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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February 7, 2012

Contents

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1   Introduction

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

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

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

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

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

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[1]Wikipedia

2 CAPM Analysis

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

2.1 HSI Components CAPM with HSI as benchmark

CAPM - Combined

```
## Warning message: missing values removed from data

##                     HSI Components to HSI
## Alpha                          0.0003
## Beta                           1.1824
## Beta+                          1.2643
## Beta-                          1.1656
## R-squared                      0.5550
## Annualized Alpha               0.0911
## Correlation                    0.7450
## Correlation p-value            0.0000
## Tracking Error                 0.2646
## Active Premium                 0.0241
## Information Ratio              0.0912
## Treynor Ratio                 -0.0697
```

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

CAPM - Distinct for each stock

```
##                       0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK
## Alpha                   0.000   0.000   0.000   0.001   0.000   0.000
## Beta                    0.988   0.147   0.378   1.110   1.120   0.114
## Beta+                   0.954   0.043   0.277   1.112   1.211   0.060
## Beta-                   0.972   0.185   0.410   1.095   1.312   0.129
## R-squared               0.639   0.080   0.179   0.494   0.560   0.028
## Annualized Alpha        0.000   0.048   0.110   0.170  -0.126   0.091
## Correlation             0.800   0.282   0.423   0.703   0.748   0.167
## Correlation p-value     0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error          0.193   0.257   0.266   0.294   0.260   0.290
## Active Premium         -0.021  -0.063   0.019   0.148  -0.166  -0.032
## Information Ratio      -0.110  -0.245   0.070   0.503  -0.639  -0.112
## Treynor Ratio           0.106   0.424   0.381   0.246  -0.036   0.815
##                       0011.HK 0012.HK 0013.HK 0016.HK 0017.HK 0019.HK
## Alpha                   0.000   0.000   0.000   0.000   0.000   0.000
## Beta                    0.639   1.019   0.948   1.004   1.136   0.785
## Beta+                   0.703   1.049   0.865   0.968   1.059   0.852
## Beta-                   0.672   0.996   0.987   0.980   1.154   0.718
## R-squared               0.452   0.556   0.527   0.643   0.503   0.384
## Annualized Alpha       -0.077   0.025   0.135   0.058  -0.061   0.072
## Correlation             0.673   0.746   0.726   0.802   0.710   0.620
## Correlation p-value     0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error          0.206   0.237   0.234   0.195   0.296   0.265
## Active Premium         -0.139  -0.001   0.112   0.043  -0.102   0.019
## Information Ratio      -0.677  -0.006   0.480   0.222  -0.346   0.070
## Treynor Ratio          -0.021   0.122   0.251   0.168   0.020   0.184
##                       0023.HK 0066.HK 0083.HK 0101.HK 0144.HK 0151.HK
## Alpha                   0.000   0.000   0.000   0.000   0.000   0.001
## Beta                    0.940   0.509   1.167   1.094   1.310   0.432
## Beta+                   1.020   0.430   1.136   1.247   1.256   0.204
## Beta-                   0.927   0.502   1.203   0.986   1.229   0.513
## R-squared               0.463   0.337   0.516   0.465   0.538   0.097
## Annualized Alpha        0.127   0.072   0.050   0.058   0.123   0.307
## Correlation             0.680   0.581   0.719   0.682   0.733   0.311
## Correlation p-value     0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error          0.264   0.225   0.297   0.307   0.326   0.374
## Active Premium          0.094   0.003   0.021   0.020   0.106   0.182
## Information Ratio       0.357   0.012   0.071   0.067   0.324   0.487
## Treynor Ratio           0.234   0.252   0.126   0.134   0.176   0.713
##                       0267.HK 0291.HK 0293.HK 0322.HK 0330.HK 0386.HK
## Alpha                   0.000   0.001   0.000   0.001  -0.002   0.000
## Beta                    1.080   0.879   0.767   0.348   0.938   0.954
## Beta+                   1.031   0.778   0.732   0.264   0.736   0.807
## Beta-                   0.978   0.910   0.752   0.380   1.115   0.997
## R-squared               0.403   0.369   0.318   0.071   0.214   0.557
## Annualized Alpha        0.066   0.179   0.141   0.344  -0.334   0.125
## Correlation             0.635   0.608   0.564   0.267   0.463   0.746
## Correlation p-value     0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error          0.342   0.301   0.298   0.368   0.468   0.222
## Active Premium          0.014   0.130   0.079   0.214  -0.459   0.106
## Information Ratio       0.042   0.433   0.265   0.580  -0.982   0.476
## Treynor Ratio           0.130   0.291   0.267   0.976  -0.355   0.242
##                       0388.HK 0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Alpha                   0.000   0.000   0.000   0.002   0.000   0.000
## Beta                    1.159   0.970   1.185   0.932   0.705   0.555
```

```
## Beta+                1.245   0.949   1.345   0.970   0.545   0.428
## Beta-                1.106   0.865   0.929   0.775   0.645   0.664
## R-squared            0.706   0.203   0.472   0.353   0.254   0.178
## Annualized Alpha     0.084   0.121   0.006   0.450   0.075  -0.028
## Correlation          0.840   0.451   0.687   0.594   0.504   0.422
## Correlation p-value  0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error       0.199   0.502   0.330   0.328   0.323   0.332
## Active Premium       0.087  -0.042  -0.035   0.412  -0.004  -0.128
## Information Ratio    0.437  -0.084  -0.107   1.256  -0.014  -0.386
## Treynor Ratio        0.183   0.078   0.076   0.570   0.170  -0.005
##                    0857.HK 0883.HK 0939.HK 0941.HK 1044.HK 1088.HK
## Alpha                0.000   0.001   0.000   0.000   0.001   0.000
## Beta                 1.100   1.282   1.062   0.710   0.461   1.216
## Beta+                1.018   1.195   1.004   0.704   0.364   1.141
## Beta-                1.100   1.244   1.037   0.733   0.406   1.149
## R-squared            0.725   0.685   0.701   0.519   0.118   0.649
## Annualized Alpha     0.044   0.153   0.006  -0.086   0.378   0.134
## Correlation          0.852   0.828   0.837   0.720   0.343   0.806
## Correlation p-value  0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error       0.178   0.238   0.182   0.193   0.357   0.240
## Active Premium       0.041   0.167  -0.006  -0.141   0.266   0.137
## Information Ratio    0.232   0.703  -0.031  -0.727   0.746   0.573
## Treynor Ratio        0.152   0.228   0.113  -0.021   0.837   0.216
##                    1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK
## Alpha                0.000   0.000   0.001   0.000   0.002   0.000
## Beta                 1.164   1.330   0.824   1.129   0.827   1.496
## Beta+                1.226   1.338   0.816   1.100   0.782   1.406
## Beta-                0.773   1.450   1.051   1.052   0.898   1.445
## R-squared            0.362   0.490   0.411   0.687   0.223   0.664
## Annualized Alpha     0.053   0.051   0.207  -0.030   0.509   0.032
## Correlation          0.602   0.700   0.641   0.829   0.472   0.815
## Correlation p-value  0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error       0.405   0.364   0.244   0.201   0.404   0.306
## Active Premium      -0.017   0.014   0.180  -0.044   0.419   0.030
## Information Ratio   -0.041   0.039   0.738  -0.218   1.036   0.097
## Treynor Ratio        0.094   0.105   0.113   0.072   0.658   0.104
##                    2318.HK 2388.HK 2600.HK 2628.HK 3328.HK 3988.HK
## Alpha                0.000   0.001  -0.001   0.000   0.000   0.000
## Beta                 1.330   0.876   1.539   1.096   1.195   1.034
## Beta+                1.377   0.887   1.585   1.069   1.159   0.957
## Beta-                1.222   0.846   1.396   1.067   1.219   1.011
## R-squared            0.622   0.443   0.619   0.639   0.729   0.632
## Annualized Alpha     0.051   0.217  -0.143  -0.116  -0.083   0.048
## Correlation          0.789   0.665   0.787   0.799   0.854   0.795
## Correlation p-value  0.000   0.000   0.000   0.000   0.000   0.000
## Tracking Error       0.283   0.258   0.344   0.216   0.196   0.206
## Active Premium       0.044   0.186  -0.173  -0.145  -0.096   0.032
## Information Ratio    0.155   0.722  -0.504  -0.672  -0.491   0.157
## Treynor Ratio        0.127   0.356  -0.031  -0.018   0.024   0.153
```

3 HSI Components Risk
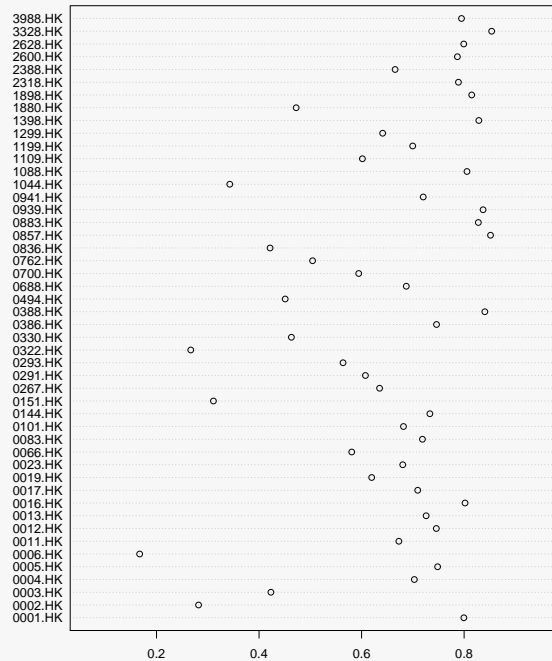
3.1 Correlation

Correlation Combined

```
##                       Correlation p-value Lower CI Upper CI
## HSI Components to HSI       0.745       0   0.6712   0.8042
```

Correlation - Distinct

```
##          Correlation p-value Lower CI Upper CI
## 0001.HK       0.7995       0   0.7633   0.8307
## 0002.HK       0.2820       0   0.1941   0.3653
## 0003.HK       0.4231       0   0.3437   0.4965
## 0004.HK       0.7029       0   0.6526   0.7470
## 0005.HK       0.7483       0   0.7044   0.7866
## 0006.HK       0.1671       0   0.0753   0.2560
## 0011.HK       0.6727       0   0.6184   0.7206
## 0012.HK       0.7458       0   0.7014   0.7843
## 0013.HK       0.7259       0   0.6787   0.7671
## 0016.HK       0.8018       0   0.7660   0.8327
## 0017.HK       0.7095       0   0.6601   0.7528
## 0019.HK       0.6197       0   0.5589   0.6738
## 0023.HK       0.6803       0   0.6270   0.7272
## 0066.HK       0.5808       0   0.5157   0.6392
## 0083.HK       0.7187       0   0.6705   0.7608
## 0101.HK       0.6817       0   0.6286   0.7285
## 0144.HK       0.7332       0   0.6871   0.7734
## 0151.HK       0.3110       0   0.2245   0.3925
## 0267.HK       0.6351       0   0.5761   0.6874
## 0291.HK       0.6075       0   0.5454   0.6630
## 0293.HK       0.5638       0   0.4969   0.6240
## 0322.HK       0.2668       0   0.1783   0.3511
## 0330.HK       0.4631       0   0.3869   0.5331
## 0386.HK       0.7462       0   0.7020   0.7847
## 0388.HK       0.8404       0   0.8108   0.8657
## 0494.HK       0.4510       0   0.3732   0.5225
## 0688.HK       0.6872       0   0.6348   0.7333
## 0700.HK       0.5944       0   0.5309   0.6513
## 0762.HK       0.5044       0   0.4318   0.5705
## 0836.HK       0.4215       0   0.3420   0.4950
## 0857.HK       0.8515       0   0.8237   0.8751
## 0883.HK       0.8277       0   0.7960   0.8549
## 0939.HK       0.8370       0   0.8068   0.8628
## 0941.HK       0.7202       0   0.6723   0.7621
## 1044.HK       0.3429       0   0.2584   0.4221
## 1088.HK       0.8056       0   0.7703   0.8359
## 1109.HK       0.6016       0   0.5388   0.6578
## 1199.HK       0.6997       0   0.6490   0.7442
## 1299.HK       0.6411       0   0.5469   0.7193
## 1398.HK       0.8287       0   0.7971   0.8557
## 1880.HK       0.4724       0   0.3969   0.5415
## 1898.HK       0.8148       0   0.7810   0.8438
## 2318.HK       0.7889       0   0.7510   0.8216
## 2388.HK       0.6654       0   0.6102   0.7142
## 2600.HK       0.7869       0   0.7487   0.8199
## 2628.HK       0.7993       0   0.7631   0.8306
```

```
## 3328.HK          0.8537        0   0.8264    0.8771
## 3988.HK          0.7949        0   0.7580    0.8268
```

Correlation HSI Components to Benchmark HSI
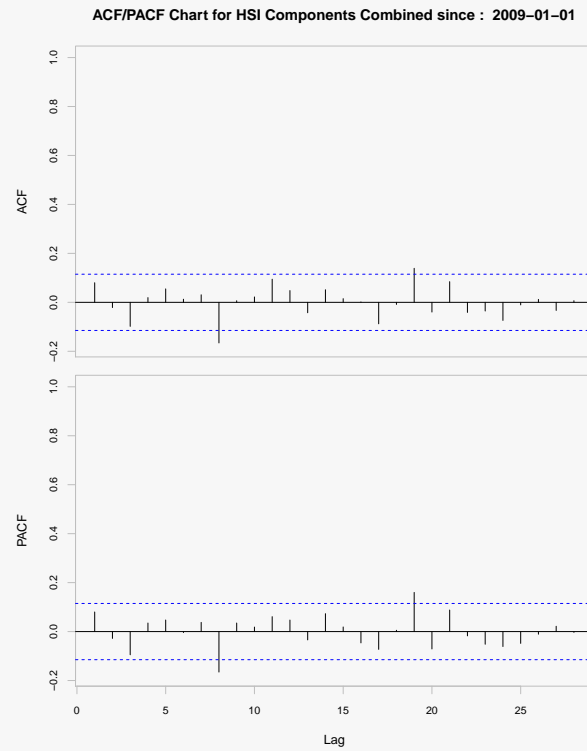
3 Month Rolling Correlation
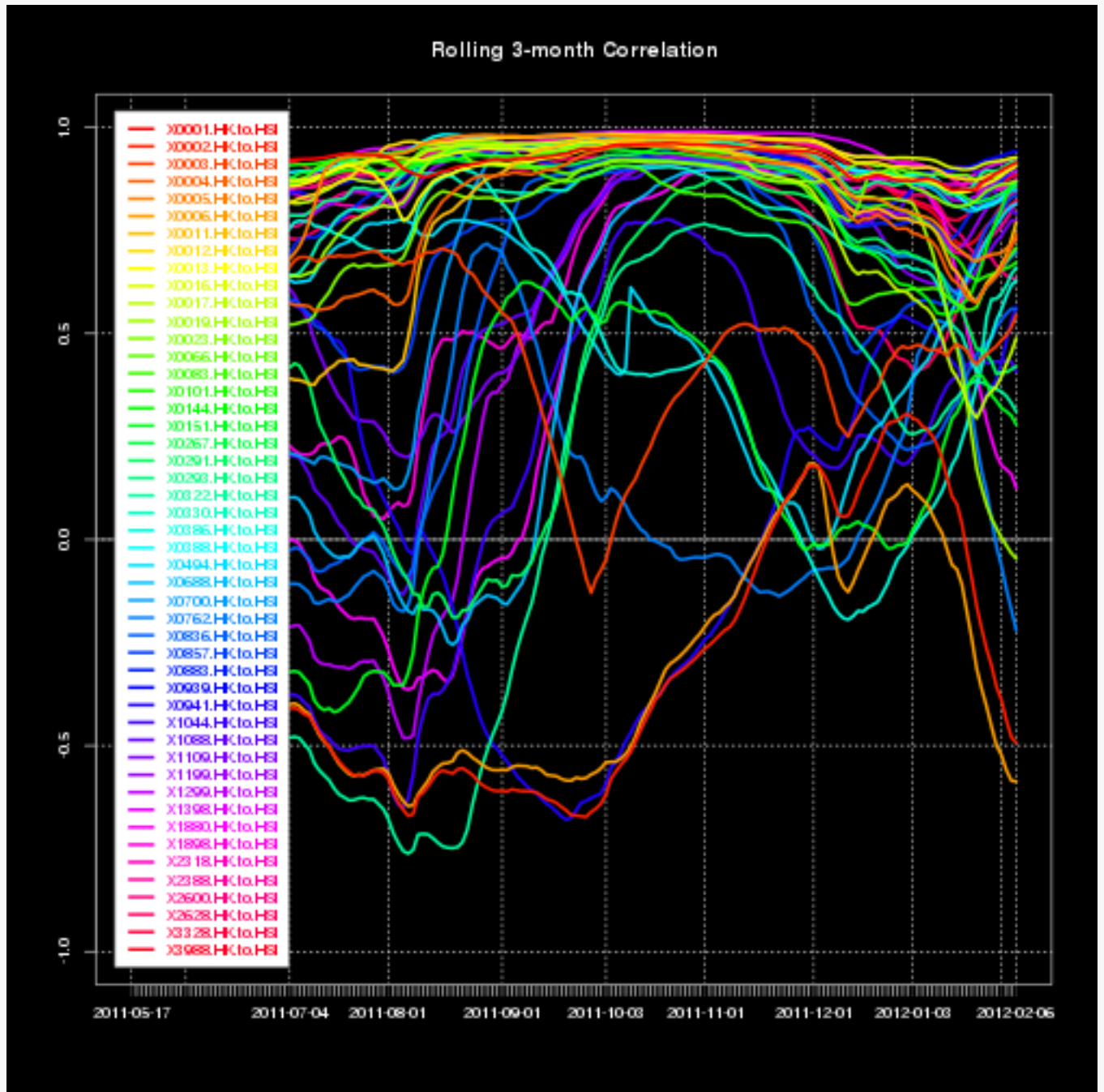
3.2 Autocorrelation Coefficients - Combined

Autocorrelation Combined

```
##                    rho1    rho2    rho3   rho4   rho5   rho6 Q(6) p-value
## daily.returns 0.0801 -0.0214 -0.0982 0.0194 0.0549 0.0128        0.4041
```


ACF/PACF Chart for HSI Components Combined since : 2009−01−01

3.3   Downside Risk - Combined

Downside Risk Combined

```
##                                HSI Components dailyReturn
## Semi Deviation                                    0.0229
## Gain Deviation                                    0.0183
## Loss Deviation                                    0.0153
## Downside Deviation (MAR=210%)                     0.0262
## Downside Deviation (Rf=0%)                        0.0229
## Downside Deviation (0%)                           0.0229
## Maximum Drawdown                                  0.4597
## Historical VaR (95%)                             -0.0366
## Historical ES (95%)                              -0.0511
## Modified VaR (95%)                               -0.0372
## Modified ES (95%)                                -0.0476
```

3.4 Drawdowns - Combined

Drawdowns Combined

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

```
##          From     Trough          To   Depth Length To Trough Recovery
## 1 2011-01-19 2011-12-19        <NA> -0.4597    248        218       NA
## 2 2010-11-09 2010-11-30 2010-12-31 -0.1276     38         16       22
## 3 2011-01-04 2011-01-13 2011-01-18 -0.0315     11          8        3
```


HSI Components Combined Drawdowns
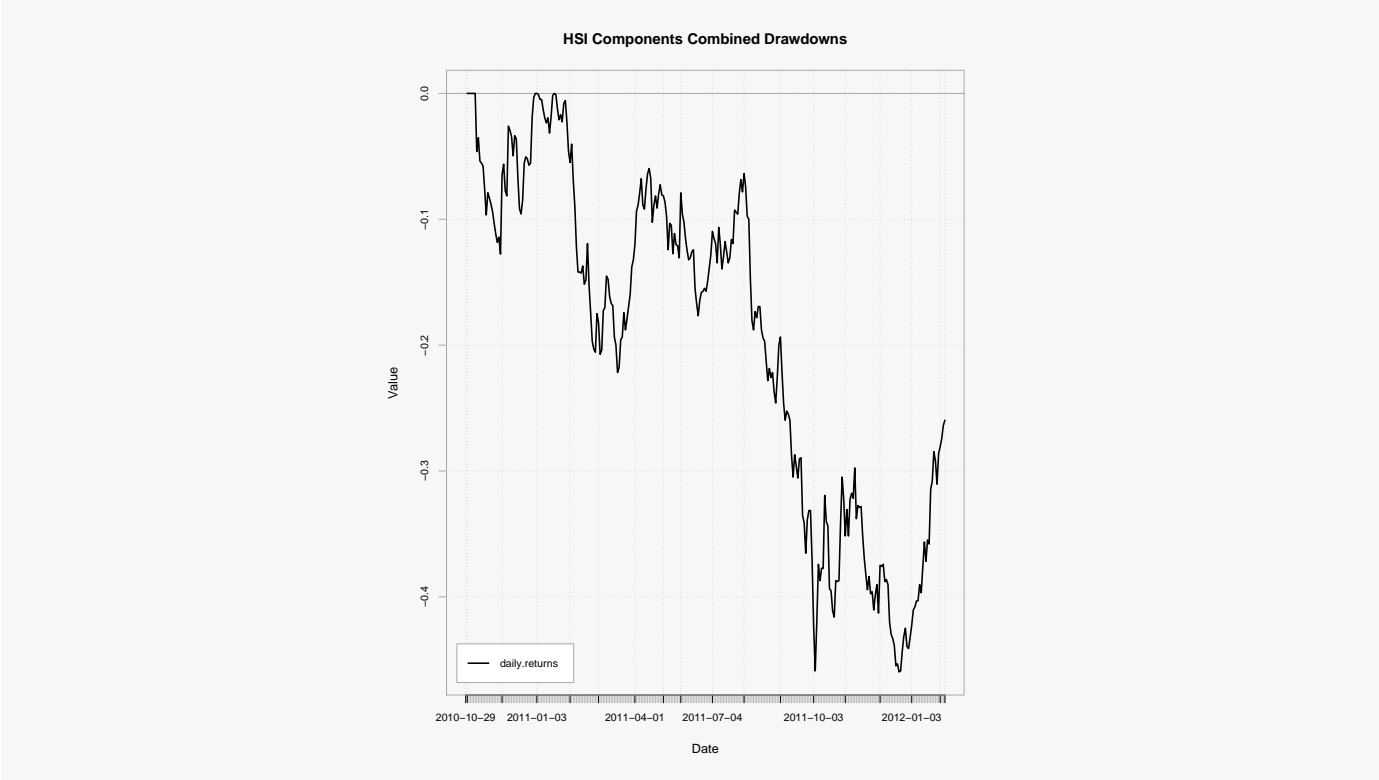
3.5 Downside Deviation - Combined

Downside Deviation Combined

```
##                               HSI Components
## Downside Deviation (MAR = 0%)          0.02288
```

