0.191   0.137
## 0688.HK -0.264  -0.112   0.212  -0.120  -0.201  -0.103
## 0700.HK          0.101   0.112                  -0.292           0.103
## 0762.HK -0.131   0.137   0.192  -0.216   0.243   0.376  -0.213   0.140
## 0836.HK -0.248   0.194  -0.209                           0.208
## 0857.HK                          0.183           -0.131  -0.204
## 0883.HK                          0.106   0.163
## 0939.HK                 -0.226  -0.135   0.132           0.137  -0.123
## 0941.HK          -0.255   0.158                  -0.249  -0.106
## 1044.HK  0.195   0.218   0.261   0.177           0.107   0.269  -0.460
## 1088.HK                                          0.118           0.319
## 1109.HK -0.307           0.191           -0.236
## 1199.HK  0.106          -0.144           0.218  -0.117   0.134   0.174
## 1299.HK  0.223  -0.238          -0.225           0.173          -0.137
## 1398.HK                 -0.202                   0.104   0.118
## 1880.HK  0.289  -0.220          -0.163  -0.206  -0.104          -0.116
## 1898.HK                 -0.120                   0.169
## 2318.HK                                  -0.186                  -0.111
## 2388.HK  0.156                           0.119   0.103
## 2600.HK -0.151                                           -0.103
## 2628.HK -0.151                           -0.191  -0.246          -0.163
## 3328.HK                 -0.139                           0.216
## 3988.HK -0.101  -0.171  -0.219  -0.109           0.129   0.201
##          Comp.18 Comp.19 Comp.20 Comp.21 Comp.22 Comp.23 Comp.24 Comp.25
## 0001.HK -0.121   0.104                                           -0.103
## 0002.HK  0.139                   -0.150           0.221          -0.281
## 0003.HK  0.296   0.108   0.205           0.164           0.230
## 0004.HK                  -0.103  -0.120   0.120   0.168  -0.121   0.198
## 0005.HK  0.183                                           -0.253  -0.136
## 0006.HK -0.118                    0.182                  -0.114   0.123
## 0011.HK          0.109           -0.204  -0.204  -0.108           0.171
## 0012.HK -0.184           0.174   -0.111           -0.120  -0.192
## 0013.HK                  -0.147                   -0.130
## 0016.HK -0.101                    0.135  -0.125                  -0.140
## 0017.HK                                  0.244           0.202
## 0019.HK          -0.204           0.173  -0.194   0.126          -0.151
## 0023.HK -0.134                    0.190                  -0.107
## 0066.HK          -0.369  -0.120  -0.226
## 0083.HK           0.118           0.247  -0.309  -0.231           0.223
## 0101.HK -0.198   0.160  -0.137  -0.285                           -0.159
## 0144.HK          -0.291   0.242                           -0.192
## 0151.HK -0.134   0.110          -0.173  -0.256   0.159
## 0267.HK  0.204  -0.144   0.104   0.208   0.214  -0.318           0.122
## 0291.HK          -0.216  -0.293
## 0293.HK           0.346   0.279                   0.284           0.289
## 0322.HK  0.102                                   -0.104
## 0330.HK           0.288                   -0.162
## 0386.HK                   0.125  -0.182  -0.186           0.135   0.144
## 0388.HK  0.212                   -0.207   0.105   0.129           0.183
## 0494.HK -0.290                            0.144           0.248   0.122
## 0688.HK                  0.170                            0.167  -0.166
## 0700.HK           0.167  -0.334          -0.268  -0.162   0.482
## 0762.HK  0.167                            0.293                   0.261
## 0836.HK                  -0.163                           0.111
```

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## 0857.HK  0.136           0.194          -0.112                  -0.238
## 0883.HK  0.165   0.110   0.173                                  -0.110
## 0939.HK -0.134                           0.106           0.117   0.104
## 0941.HK -0.485                           0.228
## 1044.HK                  0.117                                  -0.236
## 1088.HK                 -0.145  -0.133  -0.102          -0.269  -0.193
## 1109.HK                  0.176           0.158   0.167          -0.225
## 1199.HK         -0.203           0.179           0.119          -0.103
## 1299.HK         -0.120           0.231  -0.202   0.471           0.189
## 1398.HK -0.120
## 1880.HK                 -0.189  -0.228   0.230  -0.322  -0.252
## 1898.HK                                         -0.138   0.240  -0.159
## 2318.HK                 -0.145   0.150   0.114          -0.117   0.125
## 2388.HK  0.121   0.245                                          -0.169
## 2600.HK  0.149  -0.362   0.234  -0.297  -0.193   0.102   0.156   0.147
## 2628.HK  0.269          -0.341   0.222           0.219  -0.238
## 3328.HK                         -0.188
## 3988.HK -0.134
##         Comp.26 Comp.27 Comp.28 Comp.29 Comp.30 Comp.31 Comp.32 Comp.33
## 0001.HK                 -0.217   0.185                          -0.129
## 0002.HK          0.180                                 -0.208
## 0003.HK                         -0.108  -0.222          -0.130
## 0004.HK  0.174  -0.304  -0.395  -0.324  -0.221   0.122   0.119  -0.121
## 0005.HK  0.116           0.186   0.275  -0.138   0.152   0.141
## 0006.HK                                         0.192          -0.110
## 0011.HK         -0.179   0.121   0.171   0.152  -0.340   0.307  -0.258
## 0012.HK -0.116   0.133           0.147  -0.248  -0.139
## 0013.HK                 -0.249   0.324   0.170   0.372  -0.161  -0.200
## 0016.HK                 -0.211                          0.154
## 0017.HK  0.160  -0.343   0.306           0.240
## 0019.HK                  0.123          -0.186           0.129
## 0023.HK  0.329  -0.307   0.152                                   0.200
## 0066.HK          0.221   0.132                  0.230  -0.196  -0.157
## 0083.HK          0.149   0.214           0.205   0.104           0.376
## 0101.HK                  0.308  -0.221  -0.142          -0.390   0.103
## 0144.HK -0.433  -0.112           0.107
## 0151.HK  0.163          -0.105  -0.127   0.211  -0.143  -0.151
## 0267.HK                         -0.291   0.228  -0.230  -0.208
## 0291.HK         -0.122
## 0293.HK          0.146           0.118                  -0.195
## 0322.HK                                 -0.112   0.202
## 0330.HK                                 -0.124
## 0386.HK                                  0.195           0.295
## 0388.HK                 -0.130                  0.200   0.225   0.387
## 0494.HK          0.262   0.184                          0.234
## 0688.HK          0.181                   0.138                  -0.153
## 0700.HK -0.190                          -0.295          -0.100
## 0762.HK                  0.150   0.155           0.165
## 0836.HK                                         -0.113   0.140
## 0857.HK  0.136  -0.135          -0.139   0.144   0.120           0.111
## 0883.HK  0.266                  -0.165  -0.135                  -0.376
## 0939.HK -0.175                  -0.112                          -0.167
## 0941.HK         -0.214  -0.109   0.121                           0.144
## 1044.HK -0.111  -0.329   0.135
## 1088.HK -0.200          -0.139           0.206   0.107
## 1109.HK          0.102   0.129           0.168   0.205
## 1199.HK          0.134          -0.125  -0.281                   0.182
```

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## 1299.HK                                    0.115          -0.168
## 1398.HK                          -0.160          -0.122   0.117
## 1880.HK  0.239   0.203                                     0.111   0.109
## 1898.HK  0.320          -0.288   0.245   0.177  -0.175  -0.275   0.235
## 2318.HK -0.172          -0.124  -0.113          -0.134
## 2388.HK -0.205                           0.116           0.127   0.214
## 2600.HK  0.104  -0.244           0.328  -0.171           -0.170
## 2628.HK                  0.132   0.203          -0.292  -0.112
## 3328.HK  0.121           0.141                  -0.174
## 3988.HK -0.122           0.131                   0.143          -0.151
##         Comp.34 Comp.35 Comp.36 Comp.37 Comp.38 Comp.39 Comp.40 Comp.41
## 0001.HK                                 -0.112   0.186           0.168
## 0002.HK  0.296                          -0.194          -0.112
## 0003.HK
## 0004.HK  0.141          -0.123           0.137   0.214          -0.189
## 0005.HK          0.276   0.357  -0.236  -0.200   0.312          -0.235
## 0006.HK -0.205           0.139           0.149
## 0011.HK -0.259                           0.113  -0.172          -0.287
## 0012.HK  0.140  -0.198   0.388           0.163  -0.240   0.178  -0.106
## 0013.HK          0.105                  -0.159  -0.155  -0.192
## 0016.HK -0.242  -0.147                   0.140          -0.205   0.382
## 0017.HK  0.141  -0.220           0.111
## 0019.HK                  -0.171           0.124                  -0.105
## 0023.HK  0.157  -0.137   0.190          -0.102  -0.110  -0.110   0.235
## 0066.HK                          0.230
## 0083.HK  0.137          -0.359                   0.103   0.100
## 0101.HK -0.159   0.215          -0.128           0.127  -0.284
## 0144.HK  0.336   0.161                   0.275   0.154           0.111
## 0151.HK          0.159   0.142                           -0.126
## 0267.HK -0.199           0.241  -0.215  -0.160
## 0291.HK
## 0293.HK         -0.164
## 0322.HK         -0.116                                           -0.107
## 0330.HK
## 0386.HK         -0.156   0.190                           -0.362
## 0388.HK          0.103          -0.446          -0.248
## 0494.HK                                  -0.130           0.146
## 0688.HK          0.110                           0.241  -0.130  -0.134
## 0700.HK  0.126           0.153                           0.144
## 0762.HK -0.131                   0.118   0.204   0.123  -0.112
## 0836.HK                                                  0.149   0.104
## 0857.HK          0.187           0.181   0.147           0.322
## 0883.HK  0.138   0.212  -0.308  -0.105          -0.272           0.143
## 0939.HK -0.165          -0.102  -0.188  -0.185           0.276
## 0941.HK -0.148   0.131  -0.164                                   -0.146
## 1044.HK                  -0.105          -0.119
## 1088.HK -0.100  -0.469  -0.197  -0.131  -0.247           0.242
## 1109.HK                                  0.196  -0.249
## 1199.HK -0.427  -0.202           0.225          -0.185  -0.238  -0.173
## 1299.HK                  0.188                           0.155
## 1398.HK  0.135                                   0.120           0.262
## 1880.HK                                         -0.101
## 1898.HK                          -0.114   0.227                  -0.258
## 2318.HK  0.177   0.177           0.439  -0.357  -0.154  -0.139  -0.120
## 2388.HK -0.197   0.154           0.384   0.211   0.174   0.203   0.234
## 2600.HK          0.130           0.101  -0.285           0.155   0.183
## 2628.HK         -0.117  -0.170           0.220                   0.241
```
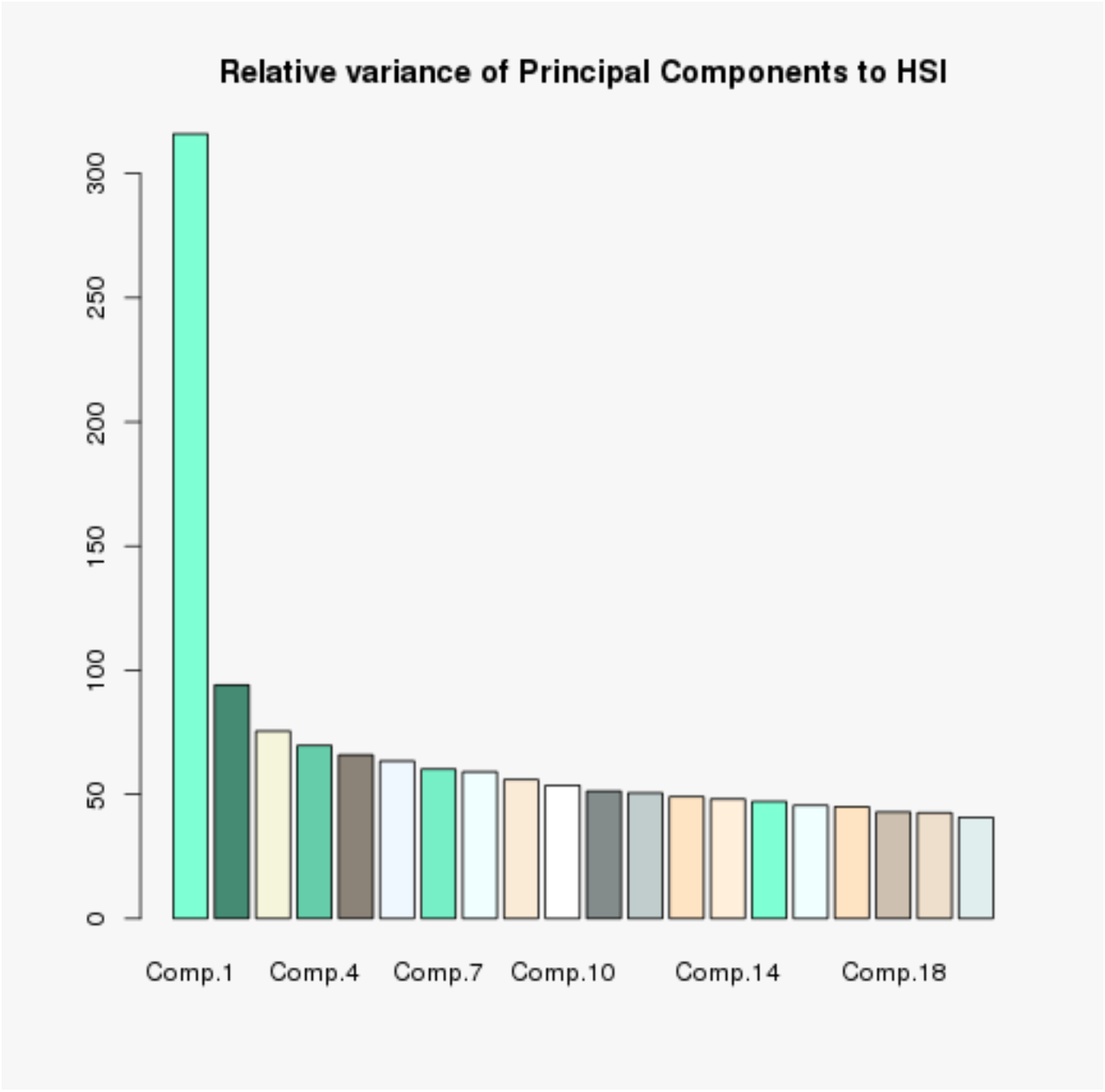
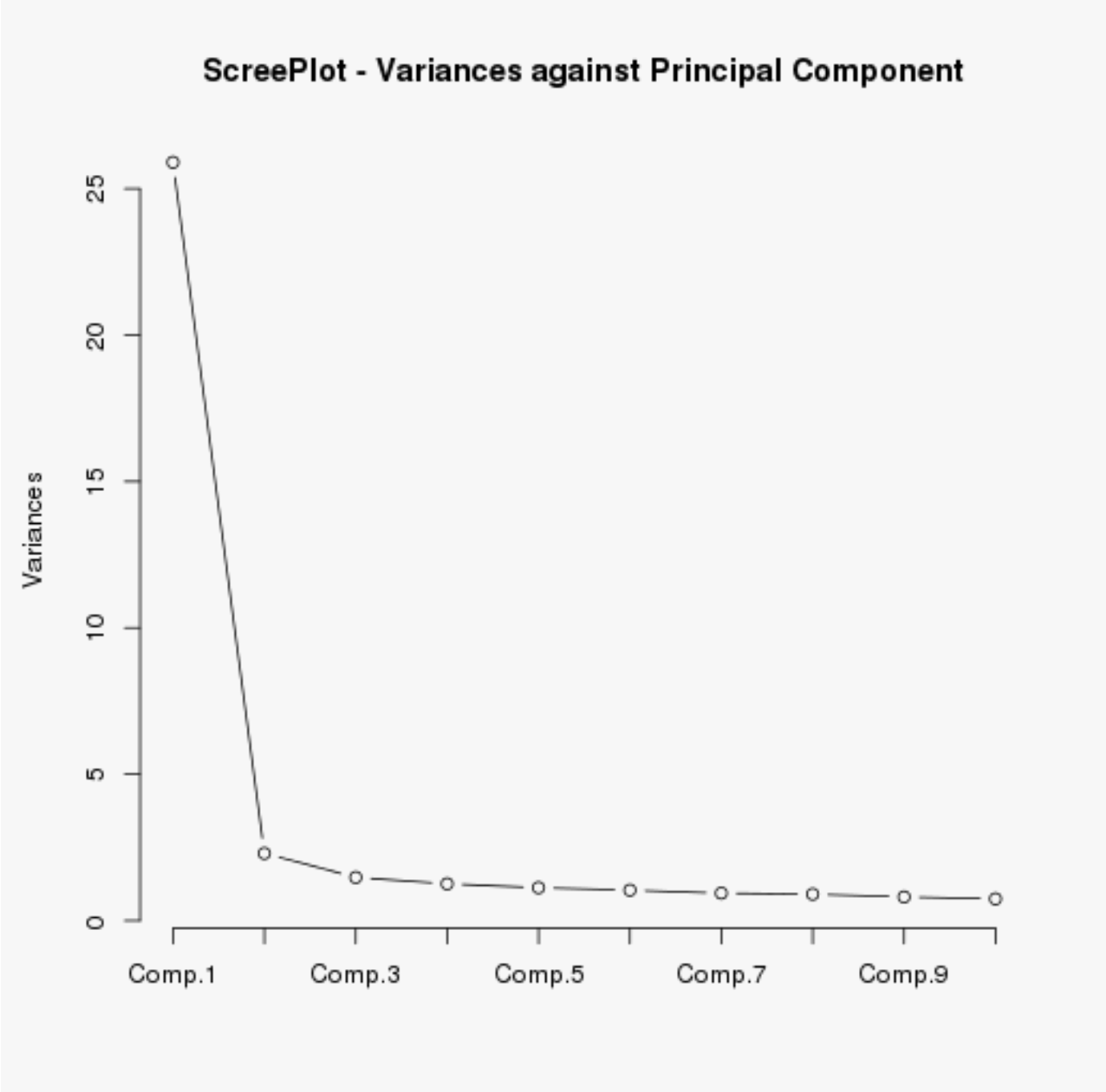