3.6 Autocorrelation Coefficients - Distinct

```
##              rho1    rho2    rho3    rho4    rho5    rho6 Q(6) p-value
## X0001.HK   0.0509 -0.0627  0.0184 -0.0340  0.0087  0.0123       0.3838
## X0002.HK  -0.1253 -0.0463 -0.0094  0.0185  0.0174 -0.0325       0.0194
## X0003.HK  -0.0992 -0.0156 -0.0205  0.0485  0.0143  0.0279       0.0991
## X0004.HK   0.0083 -0.0333 -0.0301 -0.0298  0.0913 -0.0392       0.1274
## X0005.HK  -0.0242 -0.0238  0.0601  0.0332 -0.0479  0.0304       0.3189
## X0006.HK  -0.0839 -0.0617  0.0140 -0.0231  0.0040 -0.0731       0.0419
## X0011.HK   0.1185  0.0150 -0.0164  0.0037 -0.0471 -0.0827       0.0057
## X0012.HK   0.0667 -0.0250 -0.0499 -0.0072  0.0465  0.0069       0.2707
## X0013.HK   0.0015  0.0312  0.0122 -0.0135  0.0254 -0.0262       0.9159
## X0016.HK   0.0465 -0.0561  0.0230 -0.0105  0.0406  0.0186       0.4080
## X0017.HK   0.0769  0.0212  0.0088  0.0258  0.0481 -0.0216       0.2669
## X0019.HK   0.0410  0.0467 -0.0254 -0.1053 -0.0063  0.0176       0.0553
## X0023.HK   0.0895 -0.0064 -0.0089 -0.0056 -0.0480 -0.0393       0.1593
## X0066.HK  -0.0747 -0.0002  0.0554 -0.0223 -0.0106 -0.0169       0.2889
## X0083.HK   0.1003 -0.0582 -0.0374  0.0014  0.0465  0.0028       0.0411
## X0101.HK  -0.0724 -0.0203  0.0149 -0.0420 -0.0584  0.0208       0.1810
## X0144.HK   0.0677 -0.0092  0.0004 -0.0498 -0.1074  0.0029       0.0251
## X0151.HK  -0.0180 -0.0260 -0.0875 -0.1023  0.0100  0.0011       0.0215
## X0267.HK   0.1231  0.0382 -0.0542 -0.0224  0.0418  0.0429       0.0057
## X0291.HK  -0.0351 -0.0203  0.0068 -0.0436  0.0103 -0.0035       0.8262
## X0293.HK   0.0248 -0.0455 -0.0684 -0.0535  0.0749  0.0704       0.0133
## X0322.HK  -0.0112  0.0369 -0.0900 -0.0011 -0.0163 -0.0224       0.2384
## X0330.HK   0.0437  0.1230 -0.0160  0.0393 -0.0079 -0.0175       0.0218
## X0386.HK  -0.0212 -0.0243 -0.0404 -0.0168 -0.0091  0.0326       0.7877
## X0388.HK   0.0997 -0.0100  0.0340 -0.0151  0.0048 -0.0147       0.1743
## X0494.HK  -0.0112 -0.0305 -0.0136 -0.0247 -0.0109  0.0095       0.9548
## X0688.HK   0.0795 -0.0527 -0.0528 -0.0506 -0.0088  0.0098       0.0801
## X0700.HK   0.0225 -0.0972  0.0028 -0.0909  0.0042  0.0393       0.0170
## X0762.HK  -0.0483 -0.0673 -0.0320 -0.0658  0.0307 -0.0264       0.0947
## X0836.HK  -0.0538 -0.0385 -0.0007  0.0066 -0.0127 -0.0182       0.7056
## X0857.HK   0.0435 -0.0141  0.0389 -0.0043 -0.0071  0.0051       0.8278
## X0883.HK   0.0435 -0.0520 -0.0122 -0.0289 -0.0583  0.0016       0.3275
## X0939.HK   0.0019  0.0042  0.0203 -0.0574 -0.0302 -0.0336       0.6146
## X0941.HK  -0.0155 -0.0166  0.0034 -0.0944  0.0042 -0.0257       0.2517
## X1044.HK  -0.0333 -0.0457 -0.0978 -0.0595 -0.0408  0.0149       0.0268
## X1088.HK   0.0472 -0.0024 -0.0259 -0.0334  0.0283 -0.0352       0.5858
## X1109.HK   0.0281 -0.0190 -0.0543 -0.0926  0.0105  0.0001       0.1297
## X1199.HK   0.0747  0.0470 -0.0035 -0.0650  0.0060  0.0342       0.1161
## X1299.HK  -0.0135 -0.0862  0.0176 -0.0776 -0.1106 -0.0068       0.2112
## X1398.HK   0.0190 -0.0015  0.0624 -0.0238 -0.0183 -0.0385       0.5270
## X1880.HK   0.0083 -0.0825 -0.0870 -0.0306 -0.0364 -0.0324       0.0331
## X1898.HK   0.0961  0.0163  0.0007  0.0048 -0.0489 -0.0193       0.1486
## X2318.HK   0.0676 -0.0450 -0.0685 -0.0412  0.0707  0.0072       0.0305
## X2388.HK   0.0713  0.0272  0.0568 -0.0014 -0.0396 -0.0155       0.2119
## X2600.HK   0.0674 -0.0319 -0.0321  0.0008  0.0034  0.0068       0.5282
## X2628.HK  -0.0016 -0.0191  0.0397 -0.0576 -0.0063 -0.0050       0.6611
```

```
## X3328.HK  0.0224   0.0345 -0.0052 -0.0588  0.0075 -0.0136          0.6522
## X3988.HK  0.0394  -0.0217  0.0401 -0.0434 -0.0071 -0.0694          0.2362
```

3.7   Downside Deviation - Distinct

```
##                               0001.HK 0002.HK 0003.HK 0004.HK 0005.HK
## Downside Deviation (MAR = 0%)  0.0192  0.0089  0.0156  0.0243  0.0257
##                               0006.HK 0011.HK 0012.HK 0013.HK 0016.HK
## Downside Deviation (MAR = 0%)  0.0111  0.0151  0.0214  0.0193  0.0197
##                               0017.HK 0019.HK 0023.HK 0066.HK 0083.HK
## Downside Deviation (MAR = 0%)  0.0246   0.021  0.0208  0.0133  0.0256
##                               0101.HK 0144.HK 0151.HK 0267.HK 0291.HK
## Downside Deviation (MAR = 0%)  0.0254   0.027  0.0218  0.0256  0.0229
##                               0293.HK 0322.HK 0330.HK 0386.HK 0388.HK
## Downside Deviation (MAR = 0%)  0.0214  0.0201  0.0355  0.0208    0.02
##                               0494.HK 0688.HK 0700.HK 0762.HK 0836.HK
## Downside Deviation (MAR = 0%)  0.0384  0.0261  0.0247  0.0229  0.0205
##                               0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## Downside Deviation (MAR = 0%)  0.0211  0.0241  0.0211   0.016  0.0205
##                               1088.HK 1109.HK 1199.HK 1299.HK 1398.HK
## Downside Deviation (MAR = 0%)  0.0246  0.0291   0.029  0.0201  0.0217
##                               1880.HK 1898.HK 2318.HK 2388.HK 2600.HK
## Downside Deviation (MAR = 0%)  0.0273  0.0301  0.0269    0.02    0.03
##                               2628.HK 3328.HK 3988.HK
## Downside Deviation (MAR = 0%)   0.022  0.0225  0.0219
```

4 General Statistics

Statistics Distinct

```
##              Observations NAs Minimum Quartile 1 Median Arithmetic Mean
## X0001.HK.Close         767  12   56.00     91.275  98.00           99.902
## X0002.HK.Close         767  12   51.10     52.550  57.10           59.164
## X0003.HK.Close         767  12   10.78     17.200  18.10           17.590
## X0004.HK.Close         767  12   15.20     36.650  41.65           41.738
## X0005.HK.Close         767  12   33.00     65.825  79.00           74.957
## X0006.HK.Close         767  12   41.10     43.475  47.10           48.927
## X0011.HK.Close         767  12   67.00    103.050 110.60          109.515
## X0012.HK.Close         767  12   23.75     42.550  48.55           46.950
## X0013.HK.Close         767  12   36.40     52.475  57.80           63.880
## X0016.HK.Close         767  12   55.80    100.050 111.30          108.111
## X0017.HK.Close         767  12    6.20      9.750  13.54           12.749
## X0019.HK.Close         767  12   42.90     84.550  92.50           92.626
## X0023.HK.Close         767  12   12.34     26.550  28.90           28.174
## X0066.HK.Close         767  12   16.14     25.100  26.85           26.024
## X0083.HK.Close         767  12    5.60     11.830  13.62           13.070
## X0101.HK.Close         767  12   13.66     25.550  29.10           28.611
## X0144.HK.Close         767  12   12.20     23.050  26.30           25.927
## X0151.HK.Close         767  12    2.77      4.650   6.17            5.814
## X0267.HK.Close         767  12    7.18     14.210  17.32           17.095
## X0291.HK.Close         767  12   10.66     23.600  27.90           26.054
## X0293.HK.Close         767  12    6.98     12.550  14.68           15.165
## X0322.HK.Close         767  12    8.27     16.150  19.18           18.140
## X0330.HK.Close         767  12    7.93     33.400  42.50           39.415
## X0386.HK.Close         767  12    3.65      6.190   6.78            6.794
## X0388.HK.Close         767  12   54.60    122.700 135.50          136.477
## X0494.HK.Close         757  22   11.60     16.900  32.10           29.216
## X0688.HK.Close         767  12    9.41     14.210  15.44           15.202
## X0700.HK.Close         776   3   41.80    127.150 155.00          147.412
## X0762.HK.Close         774   5    8.31      9.630  10.98           11.871
## X0836.HK.Close         767  12   11.10     14.200  15.36           15.440
## X0857.HK.Close         767  12    5.10      8.680   9.35            9.284
## X0883.HK.Close         767  12    6.08     11.100  13.18           13.524
## X0939.HK.Close         767  12    3.66      5.605   6.25            6.114
## X0941.HK.Close         767  12   63.00     73.250  75.80           75.603
## X1044.HK.Close         779   0   24.25     47.050  58.50           56.008
## X1088.HK.Close         767  12   13.90     29.925  33.20           31.601
## X1109.HK.Close         767  12    7.50     12.880  14.56           14.399
## X1199.HK.Close         767  12    5.40      9.365  10.90           11.109
## X1299.HK.Close         314 465   19.86     22.700  23.95           24.348
## X1398.HK.Close         767  12    3.03      4.955   5.73            5.462
## X1880.HK.Close         767  12    2.98      7.965  11.78           11.008
## X1898.HK.Close         767  12    4.43      9.460  10.60           10.447
## X2318.HK.Close         767  12   30.35     57.900  64.35           65.400
## X2388.HK.Close         767  12    6.30     16.670  18.40           18.687
## X2600.HK.Close         767  12    3.20      5.750   7.04            6.696
## X2628.HK.Close         767  12   17.24     25.825  30.50           29.718
## X3328.HK.Close         767  12    4.17      6.250   8.01            7.607
## X3988.HK.Close         767  12    1.84      3.045   3.94            3.666
##              Geometric Mean Quartile 3 Maximum SE Mean LCL Mean (0.95)
## X0001.HK.Close         98.530    113.950  135.70  0.5883           98.747
## X0002.HK.Close         58.808     64.050   75.00  0.2390           58.694
## X0003.HK.Close         17.453     18.990   21.00  0.0758           17.441
## X0004.HK.Close         40.003     51.250   62.00  0.4022           40.949
```

```
## X0005.HK.Close        73.913    83.100    98.00   0.4283        74.117
## X0006.HK.Close        48.572    53.575    64.80   0.2201        48.495
## X0011.HK.Close       108.742   118.900   134.00   0.4586       108.615
## X0012.HK.Close        46.126    53.150    60.50   0.2982        46.365
## X0013.HK.Close        61.935    77.950    95.90   0.5794        62.743
## X0016.HK.Close       106.369   118.750   146.30   0.6560       106.823
## X0017.HK.Close        12.289    15.320    18.54   0.1197        12.514
## X0019.HK.Close        90.163   109.300   136.40   0.7251        91.203
## X0023.HK.Close        27.632    32.175    35.90   0.1840        27.813
## X0066.HK.Close        25.797    28.250    31.15   0.1183        25.792
## X0083.HK.Close        12.803    14.800    18.56   0.0905        12.892
## X0101.HK.Close        28.009    32.375    40.30   0.2031        28.212
## X0144.HK.Close        25.383    28.925    37.55   0.1838        25.566
## X0151.HK.Close         5.660     6.955     8.19   0.0495         5.716
## X0267.HK.Close        16.597    20.600    24.40   0.1441        16.812
## X0291.HK.Close        25.032    30.800    35.25   0.2380        25.587
## X0293.HK.Close        14.632    18.340    24.05   0.1472        14.876
## X0322.HK.Close        17.493    20.850    25.95   0.1629        17.820
## X0330.HK.Close        35.571    50.600    64.30   0.5274        38.380
## X0386.HK.Close         6.714     7.605     9.64   0.0387         6.718
## X0388.HK.Close       132.553   160.950   197.50   1.0916       134.334
## X0494.HK.Close        26.793    38.900    51.90   0.4209        28.390
## X0688.HK.Close        15.073    16.650    19.44   0.0710        15.062
## X0700.HK.Close       137.208   179.850   225.00   1.6978       144.079
## X0762.HK.Close        11.642    14.180    17.40   0.0906        11.693
## X0836.HK.Close        15.355    16.640    20.15   0.0605        15.321
## X0857.HK.Close         9.180    10.120    12.36   0.0503         9.185
## X0883.HK.Close        13.086    16.430    20.95   0.1246        13.279
## X0939.HK.Close         6.046     6.815     8.28   0.0340         6.047
## X0941.HK.Close        75.498    78.000    91.45   0.1445        75.319
## X1044.HK.Close        53.823    67.900    78.25   0.5133        55.000
## X1088.HK.Close        30.942    35.250    40.80   0.2110        31.187
## X1109.HK.Close        14.159    16.380    20.00   0.0943        14.214
## X1199.HK.Close        10.871    12.700    16.76   0.0855        10.941
## X1299.HK.Close        24.273    26.137    29.55   0.1108        24.130
## X1398.HK.Close         5.398     5.990     7.03   0.0312         5.401
## X1880.HK.Close        10.246    14.260    17.54   0.1394        10.734
## X1898.HK.Close        10.209    11.760    15.86   0.0792        10.292
## X2318.HK.Close        63.908    76.300    94.30   0.4883        64.442
## X2388.HK.Close        17.895    22.950    28.95   0.1854        18.323
## X2600.HK.Close         6.479     7.880    10.66   0.0624         6.573
## X2628.HK.Close        29.091    34.500    41.00   0.2151        29.296
## X3328.HK.Close         7.455     8.720    10.56   0.0559         7.497
## X3988.HK.Close         3.606     4.150     5.00   0.0257         3.616
##              UCL Mean (0.95)  Variance   Stdev Skewness Kurtosis
## X0001.HK.Close       101.057  265.4460 16.2925  -0.0830  -0.1546
## X0002.HK.Close        59.633   43.8000  6.6182   0.3974  -1.2198
## X0003.HK.Close        17.739    4.4023  2.0982  -1.6030   1.9922
## X0004.HK.Close        42.528  124.0448 11.1375  -0.4583  -0.2392
## X0005.HK.Close        75.798  140.6965 11.8616  -0.7912   0.1903
## X0006.HK.Close        49.359   37.1532  6.0953   0.6756  -0.7606
## X0011.HK.Close       110.415  161.3238 12.7013  -0.5382  -0.0040
## X0012.HK.Close        47.536   68.2109  8.2590  -0.8885   0.2400
## X0013.HK.Close        65.018  257.4869 16.0464   0.3750  -1.0084
## X0016.HK.Close       109.398  330.0971 18.1686  -0.8386   0.6090
## X0017.HK.Close        12.984   10.9968  3.3161  -0.5519  -0.8945
## X0019.HK.Close        94.049  403.2688 20.0816  -0.4614  -0.0130
```

```
## X0023.HK.Close     28.536   25.9774  5.0968 -1.2018  0.9954
## X0066.HK.Close     26.257   10.7420  3.2775 -1.3575  1.1689
## X0083.HK.Close     13.248    6.2881  2.5076 -1.0182  0.7048
## X0101.HK.Close     29.010   31.6461  5.6255 -0.5255 -0.0254
## X0144.HK.Close     26.288   25.9164  5.0908 -0.5084  0.2860
## X0151.HK.Close      5.911    1.8760  1.3697 -0.5242 -0.8299
## X0267.HK.Close     17.378   15.9348  3.9918 -0.4496 -0.6030
## X0291.HK.Close     26.521   43.4326  6.5903 -1.0016 -0.1446
## X0293.HK.Close     15.454   16.6246  4.0773  0.1253 -0.7684
## X0322.HK.Close     18.459   20.3528  4.5114 -0.7843 -0.2142
## X0330.HK.Close     40.450  213.3020 14.6049 -0.7274 -0.4242
## X0386.HK.Close      6.870    1.1472  1.0711 -0.4894  0.5061
## X0388.HK.Close    138.620  913.8928 30.2307 -0.5531  0.2727
## X0494.HK.Close     30.043  134.1206 11.5810 -0.0181 -1.4322
## X0688.HK.Close     15.341    3.8661  1.9662 -0.7296  0.0604
## X0700.HK.Close    150.745 2236.9491 47.2964 -0.6936 -0.2902
## X0762.HK.Close     12.049    6.3520  2.5203  0.7356 -0.8999
## X0836.HK.Close     15.559    2.8089  1.6760  0.1470 -0.3414
## X0857.HK.Close      9.382    1.9368  1.3917 -0.7443  0.7489
## X0883.HK.Close     13.768   11.9162  3.4520 -0.0522 -0.7277
## X0939.HK.Close      6.180    0.8854  0.9410 -0.7224  0.0242
## X0941.HK.Close     75.886   16.0133  4.0017  0.0221  0.7606
## X1044.HK.Close     57.015  205.2657 14.3271 -0.7357 -0.5958
## X1088.HK.Close     32.015   34.1565  5.8444 -1.3619  1.3599
## X1109.HK.Close     14.585    6.8188  2.6113 -0.4251 -0.2030
## X1199.HK.Close     11.277    5.6081  2.3681  0.0844 -0.5367
## X1299.HK.Close     24.566    3.8568  1.9639  0.3355 -0.9630
## X1398.HK.Close      5.523    0.7469  0.8643 -0.9501  0.3332
## X1880.HK.Close     11.282   14.9150  3.8620 -0.4317 -0.9412
## X1898.HK.Close     10.602    4.8099  2.1932 -0.5193  0.2894
## X2318.HK.Close     66.359  182.8699 13.5229 -0.2077 -0.3511
## X2388.HK.Close     19.051   26.3751  5.1357 -0.4004 -0.2668
## X2600.HK.Close      6.818    2.9863  1.7281 -0.4373 -0.7106
## X2628.HK.Close     30.140   35.4984  5.9581 -0.3966 -0.9335
## X3328.HK.Close      7.716    2.3926  1.5468 -0.4893 -0.8925
## X3988.HK.Close      3.717    0.5082  0.7129 -0.8093 -0.3490
```

4.1 Higher Moments - Distinct

```
##              0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK 0011.HK
## CoSkewness     0.0000  0.0000  0.0000   0.000  0.0000  0.0000  0.0000
## CoKurtosis     0.0000  0.0000  0.0000   0.000  0.0000  0.0000  0.0000
## Beta CoVariance 0.9880  0.1473  0.3781   1.110  1.1204  0.1142  0.6389
## Beta CoSkewness 1.0071 -0.5768 -0.4448   1.842  0.9369 -0.1963  0.9720
## Beta CoKurtosis 0.9985  0.0865  0.3595   1.120  1.2795  0.0890  0.7198
##              0012.HK 0013.HK 0016.HK 0017.HK 0019.HK 0023.HK 0066.HK
## CoSkewness      0.000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## CoKurtosis      0.000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## Beta CoVariance 1.019  0.9483  1.0036  1.1364  0.7848  0.9403  0.5088
## Beta CoSkewness 2.045  0.0766  1.3811  0.6135  1.4440  1.8812  0.2211
## Beta CoKurtosis 1.075  0.9008  0.9864  1.1281  0.7975  0.9849  0.4531
##              0083.HK 0101.HK 0144.HK 0151.HK 0267.HK 0291.HK 0293.HK
## CoSkewness      0.000   0.000   0.000  0.0000  0.0000  0.0000  0.0000
## CoKurtosis      0.000   0.000   0.000  0.0000  0.0000  0.0000  0.0000
## Beta CoVariance 1.167   1.094   1.310  0.4316  1.0799  0.8787  0.7666
## Beta CoSkewness 1.255   2.848   1.457 -1.4971  1.2982  0.1335  1.0509
## Beta CoKurtosis 1.172   1.166   1.208  0.3368  0.9848  0.7634  0.7539
##              0322.HK 0330.HK 0386.HK 0388.HK 0494.HK 0688.HK 0700.HK
## CoSkewness     0.0000  0.0000  0.0000   0.000  0.0000   0.000  0.0000
## CoKurtosis     0.0000  0.0000  0.0000   0.000  0.0000   0.000  0.0000
## Beta CoVariance 0.3478  0.9383  0.9545   1.159  0.9699   1.185  0.9325
## Beta CoSkewness -0.1756 -0.7188 -0.1022  1.825  2.1650   3.841  1.6592
## Beta CoKurtosis 0.3078  0.8985  0.8894   1.145  0.9753   1.263  0.8977
##              0762.HK 0836.HK 0857.HK 0883.HK 0939.HK 0941.HK 1044.HK
## CoSkewness     0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## CoKurtosis     0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## Beta CoVariance 0.7052  0.5554  1.1001  1.2818  1.0624  0.7098  0.4612
## Beta CoSkewness -0.5301 -0.8163  0.5268  0.8767  0.5831  0.6919  0.0285
## Beta CoKurtosis 0.5417  0.4928  1.0088  1.2093  1.0420  0.7031  0.3952
##              1088.HK 1109.HK 1199.HK 1299.HK 1398.HK 1880.HK 1898.HK
## CoSkewness     0.0000   0.000  0.0000  0.0000   0.000  0.0000  0.0000
## CoKurtosis     0.0000   0.000  0.0000  0.0000   0.000  0.0000  0.0000
## Beta CoVariance 1.2163   1.164  1.3300  0.8235   1.129  0.8273  1.4960
## Beta CoSkewness 0.9592   3.500  0.6977  1.7998   1.000  0.1819  0.9483
## Beta CoKurtosis 1.0931   1.142  1.2568  0.9853   1.067  0.7698  1.3885
##              2318.HK 2388.HK 2600.HK 2628.HK 3328.HK 3988.HK
## CoSkewness      0.000  0.0000   0.000  0.0000  0.0000  0.0000
## CoKurtosis      0.000  0.0000   0.000  0.0000  0.0000  0.0000
## Beta CoVariance 1.330  0.8765   1.539  1.0963  1.1952  1.0337
## Beta CoSkewness 2.111  0.8399   2.235  0.8745  0.9632  0.2603
## Beta CoKurtosis 1.319  0.8492   1.449  1.0403  1.1849  0.9703
```

4.2   Higher Moments - Combined

```
##                 HSI Components to HSI Combined
## CoSkewness                            0.0000
## CoKurtosis                            0.0000
## Beta CoVariance                       1.1824
## Beta CoSkewness                       0.5382
## Beta CoKurtosis                       1.1221
```

5 Principal Components Analysis

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

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

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

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

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

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

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

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

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

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

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

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

---

[3]http://blog.revolutionanalytics.com/2011/06/big-data-pca.html
[4]http://statmath.wu.ac.at/courses/optimization/Presentations/Nops+Thomas-sPCA1.pdf
[5]http://en.wikipedia.org/wiki/Factoranalysis

5.1 PCA with stats package princomp function

```
## Importance of components:
##                           Comp.1  Comp.2  Comp.3  Comp.4  Comp.5  Comp.6
## Standard deviation        4.9171 1.45378 1.19424 1.17915 1.03864 1.00336
## Proportion of Variance    0.5037 0.04403 0.02971 0.02897 0.02247 0.02097
## Cumulative Proportion     0.5037 0.54774 0.57746 0.60642 0.62890 0.64987
##                            Comp.7  Comp.8  Comp.9 Comp.10 Comp.11 Comp.12
## Standard deviation        0.96322 0.94858 0.91110 0.89315 0.86554 0.85017
## Proportion of Variance    0.01933 0.01875 0.01729 0.01662 0.01561 0.01506
## Cumulative Proportion     0.66920 0.68794 0.70524 0.72186 0.73747 0.75252
##                           Comp.13 Comp.14 Comp.15 Comp.16 Comp.17 Comp.18
## Standard deviation        0.81724 0.80960 0.77054 0.75947 0.74913 0.71721
## Proportion of Variance    0.01391 0.01366 0.01237 0.01202 0.01169 0.01072
## Cumulative Proportion     0.76644 0.78009 0.79246 0.80448 0.81617 0.82689
##                           Comp.19 Comp.20  Comp.21  Comp.22  Comp.23   Comp.24
## Standard deviation        0.70695 0.70041 0.684992 0.650417 0.649996 0.637502
## Proportion of Variance    0.01041 0.01022 0.009775 0.008813 0.008802 0.008467
## Cumulative Proportion     0.83730 0.84752 0.857294 0.866108 0.874910 0.883377
##                            Comp.25  Comp.26  Comp.27  Comp.28  Comp.29
## Standard deviation        0.620255 0.615305 0.603952 0.593602 0.573156
## Proportion of Variance    0.008015 0.007888 0.007599 0.007341 0.006844
## Cumulative Proportion     0.891392 0.899279 0.906878 0.914219 0.921063
##                            Comp.30 Comp.31  Comp.32  Comp.33  Comp.34
## Standard deviation        0.562102 0.55209 0.534049 0.526525 0.510894
## Proportion of Variance    0.006582 0.00635 0.005942 0.005776 0.005438
## Cumulative Proportion     0.927645 0.93400 0.939937 0.945713 0.951151
##                            Comp.35  Comp.36  Comp.37  Comp.38  Comp.39
## Standard deviation        0.492448 0.489735 0.475435 0.458236 0.449569
## Proportion of Variance    0.005052 0.004997 0.004709 0.004375 0.004211
## Cumulative Proportion     0.956203 0.961200 0.965909 0.970283 0.974494
##                            Comp.40  Comp.41  Comp.42  Comp.43  Comp.44
## Standard deviation        0.435662 0.417391 0.389495 0.386686 0.368700
## Proportion of Variance    0.003954 0.003629 0.003161 0.003115 0.002832
## Cumulative Proportion     0.978448 0.982078 0.985238 0.988353 0.991185
##                           Comp.45  Comp.46  Comp.47  Comp.48
## Standard deviation        0.34500 0.328474 0.323100 0.302962
## Proportion of Variance    0.00248 0.002248 0.002175 0.001912
## Cumulative Proportion     0.99367 0.995913 0.998088 1.000000
##
##
## Loadings:
##          Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8 Comp.9
## X0001.HK -0.173        -0.180  0.132                                0.127
## X0002.HK         0.472         0.138 -0.154         0.246         -0.149
## X0003.HK         0.344         0.289  0.139                -0.108  0.103
## X0004.HK -0.160        -0.139
## X0005.HK -0.166
## X0006.HK         0.488               -0.127         0.383          0.115
## X0011.HK -0.154        -0.181  0.219 -0.127                -0.144 -0.142
## X0012.HK -0.162        -0.167                       -0.137         0.171
## X0013.HK -0.165        -0.141  0.119
## X0016.HK -0.173        -0.155                                      0.200
## X0017.HK -0.146        -0.221                                0.145  0.296
## X0019.HK -0.123                0.285        -0.158 -0.112  0.257 -0.143
## X0023.HK -0.153                0.130 -0.206                -0.155 -0.288
## X0066.HK -0.139  0.147         0.195        -0.172                -0.214
```

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## X0083.HK -0.154         -0.217                                    0.253
## X0101.HK -0.153         -0.202                  0.108      -0.158
## X0144.HK -0.153                           0.106  0.148  0.124  0.134  0.167
## X0151.HK        -0.114  0.453  0.279  0.152 -0.174         0.126  0.267
## X0267.HK -0.160                     0.105 -0.118
## X0291.HK -0.127                           0.114  0.210  0.196
## X0293.HK -0.130 -0.116         0.104         0.220         0.317 -0.182
## X0322.HK        -0.131  0.385  0.437                      -0.299
## X0330.HK        -0.101                0.420 -0.284  0.492  0.153 -0.270
## X0386.HK -0.138  0.240  0.132 -0.163  0.216  0.142 -0.212  0.118
## X0388.HK -0.172                           -0.143
## X0494.HK                     -0.101         -0.298  0.219 -0.411  0.336
## X0688.HK -0.154 -0.185         -0.140                0.162 -0.112
## X0700.HK -0.136         0.148         -0.255  0.176         0.204
## X0762.HK -0.125  0.138  0.279 -0.131         0.156 -0.189        -0.128
## X0836.HK        -0.136  0.114  0.644  0.348        -0.203
## X0857.HK -0.156  0.170         -0.148  0.117        -0.152
## X0883.HK -0.166         -0.138
## X0939.HK -0.174         0.107                      -0.151
## X0941.HK -0.122  0.297  0.143                     -0.116  0.188 -0.111
## X1044.HK -0.102 -0.120  0.307  0.208 -0.178  0.172  0.154  0.173
## X1088.HK -0.166         0.107
## X1109.HK -0.154 -0.221         -0.112                0.134 -0.120 -0.122
## X1199.HK -0.156         -0.220                0.119        0.142
## X1299.HK -0.132                     0.354        -0.305 -0.128
## X1398.HK -0.180         -0.112         -0.107
## X1880.HK -0.130         0.109         0.296  0.253
## X1898.HK -0.159                -0.204        -0.100 -0.171
## X2318.HK -0.168         -0.105         -0.116 -0.112
## X2388.HK -0.162         -0.134                            -0.199
## X2600.HK -0.159         -0.151
## X2628.HK -0.160         -0.104         -0.196
## X3328.HK -0.175         -0.141
## X3988.HK -0.174                            -0.120 -0.109
##         Comp.10 Comp.11 Comp.12 Comp.13 Comp.14 Comp.15 Comp.16 Comp.17
## X0001.HK                                  0.113        -0.111
## X0002.HK                 0.105   0.148                  0.244
## X0003.HK  0.126   0.328          -0.271                -0.162 -0.141
## X0004.HK                                  0.223         0.271  0.179
## X0005.HK                 0.202                                 0.100
## X0006.HK  0.205  -0.363                         -0.236 -0.122
## X0011.HK          0.113   0.101          0.108
## X0012.HK                 -0.130   0.166         -0.107  0.230
## X0013.HK -0.130                 -0.186          0.115
## X0016.HK                                  0.104
## X0017.HK                 0.323          -0.189         0.110 -0.179
## X0019.HK         -0.407  -0.199  -0.305                       -0.187
## X0023.HK                 -0.136          0.121  0.146 -0.173
## X0066.HK -0.173   0.140                               -0.260  0.292
## X0083.HK  0.126                  0.308         -0.203
## X0101.HK -0.117         -0.108  -0.124  -0.133         0.179
## X0144.HK -0.128          0.118                 0.247 -0.167
## X0151.HK  0.123          0.102  -0.158   0.230 -0.132
## X0267.HK         -0.108                  0.146  0.202  0.109
## X0291.HK  0.188   0.204  -0.459          -0.419  0.208  0.154
## X0293.HK -0.229  -0.219                  -0.156  0.187
## X0322.HK  0.169  -0.106   0.136   0.234  -0.263  0.344         0.138
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## X0330.HK -0.122   0.217   0.140   0.148                   0.135  -0.132
## X0386.HK -0.103                  -0.184                            0.159
## X0388.HK                  0.121                                    0.132
## X0494.HK -0.512  -0.143  -0.345                   0.112           -0.191
## X0688.HK  0.317   0.107  -0.128           0.182          -0.118
## X0700.HK -0.100                           0.278   0.154  -0.136
## X0762.HK                          0.214   0.143           0.441  -0.297
## X0836.HK         -0.305           0.141          -0.150  -0.188
## X0857.HK -0.105          -0.111  -0.105           0.120            0.300
## X0883.HK                                                           0.115
## X0939.HK                          0.110  -0.228          -0.133  -0.202
## X0941.HK          0.214  -0.153   0.182   0.119   0.155  -0.174  -0.283
## X1044.HK -0.307   0.128  -0.206   0.132          -0.565            0.189
## X1088.HK                         -0.191   0.128           0.116
## X1109.HK  0.277          -0.233           0.189
## X1199.HK                  0.201                          -0.218   0.135
## X1299.HK -0.134   0.282   0.249  -0.173          -0.106   0.103
## X1398.HK                                  -0.230
## X1880.HK                         -0.404                           -0.222
## X1898.HK         -0.123          -0.139  -0.100
## X2318.HK         -0.173                          -0.104
## X2388.HK -0.115           0.143  -0.106  -0.152                   -0.156
## X2600.HK  0.144                                           0.192   0.155
## X2628.HK                                                           0.333
## X3328.HK                                  -0.144  -0.192  -0.107
## X3988.HK                          0.166  -0.243          -0.192  -0.124
##           Comp.18 Comp.19 Comp.20 Comp.21 Comp.22 Comp.23 Comp.24 Comp.25
## X0001.HK                   0.135                  -0.195
## X0002.HK  0.153   0.110
## X0003.HK -0.364  -0.240  -0.161   0.150  -0.243   0.121            0.108
## X0004.HK  0.126                   0.137   0.217  -0.147   0.132  -0.233
## X0005.HK -0.107          -0.234          -0.207  -0.102   0.200
## X0006.HK -0.119                                  -0.108          -0.161
## X0011.HK         -0.206   0.124                   0.197
## X0012.HK                  0.119                                    0.127
## X0013.HK                  0.105                  -0.286  -0.113   0.189
## X0016.HK                          -0.152                  -0.126
## X0017.HK                                           0.169            0.116
## X0019.HK                 -0.291  -0.212                  -0.264  -0.167
## X0023.HK  0.144  -0.194          -0.114  -0.127                   -0.332
## X0066.HK  0.308   0.174  -0.126   0.108           0.280  -0.162
## X0083.HK                          -0.140  -0.178
## X0101.HK -0.170   0.231   0.286           0.164   0.204          -0.275
## X0144.HK  0.127  -0.362          -0.147   0.192                    0.152
## X0151.HK         -0.127   0.186   0.148   0.154           0.134  -0.314
## X0267.HK                 -0.101          -0.241   0.162            0.246
## X0291.HK  0.184  -0.140                   0.323          -0.199  -0.136
## X0293.HK -0.356                                           0.461  -0.101
## X0322.HK          0.212          -0.163
## X0330.HK -0.168   0.105   0.143          -0.110  -0.112  -0.157  -0.159
## X0386.HK -0.110                  -0.104   0.169   0.177  -0.157
## X0388.HK                 -0.132   0.217                   0.115   0.127
## X0494.HK                 -0.161
## X0688.HK -0.112                  -0.111                            0.133
## X0700.HK -0.353   0.122   0.156   0.379                  -0.418
## X0762.HK         -0.173  -0.232   0.234  -0.158
## X0836.HK                           0.203
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## X0857.HK                 0.175 -0.187 -0.123               -0.113
## X0883.HK                 0.130 -0.146 -0.428 -0.189        -0.111
## X0939.HK
## X0941.HK          0.286        -0.185  0.357 -0.149  0.175  0.106
## X1044.HK                       -0.141                             0.190
## X1088.HK        -0.201  0.269                        0.140  0.121
## X1109.HK                -0.100         0.133
## X1199.HK  0.199         -0.210               -0.125        -0.162
## X1299.HK                -0.292 -0.165  0.227 -0.303 -0.228
## X1398.HK                                                   -0.101
## X1880.HK  0.306  0.429               -0.304  0.246  0.209
## X1898.HK                 0.239 -0.192        -0.122         0.311
## X2318.HK -0.162  0.158          0.146        -0.201
## X2388.HK  0.110 -0.138  0.174  0.230                 0.118  0.243
## X2600.HK        -0.150 -0.127         0.213  0.402 -0.136 -0.101
## X2628.HK -0.190  0.241 -0.195  0.143        -0.131  0.279  0.127
## X3328.HK
## X3988.HK                 0.110  0.104                      -0.138
##           Comp.26 Comp.27 Comp.28 Comp.29 Comp.30 Comp.31 Comp.32 Comp.33
## X0001.HK -0.145                -0.101         0.131        -0.118
## X0002.HK -0.129          0.139         0.167 -0.460         0.202
## X0003.HK -0.157  0.143                 0.186  0.108
## X0004.HK -0.170  0.214         0.105         0.331
## X0005.HK        -0.220        -0.268  0.166 -0.195 -0.149
## X0006.HK                -0.140       -0.235  0.244
## X0011.HK  0.203          0.163       -0.343  0.107 -0.337
## X0012.HK          0.159 -0.256 -0.255               -0.254
## X0013.HK -0.257 -0.156 -0.204 -0.277               0.280  0.101
## X0016.HK                        0.110               -0.316
## X0017.HK        -0.181  0.235  0.286               0.398  0.164
## X0019.HK                0.248 -0.110       -0.181
## X0023.HK  0.126 -0.161  0.130                0.175  0.205
## X0066.HK                -0.327              -0.118  0.149
## X0083.HK  0.181 -0.232              -0.185 -0.193
## X0101.HK  0.217  0.269                0.215 -0.105  0.186
## X0144.HK  0.180  0.224        -0.331 -0.139               0.228
## X0151.HK        -0.105 -0.200  0.241       -0.150
## X0267.HK  0.265  0.435 -0.174  0.246        0.102        0.129
## X0291.HK  0.239 -0.146
## X0293.HK -0.120        -0.321  0.211       -0.122
## X0322.HK                      -0.159                      -0.198
## X0330.HK                      -0.189 -0.144
## X0386.HK        -0.114              -0.298               -0.263
## X0388.HK -0.230          0.123       -0.166  0.139 -0.122
## X0494.HK                       0.114       -0.101 -0.111
## X0688.HK -0.218                0.199       -0.160  0.109
## X0700.HK  0.137 -0.112  0.118         0.124
## X0762.HK                                    0.111  0.256 -0.211
## X0836.HK        -0.104  0.147         0.160       -0.163  0.112
## X0857.HK -0.180         0.185  0.179
## X0883.HK -0.226         0.147  0.124                      0.357
## X0939.HK -0.159  0.153                                    0.103
## X0941.HK                0.139                0.245         0.126
## X1044.HK          0.130  0.105               0.184  0.119
## X1088.HK  0.224               -0.135       -0.202  0.284 -0.116
## X1109.HK -0.205                            -0.168  0.107 -0.119
## X1199.HK          0.298                0.275 -0.108        -0.373
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## X1299.HK  0.101              -0.187   0.148              -0.115              0.129
## X1398.HK
## X1880.HK                               -0.116                      -0.109
## X1898.HK  0.163  -0.156  -0.245   0.234   0.380   0.143  -0.108
## X2318.HK          0.173           -0.115  -0.138
## X2388.HK                   0.258   0.126                      -0.167  -0.340
## X2600.HK         -0.266  -0.102  -0.182   0.312   0.223  -0.193   0.116
## X2628.HK  0.309           0.137                              0.124
## X3328.HK                                                              0.143
## X3988.HK          0.101           -0.121                      0.133
##           Comp.34 Comp.35 Comp.36 Comp.37 Comp.38 Comp.39 Comp.40 Comp.41
## X0001.HK -0.144  -0.119   0.127            0.334            0.158  -0.239
## X0002.HK                  -0.121            0.183   0.150
## X0003.HK          0.144  -0.146
## X0004.HK  0.334   0.268                            -0.283   0.131
## X0005.HK  0.375  -0.277   0.194   0.281   0.134  -0.181            0.181
## X0006.HK         -0.120   0.145                    -0.101
## X0011.HK          0.126   0.367                            -0.350
## X0012.HK         -0.252           -0.316  -0.157                    0.231
## X0013.HK                           0.135                    -0.245  -0.169
## X0016.HK -0.201           0.125                     0.154   0.305   0.110
## X0017.HK         -0.162           -0.252                    -0.153   0.132
## X0019.HK          0.105   0.117
## X0023.HK         -0.297  -0.344  -0.198            0.142
## X0066.HK -0.102   0.134   0.109            -0.140  -0.234            0.189
## X0083.HK  0.129   0.221  -0.453   0.208                            -0.252
## X0101.HK                           0.367   0.110            -0.117
## X0144.HK -0.190   0.189  -0.170            0.197            0.108   0.235
## X0151.HK -0.117  -0.119
## X0267.HK  0.179  -0.353                                    0.109  -0.206
## X0291.HK
## X0293.HK          0.107
## X0322.HK          0.113                            -0.155
## X0330.HK
## X0386.HK  0.178          -0.128  -0.109   0.305            -0.170  -0.139
## X0388.HK  0.185   0.127  -0.143   0.146            0.538            0.187
## X0494.HK
## X0688.HK                  0.137            0.133  -0.144  -0.106
## X0700.HK  0.131                  -0.123  -0.120                    0.137
## X0762.HK -0.189           0.153
## X0836.HK
## X0857.HK         -0.162                   -0.115  -0.112            0.275
## X0883.HK -0.175   0.177   0.109   0.131  -0.136                    -0.141
## X0939.HK  0.182           0.110   0.209  -0.127   0.182            -0.115
## X0941.HK                           0.107  -0.167                    -0.108
## X1044.HK
## X1088.HK  0.259   0.169   0.154  -0.205  -0.447            0.160  -0.149
## X1109.HK         -0.142                                            0.135
## X1199.HK                          -0.120  -0.130   0.119  -0.377  -0.220
## X1299.HK                                                    0.204
## X1398.HK                          -0.155                    0.129   0.200
## X1880.HK
## X1898.HK          0.206           0.130   0.193            -0.176   0.259
## X2318.HK -0.252          -0.364            -0.230  -0.164  -0.336
## X2388.HK -0.148  -0.224  -0.104                    -0.384   0.259  -0.116
## X2600.HK -0.239  -0.143                    0.113  -0.182            0.146  -0.282
## X2628.HK -0.321                  -0.102   0.132   0.195   0.190
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## X3328.HK  0.157   0.163            -0.414   0.296  -0.243          -0.244
## X3988.HK                                                   0.141
##           Comp.42 Comp.43 Comp.44 Comp.45 Comp.46 Comp.47 Comp.48
## X0001.HK   0.142  -0.122  -0.339                   0.547
## X0002.HK  -0.159  -0.108
## X0003.HK
## X0004.HK  -0.215           0.171
## X0005.HK          -0.240
## X0006.HK   0.113   0.110
## X0011.HK  -0.231
## X0012.HK   0.171   0.231   0.227  -0.232   0.111
## X0013.HK  -0.199   0.148                          -0.422   0.131
## X0016.HK  -0.174  -0.240           0.389          -0.392  -0.233
## X0017.HK                                           0.116
## X0019.HK           0.131          -0.126
## X0023.HK   0.120           0.132  -0.135          -0.119  -0.126
## X0066.HK   0.138
## X0083.HK           0.189                                   0.116
## X0101.HK   0.251
## X0144.HK
## X0151.HK
## X0267.HK                  -0.106   0.105   0.120
## X0291.HK
## X0293.HK
## X0322.HK
## X0330.HK
## X0386.HK          -0.183   0.335
## X0388.HK   0.327          -0.200   0.133   0.211
## X0494.HK
## X0688.HK          -0.205          -0.221   0.514          -0.178
## X0700.HK           0.140
## X0762.HK
## X0836.HK
## X0857.HK  -0.275   0.233  -0.432  -0.161
## X0883.HK   0.338           0.315   0.191
## X0939.HK  -0.102  -0.142          -0.423  -0.397          -0.379
## X0941.HK                           0.109                   0.136
## X1044.HK          -0.114
## X1088.HK          -0.208                           0.105
## X1109.HK           0.263           0.274  -0.539           0.162
## X1199.HK                          -0.139
## X1299.HK
## X1398.HK          -0.261          -0.135          -0.205   0.739
## X1880.HK  -0.156
## X1898.HK           0.109                           0.139
## X2318.HK          -0.370  -0.201   0.164  -0.103   0.114  -0.157
## X2388.HK                   0.147
## X2600.HK
## X2628.HK           0.142   0.219  -0.274
## X3328.HK   0.197   0.256  -0.338   0.174          -0.233  -0.199
## X3988.HK  -0.455   0.200   0.213   0.351   0.353   0.330
##
##               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   0.562   0.583   0.604
##                  Comp.30 Comp.31 Comp.32 Comp.33 Comp.34 Comp.35 Comp.36
## SS loadings        1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var     0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var     0.625   0.646   0.667   0.688   0.708   0.729   0.750
##                  Comp.37 Comp.38 Comp.39 Comp.40 Comp.41 Comp.42 Comp.43
## SS loadings        1.000   1.000   1.000   1.000   1.000   1.000   1.000
## Proportion Var     0.021   0.021   0.021   0.021   0.021   0.021   0.021
## Cumulative Var     0.771   0.792   0.812   0.833   0.854   0.875   0.896
##                  Comp.44 Comp.45 Comp.46 Comp.47 Comp.48
## SS loadings        1.000   1.000   1.000   1.000   1.000
## Proportion Var     0.021   0.021   0.021   0.021   0.021
## Cumulative Var     0.917   0.938   0.958   0.979   1.000
```

Relative variance of Principal Components to HSI
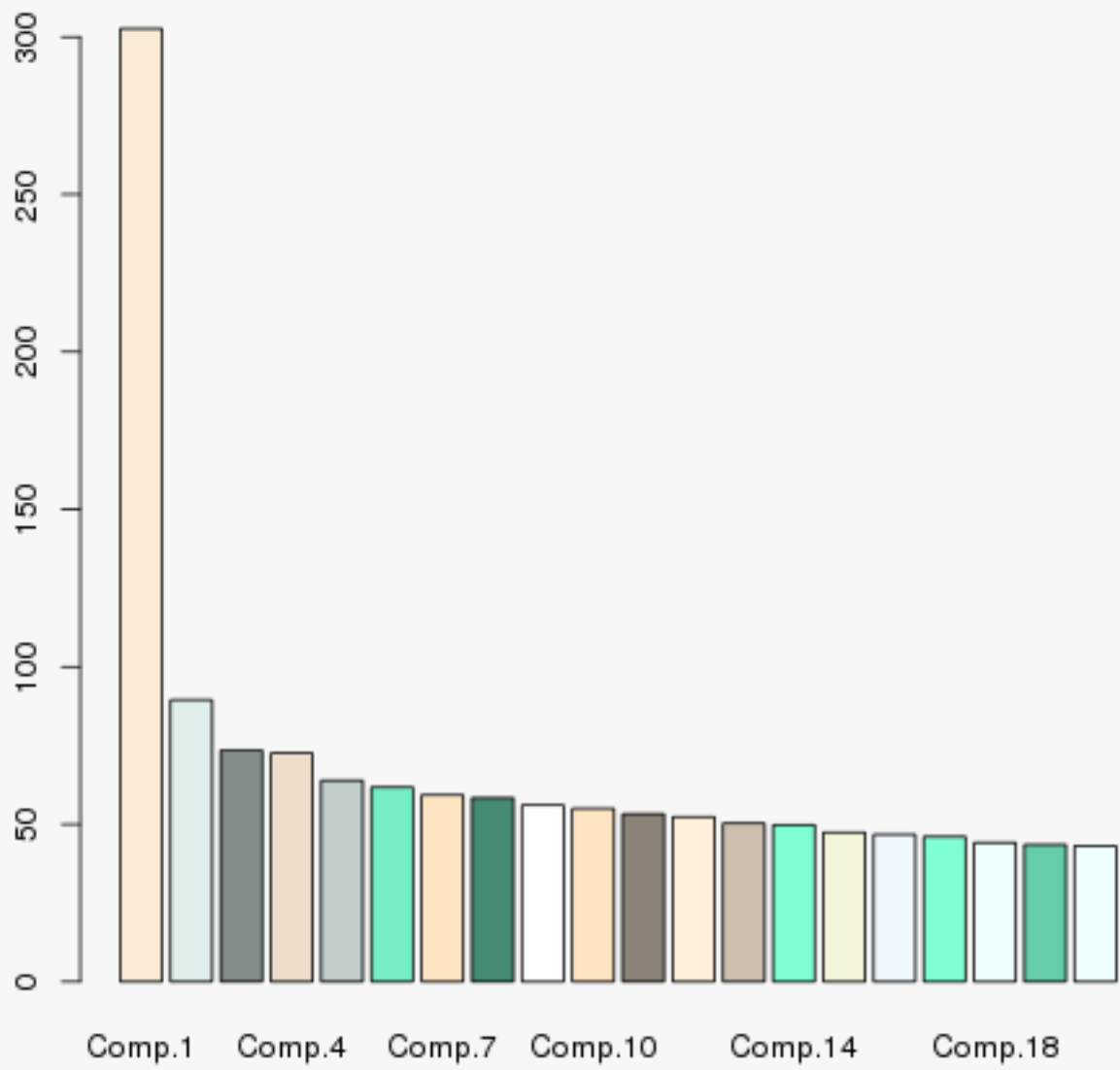
ScreePlot - Variances against Principal Component
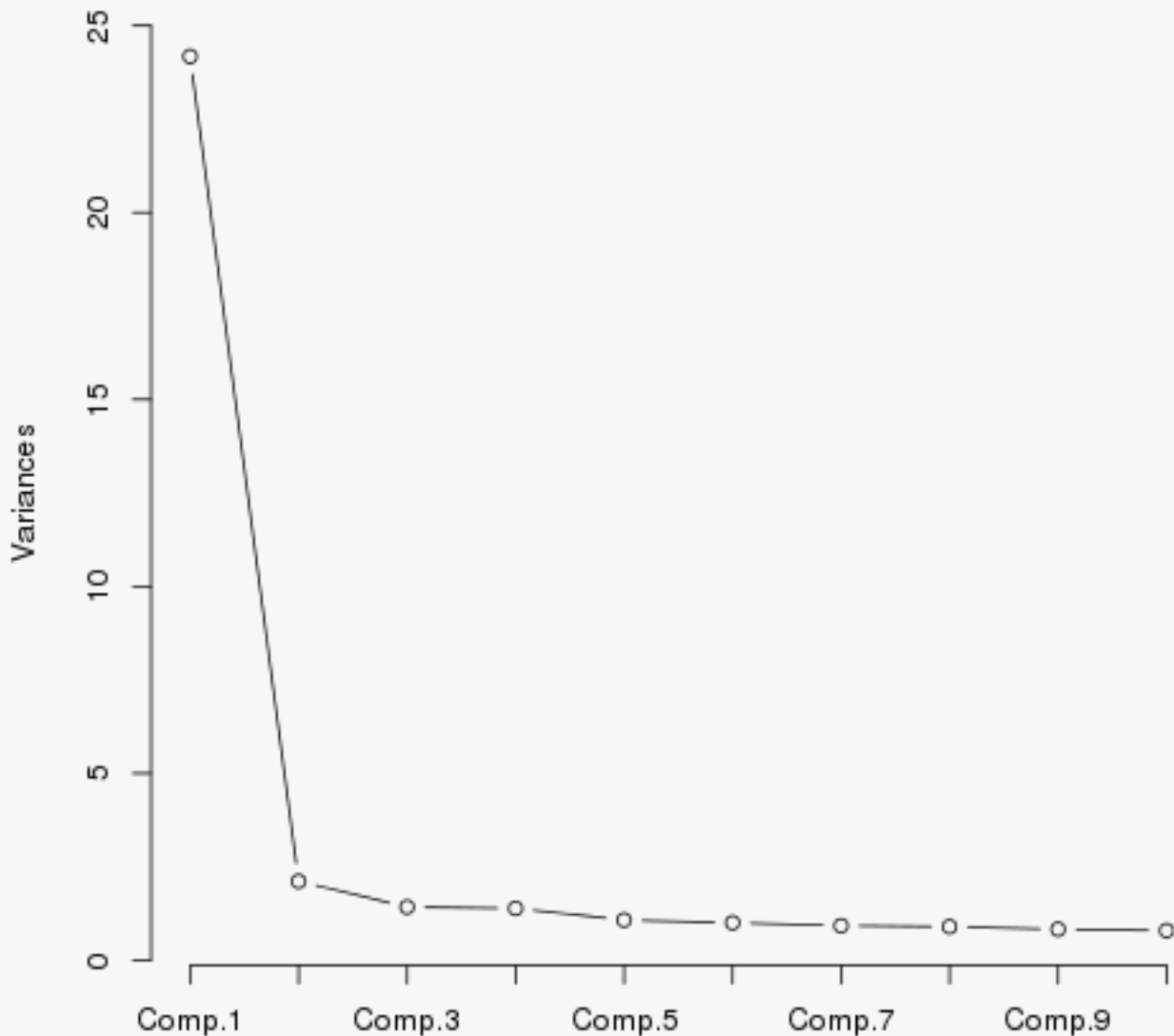
The Cattell scree test plots the components as the X axis and the corresponding eigenvalues as the Y-axis. As one moves to the right, toward later components, the eigenvalues drop. When the drop ceases and the curve makes an elbow toward less steep decline, Cattell's scree test says to drop all further 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
## X1398.HK    40 0.88 -0.06  0.08 -0.13 -0.06 0.81 0.19
## X3328.HK    47 0.86 -0.05  0.02 -0.17  0.02 0.77 0.23
## X3988.HK    48 0.86  0.01  0.06 -0.09  0.01 0.75 0.25
## X0939.HK    33 0.86 -0.01  0.13 -0.10  0.00 0.76 0.24
## X0001.HK     1 0.85 -0.03 -0.21  0.16 -0.07 0.80 0.20
## X0016.HK    10 0.85  0.01 -0.19  0.08 -0.07 0.77 0.23
## X0388.HK    25 0.85 -0.07 -0.08  0.06 -0.03 0.73 0.27
## X2318.HK    43 0.83 -0.12  0.02 -0.12 -0.06 0.72 0.28
## X0883.HK    32 0.82  0.06  0.11 -0.16 -0.04 0.71 0.29
## X0005.HK     5 0.81  0.00  0.01 -0.11 -0.02 0.68 0.32
## X1088.HK    36 0.81  0.05  0.13 -0.08  0.06 0.69 0.31
## X0013.HK     9 0.81 -0.06 -0.17  0.14 -0.05 0.71 0.29
## X0012.HK     8 0.80  0.02 -0.20  0.10  0.00 0.69 0.31
## X2388.HK    44 0.80 -0.04 -0.02  0.07 -0.14 0.66 0.34
## X0004.HK     4 0.79 -0.13 -0.17  0.05 -0.05 0.67 0.33
## X0267.HK    19 0.79 -0.13  0.06  0.07  0.11 0.66 0.34
## X2628.HK    46 0.79  0.02  0.06 -0.12 -0.01 0.64 0.36
## X1898.HK    42 0.78  0.00  0.04 -0.11 -0.01 0.62 0.38
## X2600.HK    45 0.78 -0.09  0.03 -0.18 -0.04 0.65 0.35
## X1199.HK    38 0.77 -0.02  0.00 -0.26  0.05 0.66 0.34
## X0857.HK    31 0.77  0.25  0.11 -0.17  0.12 0.70 0.30
## X1109.HK    37 0.76 -0.32 -0.01 -0.13  0.02 0.70 0.30
## X0688.HK    27 0.76 -0.27  0.00 -0.17 -0.08 0.68 0.32
## X0083.HK    15 0.76 -0.03 -0.26  0.05 -0.03 0.64 0.36
## X0011.HK     7 0.76 -0.01 -0.22  0.26 -0.13 0.70 0.30
## X0023.HK    13 0.75  0.01 -0.06  0.15 -0.21 0.64 0.36
## X0101.HK    16 0.75  0.01 -0.24  0.02  0.02 0.62 0.38
## X0144.HK    17 0.75  0.00  0.05 -0.11  0.11 0.59 0.41
## X0017.HK    11 0.72 -0.08 -0.26  0.05  0.06 0.60 0.40
## X0066.HK    14 0.68  0.21 -0.11  0.23  0.03 0.58 0.42
## X0386.HK    24 0.68  0.35  0.16 -0.19  0.22 0.69 0.31
## X0700.HK    28 0.67 -0.09  0.18 -0.08 -0.27 0.56 0.44
## X1299.HK    39 0.65 -0.01 -0.02  0.06  0.02 0.42 0.58
## X1880.HK    41 0.64 -0.12  0.13 -0.07 -0.09 0.46 0.54
## X0293.HK    21 0.64 -0.17 -0.11  0.12 -0.05 0.47 0.53
## X0291.HK    20 0.62 -0.03 -0.07  0.03  0.01 0.40 0.60
## X0762.HK    29 0.62  0.20  0.33 -0.16  0.08 0.56 0.44
## X0019.HK    12 0.61 -0.02 -0.04  0.34  0.06 0.49 0.51
## X0941.HK    34 0.60  0.43  0.17 -0.02  0.08 0.59 0.41
## X1044.HK    35 0.50 -0.17  0.37  0.25 -0.19 0.51 0.49
## X0494.HK    26 0.47  0.02  0.04 -0.12 -0.06 0.24 0.76
## X0330.HK    23 0.45 -0.15 -0.05 -0.08  0.44 0.42 0.58
## X0006.HK     6 0.20  0.71 -0.02 -0.08 -0.13 0.57 0.43
## X0002.HK     2 0.41  0.69  0.01  0.16 -0.16 0.69 0.31
## X0003.HK     3 0.46  0.50 -0.06  0.34  0.14 0.60 0.40
## X0151.HK    18 0.45 -0.17  0.54  0.33  0.16 0.65 0.35
## X0322.HK    22 0.33 -0.19  0.46  0.52  0.02 0.62 0.38
## X0836.HK    30 0.38 -0.05 -0.16  0.13  0.67 0.64 0.36
##
##                   PC1  PC2  PC3  PC4  PC5
## SS loadings     24.18 2.11 1.43 1.39 1.08
```

```
## Proportion Var  0.50 0.04 0.03 0.03 0.02
## Cumulative Var  0.50 0.55 0.58 0.61 0.63
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  41.43 0.3
## The degrees of freedom for the model are 898  and the objective function was  6.51
##  0.3The number of observations was  304  with Chi Square =  1842  with prob <  2.2e-67
##  0.3
## Fit based upon off diagonal values = 1


##              PC1        PC2
## X0001.HK 0.8511 -0.0330565
## X0002.HK 0.4141  0.6862799
## X0003.HK 0.4563  0.4996117
## X0004.HK 0.7890 -0.1266268
## X0005.HK 0.8148  0.0035211
## X0006.HK 0.1975  0.7096512
## X0011.HK 0.7557 -0.0100219
## X0012.HK 0.7972  0.0170293
## X0013.HK 0.8091 -0.0579902
## X0016.HK 0.8502  0.0143212
## X0017.HK 0.7165 -0.0827265
## X0019.HK 0.6071 -0.0236997
## X0023.HK 0.7520  0.0108848
## X0066.HK 0.6813  0.2137128
## X0083.HK 0.7565 -0.0270297
## X0101.HK 0.7508  0.0149859
## X0144.HK 0.7507 -0.0004199
## X0151.HK 0.4478 -0.1653839
## X0267.HK 0.7860 -0.1298750
## X0291.HK 0.6244 -0.0287852
## X0293.HK 0.6395 -0.1691668
## X0322.HK 0.3326 -0.1903705
## X0330.HK 0.4503 -0.1472531
## X0386.HK 0.6782  0.3488751
## X0388.HK 0.8471 -0.0713945
## X0494.HK 0.4715  0.0241196
## X0688.HK 0.7586 -0.2688274
## X0700.HK 0.6694 -0.0863603
## X0762.HK 0.6165  0.2013414
## X0836.HK 0.3846 -0.0546321
## X0857.HK 0.7654  0.2474786
## X0883.HK 0.8182  0.0631883
## X0939.HK 0.8551 -0.0148876
## X0941.HK 0.6023  0.4323801
## X1044.HK 0.5036 -0.1742006
## X1088.HK 0.8143  0.0480222
## X1109.HK 0.7597 -0.3206420
## X1199.HK 0.7664 -0.0184048
## X1299.HK 0.6484 -0.0131368
## X1398.HK 0.8830 -0.0557564
## X1880.HK 0.6414 -0.1197870
## X1898.HK 0.7814 -0.0035550
## X2318.HK 0.8267 -0.1182223
## X2388.HK 0.7967 -0.0369045
## X2600.HK 0.7807 -0.0878391
```

```
## X2628.HK 0.7852  0.0234267
## X3328.HK 0.8594 -0.0476910
## X3988.HK 0.8579  0.0083390
```