```
## 3328.HK  0.126  -0.291                          0.274          -0.284
## 3988.HK                                        -0.311  -0.240
##         Comp.42 Comp.43 Comp.44 Comp.45 Comp.46 Comp.47 Comp.48
## 0001.HK -0.329   0.347   0.250   0.269   0.216   0.466
## 0002.HK                 -0.208                          -0.133
## 0003.HK
## 0004.HK         -0.207  -0.254
## 0005.HK  0.131  -0.240                  -0.125
## 0006.HK                  0.156
## 0011.HK  0.202   0.125                          0.121
## 0012.HK         -0.124          -0.150   0.265          0.151
## 0013.HK -0.207          -0.198  -0.389          -0.114   0.221
## 0016.HK                 -0.130          -0.385  -0.311  -0.312
## 0017.HK  0.156           0.117
## 0019.HK
## 0023.HK                          -0.196   0.184
## 0066.HK  0.164           0.146
## 0083.HK         -0.133  -0.103
## 0101.HK
## 0144.HK                                                 -0.115
## 0151.HK
## 0267.HK -0.314
## 0291.HK
## 0293.HK  0.100                   0.110  -0.104
## 0322.HK                  0.127
## 0330.HK
## 0386.HK         -0.177                   0.223   0.138
## 0388.HK          0.255   0.292                  -0.148
## 0494.HK -0.111          -0.107
## 0688.HK  0.125   0.166                   0.296  -0.419   0.242
## 0700.HK                          0.109
## 0762.HK          0.171                                   0.114
## 0836.HK                                         -0.141
## 0857.HK          0.445  -0.216          -0.102  -0.105
## 0883.HK         -0.291   0.372
## 0939.HK  0.282   0.185  -0.256  -0.330   0.211   0.109  -0.348
## 0941.HK -0.111  -0.184   0.120          -0.110
## 1044.HK
## 1088.HK  0.123           0.214   0.212
## 1109.HK         -0.203          -0.121  -0.259   0.402  -0.197
## 1199.HK                          -0.103   0.143   0.124   0.149
## 1299.HK                                  -0.106
## 1398.HK                                  -0.397   0.227   0.629
## 1880.HK                 -0.148   0.123
## 1898.HK  0.281                   0.112           0.137
## 2318.HK  0.274           0.241          -0.169          -0.136
## 2388.HK -0.109  -0.308                   0.214  -0.135
## 2600.HK -0.130
## 2628.HK                 -0.152  -0.125   0.177
## 3328.HK -0.465   0.102   0.160  -0.279  -0.222  -0.176  -0.225
## 3988.HK -0.189          -0.271   0.568          -0.152
##
##                Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8
## SS loadings     1.000  1.000  1.000  1.000  1.000  1.000  1.000  1.000
## Proportion Var  0.021  0.021  0.021  0.021  0.021  0.021  0.021  0.021
## Cumulative Var  0.021  0.042  0.063  0.083  0.104  0.125  0.146  0.167
##                Comp.9 Comp.10 Comp.11 Comp.12 Comp.13 Comp.14 Comp.15
```

```
## SS loadings     1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var  0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var  0.188   0.208   0.229   0.250   0.271   0.292   0.313
##                Comp.16 Comp.17 Comp.18 Comp.19 Comp.20 Comp.21 Comp.22
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.333   0.354   0.375   0.396   0.417   0.438   0.458
##                Comp.23 Comp.24 Comp.25 Comp.26 Comp.27 Comp.28 Comp.29
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.479   0.500   0.521   0.542   0.563   0.583   0.604
##                Comp.30 Comp.31 Comp.32 Comp.33 Comp.34 Comp.35 Comp.36
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.625   0.646   0.667   0.688   0.708   0.729   0.750
##                Comp.37 Comp.38 Comp.39 Comp.40 Comp.41 Comp.42 Comp.43
## SS loadings      1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.771   0.792   0.813   0.833   0.854   0.875   0.896
##                Comp.44 Comp.45 Comp.46 Comp.47 Comp.48
## SS loadings      1.000   1.000   1.000   1.000   1.000
## Proportion Var   0.021   0.021   0.021   0.021   0.021
## Cumulative Var   0.917   0.938   0.958   0.979   1.000
```


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



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

5.2 PCA with psyche package principal Function

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

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

[6] from psyche package help(principal)

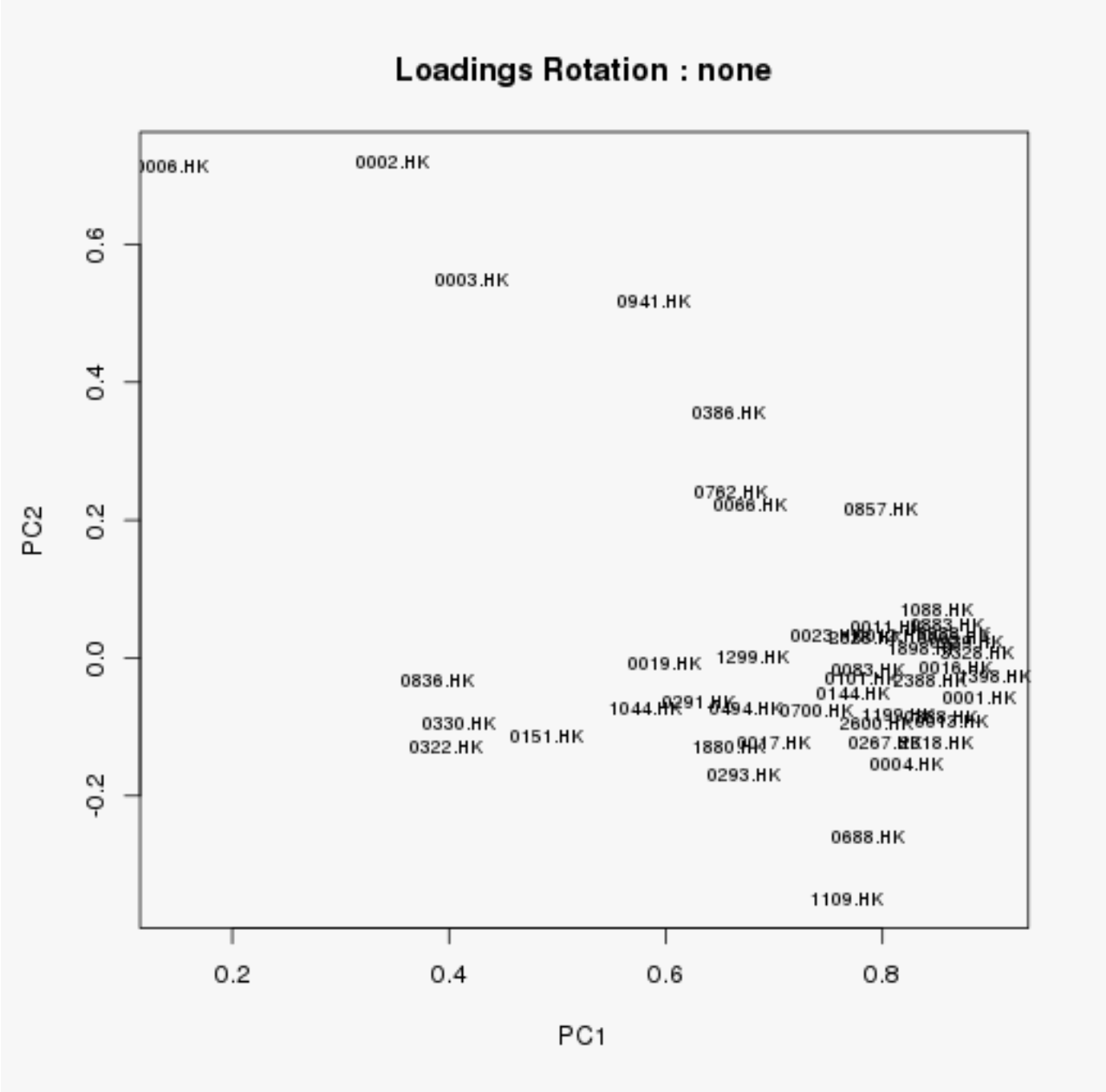
[7] http://en.wikipedia.org/wiki/Factoranalysis

5.2.1 Rotation : none

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "none")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item  PC1   PC2   PC3   PC4   PC5   h2   u2
## 1398.HK   40 0.90 -0.03 -0.06  0.05 -0.13 0.84 0.16
## 0001.HK    1 0.89 -0.06 -0.03 -0.20 -0.01 0.84 0.16
## 3328.HK   47 0.89  0.01 -0.08  0.10 -0.03 0.80 0.20
## 0939.HK   33 0.88  0.02 -0.02  0.07 -0.09 0.78 0.22
## 0016.HK   10 0.87 -0.01 -0.09 -0.18 -0.07 0.80 0.20
## 0005.HK    5 0.87  0.03 -0.07  0.04 -0.03 0.76 0.24
## 3988.HK   48 0.87  0.04 -0.03  0.01 -0.06 0.76 0.24
## 0013.HK    9 0.86 -0.09 -0.02 -0.14  0.06 0.78 0.22
## 0883.HK   32 0.86  0.05 -0.03  0.19 -0.03 0.78 0.22
## 0388.HK   25 0.85 -0.09 -0.07 -0.16 -0.03 0.77 0.23
## 2318.HK   43 0.85 -0.12 -0.10  0.03 -0.10 0.76 0.24
## 1088.HK   36 0.85  0.07  0.02  0.12  0.05 0.74 0.26
## 2388.HK   44 0.84 -0.03  0.05 -0.09 -0.16 0.75 0.25
## 1898.HK   42 0.84  0.01 -0.05  0.05 -0.01 0.71 0.29
## 0004.HK    4 0.82 -0.15 -0.09 -0.13 -0.01 0.73 0.27
## 1199.HK   38 0.81 -0.08 -0.16  0.15  0.06 0.72 0.28
## 0012.HK    8 0.81  0.03 -0.11 -0.22  0.02 0.71 0.29
## 0011.HK    7 0.80  0.05  0.10 -0.30 -0.02 0.75 0.25
## 0267.HK   19 0.80 -0.12  0.11 -0.09  0.10 0.69 0.31
## 0857.HK   31 0.80  0.22 -0.05  0.20  0.13 0.74 0.26
## 2600.HK   45 0.79 -0.09 -0.15  0.07 -0.11 0.68 0.32
## 0688.HK   27 0.79 -0.26 -0.12  0.11 -0.10 0.73 0.27
## 0083.HK   15 0.79 -0.02 -0.17 -0.15  0.00 0.67 0.33
## 2628.HK   46 0.78  0.03 -0.08  0.04 -0.05 0.63 0.37
## 0101.HK   16 0.78 -0.03 -0.19 -0.14  0.10 0.68 0.32
## 0144.HK   17 0.77 -0.05 -0.01  0.20  0.11 0.65 0.35
## 1109.HK   37 0.77 -0.35 -0.08  0.09 -0.03 0.72 0.28
## 0023.HK   13 0.75  0.03  0.14 -0.14 -0.17 0.63 0.37
## 0700.HK   28 0.74 -0.07 -0.03  0.26 -0.18 0.66 0.34
## 0017.HK   11 0.70 -0.12 -0.18 -0.21  0.05 0.59 0.41
## 1299.HK   39 0.68  0.00  0.06 -0.08  0.06 0.48 0.52
## 0066.HK   14 0.68  0.22  0.15 -0.23  0.08 0.59 0.41
## 0494.HK   26 0.67 -0.07  0.01  0.06 -0.03 0.46 0.54
## 0293.HK   21 0.67 -0.17  0.03  0.00  0.08 0.49 0.51
## 0762.HK   29 0.66  0.24  0.20  0.29  0.00 0.62 0.38
## 0386.HK   24 0.66  0.36 -0.08  0.35  0.20 0.73 0.27
## 1880.HK   41 0.66 -0.13  0.13  0.24 -0.09 0.53 0.47
## 0291.HK   20 0.63 -0.06 -0.08 -0.03  0.05 0.41 0.59
## 0019.HK   12 0.60 -0.01  0.19 -0.20  0.04 0.43 0.57
## 0941.HK   34 0.59  0.52  0.10  0.09  0.04 0.64 0.36
## 1044.HK   35 0.58 -0.07  0.45  0.22 -0.12 0.61 0.39
## 0002.HK    2 0.35  0.72  0.03 -0.13 -0.13 0.67 0.33
## 0006.HK    6 0.15  0.71 -0.16  0.12 -0.15 0.59 0.41
## 0003.HK    3 0.42  0.55  0.11 -0.31  0.12 0.60 0.40
## 0322.HK   22 0.40 -0.13  0.64 -0.16 -0.14 0.63 0.37
## 0151.HK   18 0.49 -0.11  0.60  0.12  0.00 0.62 0.38
## 0330.HK   23 0.41 -0.09 -0.08  0.07  0.48 0.42 0.58
## 0836.HK   30 0.39 -0.03  0.19  0.02  0.72 0.70 0.30
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.90 2.30 1.48 1.26 1.13
```

```
## Proportion Var  0.54 0.05 0.03 0.03 0.02
## Cumulative Var  0.54 0.59 0.62 0.64 0.67
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  49.2 0.3
## The degrees of freedom for the model are 898  and the objective function was  9.01
##  0.3The number of observations was  191  with Chi Square =  1530  with prob <  1.3e-35
##  0.3
## Fit based upon off diagonal values = 1


##             PC1       PC2
## 0001.HK 0.8897 -0.057128
## 0002.HK 0.3490  0.720251
## 0003.HK 0.4215  0.549275
## 0004.HK 0.8233 -0.153639
## 0005.HK 0.8662  0.030229
## 0006.HK 0.1453  0.712765
## 0011.HK 0.8048  0.045996
## 0012.HK 0.8091  0.033021
## 0013.HK 0.8635 -0.091279
## 0016.HK 0.8684 -0.013096
## 0017.HK 0.7007 -0.121751
## 0019.HK 0.5984 -0.007937
## 0023.HK 0.7493  0.033719
## 0066.HK 0.6786  0.223654
## 0083.HK 0.7864 -0.018559
## 0101.HK 0.7803 -0.029635
## 0144.HK 0.7735 -0.051958
## 0151.HK 0.4907 -0.113594
## 0267.HK 0.8022 -0.121720
## 0291.HK 0.6305 -0.064537
## 0293.HK 0.6729 -0.170436
## 0322.HK 0.3965 -0.129796
## 0330.HK 0.4084 -0.094341
## 0386.HK 0.6581  0.357448
## 0388.HK 0.8544 -0.086007
## 0494.HK 0.6736 -0.074164
## 0688.HK 0.7873 -0.260929
## 0700.HK 0.7391 -0.074946
## 0762.HK 0.6607  0.240632
## 0836.HK 0.3887 -0.031730
## 0857.HK 0.7983  0.215468
## 0883.HK 0.8593  0.048140
## 0939.HK 0.8771  0.023625
## 0941.HK 0.5897  0.517452
## 1044.HK 0.5811 -0.073667
## 1088.HK 0.8495  0.069931
## 1109.HK 0.7663 -0.349163
## 1199.HK 0.8146 -0.081644
## 1299.HK 0.6811  0.002676
## 1398.HK 0.9042 -0.025341
## 1880.HK 0.6575 -0.128051
## 1898.HK 0.8374  0.013115
## 2318.HK 0.8495 -0.123952
## 2388.HK 0.8439 -0.032999
## 2600.HK 0.7950 -0.093463
```

```
## 2628.HK 0.7840  0.030479
## 3328.HK 0.8875  0.008326
## 3988.HK 0.8657  0.036801
```