Loadings Rotation : none

5.2.2 Rotation : varimax

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

```
## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "varimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##            item  PC1  PC4   PC2   PC3   PC5   h2   u2
## X1398.HK    40 0.71 0.50  0.14  0.18  0.08 0.81 0.19
## X3328.HK    47 0.69 0.48  0.14  0.12  0.16 0.77 0.23
## X0883.HK    32 0.69 0.39  0.24  0.15  0.08 0.71 0.29
## X1199.HK    38 0.68 0.39  0.13  0.01  0.17 0.66 0.34
## X0939.HK    33 0.68 0.44  0.19  0.23  0.13 0.76 0.24
## X2600.HK    45 0.66 0.44  0.08  0.10  0.09 0.65 0.35
## X3988.HK    48 0.65 0.47  0.21  0.18  0.15 0.75 0.25
## X2318.HK    43 0.65 0.51  0.07  0.15  0.09 0.72 0.28
## X0857.HK    31 0.64 0.28  0.40  0.09  0.22 0.70 0.30
## X0688.HK    27 0.64 0.50 -0.10  0.12  0.06 0.68 0.32
## X1088.HK    36 0.64 0.39  0.24  0.21  0.18 0.69 0.31
## X2628.HK    46 0.62 0.42  0.20  0.14  0.12 0.64 0.36
## X0005.HK     5 0.62 0.48  0.18  0.12  0.12 0.68 0.32
## X1109.HK    37 0.61 0.50 -0.14  0.15  0.16 0.70 0.30
## X0762.HK    29 0.61 0.08  0.34  0.24  0.12 0.56 0.44
## X1898.HK    42 0.60 0.44  0.17  0.14  0.12 0.62 0.38
## X0386.HK    24 0.60 0.15  0.47  0.07  0.29 0.69 0.31
## X0144.HK    17 0.59 0.38  0.17  0.14  0.23 0.59 0.41
## X0700.HK    28 0.58 0.37  0.08  0.24 -0.16 0.56 0.44
## X1880.HK    41 0.53 0.35  0.04  0.22  0.01 0.46 0.54
## X0267.HK    19 0.50 0.49  0.08  0.30  0.25 0.66 0.34
## X0494.HK    26 0.41 0.24  0.12  0.05  0.01 0.24 0.76
## X0001.HK     1 0.40 0.75  0.19  0.14  0.13 0.80 0.20
## X0011.HK     7 0.27 0.74  0.20  0.18  0.06 0.70 0.30
## X0016.HK    10 0.45 0.70  0.22  0.11  0.11 0.77 0.23
## X0013.HK     9 0.40 0.70  0.15  0.16  0.13 0.71 0.29
## X0083.HK    15 0.39 0.67  0.15  0.02  0.15 0.64 0.36
## X0012.HK     8 0.39 0.67  0.21  0.10  0.18 0.69 0.31
## X0004.HK     4 0.45 0.66  0.07  0.12  0.13 0.67 0.33
## X0388.HK    25 0.50 0.64  0.14  0.19  0.14 0.73 0.27
## X0017.HK    11 0.36 0.63  0.09  0.02  0.24 0.60 0.40
## X0023.HK    13 0.39 0.63  0.22  0.22 -0.05 0.64 0.36
## X0101.HK    16 0.40 0.63  0.18  0.01  0.19 0.62 0.38
## X2388.HK    44 0.49 0.59  0.17  0.22  0.02 0.66 0.34
## X0293.HK    21 0.32 0.57  0.01  0.18  0.10 0.47 0.53
## X0066.HK    14 0.25 0.54  0.40  0.17  0.17 0.58 0.42
## X0019.HK    12 0.17 0.53  0.18  0.33  0.19 0.49 0.51
## X0291.HK    20 0.37 0.46  0.13  0.12  0.14 0.40 0.60
## X1299.HK    39 0.39 0.45  0.15  0.17  0.14 0.42 0.58
## X0002.HK     2 0.13 0.23  0.78  0.05 -0.10 0.69 0.31
## X0006.HK     6 0.13 0.00  0.71 -0.17 -0.12 0.57 0.43
## X0003.HK     3 0.02 0.33  0.64  0.17  0.23 0.60 0.40
## X0941.HK    34 0.43 0.18  0.57  0.16  0.14 0.59 0.41
## X0322.HK    22 0.06 0.17  0.02  0.77  0.05 0.62 0.38
## X0151.HK    18 0.28 0.09  0.04  0.73  0.18 0.65 0.35
## X1044.HK    35 0.32 0.28  0.02  0.56 -0.12 0.51 0.49
```

```
## X0836.HK   30 0.09 0.24  0.05   0.08  0.75 0.64 0.36
## X0330.HK   23 0.33 0.21 -0.05   0.06  0.51 0.42 0.58
##
##                 PC1   PC4  PC2  PC3  PC5
## SS loadings    11.54 10.79 3.40 2.61 1.85
## Proportion Var  0.24  0.22 0.07 0.05 0.04
## Cumulative Var  0.24  0.47 0.54 0.59 0.63
##
## Test of the hypothesis that 5 components are sufficient.
##
## The degrees of freedom for the null model are  1128  and the objective function was  41.43 0.3
## The degrees of freedom for the model are 898  and the objective function was  6.51
##  0.3The number of observations was  304  with Chi Square =  1842  with prob <  2.2e-67
##  0.3
## Fit based upon off diagonal values = 1


##              PC1       PC4
## X0001.HK 0.39674 0.754368
## X0002.HK 0.12551 0.227754
## X0003.HK 0.01669 0.325904
## X0004.HK 0.45128 0.657784
## X0005.HK 0.62170 0.477384
## X0006.HK 0.12634 0.002866
## X0011.HK 0.26566 0.744717
## X0012.HK 0.39340 0.665474
## X0013.HK 0.39597 0.695706
## X0016.HK 0.45133 0.701135
## X0017.HK 0.36193 0.633543
## X0019.HK 0.17166 0.529103
## X0023.HK 0.38697 0.626082
## X0066.HK 0.24719 0.543373
## X0083.HK 0.38770 0.668876
## X0101.HK 0.40186 0.625602
## X0144.HK 0.59005 0.380595
## X0151.HK 0.27610 0.085705
## X0267.HK 0.50369 0.493774
## X0291.HK 0.37163 0.458807
## X0293.HK 0.32248 0.567615
## X0322.HK 0.05657 0.168875
## X0330.HK 0.33024 0.211543
## X0386.HK 0.59669 0.148621
## X0388.HK 0.50448 0.635264
## X0494.HK 0.40602 0.244695
## X0688.HK 0.63769 0.495987
## X0700.HK 0.57612 0.374931
## X0762.HK 0.60830 0.082530
## X0836.HK 0.09278 0.243602
## X0857.HK 0.63949 0.282057
## X0883.HK 0.68703 0.394944
## X0939.HK 0.67937 0.439346
## X0941.HK 0.43343 0.178185
## X1044.HK 0.32128 0.277328
## X1088.HK 0.63509 0.392233
## X1109.HK 0.61422 0.500870
## X1199.HK 0.68049 0.386643
## X1299.HK 0.38817 0.446918
## X1398.HK 0.70821 0.497017
```

```
## X1880.HK 0.53144 0.351633
## X1898.HK 0.60499 0.439806
## X2318.HK 0.65151 0.507232
## X2388.HK 0.48513 0.589158
## X2600.HK 0.65504 0.444811
## X2628.HK 0.62435 0.416625
## X3328.HK 0.69329 0.479830
## X3988.HK 0.65327 0.473919
```

Loadings Rotation : varimax
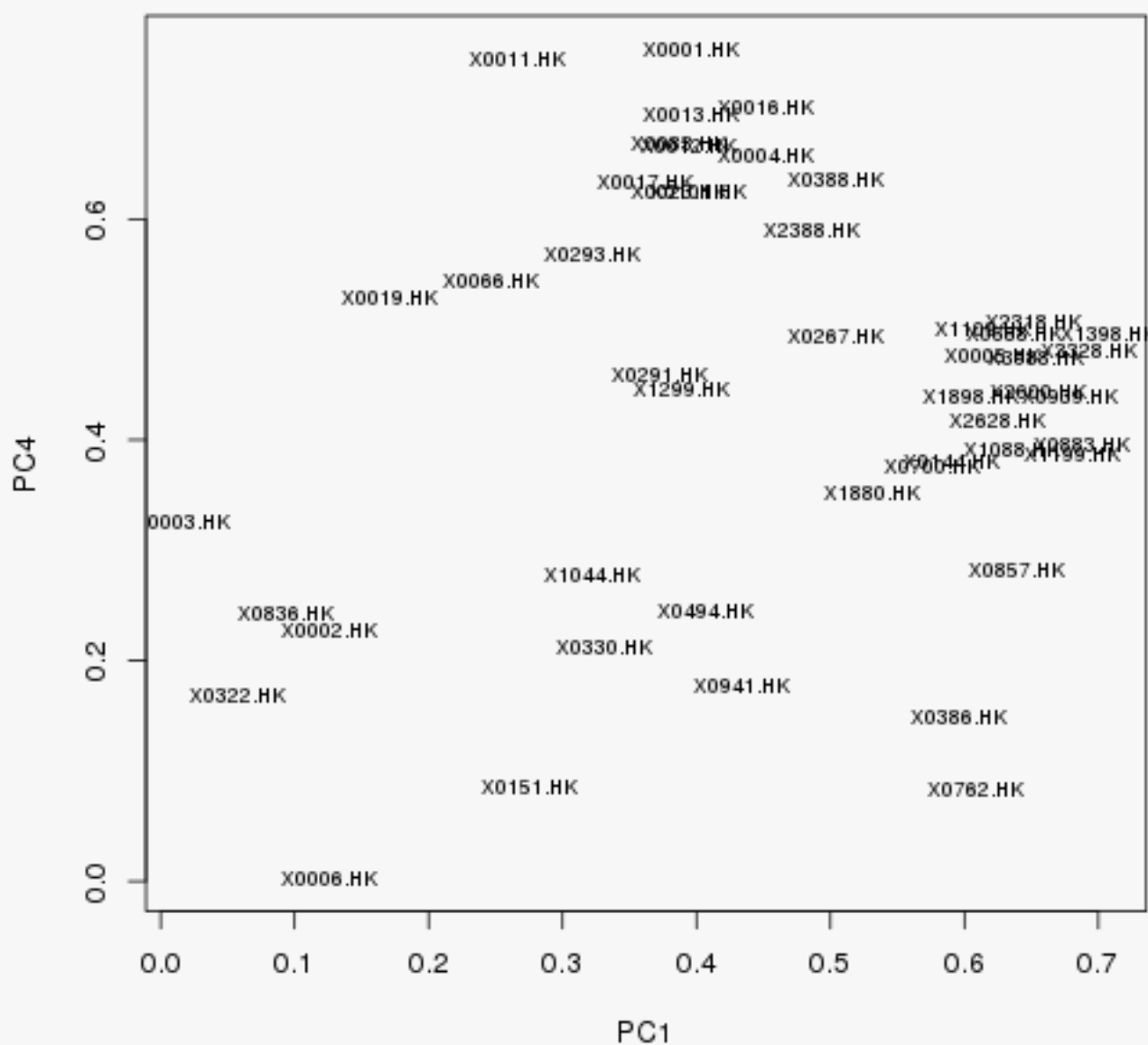
5.2.3 Rotation : quatimax

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
## X1398.HK    40 0.88 -0.06  0.08 -0.13 -0.06 0.81 0.19
## X3328.HK    47 0.86 -0.05  0.02 -0.17  0.02 0.77 0.23
## X3988.HK    48 0.86  0.01  0.06 -0.09  0.01 0.75 0.25
## X0939.HK    33 0.86 -0.01  0.13 -0.10  0.00 0.76 0.24
## X0001.HK     1 0.85 -0.03 -0.21  0.16 -0.07 0.80 0.20
## X0016.HK    10 0.85  0.01 -0.19  0.08 -0.07 0.77 0.23
## X0388.HK    25 0.85 -0.07 -0.08  0.06 -0.03 0.73 0.27
## X2318.HK    43 0.83 -0.12  0.02 -0.12 -0.06 0.72 0.28
## X0883.HK    32 0.82  0.06  0.11 -0.16 -0.04 0.71 0.29
## X0005.HK     5 0.81  0.00  0.01 -0.11 -0.02 0.68 0.32
## X1088.HK    36 0.81  0.05  0.13 -0.08  0.06 0.69 0.31
## X0013.HK     9 0.81 -0.06 -0.17  0.14 -0.05 0.71 0.29
## X0012.HK     8 0.80  0.02 -0.20  0.10  0.00 0.69 0.31
## X2388.HK    44 0.80 -0.04 -0.02  0.07 -0.14 0.66 0.34
## X0004.HK     4 0.79 -0.13 -0.17  0.05 -0.05 0.67 0.33
## X0267.HK    19 0.79 -0.13  0.06  0.07  0.11 0.66 0.34
## X2628.HK    46 0.79  0.02  0.06 -0.12 -0.01 0.64 0.36
## X1898.HK    42 0.78  0.00  0.04 -0.11 -0.01 0.62 0.38
## X2600.HK    45 0.78 -0.09  0.03 -0.18 -0.04 0.65 0.35
## X1199.HK    38 0.77 -0.02  0.00 -0.26  0.05 0.66 0.34
## X0857.HK    31 0.77  0.25  0.11 -0.17  0.12 0.70 0.30
## X1109.HK    37 0.76 -0.32 -0.01 -0.13  0.02 0.70 0.30
## X0688.HK    27 0.76 -0.27  0.00 -0.17 -0.08 0.68 0.32
## X0083.HK    15 0.76 -0.03 -0.26  0.05 -0.03 0.64 0.36
## X0011.HK     7 0.76 -0.01 -0.22  0.26 -0.13 0.70 0.30
## X0023.HK    13 0.75  0.01 -0.06  0.15 -0.21 0.64 0.36
## X0101.HK    16 0.75  0.01 -0.24  0.02  0.02 0.62 0.38
## X0144.HK    17 0.75  0.00  0.05 -0.11  0.11 0.59 0.41
## X0017.HK    11 0.72 -0.08 -0.26  0.05  0.06 0.60 0.40
## X0066.HK    14 0.68  0.21 -0.11  0.23  0.03 0.58 0.42
## X0386.HK    24 0.68  0.35  0.16 -0.19  0.22 0.69 0.31
## X0700.HK    28 0.67 -0.09  0.18 -0.08 -0.27 0.56 0.44
## X1299.HK    39 0.65 -0.01 -0.02  0.06  0.02 0.42 0.58
## X1880.HK    41 0.64 -0.12  0.13 -0.07 -0.09 0.46 0.54
## X0293.HK    21 0.64 -0.17 -0.11  0.12 -0.05 0.47 0.53
## X0291.HK    20 0.62 -0.03 -0.07  0.03  0.01 0.40 0.60
## X0762.HK    29 0.62  0.20  0.33 -0.16  0.08 0.56 0.44
## X0019.HK    12 0.61 -0.02 -0.04  0.34  0.06 0.49 0.51
## X0941.HK    34 0.60  0.43  0.17 -0.02  0.08 0.59 0.41
## X1044.HK    35 0.50 -0.17  0.37  0.25 -0.19 0.51 0.49
## X0494.HK    26 0.47  0.02  0.04 -0.12 -0.06 0.24 0.76
## X0330.HK    23 0.45 -0.15 -0.05 -0.08  0.44 0.42 0.58
## X0006.HK     6 0.20  0.71 -0.02 -0.08 -0.13 0.57 0.43
## X0002.HK     2 0.41  0.69  0.01  0.16 -0.16 0.69 0.31
## X0003.HK     3 0.46  0.50 -0.06  0.34  0.14 0.60 0.40
## X0151.HK    18 0.45 -0.17  0.54  0.33  0.16 0.65 0.35
## X0322.HK    22 0.33 -0.19  0.46  0.52  0.02 0.62 0.38
## X0836.HK    30 0.38 -0.05 -0.16  0.13  0.67 0.64 0.36
```

```
## 
##                 PC1  PC2  PC3  PC4  PC5
## SS loadings    24.18 2.11 1.43 1.39 1.08
## Proportion Var  0.50 0.04 0.03 0.03 0.02
## Cumulative Var  0.50 0.55 0.58 0.61 0.63
## 
## Test of the hypothesis that 5 components are sufficient.
## 
## The degrees of freedom for the null model are  1128  and the objective function was  41.43 0.3
## The degrees of freedom for the model are 898  and the objective function was  6.51
##  0.3The number of observations was  304  with Chi Square =  1842  with prob <  2.2e-67
##  0.3
## Fit based upon off diagonal values = 1


##              PC1         PC2
## X0001.HK 0.8511 -0.0330565
## X0002.HK 0.4141  0.6862799
## X0003.HK 0.4563  0.4996117
## X0004.HK 0.7890 -0.1266268
## X0005.HK 0.8148  0.0035211
## X0006.HK 0.1975  0.7096512
## X0011.HK 0.7557 -0.0100219
## X0012.HK 0.7972  0.0170293
## X0013.HK 0.8091 -0.0579902
## X0016.HK 0.8502  0.0143212
## X0017.HK 0.7165 -0.0827265
## X0019.HK 0.6071 -0.0236997
## X0023.HK 0.7520  0.0108848
## X0066.HK 0.6813  0.2137128
## X0083.HK 0.7565 -0.0270297
## X0101.HK 0.7508  0.0149859
## X0144.HK 0.7507 -0.0004199
## X0151.HK 0.4478 -0.1653839
## X0267.HK 0.7860 -0.1298750
## X0291.HK 0.6244 -0.0287852
## X0293.HK 0.6395 -0.1691668
## X0322.HK 0.3326 -0.1903705
## X0330.HK 0.4503 -0.1472531
## X0386.HK 0.6782  0.3488751
## X0388.HK 0.8471 -0.0713945
## X0494.HK 0.4715  0.0241196
## X0688.HK 0.7586 -0.2688274
## X0700.HK 0.6694 -0.0863603
## X0762.HK 0.6165  0.2013414
## X0836.HK 0.3846 -0.0546321
## X0857.HK 0.7654  0.2474786
## X0883.HK 0.8182  0.0631883
## X0939.HK 0.8551 -0.0148876
## X0941.HK 0.6023  0.4323801
## X1044.HK 0.5036 -0.1742006
## X1088.HK 0.8143  0.0480222
## X1109.HK 0.7597 -0.3206420
## X1199.HK 0.7664 -0.0184048
## X1299.HK 0.6484 -0.0131368
## X1398.HK 0.8830 -0.0557564
## X1880.HK 0.6414 -0.1197870
## X1898.HK 0.7814 -0.0035550
```

```
## X2318.HK 0.8267 -0.1182223
## X2388.HK 0.7967 -0.0369045
## X2600.HK 0.7807 -0.0878391
## X2628.HK 0.7852  0.0234267
## X3328.HK 0.8594 -0.0476910
## X3988.HK 0.8579  0.0083390
```

Loadings Rotation : quatimax
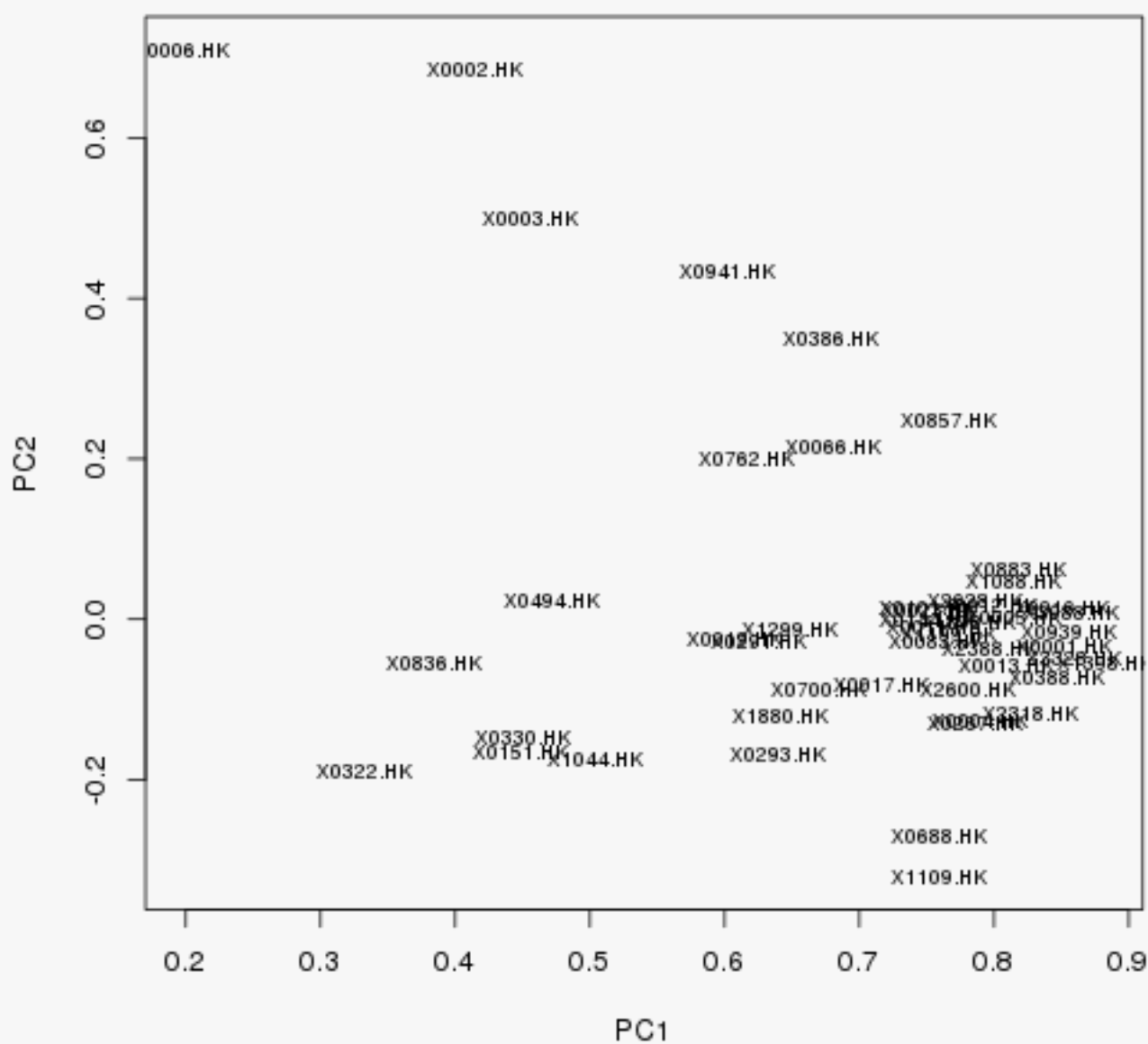
5.2.4   Rotation : simplimax

A compromise between Varimax and Quartimax criteria.

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

## Principal Components Analysis
## Call: principal(r = dxtaRetok, nfactors = 5, rotate = "simplimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##           item  PC1   PC2   PC4   PC3   PC5   h2   u2
## X1398.HK    40 0.88 -0.07  0.21  0.07 -0.06 0.81 0.19
## X3988.HK    48 0.86  0.01  0.18  0.06  0.01 0.75 0.25
## X3328.HK    47 0.86 -0.06  0.24  0.02  0.02 0.77 0.23
## X0939.HK    33 0.86 -0.01  0.19  0.12  0.00 0.76 0.24
## X0001.HK     1 0.85 -0.04 -0.09 -0.21 -0.09 0.80 0.20
## X0016.HK    10 0.85  0.00 -0.01 -0.18 -0.09 0.77 0.23
## X0388.HK    25 0.85 -0.07  0.01 -0.08 -0.05 0.73 0.27
## X2318.HK    43 0.83 -0.13  0.19  0.02 -0.06 0.72 0.28
## X0883.HK    32 0.82  0.05  0.26  0.10 -0.03 0.71 0.29
## X1088.HK    36 0.82  0.05  0.18  0.12  0.06 0.69 0.31
## X0005.HK     5 0.82 -0.01  0.19  0.01 -0.02 0.68 0.32
## X0013.HK     9 0.81 -0.06 -0.08 -0.16 -0.07 0.71 0.29
## X0012.HK     8 0.80  0.01 -0.04 -0.20 -0.02 0.69 0.31
## X2388.HK    44 0.80 -0.04  0.00 -0.01 -0.15 0.66 0.34
## X0004.HK     4 0.79 -0.14  0.00 -0.17 -0.07 0.67 0.33
## X0267.HK    19 0.79 -0.11 -0.01  0.06  0.10 0.66 0.34
## X2628.HK    46 0.79  0.02  0.21  0.06  0.00 0.64 0.36
## X1898.HK    42 0.78 -0.01  0.18  0.04 -0.01 0.62 0.38
## X2600.HK    45 0.78 -0.11  0.24  0.02 -0.04 0.65 0.35
## X0857.HK    31 0.77  0.25  0.29  0.10  0.14 0.70 0.30
## X1199.HK    38 0.76 -0.04  0.33 -0.01  0.05 0.66 0.34
## X0011.HK     7 0.76 -0.01 -0.20 -0.21 -0.16 0.70 0.30
## X0083.HK    15 0.76 -0.04  0.00 -0.26 -0.05 0.64 0.36
## X1109.HK    37 0.76 -0.33  0.16 -0.02  0.01 0.70 0.30
## X0688.HK    27 0.76 -0.29  0.20 -0.01 -0.09 0.68 0.32
## X0023.HK    13 0.76  0.00 -0.08 -0.05 -0.23 0.64 0.36
## X0101.HK    16 0.75  0.00  0.03 -0.24  0.00 0.62 0.38
## X0144.HK    17 0.75  0.00  0.19  0.05  0.11 0.59 0.41
## X0017.HK    11 0.72 -0.09 -0.01 -0.26  0.04 0.60 0.40
## X0066.HK    14 0.69  0.23 -0.14 -0.11  0.01 0.58 0.42
## X0386.HK    24 0.68  0.36  0.31  0.15  0.24 0.69 0.31
## X0700.HK    28 0.67 -0.10  0.15  0.17 -0.27 0.56 0.44
## X1299.HK    39 0.65 -0.01  0.00 -0.02  0.01 0.42 0.58
## X1880.HK    41 0.64 -0.12  0.13  0.13 -0.09 0.46 0.54
## X0293.HK    21 0.64 -0.17 -0.09 -0.11 -0.07 0.47 0.53
## X0291.HK    20 0.63 -0.03  0.02 -0.07  0.00 0.40 0.60
## X0762.HK    29 0.62  0.22  0.26  0.33  0.10 0.56 0.44
## X0019.HK    12 0.61  0.01 -0.28 -0.03  0.04 0.49 0.51
## X0941.HK    34 0.61  0.45  0.14  0.17  0.09 0.59 0.41
## X1044.HK    35 0.51 -0.14 -0.19  0.38 -0.20 0.51 0.49
## X0494.HK    26 0.47  0.01  0.17  0.03 -0.06 0.24 0.76
## X0330.HK    23 0.45 -0.12  0.10 -0.06  0.43 0.42 0.58
## X0006.HK     6 0.20  0.69  0.18 -0.02 -0.11 0.57 0.43
## X0002.HK     2 0.42  0.69 -0.03  0.02 -0.15 0.69 0.31
## X0003.HK     3 0.47  0.54 -0.23 -0.05  0.14 0.60 0.40
## X0322.HK    22 0.34 -0.11 -0.47  0.48  0.00 0.62 0.38
## X0151.HK    18 0.46 -0.08 -0.26  0.55  0.15 0.65 0.35
## X0836.HK    30 0.39  0.00 -0.11 -0.16  0.66 0.64 0.36
```

```
##
##                  PC1  PC2  PC4  PC3  PC5
## SS loadings    24.14 2.11 1.44 1.43 1.08
## Proportion Var  0.50 0.04 0.03 0.03 0.02
## Cumulative Var  0.50 0.55 0.58 0.61 0.63
##
##  With component correlations of
##        PC1   PC2   PC4   PC3   PC5
## PC1   1.00 -0.01 -0.08  0.00  0.01
## PC2  -0.01  1.00 -0.03 -0.07 -0.10
## PC4  -0.08 -0.03  1.00 -0.03 -0.06
## PC3   0.00 -0.07 -0.03  1.00 -0.01
## PC5   0.01 -0.10 -0.06 -0.01  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  41.43 0.3
## The degrees of freedom for the model are 898  and the objective function was  6.51
##  0.3The number of observations was  304  with Chi Square =  1842  with prob <  2.2e-67
##  0.3
## Fit based upon off diagonal values = 1


##              PC1        PC2
## X0001.HK 0.8547 -0.0404098
## X0002.HK 0.4224  0.6885641
## X0003.HK 0.4678  0.5373795
## X0004.HK 0.7902 -0.1390443
## X0005.HK 0.8155 -0.0076370
## X0006.HK 0.2012  0.6897371
## X0011.HK 0.7606 -0.0132508
## X0012.HK 0.8006  0.0113511
## X0013.HK 0.8124 -0.0620562
## X0016.HK 0.8530  0.0017011
## X0017.HK 0.7179 -0.0938147
## X0019.HK 0.6147  0.0092184
## X0023.HK 0.7555  0.0033740
## X0066.HK 0.6885  0.2281920
## X0083.HK 0.7580 -0.0449674
## X0101.HK 0.7525 -0.0002955
## X0144.HK 0.7521  0.0017033
## X0151.HK 0.4573 -0.0805934
## X0267.HK 0.7898 -0.1094409
## X0291.HK 0.6265 -0.0303551
## X0293.HK 0.6415 -0.1701969
## X0322.HK 0.3435 -0.1057231
## X0330.HK 0.4516 -0.1234749
## X0386.HK 0.6818  0.3604846
## X0388.HK 0.8497 -0.0744161
## X0494.HK 0.4711  0.0111975
## X0688.HK 0.7558 -0.2903302
## X0700.HK 0.6689 -0.1011077
## X0762.HK 0.6195  0.2185717
## X0836.HK 0.3907 -0.0018218
## X0857.HK 0.7680  0.2492038
## X0883.HK 0.8189  0.0534152
## X0939.HK 0.8567 -0.0142407
## X0941.HK 0.6085  0.4497175
```

```
## X1044.HK 0.5089 -0.1377497
## X1088.HK 0.8168  0.0547807
## X1109.HK 0.7575 -0.3319731
## X1199.HK 0.7645 -0.0388847
## X1299.HK 0.6514 -0.0076492
## X1398.HK 0.8832 -0.0669855
## X1880.HK 0.6415 -0.1231063
## X1898.HK 0.7823 -0.0108732
## X2318.HK 0.8262 -0.1325233
## X2388.HK 0.7993 -0.0422493
## X2600.HK 0.7794 -0.1056138
## X2628.HK 0.7860  0.0163906
## X3328.HK 0.8592 -0.0599906
## X3988.HK 0.8596  0.0054988
```