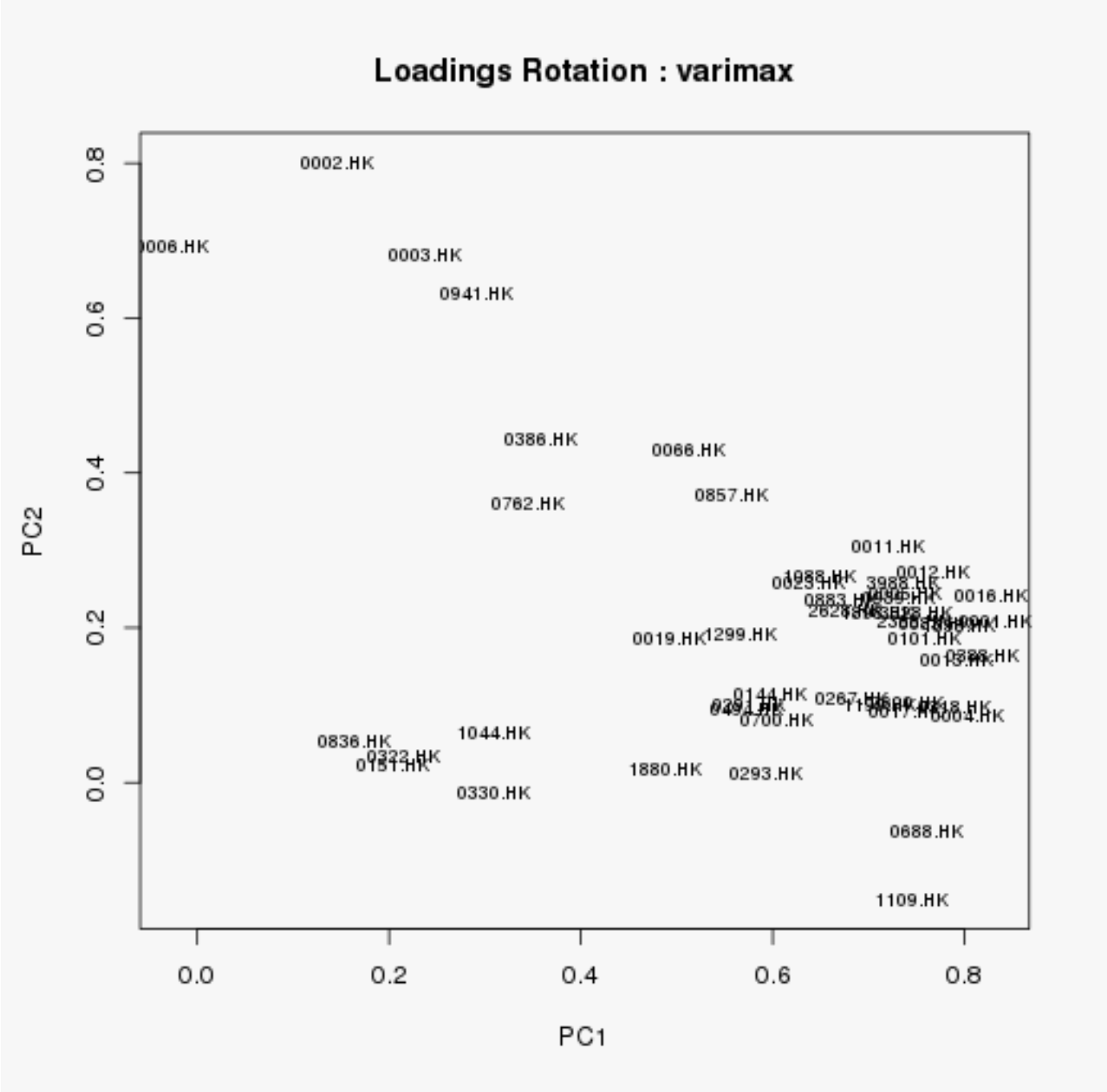
5.2.2 Rotation : varimax

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

```
## 0836.HK   30  0.16  0.05  0.07  0.18  0.80 0.70 0.30
## 0330.HK   23  0.31 -0.01  0.14 -0.02  0.55 0.42 0.58
##
##                  PC1  PC2  PC4  PC3  PC5
## SS loadings    18.86 3.85 3.75 3.46 2.15
## Proportion Var  0.39 0.08 0.08 0.07 0.04
## Cumulative Var  0.39 0.47 0.55 0.62 0.67
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  49.2 0.3
## The degrees of freedom for the model are 898  and the objective function was  9.01
##  0.3The number of observations was  191  with Chi Square =  1530  with prob <  1.3e-35
##  0.3
## Fit based upon off diagonal values = 1

##              PC1      PC2
## 0001.HK  0.83322  0.20802
## 0002.HK  0.14633  0.80107
## 0003.HK  0.23782  0.68252
## 0004.HK  0.80380  0.08549
## 0005.HK  0.73925  0.24470
## 0006.HK -0.02517  0.69337
## 0011.HK  0.72024  0.30538
## 0012.HK  0.76773  0.27176
## 0013.HK  0.79150  0.15721
## 0016.HK  0.82846  0.24083
## 0017.HK  0.73789  0.09239
## 0019.HK  0.49312  0.18618
## 0023.HK  0.63770  0.25841
## 0066.HK  0.51313  0.42953
## 0083.HK  0.76870  0.20414
## 0101.HK  0.75755  0.18679
## 0144.HK  0.59859  0.11400
## 0151.HK  0.20471  0.02153
## 0267.HK  0.68244  0.10852
## 0291.HK  0.57579  0.10135
## 0293.HK  0.59207  0.01156
## 0322.HK  0.21456  0.03442
## 0330.HK  0.30850 -0.01180
## 0386.HK  0.35819  0.44367
## 0388.HK  0.81809  0.16351
## 0494.HK  0.57302  0.09458
## 0688.HK  0.76104 -0.06355
## 0700.HK  0.60500  0.08022
## 0762.HK  0.34420  0.35955
## 0836.HK  0.16392  0.05356
## 0857.HK  0.55632  0.37287
## 0883.HK  0.67188  0.23688
## 0939.HK  0.73187  0.23971
## 0941.HK  0.29220  0.63257
## 1044.HK  0.31024  0.06517
## 1088.HK  0.64944  0.26663
## 1109.HK  0.74416 -0.15098
## 1199.HK  0.71160  0.09985
## 1299.HK  0.56706  0.19252
## 1398.HK  0.79329  0.20193
```

```
## 1880.HK  0.48794  0.01661
## 1898.HK  0.70850  0.21935
## 2318.HK  0.79029  0.09640
## 2388.HK  0.74836  0.20782
## 2600.HK  0.74131  0.10239
## 2628.HK  0.67506  0.22290
## 3328.HK  0.75066  0.21923
## 3988.HK  0.73627  0.25710
```



5.2.3 Rotation : quatimax

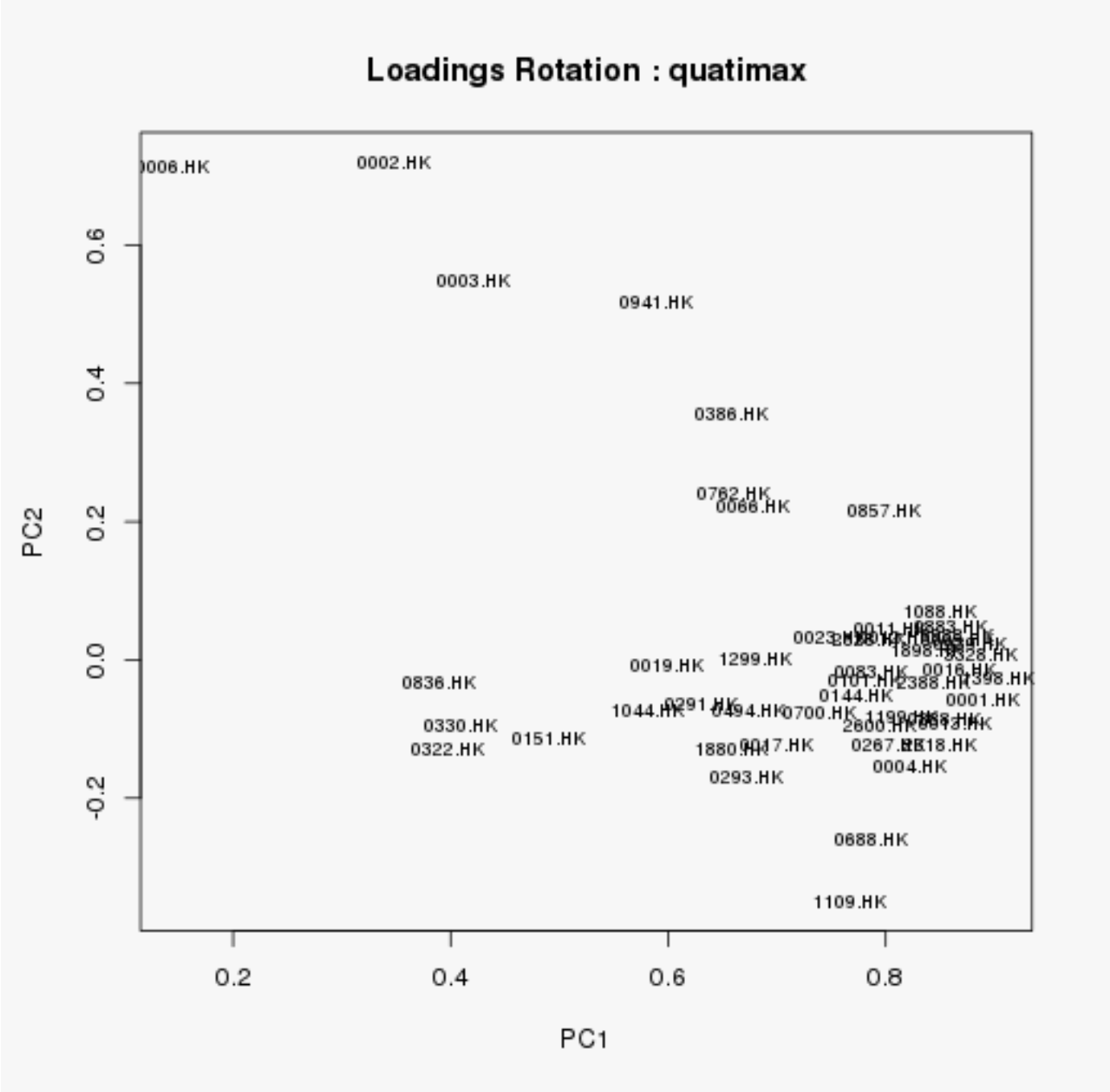
Quartimax rotation is an orthogonal alternative which minimizes the number of factors needed to explain each variable. This type of rotation often generates a general factor on which most variables are loaded to a high or medium degree. Such a factor structure is usually not helpful to the research purpose.

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "quatimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item  PC1   PC2   PC3   PC4   PC5   h2   u2
## 1398.HK   40 0.90 -0.03 -0.06  0.05 -0.13 0.84 0.16
## 0001.HK    1 0.89 -0.06 -0.03 -0.20 -0.01 0.84 0.16
## 3328.HK   47 0.89  0.01 -0.08  0.10 -0.03 0.80 0.20
## 0939.HK   33 0.88  0.02 -0.02  0.07 -0.09 0.78 0.22
## 0016.HK   10 0.87 -0.01 -0.09 -0.18 -0.07 0.80 0.20
## 0005.HK    5 0.87  0.03 -0.07  0.04 -0.03 0.76 0.24
## 3988.HK   48 0.87  0.04 -0.03  0.01 -0.06 0.76 0.24
## 0013.HK    9 0.86 -0.09 -0.02 -0.14  0.06 0.78 0.22
## 0883.HK   32 0.86  0.05 -0.03  0.19 -0.03 0.78 0.22
## 0388.HK   25 0.85 -0.09 -0.07 -0.16 -0.03 0.77 0.23
## 2318.HK   43 0.85 -0.12 -0.10  0.03 -0.10 0.76 0.24
## 1088.HK   36 0.85  0.07  0.02  0.12  0.05 0.74 0.26
## 2388.HK   44 0.84 -0.03  0.05 -0.09 -0.16 0.75 0.25
## 1898.HK   42 0.84  0.01 -0.05  0.05 -0.01 0.71 0.29
## 0004.HK    4 0.82 -0.15 -0.09 -0.13 -0.01 0.73 0.27
## 1199.HK   38 0.81 -0.08 -0.16  0.15  0.06 0.72 0.28
## 0012.HK    8 0.81  0.03 -0.11 -0.22  0.02 0.71 0.29
## 0011.HK    7 0.80  0.05  0.10 -0.30 -0.02 0.75 0.25
## 0267.HK   19 0.80 -0.12  0.11 -0.09  0.10 0.69 0.31
## 0857.HK   31 0.80  0.22 -0.05  0.20  0.13 0.74 0.26
## 2600.HK   45 0.79 -0.09 -0.15  0.07 -0.11 0.68 0.32
## 0688.HK   27 0.79 -0.26 -0.12  0.11 -0.10 0.73 0.27
## 0083.HK   15 0.79 -0.02 -0.17 -0.15  0.00 0.67 0.33
## 2628.HK   46 0.78  0.03 -0.08  0.04 -0.05 0.63 0.37
## 0101.HK   16 0.78 -0.03 -0.19 -0.14  0.10 0.68 0.32
## 0144.HK   17 0.77 -0.05 -0.01  0.20  0.11 0.65 0.35
## 1109.HK   37 0.77 -0.35 -0.08  0.09 -0.03 0.72 0.28
## 0023.HK   13 0.75  0.03  0.14 -0.14 -0.17 0.63 0.37
## 0700.HK   28 0.74 -0.07 -0.03  0.26 -0.18 0.66 0.34
## 0017.HK   11 0.70 -0.12 -0.18 -0.21  0.05 0.59 0.41
## 1299.HK   39 0.68  0.00  0.06 -0.08  0.06 0.48 0.52
## 0066.HK   14 0.68  0.22  0.15 -0.23  0.08 0.59 0.41
## 0494.HK   26 0.67 -0.07  0.01  0.06 -0.03 0.46 0.54
## 0293.HK   21 0.67 -0.17  0.03  0.00  0.08 0.49 0.51
## 0762.HK   29 0.66  0.24  0.20  0.29  0.00 0.62 0.38
## 0386.HK   24 0.66  0.36 -0.08  0.35  0.20 0.73 0.27
## 1880.HK   41 0.66 -0.13  0.13  0.24 -0.09 0.53 0.47
## 0291.HK   20 0.63 -0.06 -0.08 -0.03  0.05 0.41 0.59
## 0019.HK   12 0.60 -0.01  0.19 -0.20  0.04 0.43 0.57
## 0941.HK   34 0.59  0.52  0.10  0.09  0.04 0.64 0.36
## 1044.HK   35 0.58 -0.07  0.45  0.22 -0.12 0.61 0.39
## 0002.HK    2 0.35  0.72  0.03 -0.13 -0.13 0.67 0.33
## 0006.HK    6 0.15  0.71 -0.16  0.12 -0.15 0.59 0.41
## 0003.HK    3 0.42  0.55  0.11 -0.31  0.12 0.60 0.40
## 0322.HK   22 0.40 -0.13  0.64 -0.16 -0.14 0.63 0.37
## 0151.HK   18 0.49 -0.11  0.60  0.12  0.00 0.62 0.38
## 0330.HK   23 0.41 -0.09 -0.08  0.07  0.48 0.42 0.58
## 0836.HK   30 0.39 -0.03  0.19  0.02  0.72 0.70 0.30
```

```
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.90 2.30 1.48 1.26 1.13
## Proportion Var  0.54 0.05 0.03 0.03 0.02
## Cumulative Var  0.54 0.59 0.62 0.64 0.67
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  49.2 0.3
## The degrees of freedom for the model are 898  and the objective function was  9.01
##  0.3The number of observations was  191  with Chi Square =  1530  with prob <  1.3e-35
##  0.3
## Fit based upon off diagonal values = 1
```

```
##             PC1       PC2
## 0001.HK 0.8897 -0.057128
## 0002.HK 0.3490  0.720251
## 0003.HK 0.4215  0.549275
## 0004.HK 0.8233 -0.153639
## 0005.HK 0.8662  0.030229
## 0006.HK 0.1453  0.712765
## 0011.HK 0.8048  0.045996
## 0012.HK 0.8091  0.033021
## 0013.HK 0.8635 -0.091279
## 0016.HK 0.8684 -0.013096
## 0017.HK 0.7007 -0.121751
## 0019.HK 0.5984 -0.007937
## 0023.HK 0.7493  0.033719
## 0066.HK 0.6786  0.223654
## 0083.HK 0.7864 -0.018559
## 0101.HK 0.7803 -0.029635
## 0144.HK 0.7735 -0.051958
## 0151.HK 0.4907 -0.113594
## 0267.HK 0.8022 -0.121720
## 0291.HK 0.6305 -0.064537
## 0293.HK 0.6729 -0.170436
## 0322.HK 0.3965 -0.129796
## 0330.HK 0.4084 -0.094341
## 0386.HK 0.6581  0.357448
## 0388.HK 0.8544 -0.086007
## 0494.HK 0.6736 -0.074164
## 0688.HK 0.7873 -0.260929
## 0700.HK 0.7391 -0.074946
## 0762.HK 0.6607  0.240632
## 0836.HK 0.3887 -0.031730
## 0857.HK 0.7983  0.215468
## 0883.HK 0.8593  0.048140
## 0939.HK 0.8771  0.023625
## 0941.HK 0.5897  0.517452
## 1044.HK 0.5811 -0.073667
## 1088.HK 0.8495  0.069931
## 1109.HK 0.7663 -0.349163
## 1199.HK 0.8146 -0.081644
## 1299.HK 0.6811  0.002676
## 1398.HK 0.9042 -0.025341
## 1880.HK 0.6575 -0.128051
## 1898.HK 0.8374  0.013115
```

```
## 2318.HK 0.8495 -0.123952
## 2388.HK 0.8439 -0.032999
## 2600.HK 0.7950 -0.093463
## 2628.HK 0.7840  0.030479
## 3328.HK 0.8875  0.008326
## 3988.HK 0.8657  0.036801
```



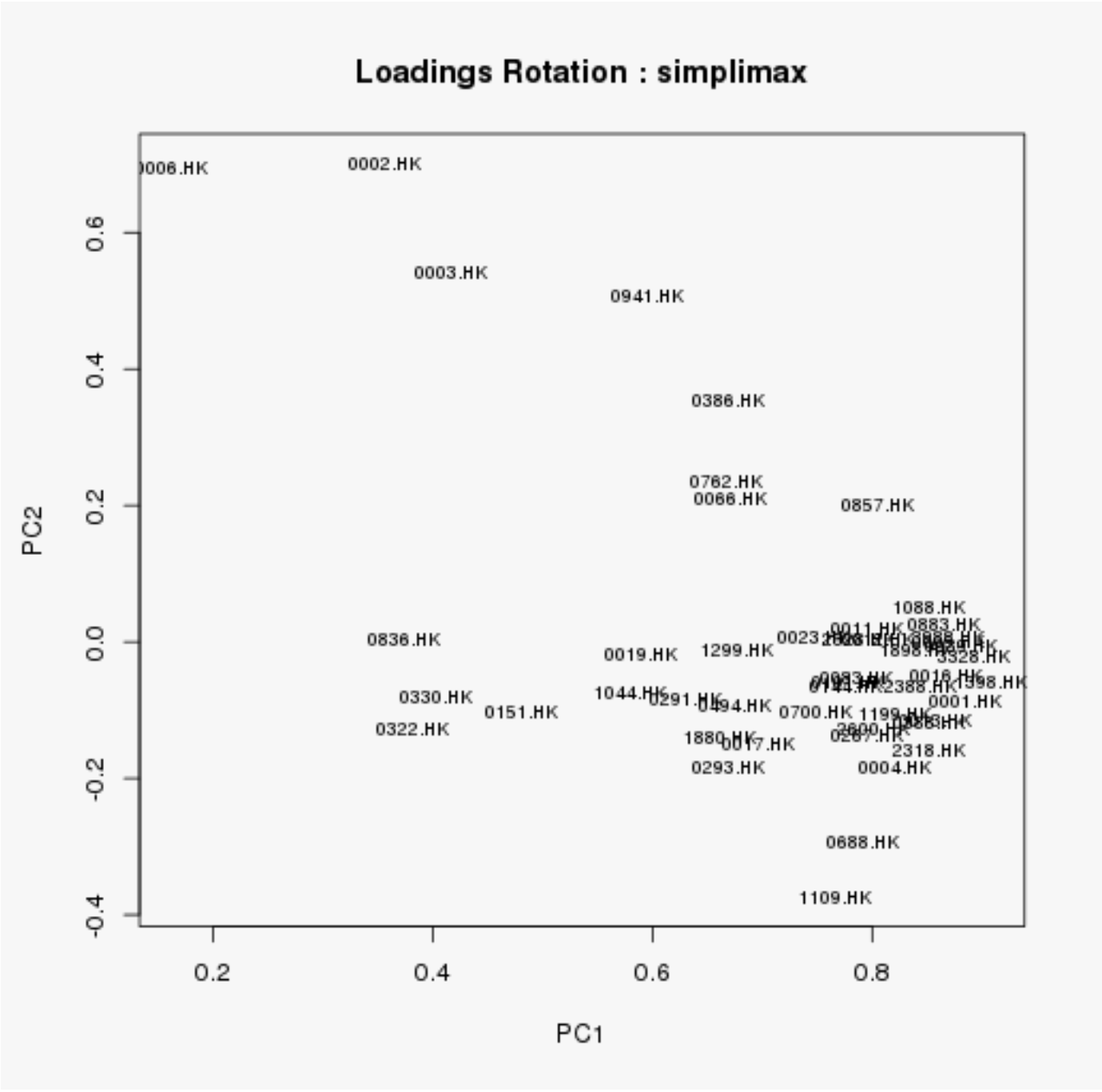
5.2.4 Rotation : simplimax

A compromise between Varimax and Quartimax criteria.

```
## Warning message: convergence not obtained in GPFoblq. 1000 iterations used.

## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "simplimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item  PC1   PC2   PC3   PC4   PC5   h2   u2
## 1398.HK   40 0.91 -0.06 -0.03  0.00 -0.10 0.84 0.16
## 3328.HK   47 0.89 -0.02 -0.05 -0.05  0.00 0.80 0.20
## 0001.HK    1 0.88 -0.09  0.00  0.26  0.01 0.84 0.16
## 0939.HK   33 0.88 -0.01  0.02 -0.01 -0.07 0.78 0.22
## 0005.HK    5 0.87  0.00 -0.04  0.01  0.00 0.76 0.24
## 3988.HK   48 0.87  0.01  0.00  0.04 -0.04 0.76 0.24
## 0016.HK   10 0.87 -0.05 -0.06  0.23 -0.05 0.80 0.20
## 0883.HK   32 0.87  0.02  0.01 -0.13  0.00 0.78 0.22
## 0013.HK    9 0.86 -0.12  0.01  0.20  0.08 0.78 0.22
## 2318.HK   43 0.85 -0.16 -0.06  0.03 -0.08 0.76 0.24
## 1088.HK   36 0.85  0.05  0.06 -0.06  0.07 0.74 0.26
## 0388.HK   25 0.85 -0.12 -0.04  0.21 -0.01 0.77 0.23
## 2388.HK   44 0.84 -0.07  0.09  0.16 -0.14 0.75 0.25
## 1898.HK   42 0.84 -0.01 -0.02  0.00  0.01 0.71 0.29
## 0004.HK    4 0.82 -0.18 -0.05  0.18  0.01 0.73 0.27
## 1199.HK   38 0.82 -0.11 -0.12 -0.12  0.09 0.72 0.28
## 0012.HK    8 0.81  0.00 -0.08  0.25  0.04 0.71 0.29
## 0857.HK   31 0.81  0.20 -0.02 -0.17  0.15 0.74 0.26
## 2600.HK   45 0.80 -0.13 -0.11 -0.03 -0.08 0.68 0.32
## 0011.HK    7 0.80  0.02  0.12  0.37 -0.01 0.75 0.25
## 0267.HK   19 0.79 -0.14  0.15  0.16  0.11 0.69 0.31
## 0688.HK   27 0.79 -0.29 -0.08 -0.05 -0.07 0.73 0.27
## 2628.HK   46 0.79  0.00 -0.05  0.00 -0.03 0.63 0.37
## 0083.HK   15 0.79 -0.05 -0.14  0.18  0.02 0.67 0.33
## 0101.HK   16 0.78 -0.06 -0.17  0.16  0.12 0.68 0.32
## 0144.HK   17 0.78 -0.07  0.02 -0.15  0.13 0.65 0.35
## 1109.HK   37 0.77 -0.37 -0.03 -0.03  0.00 0.72 0.28
## 0700.HK   28 0.75 -0.10  0.01 -0.21 -0.15 0.66 0.34
## 0023.HK   13 0.75  0.01  0.16  0.21 -0.16 0.63 0.37
## 0017.HK   11 0.70 -0.15 -0.15  0.24  0.07 0.59 0.41
## 1299.HK   39 0.68 -0.01  0.08  0.13  0.07 0.48 0.52
## 0494.HK   26 0.68 -0.09  0.04 -0.01 -0.01 0.46 0.54
## 0066.HK   14 0.67  0.21  0.16  0.28  0.09 0.59 0.41
## 0386.HK   24 0.67  0.35 -0.06 -0.34  0.23 0.73 0.27
## 0293.HK   21 0.67 -0.18  0.06  0.06  0.10 0.49 0.51
## 0762.HK   29 0.67  0.23  0.22 -0.23  0.01 0.62 0.38
## 1880.HK   41 0.66 -0.14  0.17 -0.16 -0.06 0.53 0.47
## 0291.HK   20 0.63 -0.08 -0.05  0.06  0.07 0.41 0.59
## 0941.HK   34 0.60  0.51  0.11 -0.06  0.05 0.64 0.36
## 0019.HK   12 0.59 -0.02  0.21  0.26  0.04 0.43 0.57
## 1044.HK   35 0.58 -0.07  0.48 -0.11 -0.11 0.61 0.39
## 0002.HK    2 0.36  0.70  0.01  0.13 -0.14 0.67 0.33
## 0006.HK    6 0.16  0.70 -0.19 -0.16 -0.15 0.59 0.41
## 0003.HK    3 0.42  0.54  0.10  0.32  0.11 0.60 0.40
## 0322.HK   22 0.38 -0.13  0.66  0.29 -0.15 0.63 0.37
## 0151.HK   18 0.48 -0.10  0.63  0.00  0.00 0.62 0.38
## 0330.HK   23 0.40 -0.08 -0.06 -0.07  0.50 0.42 0.58
## 0836.HK   30 0.37  0.00  0.21  0.00  0.73 0.70 0.30
```

```
##
##                  PC1  PC2  PC3  PC4  PC5
## SS loadings    25.83 2.30 1.49 1.30 1.14
## Proportion Var  0.54 0.05 0.03 0.03 0.02
## Cumulative Var  0.54 0.59 0.62 0.64 0.67
##
##  With component correlations of
##       PC1   PC2   PC3   PC4   PC5
## PC1  1.00  0.02 -0.02 -0.04 -0.01
## PC2  0.02  1.00 -0.01  0.06 -0.04
## PC3 -0.02 -0.01  1.00 -0.11  0.02
## PC4 -0.04  0.06 -0.11  1.00  0.08
## PC5 -0.01 -0.04  0.02  0.08  1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  49.2 0.3
## The degrees of freedom for the model are 898  and the objective function was  9.01
##  0.3The number of observations was  191  with Chi Square =  1530  with prob <  1.3e-35
##  0.3
## Fit based upon off diagonal values = 1

##            PC1       PC2
## 0001.HK 0.8848 -0.088364
## 0002.HK 0.3560  0.701620
## 0003.HK 0.4162  0.541974
## 0004.HK 0.8201 -0.183935
## 0005.HK 0.8696  0.001758
## 0006.HK 0.1626  0.696191
## 0011.HK 0.7963  0.019645
## 0012.HK 0.8058  0.002159
## 0013.HK 0.8584 -0.116570
## 0016.HK 0.8667 -0.049135
## 0017.HK 0.6964 -0.150721
## 0019.HK 0.5891 -0.019525
## 0023.HK 0.7466  0.005792
## 0066.HK 0.6712  0.210135
## 0083.HK 0.7857 -0.051083
## 0101.HK 0.7785 -0.057349
## 0144.HK 0.7768 -0.065020
## 0151.HK 0.4813 -0.101077
## 0267.HK 0.7948 -0.136959
## 0291.HK 0.6299 -0.083567
## 0293.HK 0.6690 -0.184301
## 0322.HK 0.3811 -0.126185
## 0330.HK 0.4025 -0.081620
## 0386.HK 0.6697  0.353421
## 0388.HK 0.8515 -0.118641
## 0494.HK 0.6751 -0.093925
## 0688.HK 0.7913 -0.292164
## 0700.HK 0.7490 -0.102105
## 0762.HK 0.6677  0.234999
## 0836.HK 0.3733  0.004118
## 0857.HK 0.8051  0.201548
## 0883.HK 0.8661  0.024278
## 0939.HK 0.8813 -0.005857
## 0941.HK 0.5957  0.508643
```