Loadings Rotation : simplimax
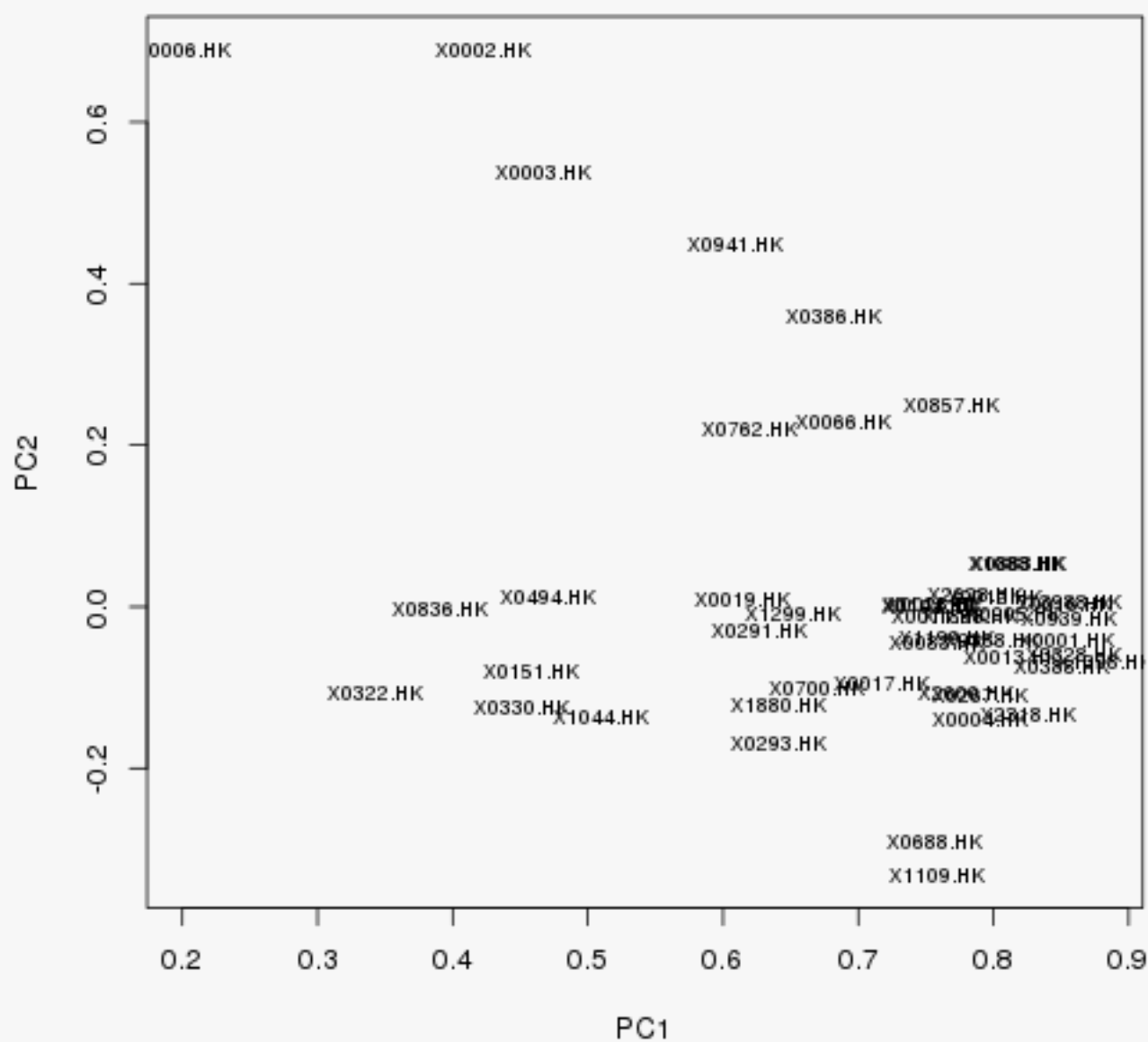
5.2.5 Rotation : oblimin

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   PC4   PC5   h2   u2
## X0688.HK    27  0.89 -0.22  0.00  0.09 -0.06 0.68 0.32
## X1109.HK    37  0.86 -0.28  0.03  0.08  0.05 0.70 0.30
## X2318.HK    43  0.84 -0.05  0.03  0.10 -0.03 0.72 0.28
## X1398.HK    40  0.84  0.03  0.06  0.15 -0.04 0.81 0.19
## X0004.HK     4  0.83 -0.04 -0.01 -0.14  0.05 0.67 0.33
## X0001.HK     1  0.82  0.08  0.01 -0.24  0.07 0.80 0.20
## X0016.HK    10  0.82  0.12 -0.02 -0.16  0.04 0.77 0.23
## X3328.HK    47  0.82  0.02  0.00  0.16  0.05 0.77 0.23
## X2600.HK    45  0.80 -0.03 -0.01  0.15 -0.02 0.65 0.35
## X0388.HK    25  0.79  0.03  0.07 -0.08  0.05 0.73 0.27
## X0083.HK    15  0.79  0.05 -0.11 -0.18  0.09 0.64 0.36
## X0013.HK     9  0.77  0.05  0.04 -0.20  0.06 0.71 0.29
## X1199.HK    38  0.76  0.02 -0.10  0.23  0.07 0.66 0.34
## X0005.HK     5  0.76  0.08  0.01  0.11  0.02 0.68 0.32
## X2388.HK    44  0.75  0.08  0.11 -0.09 -0.07 0.66 0.34
## X3988.HK    48  0.74  0.10  0.08  0.14  0.05 0.75 0.25
## X0101.HK    16  0.74  0.08 -0.11 -0.13  0.13 0.62 0.38
## X0012.HK     8  0.73  0.11 -0.02 -0.17  0.12 0.69 0.31
## X0017.HK    11  0.73 -0.02 -0.10 -0.16  0.18 0.60 0.40
## X0939.HK    33  0.73  0.08  0.13  0.17  0.02 0.76 0.24
## X0023.HK    13  0.72  0.14  0.11 -0.19 -0.13 0.64 0.36
## X0011.HK     7  0.72  0.12  0.06 -0.34  0.01 0.70 0.30
## X0883.HK    32  0.72  0.14  0.05  0.21 -0.03 0.71 0.29
## X0700.HK    28  0.71  0.01  0.15  0.10 -0.28 0.56 0.44
## X1898.HK    42  0.71  0.07  0.04  0.13  0.03 0.62 0.38
## X2628.HK    46  0.69  0.10  0.04  0.16  0.02 0.64 0.36
## X0293.HK    21  0.66 -0.09  0.08 -0.17  0.03 0.47 0.53
## X1088.HK    36  0.63  0.14  0.13  0.19  0.08 0.69 0.31
## X1880.HK    41  0.62 -0.05  0.14  0.11 -0.09 0.46 0.54
## X0267.HK    19  0.62 -0.03  0.22  0.02  0.16 0.66 0.34
## X0144.HK    17  0.61  0.06  0.05  0.17  0.14 0.59 0.41
## X0291.HK    20  0.57  0.04  0.03 -0.05  0.08 0.40 0.60
## X1299.HK    39  0.54  0.07  0.10 -0.03  0.08 0.42 0.58
## X0857.HK    31  0.50  0.32  0.02  0.29  0.14 0.70 0.30
## X0494.HK    26  0.46  0.07 -0.01  0.11 -0.05 0.24 0.76
## X0066.HK    14  0.43  0.34  0.10 -0.18  0.14 0.58 0.42
## X0019.HK    12  0.38  0.10  0.28 -0.24  0.16 0.49 0.51
## X0002.HK     2  0.05  0.82  0.03 -0.06 -0.10 0.69 0.31
## X0006.HK     6 -0.04  0.77 -0.18  0.10 -0.11 0.57 0.43
## X0003.HK     3 -0.03  0.63  0.17 -0.17  0.26 0.60 0.40
## X0941.HK    34  0.21  0.53  0.13  0.21  0.10 0.59 0.41
## X0386.HK    24  0.31  0.41  0.03  0.37  0.23 0.69 0.31
## X0322.HK    22 -0.07 -0.02  0.82 -0.12  0.01 0.62 0.38
## X0151.HK    18 -0.02 -0.02  0.78  0.12  0.12 0.65 0.35
## X1044.HK    35  0.33 -0.03  0.54 -0.03 -0.21 0.51 0.49
## X0762.HK    29  0.31  0.28  0.21  0.38  0.04 0.56 0.44
## X0836.HK    30  0.03 -0.06  0.08  0.01  0.78 0.64 0.36
## X0330.HK    23  0.28 -0.16  0.02  0.16  0.49 0.42 0.58
```

```
##
##                      PC1  PC2  PC3  PC4  PC5
## SS loadings     20.88 3.33 2.63 1.50 1.86
## Proportion Var   0.43 0.07 0.05 0.03 0.04
## Cumulative Var   0.43 0.50 0.56 0.59 0.63
##
##   With component correlations of
##       PC1  PC2  PC3   PC4   PC5
## PC1 1.00 0.39 0.45  0.12  0.38
## PC2 0.39 1.00 0.15  0.03  0.18
## PC3 0.45 0.15 1.00  0.06  0.15
## PC4 0.12 0.03 0.06  1.00 -0.02
## PC5 0.38 0.18 0.15 -0.02  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  41.43 0.3
## The degrees of freedom for the model are 898  and the objective function was  6.51
##  0.3The number of observations was  304  with Chi Square =  1842  with prob <  2.2e-67
##  0.3
## Fit based upon off diagonal values = 1


##                 PC1        PC2
## X0001.HK   0.82188   0.080674
## X0002.HK   0.05398   0.818896
## X0003.HK  -0.02665   0.630306
## X0004.HK   0.82602  -0.044024
## X0005.HK   0.75545   0.079376
## X0006.HK  -0.04376   0.766895
## X0011.HK   0.72102   0.119116
## X0012.HK   0.73148   0.113354
## X0013.HK   0.77403   0.049350
## X0016.HK   0.82083   0.119459
## X0017.HK   0.73055  -0.023622
## X0019.HK   0.38008   0.102799
## X0023.HK   0.72198   0.140851
## X0066.HK   0.43290   0.337715
## X0083.HK   0.78512   0.048002
## X0101.HK   0.73872   0.084765
## X0144.HK   0.61466   0.060371
## X0151.HK  -0.01656  -0.023711
## X0267.HK   0.62055  -0.034559
## X0291.HK   0.56735   0.041671
## X0293.HK   0.65792  -0.086364
## X0322.HK  -0.07065  -0.023011
## X0330.HK   0.28298  -0.158051
## X0386.HK   0.31486   0.405987
## X0388.HK   0.79449   0.031148
## X0494.HK   0.46069   0.065675
## X0688.HK   0.89209  -0.221568
## X0700.HK   0.70789   0.008263
## X0762.HK   0.30654   0.277418
## X0836.HK   0.02639  -0.055711
## X0857.HK   0.50488   0.316672
## X0883.HK   0.71517   0.143176
## X0939.HK   0.72754   0.076464
## X0941.HK   0.20661   0.532509
```

```
## X1044.HK  0.33477 -0.030323
## X1088.HK  0.62501  0.135876
## X1109.HK  0.85557 -0.278518
## X1199.HK  0.75715  0.015719
## X1299.HK  0.54053  0.069848
## X1398.HK  0.84109  0.029946
## X1880.HK  0.62334 -0.047170
## X1898.HK  0.70668  0.070829
## X2318.HK  0.84169 -0.045951
## X2388.HK  0.75492  0.078087
## X2600.HK  0.80059 -0.030494
## X2628.HK  0.69296  0.098245
## X3328.HK  0.81552  0.018089
## X3988.HK  0.74117  0.095970
```

Loadings Rotation : oblimin
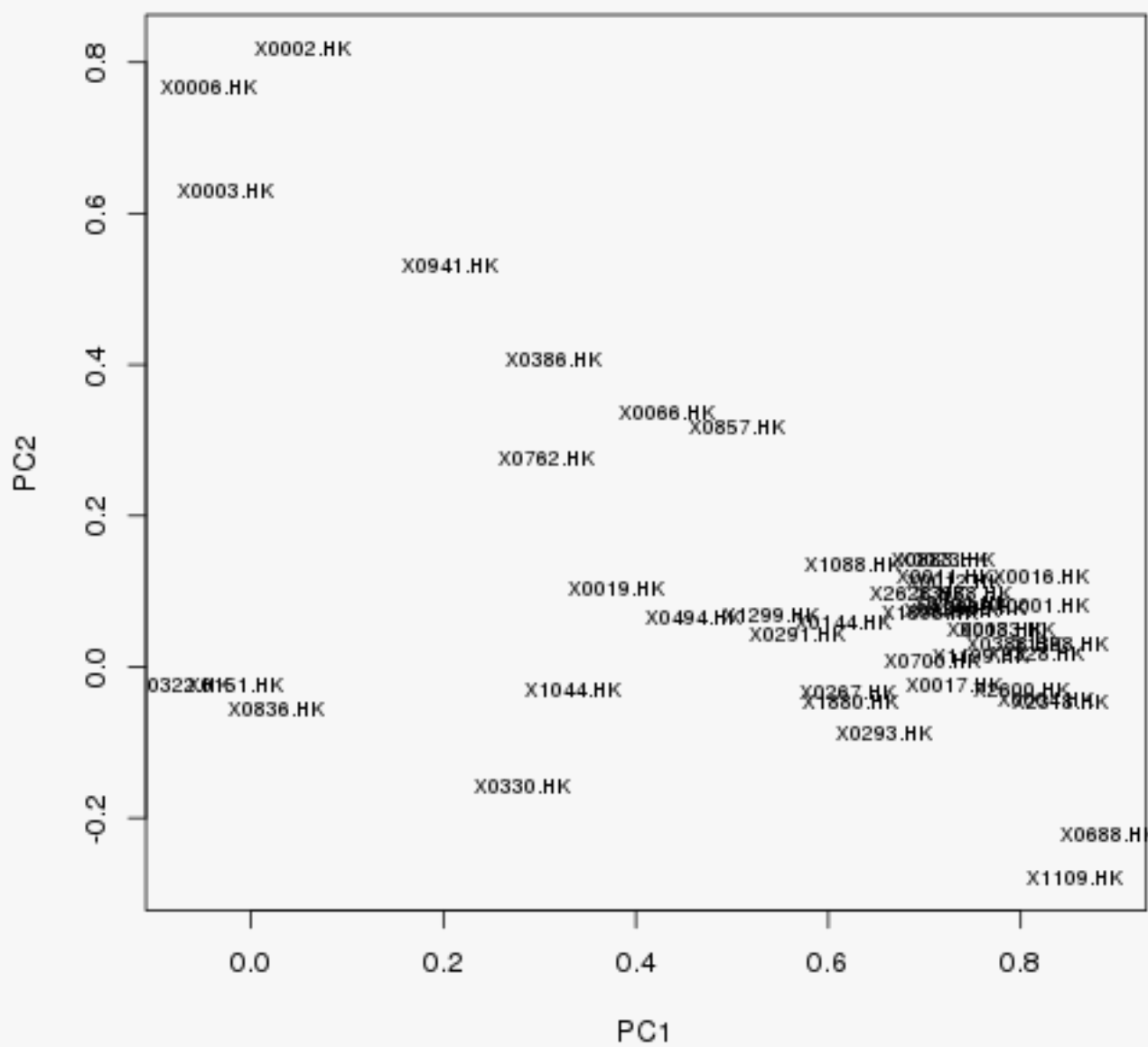
5.2.6 Rotation : promax

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
## X1199.HK    38  0.77  0.13 -0.03 -0.16  0.04 0.66 0.34
## X0762.HK    29  0.74 -0.32  0.23  0.17  0.02 0.56 0.44
## X0883.HK    32  0.74  0.12  0.10 -0.01 -0.06 0.71 0.29
## X1398.HK    40  0.72  0.25 -0.01  0.01 -0.06 0.81 0.19
## X3328.HK    47  0.72  0.24 -0.03 -0.05  0.03 0.77 0.23
## X0857.HK    31  0.70 -0.04  0.26 -0.04  0.10 0.70 0.30
## X2600.HK    45  0.70  0.23 -0.07 -0.06 -0.04 0.65 0.35
## X0386.HK    24  0.69 -0.23  0.35 -0.03  0.20 0.69 0.31
## X0939.HK    33  0.69  0.16  0.03  0.08 -0.01 0.76 0.24
## X0688.HK    27  0.67  0.33 -0.26 -0.04 -0.07 0.68 0.32
## X2318.HK    43  0.65  0.31 -0.09 -0.02 -0.05 0.72 0.28
## X2628.HK    46  0.64  0.18  0.05 -0.01 -0.01 0.64 0.36
## X3988.HK    48  0.64  0.23  0.05  0.03  0.02 0.75 0.25
## X1088.HK    36  0.64  0.11  0.09  0.08  0.06 0.69 0.31
## X1109.HK    37  0.62  0.32 -0.32  0.00  0.05 0.70 0.30
## X0700.HK    28  0.61  0.19 -0.01  0.12 -0.31 0.56 0.44
## X0005.HK     5  0.61  0.28  0.04 -0.04 -0.01 0.68 0.32
## X1898.HK    42  0.60  0.23  0.03 -0.01  0.00 0.62 0.38
## X0144.HK    17  0.60  0.13  0.01  0.01  0.12 0.59 0.41
## X1880.HK    41  0.55  0.16 -0.08  0.11 -0.10 0.46 0.54
## X0494.HK    26  0.44  0.10  0.04 -0.05 -0.07 0.24 0.76
## X0267.HK    19  0.39  0.30 -0.08  0.19  0.15 0.66 0.34
## X0011.HK     7 -0.07  0.84  0.11  0.03 -0.04 0.70 0.30
## X0001.HK     1  0.12  0.78  0.06 -0.03  0.02 0.80 0.20
## X0013.HK     9  0.15  0.70  0.03  0.01  0.03 0.71 0.29
## X0083.HK    15  0.19  0.69  0.03 -0.15  0.05 0.64 0.36
## X0016.HK    10  0.24  0.69  0.10 -0.07 -0.01 0.77 0.23
## X0012.HK     8  0.17  0.65  0.09 -0.06  0.08 0.69 0.31
## X0017.HK    11  0.17  0.64 -0.05 -0.14  0.15 0.60 0.40
## X0004.HK     4  0.28  0.63 -0.07 -0.05  0.02 0.67 0.33
## X0023.HK    13  0.17  0.62  0.13  0.08 -0.18 0.64 0.36
## X0101.HK    16  0.22  0.62  0.06 -0.16  0.09 0.62 0.38
## X0293.HK    21  0.13  0.57 -0.10  0.06  0.01 0.47 0.53
## X0388.HK    25  0.34  0.55  0.00  0.03  0.02 0.73 0.27
## X0066.HK    14 -0.03  0.53  0.32  0.07  0.09 0.58 0.42
## X0019.HK    12 -0.14  0.52  0.08  0.27  0.14 0.49 0.51
## X2388.HK    44  0.34  0.51  0.06  0.08 -0.11 0.66 0.34
## X0291.HK    20  0.25  0.38  0.02  0.00  0.05 0.40 0.60
## X1299.HK    39  0.27  0.34  0.04  0.07  0.06 0.42 0.58
## X0002.HK     2 -0.05  0.21  0.82 -0.01 -0.18 0.69 0.31
## X0006.HK     6  0.13 -0.05  0.77 -0.24 -0.19 0.57 0.43
## X0003.HK     3 -0.30  0.31  0.62  0.14  0.20 0.60 0.40
## X0941.HK    34  0.42 -0.09  0.49  0.08  0.05 0.59 0.41
## X0322.HK    22 -0.19  0.01 -0.04  0.87  0.02 0.62 0.38
## X0151.HK    18  0.17 -0.25 -0.07  0.81  0.14 0.65 0.35
## X1044.HK    35  0.21  0.11 -0.04  0.56 -0.21 0.51 0.49
## X0836.HK    30 -0.09  0.11 -0.12  0.06  0.80 0.64 0.36
## X0330.HK    23  0.32  0.00 -0.22  0.00  0.51 0.42 0.58
##
```

```
##                    PC1    PC4  PC2  PC3  PC5
## SS loadings     13.27 10.57 2.78 2.09 1.48
## Proportion Var   0.28  0.22 0.06 0.04 0.03
## Cumulative Var   0.28  0.50 0.55 0.60 0.63
##
##  With component correlations of
##       PC1  PC4  PC2  PC3  PC5
## PC1 1.00 0.74 0.39 0.51 0.42
## PC4 0.74 1.00 0.32 0.52 0.40
## PC2 0.39 0.32 1.00 0.22 0.31
## PC3 0.51 0.52 0.22 1.00 0.21
## PC5 0.42 0.40 0.31 0.21 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  41.43 0.3
## The degrees of freedom for the model are 898  and the objective function was  6.51
##  0.3The number of observations was  304  with Chi Square =  1842  with prob <  2.2e-67
##  0.3
## Fit based upon off diagonal values = 1


##               PC1        PC4
## X0001.HK   0.12473   0.781378
## X0002.HK  -0.05053   0.205533
## X0003.HK  -0.30119   0.314289
## X0004.HK   0.28036   0.631828
## X0005.HK   0.60809   0.275036
## X0006.HK   0.13200  -0.049393
## X0011.HK  -0.06777   0.844669
## X0012.HK   0.16689   0.654938
## X0013.HK   0.15441   0.696316
## X0016.HK   0.23819   0.686459
## X0017.HK   0.16876   0.643564
## X0019.HK  -0.14050   0.524472
## X0023.HK   0.17349   0.624364
## X0066.HK  -0.03067   0.529998
## X0083.HK   0.18774   0.693455
## X0101.HK   0.22490   0.616504
## X0144.HK   0.59908   0.128233
## X0151.HK   0.17074  -0.247644
## X0267.HK   0.38539   0.298128
## X0291.HK   0.25466   0.384611
## X0293.HK   0.13320   0.568505
## X0322.HK  -0.18894   0.010811
## X0330.HK   0.32344   0.001789
## X0386.HK   0.69105  -0.226836
## X0388.HK   0.34115   0.545019
## X0494.HK   0.44409   0.104640
## X0688.HK   0.66968   0.326544
## X0700.HK   0.60891   0.193561
## X0762.HK   0.74157  -0.319876
## X0836.HK  -0.08832   0.110955
## X0857.HK   0.69976  -0.043345
## X0883.HK   0.73673   0.120050
## X0939.HK   0.68728   0.161920
## X0941.HK   0.41575  -0.091813
## X1044.HK   0.21078   0.108291
```

```
## X1088.HK  0.63616  0.106933
## X1109.HK  0.62269  0.321105
## X1199.HK  0.77056  0.134202
## X1299.HK  0.26754  0.341819
## X1398.HK  0.72136  0.252268
## X1880.HK  0.54875  0.155121
## X1898.HK  0.59983  0.226323
## X2318.HK  0.65047  0.310197
## X2388.HK  0.33671  0.505980
## X2600.HK  0.69742  0.230142
## X2628.HK  0.63689  0.181514
## X3328.HK  0.71671  0.235692
## X3988.HK  0.63648  0.230455
```