```
## 1044.HK 0.5795 -0.074202
## 1088.HK 0.8523  0.051316
## 1109.HK 0.7666 -0.374044
## 1199.HK 0.8200 -0.105351
## 1299.HK 0.6771 -0.012965
## 1398.HK 0.9090 -0.059893
## 1880.HK 0.6613 -0.141529
## 1898.HK 0.8403 -0.012767
## 2318.HK 0.8527 -0.157484
## 2388.HK 0.8431 -0.065405
## 2600.HK 0.8006 -0.126805
## 2628.HK 0.7882  0.002660
## 3328.HK 0.8924 -0.020274
## 3988.HK 0.8685  0.007315
```


Loadings Rotation : simplimax
0006.HK
0002.HK
0003.HK
0941.HK
0386.HK
0762.HK
0066.HK
0857.HK
1088.HK
0836.HK
0019.HK
1299.HK
0330.HK
0151.HK
0322.HK
0001.HK
0700.HK
0293.HK
0004.HK
2318.HK
0688.HK
1109.HK
PC1
PC2
0.2
0.4
0.6
0.8
-0.4
-0.2
0.0
0.2
0.4
0.6

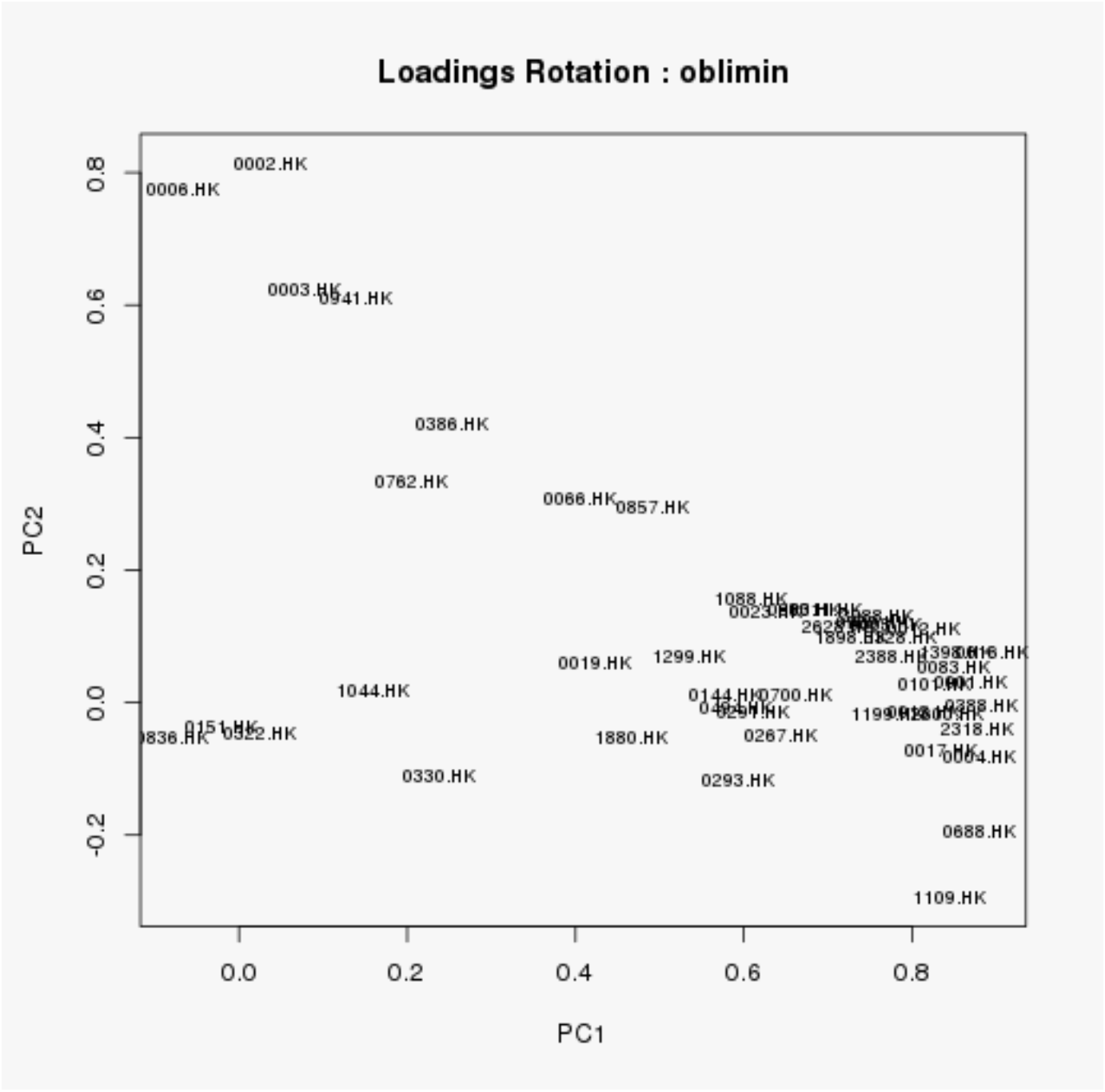
5.2.5 Rotation : oblimin

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

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "oblimin")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item   PC1   PC2   PC3   PC5   PC4   h2   u2
## 0016.HK   10  0.90  0.08 -0.01 -0.03 -0.13 0.80 0.20
## 0388.HK   25  0.88  0.00  0.01  0.00 -0.12 0.77 0.23
## 0688.HK   27  0.88 -0.19  0.01 -0.06  0.16 0.73 0.27
## 0004.HK    4  0.88 -0.08 -0.01  0.03 -0.09 0.73 0.27
## 2318.HK   43  0.88 -0.04  0.02 -0.06  0.08 0.76 0.24
## 0001.HK    1  0.87  0.03  0.05  0.04 -0.16 0.84 0.16
## 1398.HK   40  0.85  0.07  0.07 -0.07  0.11 0.84 0.16
## 0083.HK   15  0.85  0.05 -0.12  0.02 -0.10 0.67 0.33
## 1109.HK   37  0.84 -0.29  0.05  0.02  0.13 0.72 0.28
## 2600.HK   45  0.84 -0.02 -0.03 -0.07  0.13 0.68 0.32
## 0017.HK   11  0.83 -0.07 -0.15  0.05 -0.17 0.59 0.41
## 0101.HK   16  0.83  0.03 -0.16  0.13 -0.10 0.68 0.32
## 0012.HK    8  0.81  0.11 -0.06  0.05 -0.17 0.71 0.29
## 0013.HK    9  0.81 -0.01  0.05  0.12 -0.11 0.78 0.22
## 3328.HK   47  0.79  0.10  0.03  0.04  0.14 0.80 0.20
## 2388.HK   44  0.78  0.07  0.19 -0.10 -0.05 0.75 0.25
## 1199.HK   38  0.77 -0.02 -0.07  0.12  0.20 0.72 0.28
## 0005.HK    5  0.77  0.12  0.03  0.04  0.08 0.76 0.24
## 3988.HK   48  0.76  0.13  0.08  0.01  0.06 0.76 0.24
## 0939.HK   33  0.75  0.12  0.11 -0.01  0.11 0.78 0.22
## 1898.HK   42  0.73  0.10  0.05  0.06  0.09 0.71 0.29
## 2628.HK   46  0.71  0.11  0.02  0.01  0.09 0.63 0.37
## 0011.HK    7  0.70  0.14  0.16  0.03 -0.28 0.75 0.25
## 0883.HK   32  0.67  0.14  0.10  0.06  0.23 0.78 0.22
## 0700.HK   28  0.66  0.01  0.13 -0.11  0.31 0.66 0.34
## 0267.HK   19  0.64 -0.05  0.20  0.18 -0.08 0.69 0.31
## 0023.HK   13  0.63  0.14  0.26 -0.11 -0.11 0.63 0.37
## 0291.HK   20  0.61 -0.01 -0.03  0.09  0.00 0.41 0.59
## 1088.HK   36  0.61  0.16  0.12  0.15  0.14 0.74 0.26
## 0293.HK   21  0.59 -0.12  0.11  0.14  0.01 0.49 0.51
## 0494.HK   26  0.59 -0.01  0.11  0.03  0.09 0.46 0.54
## 0144.HK   17  0.58  0.01  0.08  0.21  0.23 0.65 0.35
## 1299.HK   39  0.53  0.07  0.12  0.13 -0.06 0.48 0.52
## 0857.HK   31  0.49  0.29  0.02  0.24  0.23 0.74 0.26
## 1880.HK   41  0.47 -0.05  0.28  0.01  0.26 0.53 0.47
## 0019.HK   12  0.42  0.06  0.24  0.10 -0.20 0.43 0.57
## 0066.HK   14  0.40  0.31  0.18  0.16 -0.23 0.59 0.41
## 0002.HK    2  0.04  0.81  0.03 -0.09 -0.10 0.67 0.33
## 0006.HK    6 -0.07  0.78 -0.17 -0.13  0.17 0.59 0.41
## 0003.HK    3  0.08  0.62  0.07  0.17 -0.31 0.60 0.40
## 0941.HK   34  0.14  0.61  0.14  0.15  0.10 0.64 0.36
## 0386.HK   24  0.25  0.42 -0.04  0.33  0.37 0.73 0.27
## 0762.HK   29  0.21  0.33  0.31  0.14  0.30 0.62 0.38
## 0322.HK   22  0.02 -0.05  0.78 -0.04 -0.21 0.63 0.37
## 0151.HK   18 -0.02 -0.04  0.74  0.16  0.07 0.62 0.38
## 1044.HK   35  0.16  0.02  0.63  0.03  0.20 0.61 0.39
## 0836.HK   30 -0.08 -0.05  0.09  0.85 -0.04 0.70 0.30
## 0330.HK   23  0.24 -0.11 -0.13  0.56  0.05 0.42 0.58
```

```
##
##                  PC1  PC2  PC3  PC5  PC4
## SS loadings    21.85 3.36 3.11 2.28 1.46
## Proportion Var  0.46 0.07 0.06 0.05 0.03
## Cumulative Var  0.46 0.53 0.59 0.64 0.67
##
##  With component correlations of
##      PC1  PC2  PC3  PC5  PC4
## PC1 1.00 0.36 0.50 0.45 0.17
## PC2 0.36 1.00 0.17 0.19 0.05
## PC3 0.50 0.17 1.00 0.25 0.06
## PC5 0.45 0.19 0.25 1.00 0.05
## PC4 0.17 0.05 0.06 0.05 1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  49.2 0.3
## The degrees of freedom for the model are 898  and the objective function was  9.01
##  0.3The number of observations was  191  with Chi Square =  1530  with prob <  1.3e-35
##  0.3
## Fit based upon off diagonal values = 1

##              PC1       PC2
## 0001.HK  0.87113  0.030688
## 0002.HK  0.03791  0.814017
## 0003.HK  0.07805  0.622231
## 0004.HK  0.87941 -0.082086
## 0005.HK  0.76738  0.119263
## 0006.HK -0.06540  0.775079
## 0011.HK  0.69664  0.140001
## 0012.HK  0.81354  0.111256
## 0013.HK  0.81332 -0.014804
## 0016.HK  0.89638  0.077337
## 0017.HK  0.83494 -0.071024
## 0019.HK  0.42293  0.060732
## 0023.HK  0.62568  0.137263
## 0066.HK  0.40451  0.308232
## 0083.HK  0.85080  0.052167
## 0101.HK  0.82664  0.028982
## 0144.HK  0.57800  0.012316
## 0151.HK -0.02050 -0.037535
## 0267.HK  0.64422 -0.049100
## 0291.HK  0.61013 -0.013200
## 0293.HK  0.59429 -0.117669
## 0322.HK  0.02492 -0.046553
## 0330.HK  0.23843 -0.109447
## 0386.HK  0.25351  0.420371
## 0388.HK  0.88314 -0.003540
## 0494.HK  0.59053 -0.006347
## 0688.HK  0.88051 -0.193205
## 0700.HK  0.66127  0.010809
## 0762.HK  0.20519  0.332797
## 0836.HK -0.07809 -0.052864
## 0857.HK  0.49312  0.294224
## 0883.HK  0.67174  0.139925
## 0939.HK  0.75339  0.122411
## 0941.HK  0.13860  0.610090
```

```
## 1044.HK  0.15895  0.016974
## 1088.HK  0.60982  0.157432
## 1109.HK  0.84420 -0.293590
## 1199.HK  0.77002 -0.018322
## 1299.HK  0.53440  0.070812
## 1398.HK  0.85292  0.074609
## 1880.HK  0.46652 -0.053778
## 1898.HK  0.72866  0.097501
## 2318.HK  0.87850 -0.040098
## 2388.HK  0.77702  0.070240
## 2600.HK  0.84193 -0.015828
## 2628.HK  0.71295  0.113125
## 3328.HK  0.78508  0.097786
## 3988.HK  0.75874  0.132013
```


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
0006.HK
0003.HK
0941.HK
0386.HK
0762.HK
0066.HK
0857.HK
1088.HK
0019.HK
1299.HK
1044.HK
0144.HK
0700.HK
0267.HK
1880.HK
0330.HK
0293.HK
0688.HK
1109.HK
2318.HK
0083.HK

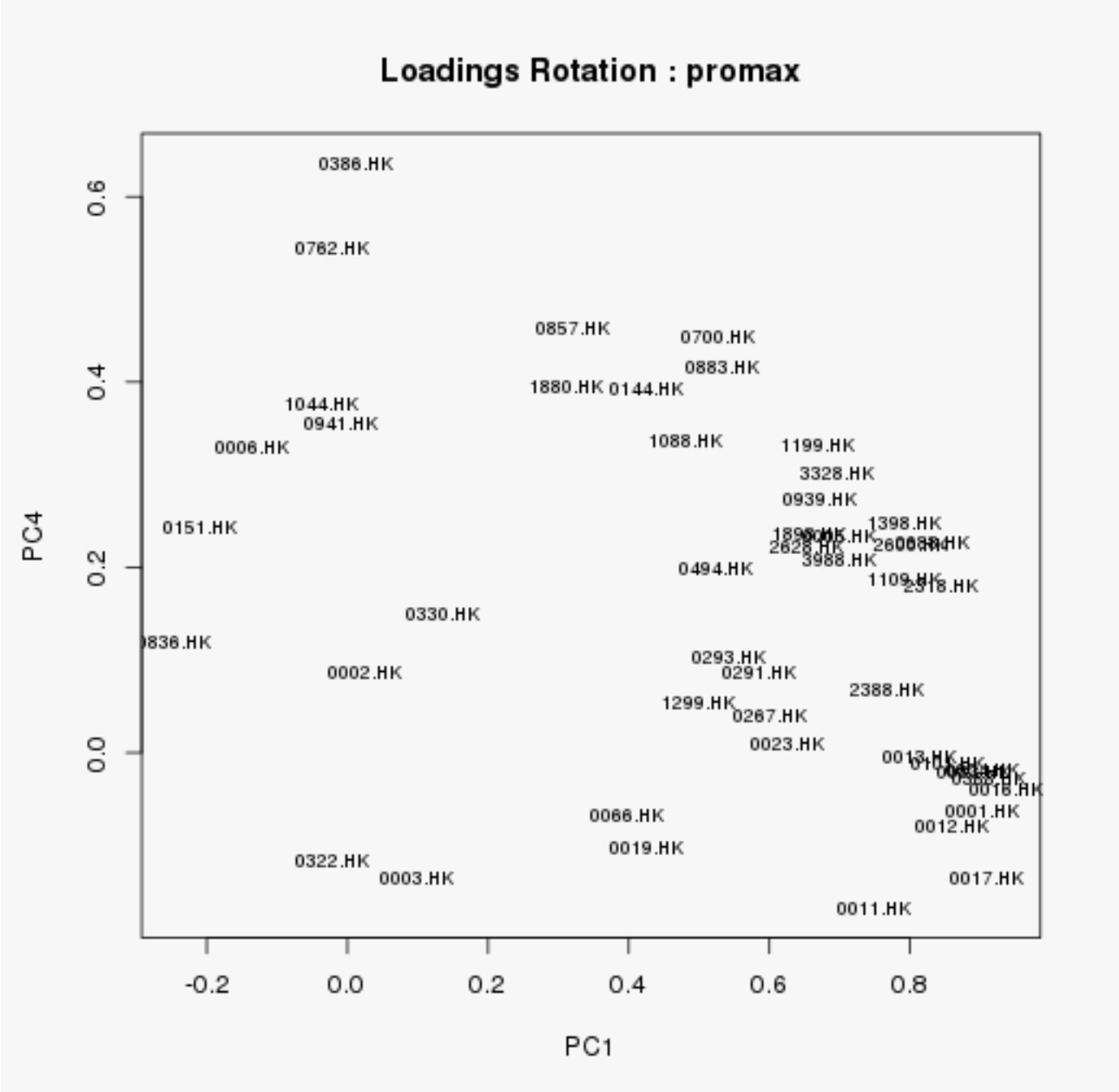
5.2.6 Rotation : promax

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

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "promax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##         item   PC1   PC4   PC2   PC3   PC5   h2   u2
## 0016.HK   10  0.94 -0.04  0.08 -0.03 -0.07 0.80 0.20
## 0388.HK   25  0.91 -0.03  0.00  0.00 -0.03 0.77 0.23
## 0017.HK   11  0.91 -0.14 -0.06 -0.16  0.05 0.59 0.41
## 0004.HK    4  0.90 -0.02 -0.09 -0.02  0.00 0.73 0.27
## 0001.HK    1  0.90 -0.06  0.04  0.04  0.01 0.84 0.16
## 0083.HK   15  0.89 -0.02  0.05 -0.14 -0.01 0.67 0.33
## 0012.HK    8  0.86 -0.08  0.12 -0.07  0.02 0.71 0.29
## 0101.HK   16  0.85 -0.01  0.03 -0.19  0.11 0.68 0.32
## 2318.HK   43  0.85  0.18 -0.07 -0.02 -0.11 0.76 0.24
## 0688.HK   27  0.83  0.23 -0.24 -0.03 -0.11 0.73 0.27
## 0013.HK    9  0.81  0.00 -0.02  0.03  0.10 0.78 0.22
## 2600.HK   45  0.80  0.23 -0.05 -0.09 -0.12 0.68 0.32
## 1109.HK   37  0.79  0.19 -0.34  0.02 -0.01 0.72 0.28
## 1398.HK   40  0.79  0.25  0.04  0.02 -0.13 0.84 0.16
## 2388.HK   44  0.77  0.07  0.06  0.17 -0.15 0.75 0.25
## 0011.HK    7  0.75 -0.17  0.17  0.18  0.01 0.75 0.25
## 0005.HK    5  0.70  0.23  0.08 -0.02 -0.01 0.76 0.24
## 3988.HK   48  0.70  0.21  0.10  0.03 -0.05 0.76 0.24
## 3328.HK   47  0.70  0.30  0.05 -0.03 -0.01 0.80 0.20
## 0939.HK   33  0.67  0.27  0.08  0.06 -0.08 0.78 0.22
## 1199.HK   38  0.67  0.33 -0.08 -0.14  0.08 0.72 0.28
## 1898.HK   42  0.66  0.24  0.06 -0.01  0.01 0.71 0.29
## 2628.HK   46  0.65  0.22  0.08 -0.03 -0.05 0.63 0.37
## 0023.HK   13  0.62  0.01  0.14  0.26 -0.16 0.63 0.37
## 0267.HK   19  0.60  0.04 -0.07  0.19  0.16 0.69 0.31
## 0291.HK   20  0.59  0.09 -0.03 -0.05  0.07 0.41 0.59
## 0293.HK   21  0.54  0.10 -0.15  0.09  0.13 0.49 0.51
## 0883.HK   32  0.53  0.42  0.08  0.02  0.00 0.78 0.22
## 0700.HK   28  0.53  0.45 -0.06  0.06 -0.18 0.66 0.34
## 0494.HK   26  0.52  0.20 -0.04  0.07 -0.01 0.46 0.54
## 1299.HK   39  0.50  0.05  0.06  0.11  0.10 0.48 0.52
## 1088.HK   36  0.48  0.34  0.10  0.06  0.10 0.74 0.26
## 0019.HK   12  0.43 -0.10  0.07  0.26  0.09 0.43 0.57
## 0144.HK   17  0.43  0.39 -0.06  0.02  0.17 0.65 0.35
## 0066.HK   14  0.40 -0.07  0.32  0.18  0.14 0.59 0.41
## 0386.HK   24  0.01  0.64  0.33 -0.16  0.27 0.73 0.27
## 0762.HK   29 -0.02  0.55  0.26  0.24  0.06 0.62 0.38
## 0857.HK   31  0.32  0.46  0.23 -0.07  0.18 0.74 0.26
## 1880.HK   41  0.31  0.39 -0.12  0.24 -0.04 0.53 0.47
## 0002.HK    2  0.02  0.09  0.84 -0.01 -0.17 0.67 0.33
## 0006.HK    6 -0.13  0.33  0.76 -0.26 -0.22 0.59 0.41
## 0003.HK    3  0.10 -0.14  0.66  0.07  0.15 0.60 0.40
## 0941.HK   34 -0.01  0.35  0.58  0.08  0.08 0.64 0.36
## 0322.HK   22 -0.02 -0.12 -0.03  0.86 -0.04 0.63 0.37
## 0151.HK   18 -0.21  0.24 -0.09  0.77  0.14 0.62 0.38
## 1044.HK   35 -0.04  0.38 -0.05  0.62 -0.02 0.61 0.39
## 0836.HK   30 -0.25  0.12 -0.10  0.09  0.92 0.70 0.30
## 0330.HK   23  0.13  0.15 -0.16 -0.16  0.59 0.42 0.58
##
```

```
##                   PC1  PC4  PC2  PC3  PC5
## SS loadings    19.93 4.99 2.94 2.55 1.66
## Proportion Var  0.42 0.10 0.06 0.05 0.03
## Cumulative Var  0.42 0.52 0.58 0.63 0.67
##
##  With component correlations of
##      PC1  PC4  PC2  PC3  PC5
## PC1 1.00 0.57 0.39 0.59 0.56
## PC4 0.57 1.00 0.20 0.34 0.28
## PC2 0.39 0.20 1.00 0.27 0.33
## PC3 0.59 0.34 0.27 1.00 0.36
## PC5 0.56 0.28 0.33 0.36 1.00
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  49.2 0.3
## The degrees of freedom for the model are 898  and the objective function was  9.01
##  0.3The number of observations was  191  with Chi Square =  1530  with prob <  1.3e-35
##  0.3
## Fit based upon off diagonal values = 1

##                PC1       PC4
## 0001.HK  0.902778 -0.061867
## 0002.HK  0.024022  0.087536
## 0003.HK  0.098724 -0.135974
## 0004.HK  0.904315 -0.019151
## 0005.HK  0.700719  0.232869
## 0006.HK -0.134305  0.329842
## 0011.HK  0.747938 -0.167597
## 0012.HK  0.860888 -0.078574
## 0013.HK  0.813279 -0.003454
## 0016.HK  0.938030 -0.039036
## 0017.HK  0.910264 -0.136025
## 0019.HK  0.426435 -0.102456
## 0023.HK  0.624521  0.008353
## 0066.HK  0.397527 -0.068519
## 0083.HK  0.889703 -0.020620
## 0101.HK  0.853387 -0.012191
## 0144.HK  0.425577  0.391910
## 0151.HK -0.208606  0.243198
## 0267.HK  0.600621  0.040251
## 0291.HK  0.586549  0.087733
## 0293.HK  0.542977  0.101805
## 0322.HK -0.020785 -0.116896
## 0330.HK  0.134626  0.150457
## 0386.HK  0.011835  0.636104
## 0388.HK  0.912869 -0.027763
## 0494.HK  0.522876  0.199851
## 0688.HK  0.833371  0.225722
## 0700.HK  0.528084  0.448606
## 0762.HK -0.022628  0.545228
## 0836.HK -0.245132  0.119992
## 0857.HK  0.321191  0.457354
## 0883.HK  0.531799  0.415536
## 0939.HK  0.671458  0.272998
## 0941.HK -0.008311  0.354475
## 1044.HK -0.037527  0.376013
```

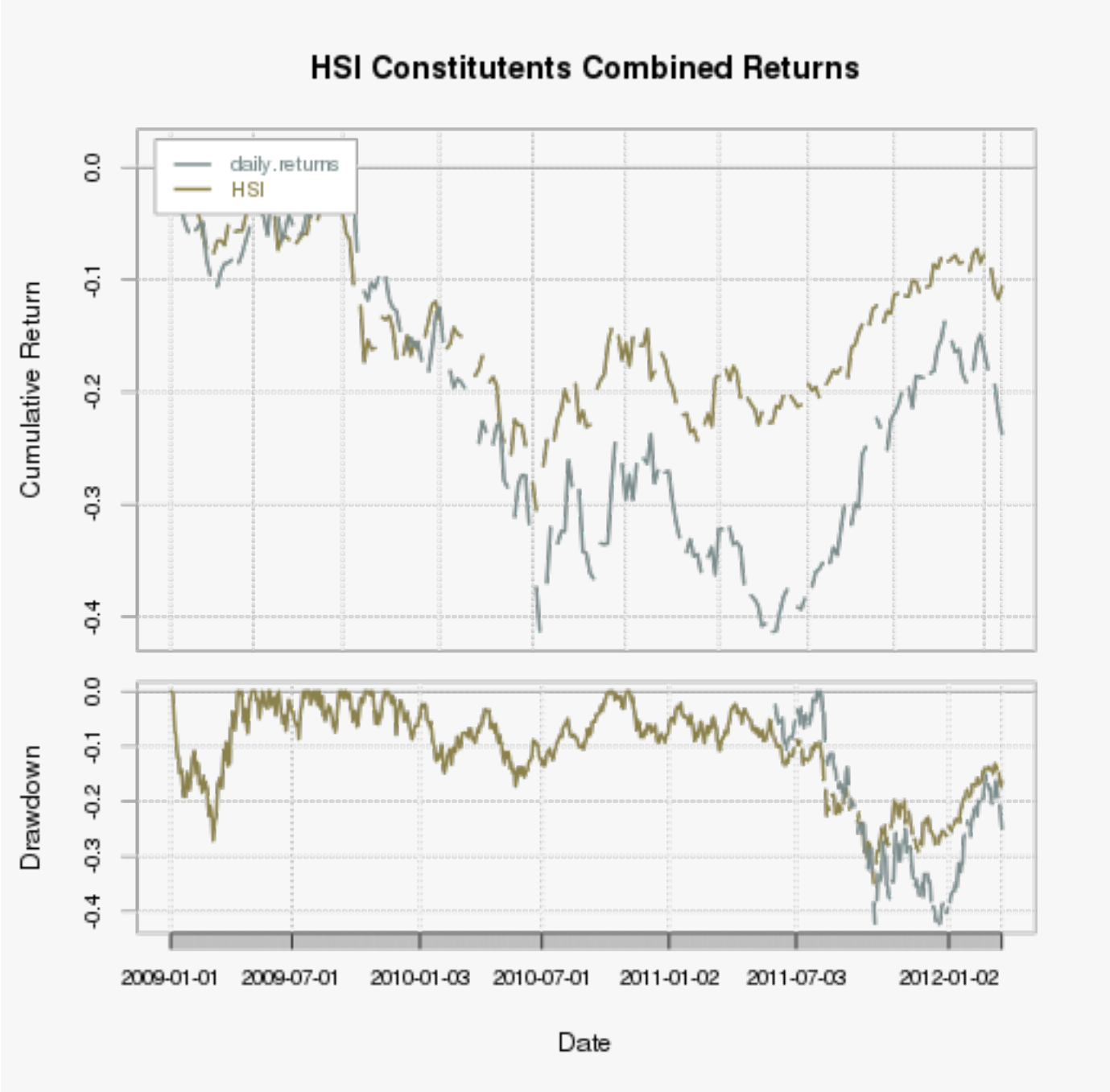
```
## 1088.HK  0.480176  0.336239
## 1109.HK  0.792839  0.187321
## 1199.HK  0.670001  0.332824
## 1299.HK  0.499467  0.054635
## 1398.HK  0.792759  0.247957
## 1880.HK  0.312500  0.394580
## 1898.HK  0.655565  0.236590
## 2318.HK  0.845017  0.180109
## 2388.HK  0.766163  0.068644
## 2600.HK  0.800805  0.225009
## 2628.HK  0.654728  0.222945
## 3328.HK  0.695321  0.302548
## 3988.HK  0.700093  0.207667
```



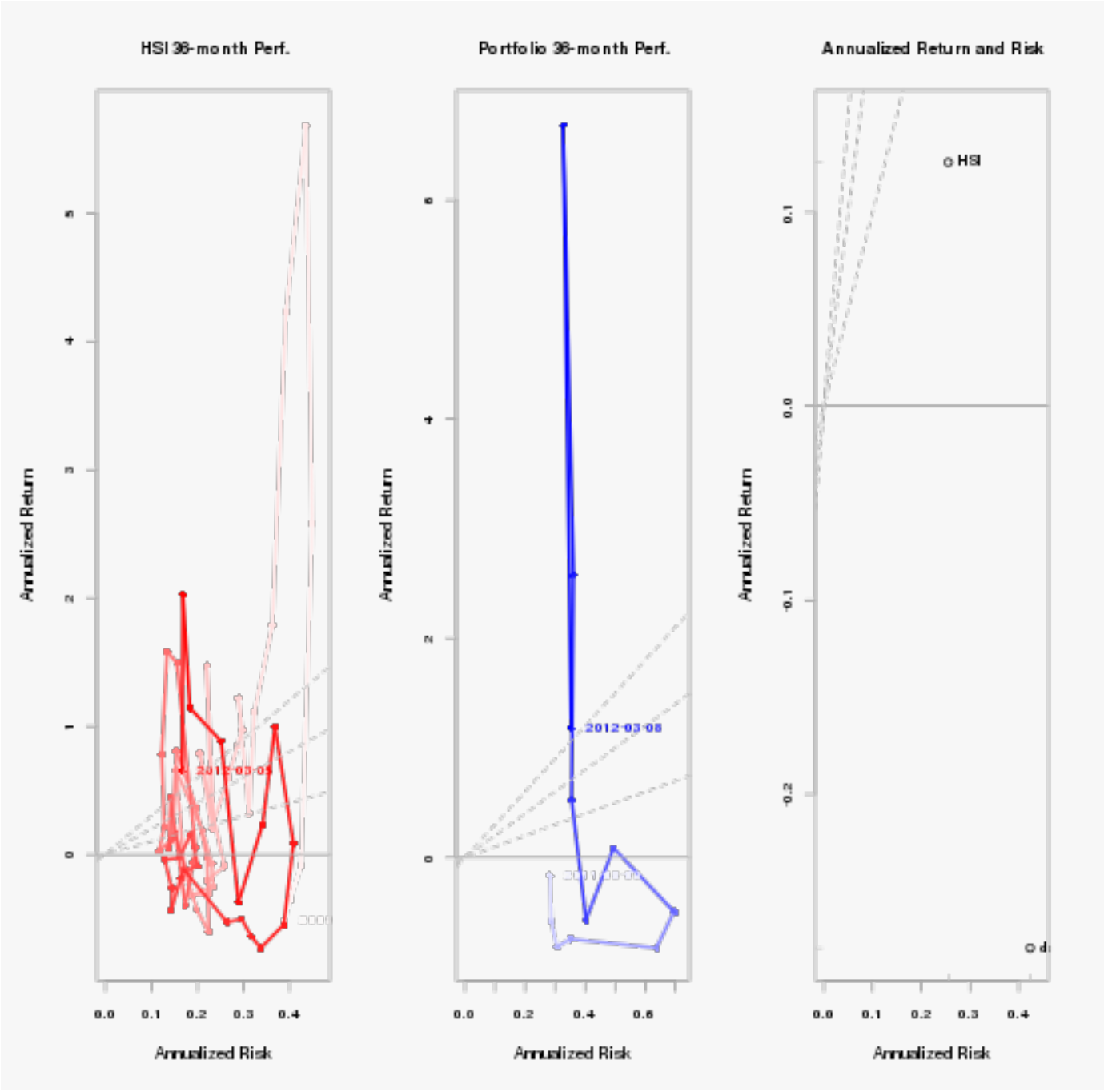
PCA is a science in itself and can not be fully covered and even less interpreted in this paper. The factors produced by principal component analysis are conceptualized as being linear combinations of the variables whereas the factors produced by common factor analysis are conceptualized as being latent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

6 HSI Components Performance

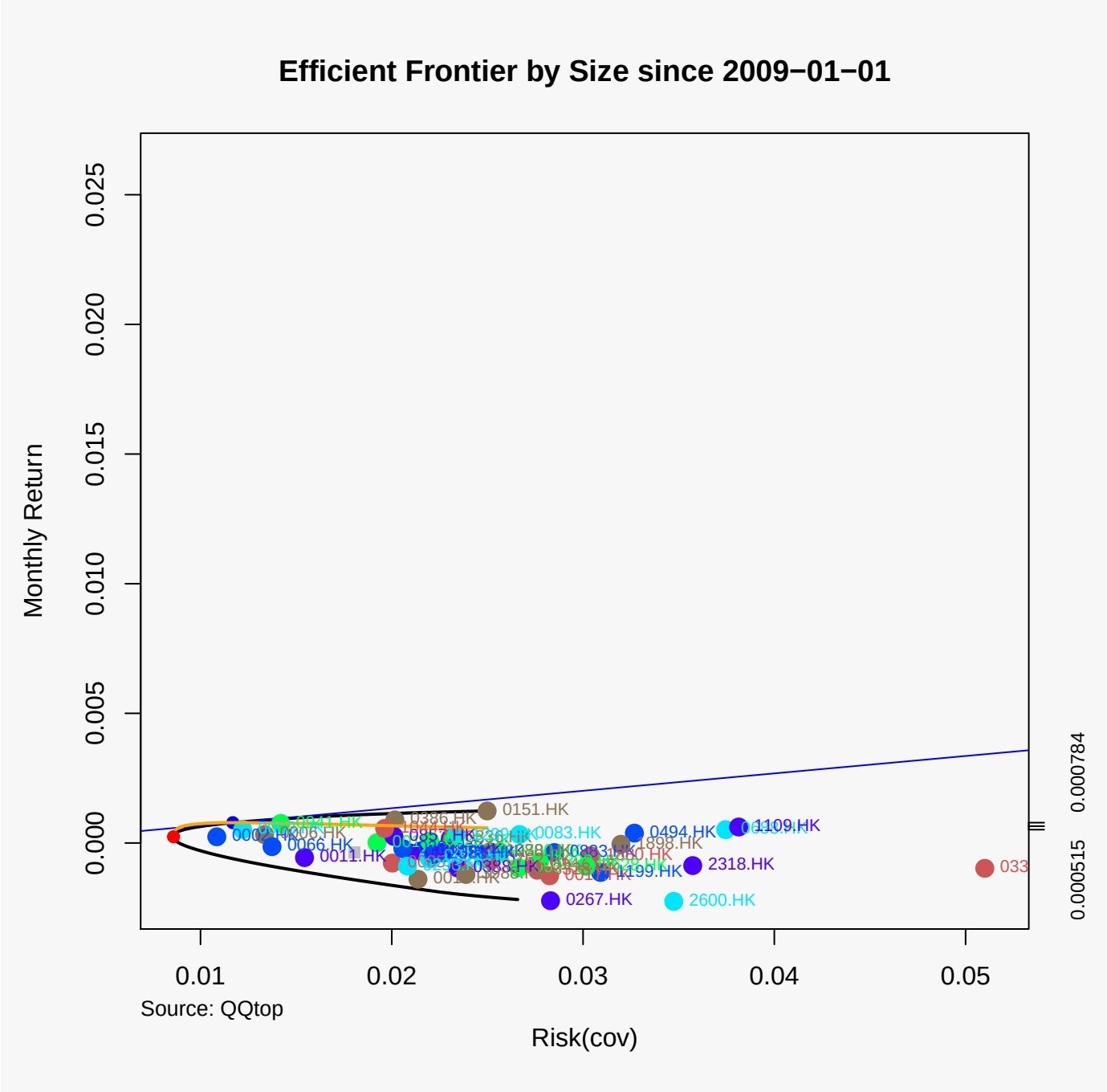
6.1 Performance Chart



6.2 Performance SnailTrail Chart



6.3 HSI Components Frontier




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