Loadings Rotation : promax
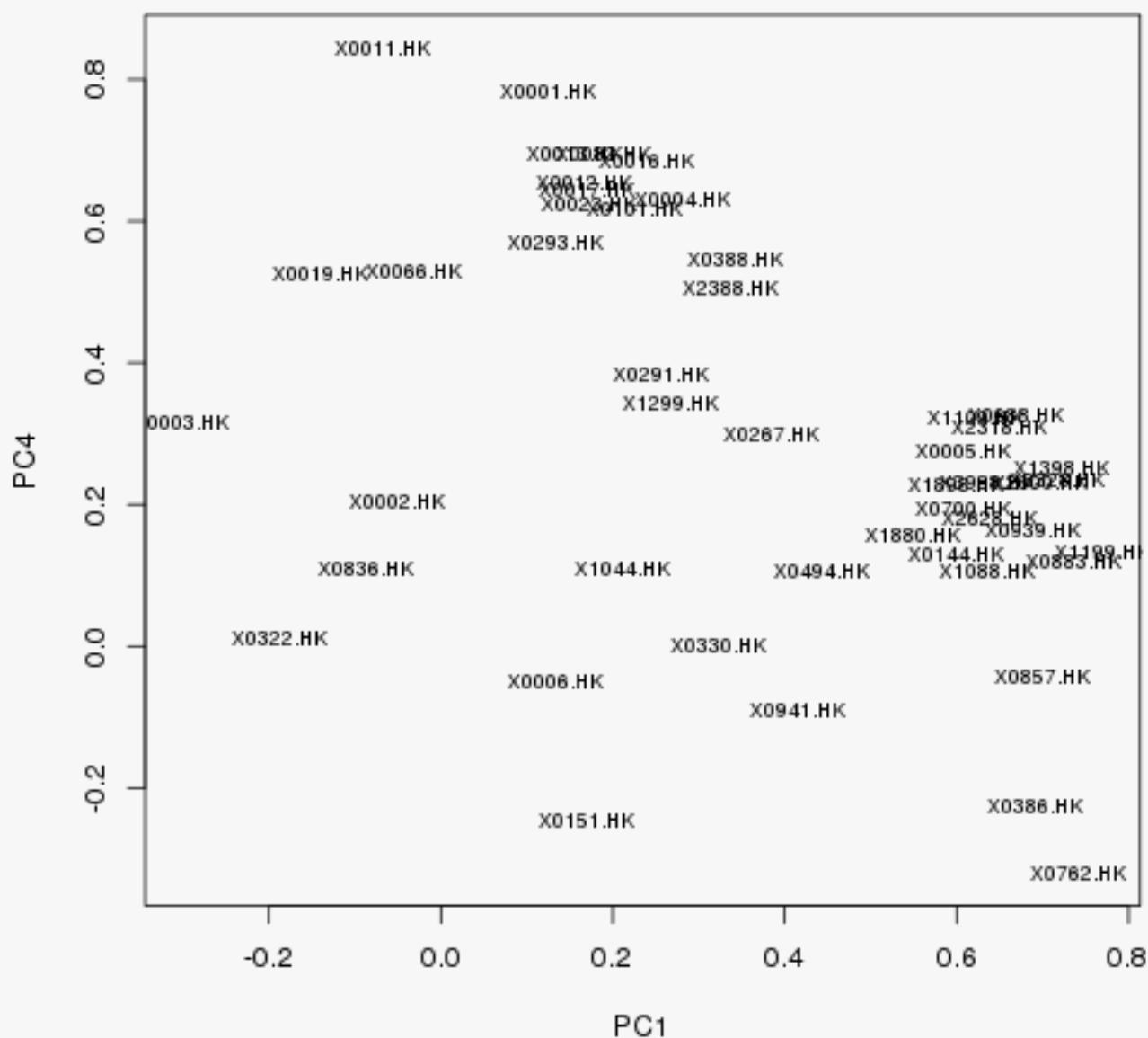
PCA is a science in itself and can not be fully covered and even less interpreted in this paper. The factors produced by principal component analysis are conceptualized as being linear combinations of the variables whereas the factors produced by common factor analysis are conceptualized as being latent 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
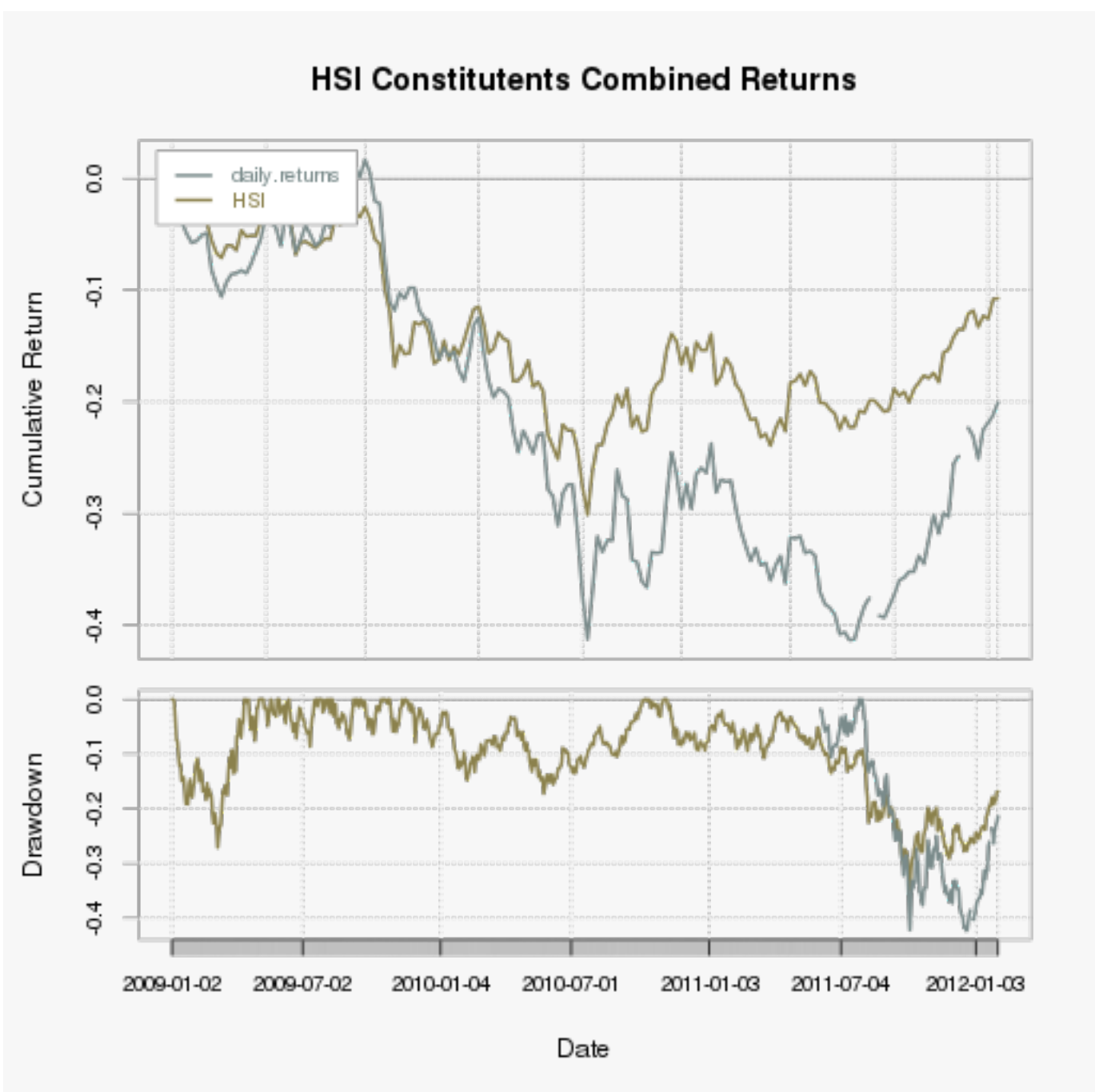
6.2 Performance SnailTrail Chart
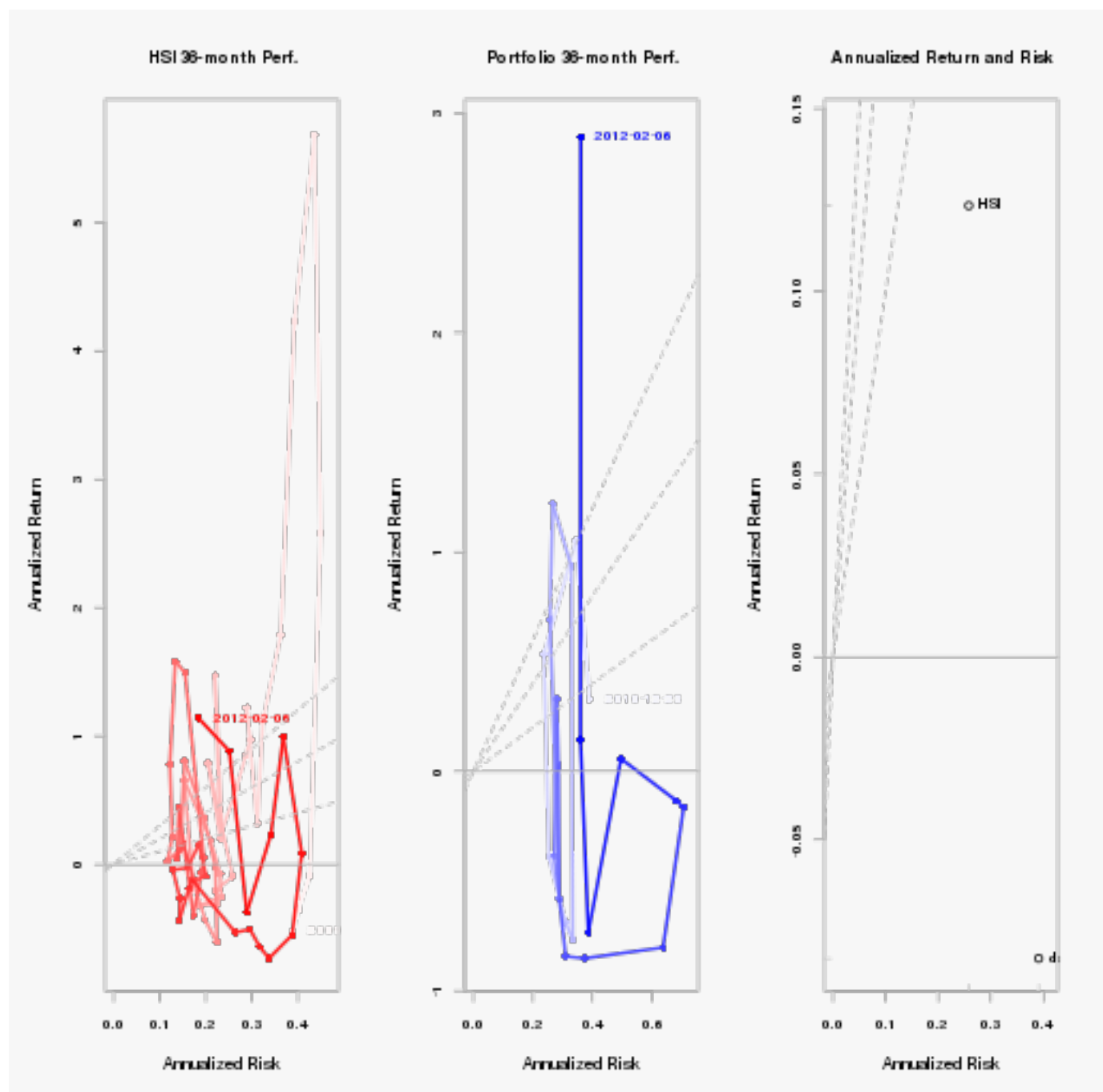
6.3 HSI Components Frontier

Efficient Frontier by Size since 2009–01–01
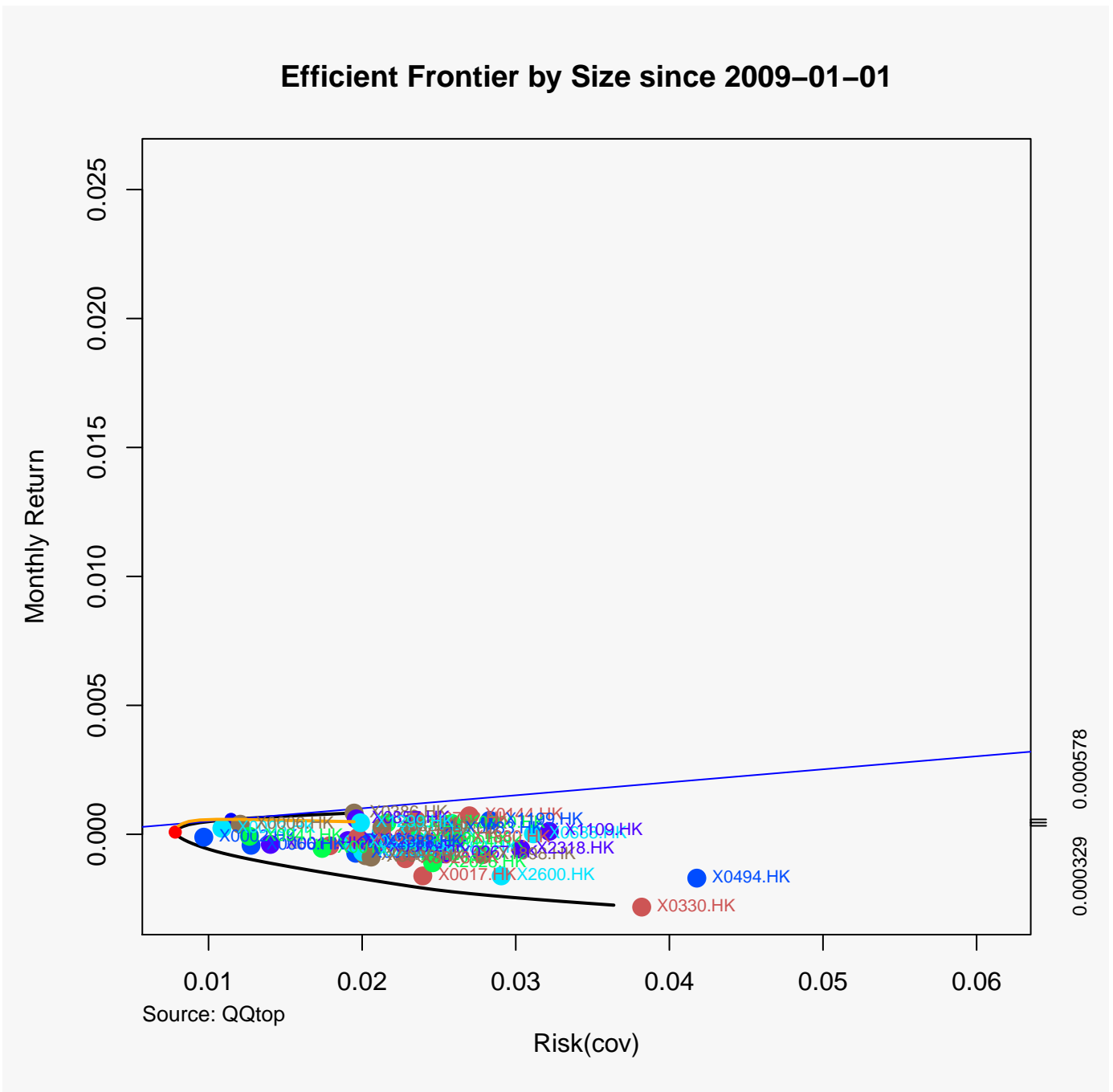
```
##
## Title:
##  MV Portfolio Frontier
##  Estimator:        covEstimator
##  Solver:           solveRquadprog
##  Optimize:         minRisk
##  Constraints:      LongOnly
##  Portfolio Points: 5 of 49
##
## Portfolio Weights:
##    X0001.HK X0002.HK X0003.HK X0004.HK X0005.HK X0006.HK X0011.HK X0012.HK
```

```
## 1      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 13     0.0000    0.0626    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 25     0.0000    0.4554    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 37     0.0000    0.3645    0.1483    0.0000    0.0000    0.1371    0.0483    0.0000
## 49     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
##      X0013.HK X0016.HK X0017.HK X0019.HK X0023.HK X0066.HK X0083.HK X0101.HK
## 1      0.0000    0.0000    0.0321    0.0000    0.0000    0.0000    0.0000    0.0000
## 13     0.0000    0.0000    0.3883    0.0878    0.0000    0.0000    0.0000    0.0000
## 25     0.0000    0.0000    0.1931    0.0805    0.0000    0.0805    0.0000    0.0000
## 37     0.0000    0.0000    0.0000    0.0016    0.0000    0.0907    0.0000    0.0000
## 49     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
##      X0144.HK X0151.HK X0267.HK X0291.HK X0293.HK X0322.HK X0330.HK X0386.HK
## 1      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.9362    0.0000
## 13     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.3290    0.0000
## 25     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.1556    0.0000
## 37     0.0000    0.0000    0.0000    0.0000    0.0308    0.0356    0.0194    0.0000
## 49     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    1.0000
##      X0388.HK X0494.HK X0688.HK X0700.HK X0762.HK X0836.HK X0857.HK X0883.HK
## 1      0.0000    0.0317    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 13     0.0000    0.0731    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 25     0.0000    0.0330    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 37     0.0000    0.0000    0.0000    0.0000    0.0000    0.0399    0.0000    0.0000
## 49     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
##      X0939.HK X0941.HK X1044.HK X1088.HK X1109.HK X1199.HK X1299.HK X1398.HK
## 1      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
## 25     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 37     0.0000    0.0371    0.0468    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
##      X1880.HK X1898.HK X2318.HK X2388.HK X2600.HK X2628.HK X3328.HK X3988.HK
## 1      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    0.0593    0.0000    0.0000    0.0000
## 25     0.0000    0.0000    0.0000    0.0000    0.0019    0.0000    0.0000    0.0000
## 37     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
##
## Covariance Risk Budgets:
##      X0001.HK X0002.HK X0003.HK X0004.HK X0005.HK X0006.HK X0011.HK X0012.HK
## 1      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 13     0.0000    0.0078    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 25     0.0000    0.2032    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 37     0.0000    0.3685    0.1365    0.0000    0.0000    0.1206    0.0524    0.0000
## 49     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
##      X0013.HK X0016.HK X0017.HK X0019.HK X0023.HK X0066.HK X0083.HK X0101.HK
## 1      0.0000    0.0000    0.0082    0.0000    0.0000    0.0000    0.0000    0.0000
## 13     0.0000    0.0000    0.3413    0.0426    0.0000    0.0000    0.0000    0.0000
## 25     0.0000    0.0000    0.2752    0.0736    0.0000    0.0524    0.0000    0.0000
## 37     0.0000    0.0000    0.0000    0.0020    0.0000    0.0992    0.0000    0.0000
## 49     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
##      X0144.HK X0151.HK X0267.HK X0291.HK X0293.HK X0322.HK X0330.HK X0386.HK
## 1      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.9819    0.0000
## 13     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.4889    0.0000
## 25     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.3442    0.0000
## 37     0.0000    0.0000    0.0000    0.0000    0.0357    0.0308    0.0334    0.0000
## 49     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    1.0000
##      X0388.HK X0494.HK X0688.HK X0700.HK X0762.HK X0836.HK X0857.HK X0883.HK
## 1      0.0000    0.0099    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
```

```
## 13    0.0000    0.0674    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 25    0.0000    0.0489    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 37    0.0000    0.0000    0.0000    0.0000    0.0000    0.0364    0.0000    0.0000
## 49    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
##     X0939.HK X0941.HK X1044.HK X1088.HK X1109.HK X1199.HK X1299.HK X1398.HK
## 1     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
## 25    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
## 37    0.0000    0.0372    0.0474    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
##     X1880.HK X1898.HK X2318.HK X2388.HK X2600.HK X2628.HK X3328.HK X3988.HK
## 1     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    0.0520    0.0000    0.0000    0.0000
## 25    0.0000    0.0000    0.0000    0.0000    0.0027    0.0000    0.0000    0.0000
## 37    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
##
## Target Return and Risks:
##       mean       mu     Cov   Sigma    CVaR     VaR
## 1   -0.0027  -0.0027  0.0364  0.0364  0.0972  0.0513
## 13  -0.0019  -0.0019  0.0214  0.0214  0.0561  0.0374
## 25  -0.0010  -0.0010  0.0127  0.0127  0.0325  0.0262
## 37  -0.0001  -0.0001  0.0080  0.0080  0.0186  0.0133
## 49   0.0008   0.0008  0.0195  0.0195  0.0415  0.0302
##
## Description:
##  Tue Feb  7 21:31:12 2012 by user:
```

7 HSI Components Ratios

7.1 Sharpe Ratio - Combined

```
##                                         daily.returns
## Annualized StdDev Sharpe (Rf=0%, p=95%):       -0.2108
## Annualized VaR Sharpe (Rf=0%, p=95%):          -2.2162
## Annualized ES Sharpe (Rf=0%, p=95%):           -1.7320
```

7.2 Sharpe - Distinct

```
##                                            X0001.HK X0002.HK X0003.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.3242   0.4589   0.6198
## Annualized VaR Sharpe (Rf=0%, p=95%):        3.4547   4.6211   5.9279
## Annualized ES Sharpe (Rf=0%, p=95%):         2.6878   3.2539   2.5499
##                                            X0004.HK X0005.HK X0006.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.6648  -0.1045   0.5235
## Annualized VaR Sharpe (Rf=0%, p=95%):        7.2661  -1.0894   5.3716
## Annualized ES Sharpe (Rf=0%, p=95%):         5.7000  -0.5260   3.8338
##                                            X0011.HK X0012.HK X0013.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):    -0.0554   0.3495   0.6996
## Annualized VaR Sharpe (Rf=0%, p=95%):       -0.6368   3.8657   7.6742
## Annualized ES Sharpe (Rf=0%, p=95%):        -0.6053   3.0773   5.9283
##                                            X0016.HK X0017.HK X0019.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.5183   0.0555   0.4374
## Annualized VaR Sharpe (Rf=0%, p=95%):        5.5345   0.5840   4.3459
## Annualized ES Sharpe (Rf=0%, p=95%):         4.3186   0.4078   2.5837
##                                            X0023.HK X0066.HK X0083.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.6115   0.5622   0.3472
## Annualized VaR Sharpe (Rf=0%, p=95%):        7.5630   6.5773   3.6686
## Annualized ES Sharpe (Rf=0%, p=95%):         7.3641   5.6034   2.6772
##                                            X0101.HK X0144.HK X0151.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.3496   0.4973   0.8513
## Annualized VaR Sharpe (Rf=0%, p=95%):        3.8240   5.3468   9.0951
## Annualized ES Sharpe (Rf=0%, p=95%):         3.0329   4.2405   6.8985
##                                            X0267.HK X0291.HK X0293.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.3164   0.6794   0.5781
## Annualized VaR Sharpe (Rf=0%, p=95%):        3.6698   7.3549   6.0514
## Annualized ES Sharpe (Rf=0%, p=95%):         3.1226   5.8822   4.5134
##                                            X0322.HK X0330.HK X0386.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):       1.00  -0.6322   0.6944
## Annualized VaR Sharpe (Rf=0%, p=95%):         13.65  -5.8345   7.1500
## Annualized ES Sharpe (Rf=0%, p=95%):          13.65  -3.1121   5.3676
##                                            X0388.HK X0494.HK X0688.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.5923   0.1339   0.2014
## Annualized VaR Sharpe (Rf=0%, p=95%):        6.7118   1.7719   2.3380
## Annualized ES Sharpe (Rf=0%, p=95%):         5.4635   1.7719   2.0135
##                                            X0700.HK X0762.HK X0836.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):       1.31   0.3313  -0.0076
## Annualized VaR Sharpe (Rf=0%, p=95%):         13.85   3.6646  -0.0782
## Annualized ES Sharpe (Rf=0%, p=95%):          10.27   2.9149  -0.0621
##                                            X0857.HK X0883.HK X0939.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.4966   0.7262   0.3629
## Annualized VaR Sharpe (Rf=0%, p=95%):        4.9972   7.6126   3.5992
## Annualized ES Sharpe (Rf=0%, p=95%):         3.7819   5.7046   2.4932
##                                            X0941.HK X1044.HK X1088.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):    -0.0585    1.111   0.6688
## Annualized VaR Sharpe (Rf=0%, p=95%):       -0.6163   12.278   6.7710
## Annualized ES Sharpe (Rf=0%, p=95%):        -0.4747    9.546   5.1907
##                                            X1109.HK X1199.HK X1299.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.2162   0.2827   0.2962
## Annualized VaR Sharpe (Rf=0%, p=95%):        2.5408   3.1138   3.0530
## Annualized ES Sharpe (Rf=0%, p=95%):         2.1953   2.4945   1.9227
##                                            X1398.HK X1880.HK X1898.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.2302    1.194   0.3247
## Annualized VaR Sharpe (Rf=0%, p=95%):        2.5890   13.580   3.1783
```

```
## Annualized ES Sharpe (Rf=0%, p=95%):        2.1079    10.720    2.1526
##                                             X2318.HK X2388.HK X2600.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.3859    0.9097   -0.0939
## Annualized VaR Sharpe (Rf=0%, p=95%):        4.0904   10.4246   -0.9980
## Annualized ES Sharpe (Rf=0%, p=95%):         2.9303    8.4380   -0.7904
##                                             X2628.HK X3328.HK X3988.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):    -0.0550    0.0800    0.4664
## Annualized VaR Sharpe (Rf=0%, p=95%):       -0.5481    0.8097    4.9031
## Annualized ES Sharpe (Rf=0%, p=95%):        -0.3836    0.5972    3.5467
```