```
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.2148  0.0000  0.0000  0.0000
## 25  0.0000  0.2206  0.0000  0.0000  0.0000  0.2509  0.0940  0.0000  0.0000
## 37  0.0000  0.2758  0.2323  0.0000  0.0000  0.2039  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  0.0621  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.3555  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0018  0.1976  0.0000  0.0442  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0274  0.0000  0.0000  0.0000  0.0397
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  1.0000
##    0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK 0388.HK 0494.HK 0688.HK
## 1   0.6980  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.3090  0.0000  0.0441  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0894  0.0000  0.0802  0.0212  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0040  0.0000  0.0460  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  0.0000  0.0000  0.0636  0.0000  0.0000  0.0000  0.0438  0.0635  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.2399
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0766
## 25  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    2628.HK 3328.HK 3988.HK
## 1   0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000
##
## Covariance Risk Budgets:
##    0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK 0011.HK 0012.HK 0013.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.0350  0.0000  0.0000  0.0000
## 25  0.0000  0.1393  0.0000  0.0000  0.0000  0.1474  0.0985  0.0000  0.0000
## 37  0.0000  0.2683  0.2385  0.0000  0.0000  0.2017  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  0.0308  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.3682  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0026  0.2922  0.0000  0.0366  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0247  0.0000  0.0000  0.0000  0.0462
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  1.0000
##    0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK 0388.HK 0494.HK 0688.HK
## 1   0.7183  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 13  0.4500  0.0000  0.0344  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.1706  0.0000  0.0976  0.0152  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0035  0.0000  0.0432  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  0.0000  0.0000  0.0612  0.0000  0.0000  0.0000  0.0469  0.0657  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## 1   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.2508
## 13  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1125
## 25  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
##    2628.HK 3328.HK 3988.HK
## 1   0.0000  0.0000  0.0000
## 13  0.0000  0.0000  0.0000
## 25  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000
## 49  0.0000  0.0000  0.0000
##
## Target Return and Risks:
##       mean      mu     Cov   Sigma    CVaR     VaR
## 1  -0.0022 -0.0022  0.0266  0.0266  0.0615  0.0474
## 13 -0.0013 -0.0013  0.0172  0.0172  0.0421  0.0301
## 25 -0.0005 -0.0005  0.0109  0.0109  0.0255  0.0195
## 37  0.0004  0.0004  0.0087  0.0087  0.0180  0.0146
## 49  0.0012  0.0012  0.0250  0.0250  0.0490  0.0348
##
## Description:
##  Sat Mar 10 13:05:29 2012 by user:
```

7 HSI Components Ratios

7.1 Sharpe Ratio - Combined

```
##                                          daily.returns
## Annualized StdDev Sharpe (Rf=0%, p=95%):       -0.6593
## Annualized VaR Sharpe (Rf=0%, p=95%):          -6.7031
## Annualized ES Sharpe (Rf=0%, p=95%):           -5.2089
```

7.2 Sharpe - Distinct

```
##                                          0001.HK 0002.HK 0003.HK 0004.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):  0.3553  0.6719   0.729  0.6192
## Annualized VaR Sharpe (Rf=0%, p=95%):     3.7842  6.8158   7.000  6.7610
## Annualized ES Sharpe (Rf=0%, p=95%):      2.9449  4.7953   3.006  5.3087
##                                          0005.HK 0006.HK 0011.HK 0012.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%): -0.1050  0.6036  0.0475   0.404
## Annualized VaR Sharpe (Rf=0%, p=95%):    -1.1000  6.2179  0.5517   4.487
## Annualized ES Sharpe (Rf=0%, p=95%):     -0.5464  4.4379  0.5332   3.585
##                                          0013.HK 0016.HK 0017.HK 0019.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):  0.6837  0.5877  0.1333  0.4735
## Annualized VaR Sharpe (Rf=0%, p=95%):     7.5139  6.2932  1.3976  4.7141
## Annualized ES Sharpe (Rf=0%, p=95%):      5.8133  4.9112  0.9635  2.7887
##                                          0023.HK 0066.HK 0083.HK 0101.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):   0.596  0.6309  0.3933  0.3483
## Annualized VaR Sharpe (Rf=0%, p=95%):      7.379  7.4044  4.1517  3.8179
## Annualized ES Sharpe (Rf=0%, p=95%):       7.250  6.3146  3.0123  3.0311
##                                          0144.HK 0151.HK 0267.HK 0291.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):  0.4022   1.056  0.2274  0.6928
## Annualized VaR Sharpe (Rf=0%, p=95%):     4.3137  11.409  2.6367  7.5094
## Annualized ES Sharpe (Rf=0%, p=95%):      3.4201   8.703  2.2573  5.9942
##                                          0293.HK 0322.HK 0330.HK 0386.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):   0.514    1.05 -0.4557  0.6171
## Annualized VaR Sharpe (Rf=0%, p=95%):      5.380   14.41 -4.7877  6.3242
## Annualized ES Sharpe (Rf=0%, p=95%):       4.032   14.41 -3.2010  4.7307
##                                          0388.HK 0494.HK 0688.HK 0700.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):  0.5691 -0.0706  0.2454   1.347
## Annualized VaR Sharpe (Rf=0%, p=95%):     6.4507 -0.7135  2.8335  14.274
## Annualized ES Sharpe (Rf=0%, p=95%):      5.2605 -0.5750  2.4116  10.564
##                                          0762.HK 0836.HK 0857.HK 0883.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):  0.3684 -0.0074  0.4741  0.7187
## Annualized VaR Sharpe (Rf=0%, p=95%):     4.0804 -0.0760  4.7732  7.5379
## Annualized ES Sharpe (Rf=0%, p=95%):      3.2454 -0.0602  3.6048  5.6394
##                                          0939.HK 0941.HK 1044.HK 1088.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):  0.3356 -0.0031   1.182  0.6148
## Annualized VaR Sharpe (Rf=0%, p=95%):     3.3271 -0.0326  13.107  6.2276
## Annualized ES Sharpe (Rf=0%, p=95%):      2.3047 -0.0250  10.183  4.7616
##                                          1109.HK 1199.HK 1299.HK 1398.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):  0.2089   0.224   0.429  0.1867
## Annualized VaR Sharpe (Rf=0%, p=95%):     2.4397   2.460   4.300  2.0959
## Annualized ES Sharpe (Rf=0%, p=95%):      2.0935   1.969   2.495  1.7063
##                                          1880.HK 1898.HK 2318.HK 2388.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):   1.205  0.2588  0.3574  0.9145
## Annualized VaR Sharpe (Rf=0%, p=95%):     13.716  2.5342  3.7818 10.4877
## Annualized ES Sharpe (Rf=0%, p=95%):      10.838  1.7159  2.7105  8.4916
##                                          2600.HK 2628.HK 3328.HK 3988.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%): -0.0901 -0.1367  0.0293  0.4065
## Annualized VaR Sharpe (Rf=0%, p=95%):    -0.9575 -1.3512  0.2961  4.2701
## Annualized ES Sharpe (Rf=0%, p=95%):     -0.7585 -0.9458  0.2187  3.0928
```

7.3 Information Ratio - Combined

```
## [1] "Information Ratio :  -0.0717"
```

7.4 Information Ratio - Distinct

```
##                          0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK
## Information Ratio: HSI -0.0268 -0.1207  0.1322  0.2697 -0.3472 -0.0603
##                          0011.HK 0012.HK 0013.HK 0016.HK 0017.HK 0019.HK
## Information Ratio: HSI -0.3378   0.043  0.2542  0.1558 -0.1415  0.0726
##                          0023.HK 0066.HK 0083.HK 0101.HK 0144.HK 0151.HK
## Information Ratio: HSI   0.196  0.0536  0.0826  0.0393  0.1144  0.5771
##                          0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK
## Information Ratio: HSI -0.0502  0.2899  0.1312  0.5534 -0.6266  0.1897
##                          0388.HK 0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Information Ratio: HSI  0.1779  0.2007 -0.0295  0.8863  0.0197 -0.2989
##                          0857.HK 0883.HK 0939.HK 0941.HK 1044.HK 1088.HK
## Information Ratio: HSI  0.0784  0.3394 -0.0368 -0.3487  0.6994  0.2488
##                          1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK
## Information Ratio: HSI -0.0365 -0.0263  0.5807 -0.1385  0.8302 -0.0046
##                          2318.HK 2388.HK 2600.HK 2628.HK 3328.HK 3988.HK
## Information Ratio: HSI  0.0613  0.4573 -0.2982 -0.3907 -0.2639  0.0282
```

8 HSI Components Table Latest Quotes

```
## [1] "Date :  2012-03-09 02:59:00"
```

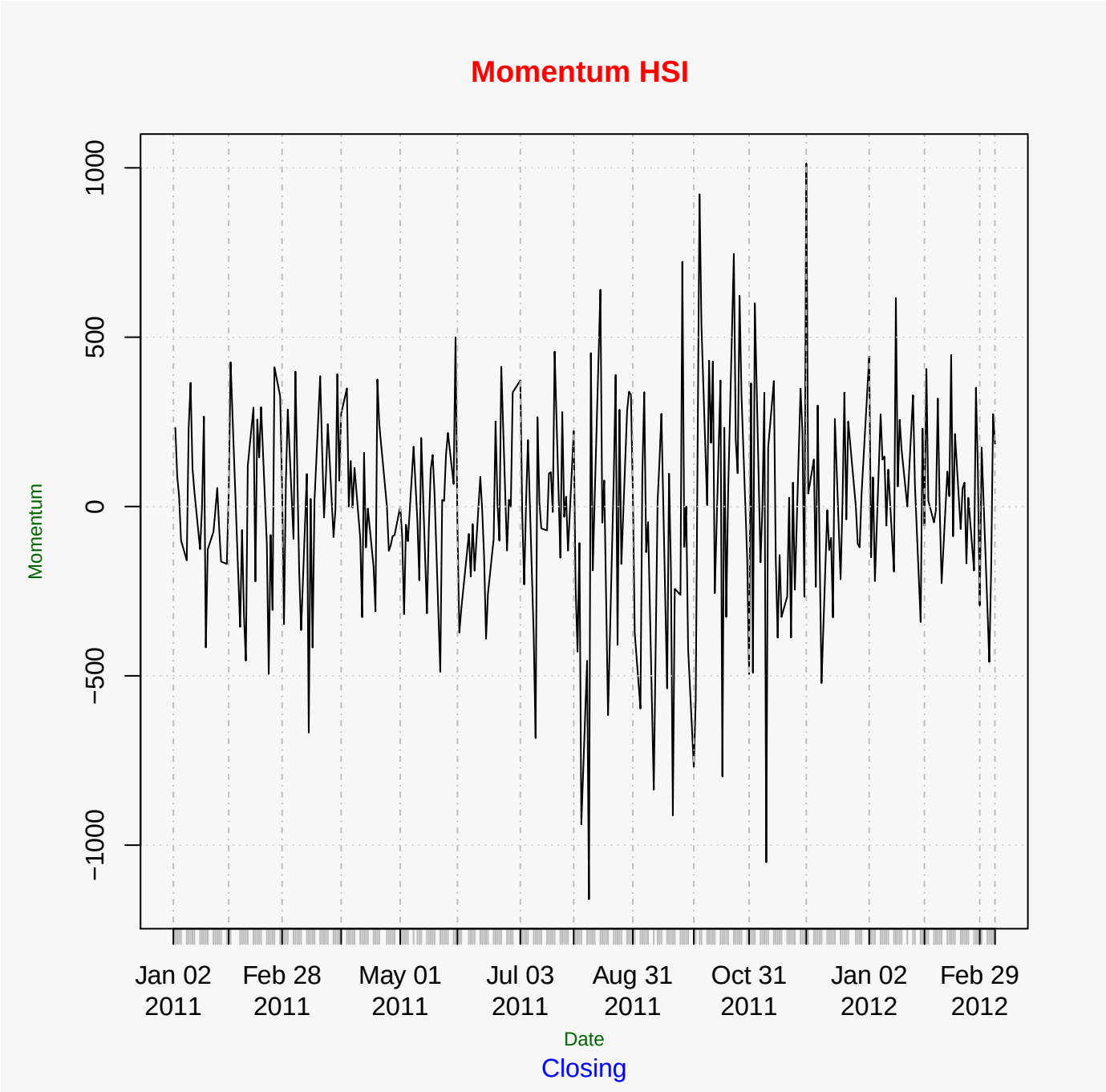
	Name	Bid	Ask	Change	52-week Range
0001.HK	CHEUNG KONG	106.70	106.90	-1.10	79.10 - 137.60
0002.HK	CLP HOLDINGS	67.50	67.55	-0.44	59.85 - 75.20
0003.HK	HK & CHINA GAS	19.54	19.56	-0.12	16.70 - 19.68
0004.HK	WHARF HOLDINGS	44.65	44.85	0.10	33.15 - 63.80
0005.HK	HSBC HOLDINGS	68.30	68.35	0.65	56.35 - 91.90
0006.HK	POWER ASSETS	59.15	59.30	0.40	48.10 - 64.80
0011.HK	HANG SENG BANK	108.60	108.70	0.20	84.40 - 127.00
0012.HK	HENDERSON LAND	45.45	45.65	-0.65	33.20 - 61.50
0013.HK	HUTCHISON	77.55	77.60	1.40	53.60 - 97.45
0016.HK	SHK PPT	116.70	117.00	0.40	85.45 - 129.00
0017.HK	NEW WORLD DEV	9.57	9.64	-0.05	7.00 - 14.40
0019.HK	SWIRE PACIFIC A	86.65	86.80	-0.60	79.30 - 137.20
0023.HK	BANK OF E ASIA	30.45	30.55	-0.05	21.85 - 34.45
0066.HK	MTR CORPORATION	27.80	27.90	0.40	22.45 - 29.25
0083.HK	SINO LAND	13.40	13.46	0.02	9.33 - 14.44
0101.HK	HANG LUNG PPT	27.80	28.00	-0.30	20.85 - 40.50
0144.HK	CHINA MER HOLD	26.70	26.85	0.65	19.00 - 37.60
0151.HK	WANT WANT CHINA	8.69	8.70	-0.07	5.68 - 8.80
0267.HK	CITIC PACIFIC	13.62	13.64	-0.12	10.26 - 24.60
0291.HK	CHINA RESOURCES	29.40	29.45	0.80	24.10 - 35.50
0293.HK	CATHAY PAC AIR	15.16	15.18	0.10	11.80 - 24.10
0322.HK	TINGYI	23.25	23.30	0.05	17.32 - 26.00
0330.HK	ESPRIT HOLDINGS	18.48	18.52	0.28	7.55 - 37.80
0386.HK	SINOPEC CORP	9.00	9.01	0.10	6.22 - 8.90
0388.HK	HKEX	137.00	137.20	0.40	99.15 - 198.60
0494.HK	LI & FUNG	17.66	17.78	0.34	10.82 - 44.50
0688.HK	CHINA OVERSEAS	15.54	15.62	0.04	9.99 - 17.86
0700.HK	TENCENT	198.50	198.60	1.40	139.90 - 230.80
0762.HK	CHINA UNICOM	14.14	14.18	-0.08	10.24 - 17.68
0836.HK	CHINA RES POWER	15.12	15.24	0.20	10.82 - 16.44
0857.HK	PETROCHINA	11.50	11.54	0.16	8.59 - 12.50
0883.HK	CNOOC	16.94	16.98	0.24	11.20 - 21.30
0939.HK	CCB	6.28	6.29	0.03	4.41 - 8.47
0941.HK	CHINA MOBILE	84.15	84.20	3.25	68.05 - 83.80
1044.HK	HENGAN INT'L	74.40	74.60	0.75	54.10 - 75.40
1088.HK	CHINA SHENHUA	34.35	34.40	0.45	27.10 - 40.20
1109.HK	CHINA RES LAND	13.74	13.82	0.28	7.28 - 17.24
1199.HK	COSCO PACIFIC	11.68	11.70	0.48	7.52 - 17.16
1299.HK	AIA	27.35	27.40	-0.05	19.84 - 29.90
1398.HK	ICBC	5.29	5.30	0.05	3.46 - 6.90
1880.HK	BELLE INT'L	14.24	14.32	0.58	11.56 - 17.54
1898.HK	CHINA COAL	9.44	9.46	0.04	6.59 - 15.08
2318.HK	PING AN	62.60	62.65	0.35	37.35 - 96.25
2388.HK	BOC HONG KONG	21.10	21.25	0.10	14.24 - 29.40
2600.HK	CHALCO	3.94	3.95	0.03	3.20 - 8.30
2628.HK	CHINA LIFE	20.95	21.00	-0.15	17.04 - 30.60
3328.HK	BANKCOMM	6.15	6.18	0.06	4.15 - 9.53
3988.HK	BANK OF CHINA	3.26	3.27	0.02	2.20 - 5.02

9 Hang Seng Index

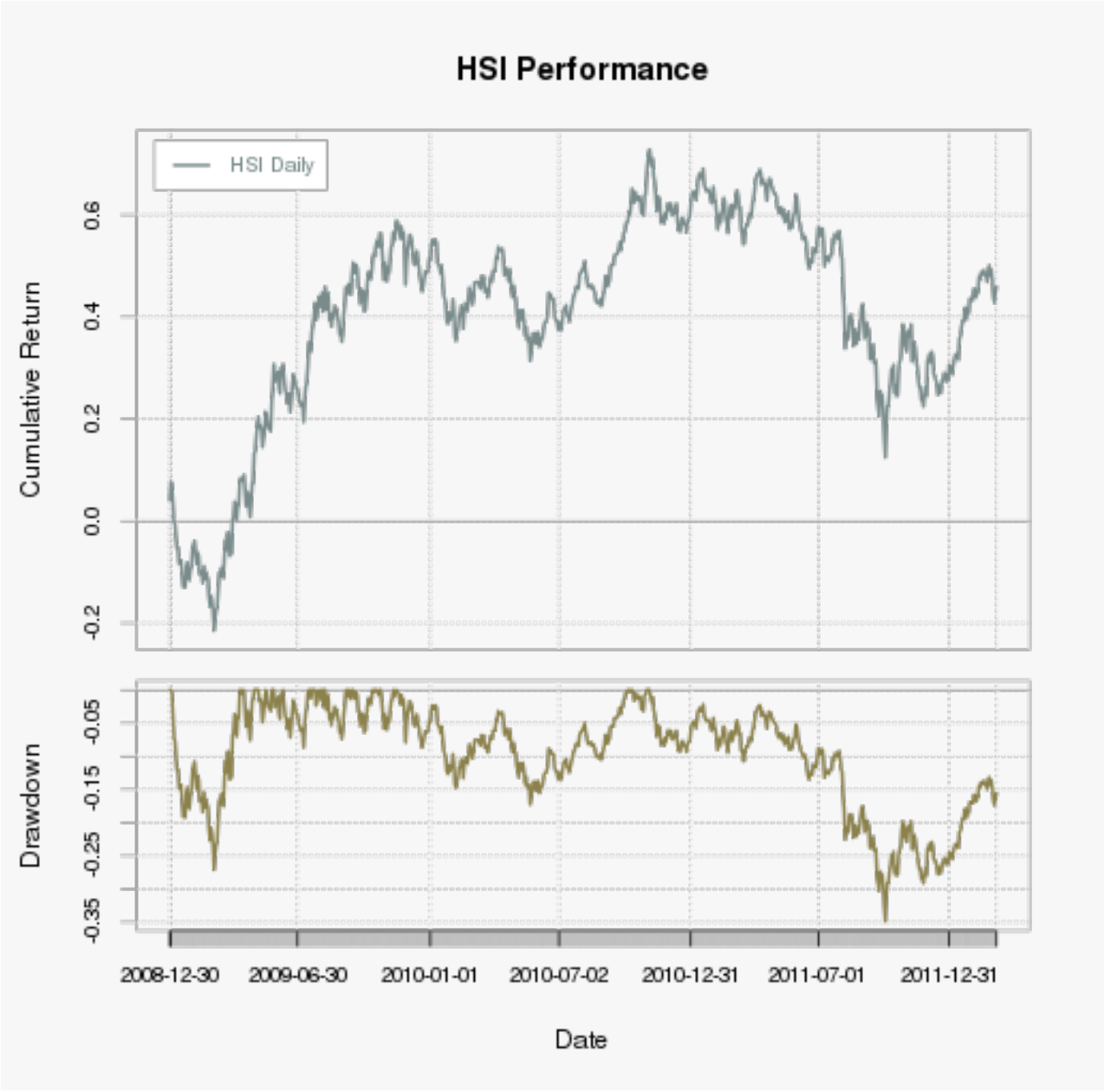
Latest Hang Seng Index

	Trade Time	Name	Last	Change	Days Range	52−week Range
^HSI	2012−03−09 03:01:00	HANG SENG INDEX	21086	185.3	20917.68 − 21209.789	16170.30 − 24468.60

9.1 Hang Seng Index - Momentum



9.2 HSI Performance



9.3 HSI Ratios

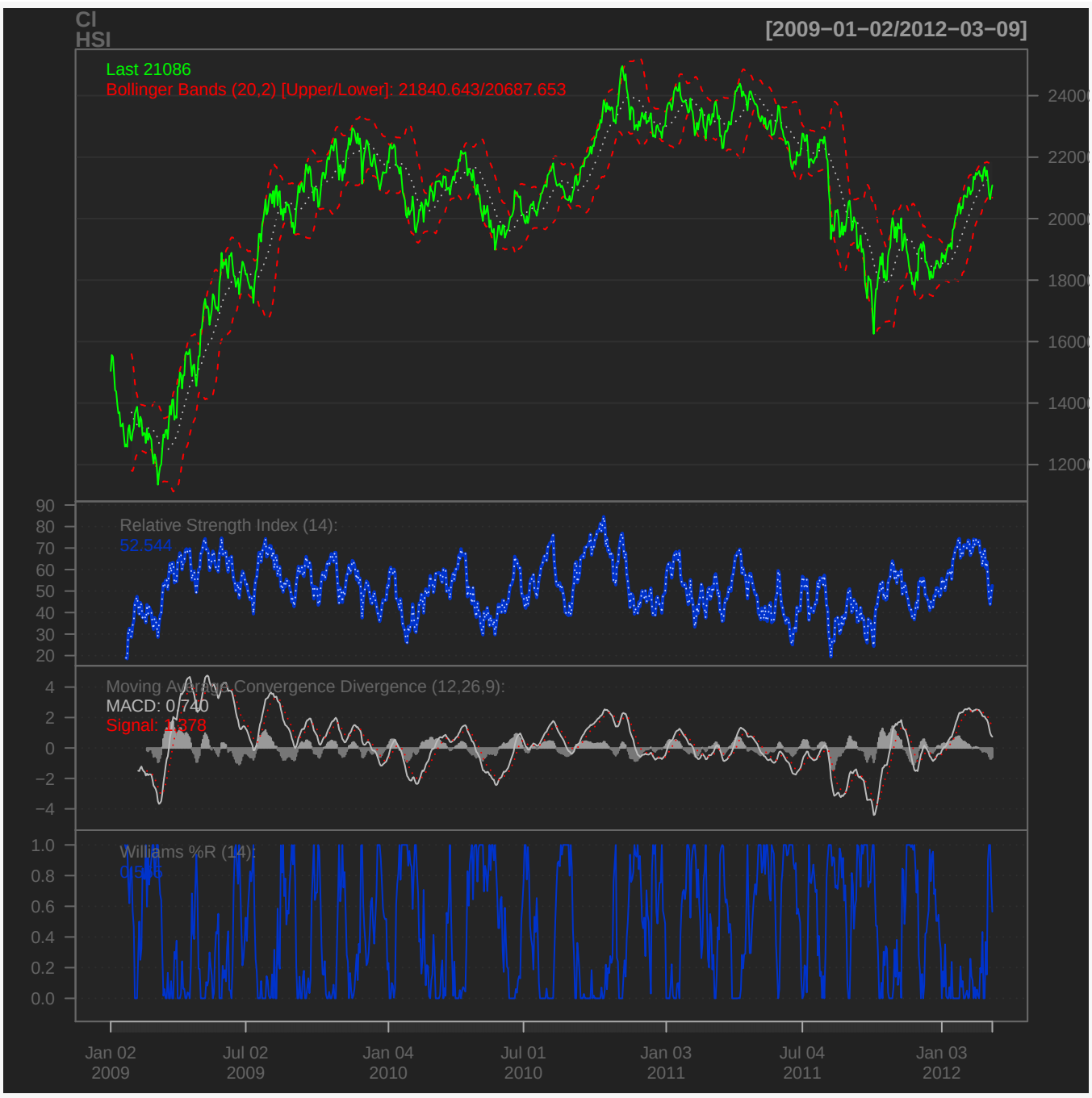
```
##              RSI
## 2012-02-26 61.89
## 2012-02-27 67.76
## 2012-02-28 69.37
## 2012-02-29 60.79
## 2012-03-01 63.68
## 2012-03-04 56.09
## 2012-03-05 46.81
## 2012-03-06 43.78
## 2012-03-07 49.20
## 2012-03-08 52.54
```

```
##              macd signal
## 2012-02-26 2.1032  2.359
## 2012-02-27 2.0727  2.302
## 2012-02-28 2.0662  2.255
## 2012-02-29 1.9277  2.189
## 2012-03-01 1.8623  2.124
## 2012-03-04 1.6786  2.035
## 2012-03-05 1.3436  1.897
## 2012-03-06 0.9985  1.717
## 2012-03-07 0.8193  1.538
## 2012-03-08 0.7396  1.378
```

```
## [1] "BBands"
```

```
##                dn  mavg    up    pctB
## 2012-02-26 20311 21042 21773  0.6203
## 2012-02-27 20400 21101 21801  0.8339
## 2012-02-28 20519 21168 21818  0.8940
## 2012-02-29 20576 21201 21826  0.6499
## 2012-03-01 20632 21241 21850  0.7638
## 2012-03-04 20711 21269 21827  0.4970
## 2012-03-05 20736 21274 21812  0.0652
## 2012-03-06 20656 21255 21853 -0.0235
## 2012-03-07 20640 21249 21858  0.2142
## 2012-03-08 20688 21264 21841  0.3455
```

```
##             WPR %
## 2012-02-26  43.30
## 2012-02-27   0.00
## 2012-02-28   0.00
## 2012-02-29  36.85
## 2012-03-01  15.46
## 2012-03-04  89.73
## 2012-03-05 100.00
## 2012-03-06 100.00
## 2012-03-07  74.06
## 2012-03-08  56.46
```


CI
HSI
[2009−01−02/2012−03−09]
Last 21086
Bollinger Bands (20,2) [Upper/Lower]: 21840.643/20687.653
Relative Strength Index (14):
52.544
Moving Average Convergence Divergence (12,26,9):
MACD: 0.740
Signal: 1.378
Williams %R (14):
Jan 02 2009
Jul 02 2009
Jan 04 2010
Jul 01 2010
Jan 03 2011
Jul 04 2011
Jan 03 2012

9.4 HSI Volatility

9.5 HSI Statistics

```
##                                          HSI-Daily HSI-Monthly
## Annualized StdDev Sharpe (Rf=0%, p=95%):    0.4917      0.4565
## Annualized VaR Sharpe (Rf=0%, p=95%):       5.0530      1.1058
## Annualized ES Sharpe (Rf=0%, p=95%):        3.7193      0.8707

##          HSI-Daily HSI-Monthly
## Skewness    0.1141      0.1136

##          HSI-Daily HSI-Monthly
## Kurtosis     1.431    -0.08961
```

```
##       Index               HSI Daily
##  Min.   :2008-12-31   Min.   :-0.056605
##  1st Qu.:2009-10-18   1st Qu.:-0.008071
##  Median :2010-08-04   Median : 0.000367
##  Mean   :2010-08-04   Mean   : 0.000600
##  3rd Qu.:2011-05-21   3rd Qu.: 0.010165
##  Max.   :2012-03-07   Max.   : 0.074147

##       Index              HSI Monthly
##  Min.   :2009-01-28   Min.   :-0.14329
##  1st Qu.:2009-11-13   1st Qu.:-0.02543
##  Median :2010-08-29   Median : 0.00812
##  Mean   :2010-08-28   Mean   : 0.01101
##  3rd Qu.:2011-06-13   3rd Qu.: 0.04141
##  Max.   :2012-03-07   Max.   : 0.17074
```

10 Dataset First and Last Rows Info

```
##            X0001.HK.Close
## 2009-01-02           76.9
## 2012-03-08          107.9
##            X0002.HK.Close
## 2009-01-02           52.4
## 2012-03-08           68.9
##            X0003.HK.Close
## 2009-01-02          12.08
## 2012-03-08          19.68
##            X0004.HK.Close
## 2009-01-02           22.0
## 2012-03-08           44.6
##            X0005.HK.Close
## 2009-01-02          77.00
## 2012-03-08          67.65
##            X0006.HK.Close
## 2009-01-02          42.75
## 2012-03-08          58.75
##            X0011.HK.Close
## 2009-01-02          104.7
## 2012-03-08          108.6
##            X0012.HK.Close
## 2009-01-02          30.35
## 2012-03-08          46.25
##            X0013.HK.Close
## 2009-01-02          39.85
## 2012-03-08          76.25
##            X0016.HK.Close
## 2009-01-02           67.3
## 2012-03-08          116.3
##            X0017.HK.Close
## 2009-01-02           8.18
## 2012-03-08           9.69
##            X0019.HK.Close
## 2009-01-02          55.75
## 2012-03-08          87.45
##            X0023.HK.Close
## 2009-01-02          16.68
## 2012-03-08          30.50
##            X0066.HK.Close
## 2009-01-02          18.08
## 2012-03-08          27.45
##            X0083.HK.Close
## 2009-01-02           8.36
## 2012-03-08          13.50
##            X0101.HK.Close
## 2009-01-02          18.36
## 2012-03-08          28.00
##            X0144.HK.Close
## 2009-01-02          15.40
## 2012-03-08          26.25
##            X0151.HK.Close
## 2009-01-02           3.17
## 2012-03-08           8.75
##            X0267.HK.Close
```

```
## 2009-01-02          10.20
## 2012-03-08          13.74
##            X0291.HK.Close
## 2009-01-02          14.00
## 2012-03-08          28.75
##            X0293.HK.Close
## 2009-01-02           8.91
## 2012-03-08          15.04
##            X0322.HK.Close
## 2009-01-02           8.98
## 2012-03-08          23.15
##            X0330.HK.Close
## 2009-01-02          44.80
## 2012-03-08          18.24
##            X0386.HK.Close
## 2009-01-02           4.96
## 2012-03-08           8.89
##            X0388.HK.Close
## 2009-01-02           76.6
## 2012-03-08          136.7
##            X0494.HK.Close
## 2011-06-02          17.92
## 2012-03-08          17.42
##            X0688.HK.Close
## 2009-01-02          11.22
## 2012-03-08          15.56
##            X0700.HK.Close
## 2009-01-01           50.0
## 2012-03-08          197.3
##            X0762.HK.Close
## 2009-01-01           9.63
## 2012-03-08          14.28
##            X0836.HK.Close
## 2009-01-02          15.12
## 2012-03-08          15.00
##            X0857.HK.Close
## 2009-01-02            7.2
## 2012-03-08           11.4
##            X0883.HK.Close
## 2009-01-02           7.59
## 2012-03-08          16.74
##            X0939.HK.Close
## 2009-01-02           4.52
## 2012-03-08           6.27
##            X0941.HK.Close
## 2009-01-02           81.2
## 2012-03-08           81.0
##            X1044.HK.Close
## 2009-01-01          24.90
## 2012-03-08          73.85
##            X1088.HK.Close
## 2009-01-02          17.40
## 2012-03-08          34.05
##            X1109.HK.Close
## 2009-01-02           9.90
## 2012-03-08          13.54
##            X1199.HK.Close
```

```
## 2009-01-02           8.07
## 2012-03-08          11.20
##            X1299.HK.Close
## 2010-10-29           23.1
## 2012-03-08           27.4
##            X1398.HK.Close
## 2009-01-02           4.30
## 2012-03-08           5.25
##            X1880.HK.Close
## 2009-01-02           3.50
## 2012-03-08          13.72
##            X1898.HK.Close
## 2009-01-02           6.55
## 2012-03-08           9.41
##            X2318.HK.Close
## 2009-01-02           39.6
## 2012-03-08           62.4
##            X2388.HK.Close
## 2009-01-02           9.06
## 2012-03-08          21.15
##            X2600.HK.Close
## 2009-01-02           4.55
## 2012-03-08           3.93
##            X2628.HK.Close
## 2009-01-02          24.75
## 2012-03-08          21.15
##            X3328.HK.Close
## 2009-01-02           5.91
## 2012-03-08           6.11
##            X3988.HK.Close
## 2009-01-02           2.17
## 2012-03-08           3.24
```

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

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