7.3   Information Ratio - Combined

```
## [1] "Information Ratio :  0.0912"
```

7.4   Information Ratio - Distinct

```
##                      X0001.HK X0002.HK X0003.HK X0004.HK X0005.HK
## Information Ratio: HSI  -0.1103  -0.2454   0.0699   0.5028  -0.6387
##                      X0006.HK X0011.HK X0012.HK X0013.HK X0016.HK
## Information Ratio: HSI  -0.1122  -0.6772  -0.0055   0.4795   0.2222
##                      X0017.HK X0019.HK X0023.HK X0066.HK X0083.HK
## Information Ratio: HSI  -0.3462   0.0703   0.3574   0.0116    0.071
##                      X0101.HK X0144.HK X0151.HK X0267.HK X0291.HK
## Information Ratio: HSI   0.0667   0.3236   0.4868   0.0422    0.433
##                      X0293.HK X0322.HK X0330.HK X0386.HK X0388.HK
## Information Ratio: HSI   0.2646   0.5802  -0.9815   0.4757   0.4374
##                      X0494.HK X0688.HK X0700.HK X0762.HK X0836.HK
## Information Ratio: HSI  -0.0841  -0.1069    1.256  -0.0136  -0.3863
##                      X0857.HK X0883.HK X0939.HK X0941.HK X1044.HK
## Information Ratio: HSI   0.2323   0.7028  -0.0313  -0.7272   0.7455
##                      X1088.HK X1109.HK X1199.HK X1299.HK X1398.HK
## Information Ratio: HSI    0.573  -0.0412   0.0393   0.7381  -0.2182
##                      X1880.HK X1898.HK X2318.HK X2388.HK X2600.HK
## Information Ratio: HSI    1.036   0.0968   0.1546   0.7223   -0.504
##                      X2628.HK X3328.HK X3988.HK
## Information Ratio: HSI  -0.6724   -0.491   0.1571
```

8 HSI Components Table Latest Quotes

```
## [1] "Date :  2012-02-07 02:59:00"

##                   Name     Bid    Ask Change   52-week Range
## 0001.HK     CHEUNG KONG 104.80 105.00   0.60   79.10 - 131.80
## 0002.HK     CLP HOLDINGS  63.50  63.60   0.60   59.85 -  75.20
## 0003.HK  HK & CHINA GAS  18.34  18.36   0.14   16.70 -  19.68
## 0004.HK   WHARF HOLDINGS  44.65  44.90  -1.15   33.15 -  59.00
## 0005.HK    HSBC HOLDINGS  68.40  68.45   0.50   56.35 -  91.90
## 0006.HK     POWER ASSETS  55.80  56.00  -0.15   48.10 -  64.80
## 0011.HK  HANG SENG BANK 101.20 101.30   0.60   84.40 - 133.90
## 0012.HK   HENDERSON LAND  42.80  43.15  -0.40   33.20 -  61.50
## 0013.HK        HUTCHISON  76.50  76.60   0.15   53.60 -  95.00
## 0016.HK          SHK PPT 106.10 106.40  -2.10   85.45 - 129.90
## 0017.HK    NEW WORLD DEV   8.74   8.78   0.00    7.00 -  14.84
## 0019.HK SWIRE PACIFIC A  84.25  84.45   0.25   79.30 - 122.50
## 0023.HK   BANK OF E ASIA  30.90  30.95   0.35   21.85 -  35.10
## 0066.HK MTR CORPORATION  26.15  26.25   0.20   22.45 -  31.55
## 0083.HK        SINO LAND  12.44  12.48  -0.18    9.33 -  14.92
## 0101.HK    HANG LUNG PPT  27.80  27.95   0.15   20.85 -  40.50
## 0144.HK   CHINA MER HOLD  27.85  27.95  -0.95   19.00 -  37.60
## 0151.HK WANT WANT CHINA   7.28   7.30   0.13    5.68 -   8.30
## 0267.HK    CITIC PACIFIC  15.08  15.12  -0.12   10.26 -  24.60
## 0291.HK CHINA RESOURCES  27.60  27.65  -0.35   24.10 -  35.50
## 0293.HK   CATHAY PAC AIR  15.80  15.82   0.08   11.80 -  20.85
## 0322.HK           TINGYI  22.15  22.25   0.35   17.32 -  26.00
## 0330.HK  ESPRIT HOLDINGS  13.64  13.68   0.62    7.55 -  45.65
## 0386.HK     SINOPEC CORP   9.27   9.28  -0.06    6.22 -   8.90
## 0388.HK             HKEX 135.80 135.90  -1.90   99.15 - 198.60
## 0494.HK        LI & FUNG  17.40  17.48  -0.08   10.82 -  48.50
## 0688.HK   CHINA OVERSEAS  14.46  14.50  -0.14    9.99 -  17.86
## 0700.HK          TENCENT 183.70 184.20  -2.20  139.90 - 230.80
## 0762.HK    CHINA UNICOM   14.04  14.06   0.44   10.24 -  17.68
## 0836.HK CHINA RES POWER  15.30  15.32   0.32   10.82 -  16.44
## 0857.HK       PETROCHINA  11.56  11.60   0.10    8.59 -  12.50
## 0883.HK            CNOOC  16.74  16.76   0.20   11.20 -  21.30
## 0939.HK              CCB   6.32   6.33  -0.06    4.41 -   8.47
## 0941.HK     CHINA MOBILE  77.90  78.00   0.30   68.05 -  83.80
## 1044.HK      HENGAN INT'L  68.05  68.25  -0.25   54.10 -  75.40
## 1088.HK    CHINA SHENHUA  35.75  35.80   0.35   27.10 -  40.20
## 1109.HK   CHINA RES LAND  13.48  13.52  -0.02    7.28 -  17.24
## 1199.HK    COSCO PACIFIC  11.80  11.82  -0.22    7.52 -  17.16
## 1299.HK              AIA  25.75  25.80  -0.05   19.84 -  29.90
## 1398.HK             ICBC   5.44   5.46  -0.01    3.46 -   6.90
## 1880.HK      BELLE INT'L  13.16  13.22   0.10   11.56 -  17.54
## 1898.HK       CHINA COAL   9.96   9.98  -0.20    6.59 -  15.08
## 2318.HK          PING AN  62.70  62.75  -1.05   37.35 -  96.25
## 2388.HK   BOC HONG KONG  20.90  20.95   0.20   14.24 -  29.40
## 2600.HK           CHALCO   3.88   3.89  -0.03    3.20 -   7.88
## 2628.HK       CHINA LIFE  22.75  22.80  -0.50   17.04 -  36.90
## 3328.HK          BANKCOMM   6.43   6.45  -0.01    4.15 -   9.53
## 3988.HK    BANK OF CHINA   3.34   3.36  -0.04    2.20 -   5.02
```
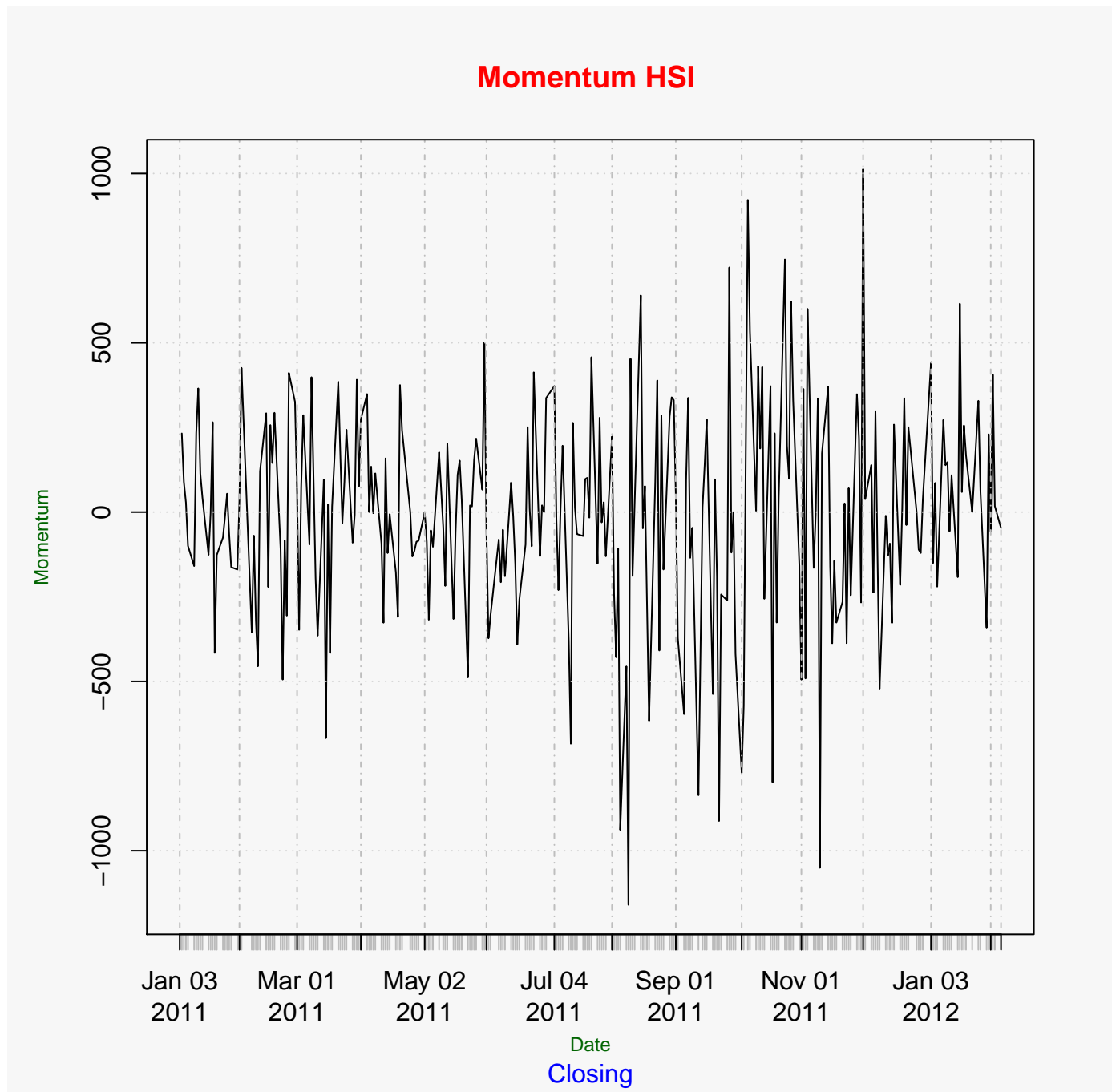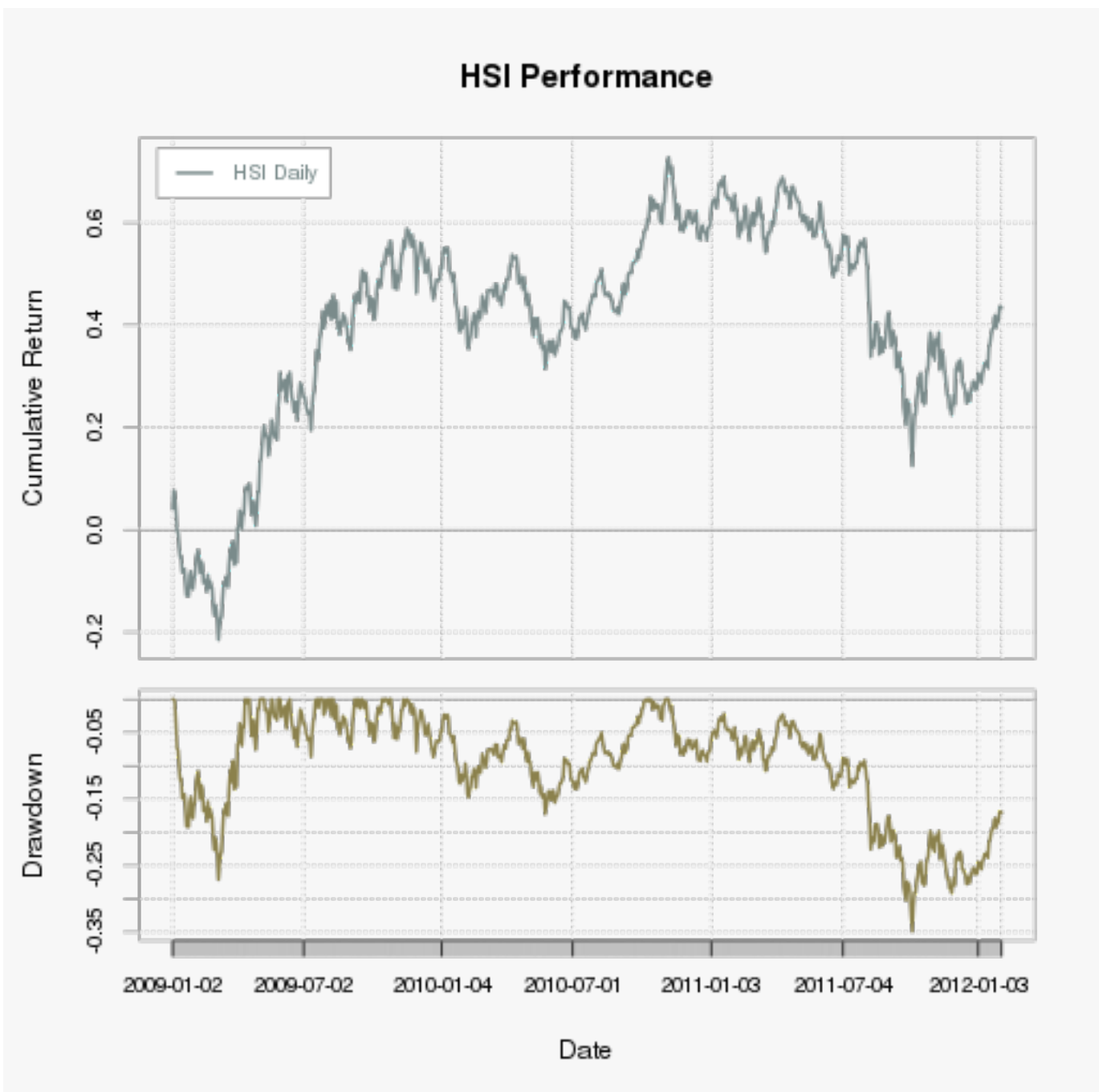
9 Hang Seng Index

Latest Hang Seng Index

	Trade Time	Name	Last	Change	Days Range	52–week Range
^HSI	2012–02–07 03:01:00	HANG SENG INDEX	20699	−10.75	20649.27 – 20881.85	16170.30 – 24468.60

9.1 Hang Seng Index - Momentum

Momentum HSI

9.2 HSI Performance

9.3 HSI Ratios

```
##               RSI
## 2012-01-20 70.29
## 2012-01-23 70.29
## 2012-01-26 73.80
## 2012-01-27 74.42
## 2012-01-30 65.34
## 2012-01-31 68.16
## 2012-02-01 66.71
## 2012-02-02 71.38
## 2012-02-03 71.56
## 2012-02-06 70.25


##             macd signal
## 2012-01-20 1.698 0.9759
## 2012-01-23 1.873 1.1554
## 2012-01-26 2.121 1.3484
## 2012-01-27 2.312 1.5412
## 2012-01-30 2.296 1.6922
## 2012-01-31 2.349 1.8235
## 2012-02-01 2.339 1.9265
## 2012-02-02 2.465 2.0342
## 2012-02-03 2.540 2.1355
## 2012-02-06 2.550 2.2184

## [1] "BBands"

##                dn  mavg    up   pctB
## 2012-01-20 17991 18985 19979 1.0660
## 2012-01-23 18005 19072 20138 0.9869
## 2012-01-26 17962 19162 20362 1.0321
## 2012-01-27 17949 19256 20562 0.9768
## 2012-01-30 18021 19338 20655 0.8122
## 2012-01-31 18118 19437 20757 0.8612
## 2012-02-01 18243 19532 20822 0.8105
## 2012-02-02 18271 19626 20980 0.9112
## 2012-02-03 18353 19727 21101 0.8748
## 2012-02-06 18451 19822 21192 0.8240


##            WPR %
## 2012-01-20  0.00
## 2012-01-23  0.00
## 2012-01-26  0.00
## 2012-01-27  0.00
## 2012-01-30 20.86
## 2012-01-31  7.42
## 2012-02-01 11.30
## 2012-02-02  0.00
## 2012-02-03  0.00
## 2012-02-06  2.70
```

9.4 HSI Volatility

9.5 HSI Statistics

```
##                                  HSI-Daily HSI-Monthly
## Annualized StdDev Sharpe (Rf=0%, p=95%):     0.478      0.4421
## Annualized VaR Sharpe (Rf=0%, p=95%):        4.909      1.0707
## Annualized ES Sharpe (Rf=0%, p=95%):         3.621      0.8407


##          HSI-Daily HSI-Monthly
## Skewness    0.1157      0.1194


##          HSI-Daily HSI-Monthly
## Kurtosis     1.396    -0.04284
```

```
##       Index             HSI Daily
##   Min.   :2009-01-02   Min.   :-0.056605
##   1st Qu.:2009-10-11   1st Qu.:-0.008071
##   Median :2010-07-20   Median : 0.000300
##   Mean   :2010-07-19   Mean   : 0.000594
##   3rd Qu.:2011-04-26   3rd Qu.: 0.010209
##   Max.   :2012-02-06   Max.   : 0.074147

##       Index            HSI Monthly
##   Min.   :2009-01-30   Min.   :-0.14329
##   1st Qu.:2009-11-06   1st Qu.:-0.01913
##   Median :2010-08-15   Median : 0.00817
##   Mean   :2010-08-14   Mean   : 0.01077
##   3rd Qu.:2011-05-23   3rd Qu.: 0.03680
##   Max.   :2012-02-06   Max.   : 0.17074
```

10 Dataset First and Last Rows Info

```
##           X0001.HK.Close
## 2009-01-02          76.9
## 2012-02-06         104.0
##           X0002.HK.Close
## 2009-01-02          52.4
## 2012-02-06          63.0
##           X0003.HK.Close
## 2009-01-02         12.08
## 2012-02-06         18.20
##           X0004.HK.Close
## 2009-01-02          22.0
## 2012-02-06          45.9
##           X0005.HK.Close
## 2009-01-02         77.00
## 2012-02-06         67.85
##           X0006.HK.Close
## 2009-01-02         42.75
## 2012-02-06         56.05
##           X0011.HK.Close
## 2009-01-02         104.7
## 2012-02-06         100.4
##           X0012.HK.Close
## 2009-01-02         30.35
## 2012-02-06         43.35
##           X0013.HK.Close
## 2009-01-02         39.85
## 2012-02-06         76.30
##           X0016.HK.Close
## 2009-01-02          67.3
## 2012-02-06         108.2
##           X0017.HK.Close
## 2009-01-02          8.18
## 2012-02-06          8.77
##           X0019.HK.Close
## 2009-01-02         55.75
## 2012-02-06         84.00
##           X0023.HK.Close
## 2009-01-02         16.68
## 2012-02-06         30.55
##           X0066.HK.Close
## 2009-01-02         18.08
## 2012-02-06         26.10
##           X0083.HK.Close
## 2009-01-02          8.36
## 2012-02-06         12.68
##           X0101.HK.Close
## 2009-01-02         18.36
## 2012-02-06         27.80
##           X0144.HK.Close
## 2009-01-02          15.4
## 2012-02-06          29.0
##           X0151.HK.Close
## 2009-01-02          3.17
## 2012-02-06          7.17
##           X0267.HK.Close
```

```
## 2009-01-02               10.2
## 2012-02-06               15.2
##              X0291.HK.Close
## 2009-01-02                14
## 2012-02-06                28
##              X0293.HK.Close
## 2009-01-02              8.91
## 2012-02-06             15.70
##              X0322.HK.Close
## 2009-01-02              8.98
## 2012-02-06             21.85
##              X0330.HK.Close
## 2009-01-02             44.80
## 2012-02-06             13.04
##              X0386.HK.Close
## 2009-01-02              4.96
## 2012-02-06              9.34
##              X0388.HK.Close
## 2009-01-02              76.6
## 2012-02-06             137.7
##              X0494.HK.Close
## 2009-01-02             14.04
## 2012-02-06             17.46
##              X0688.HK.Close
## 2009-01-02             11.22
## 2012-02-06             14.60
##              X0700.HK.Close
## 2009-01-01              50.0
## 2012-02-06             185.8
##              X0762.HK.Close
## 2009-01-01              9.63
## 2012-02-06             13.64
##              X0836.HK.Close
## 2009-01-02             15.12
## 2012-02-06             15.00
##              X0857.HK.Close
## 2009-01-02              7.20
## 2012-02-06             11.52
##              X0883.HK.Close
## 2009-01-02              7.59
## 2012-02-06             16.58
##              X0939.HK.Close
## 2009-01-02              4.52
## 2012-02-06              6.38
##              X0941.HK.Close
## 2009-01-02             81.20
## 2012-02-06             77.55
##              X1044.HK.Close
## 2009-01-01              24.9
## 2012-02-06              68.3
##              X1088.HK.Close
## 2009-01-02              17.4
## 2012-02-06              35.4
##              X1109.HK.Close
## 2009-01-02              9.90
## 2012-02-06             13.56
##              X1199.HK.Close
```

```
## 2009-01-02            8.07
## 2012-02-06           12.02
##            X1299.HK.Close
## 2010-10-29            23.1
## 2012-02-06            25.8
##            X1398.HK.Close
## 2009-01-02            4.30
## 2012-02-06            5.46
##            X1880.HK.Close
## 2009-01-02            3.50
## 2012-02-06           13.14
##            X1898.HK.Close
## 2009-01-02            6.55
## 2012-02-06           10.16
##            X2318.HK.Close
## 2009-01-02           39.60
## 2012-02-06           63.75
##            X2388.HK.Close
## 2009-01-02            9.06
## 2012-02-06           20.70
##            X2600.HK.Close
## 2009-01-02            4.55
## 2012-02-06            3.92
##            X2628.HK.Close
## 2009-01-02           24.75
## 2012-02-06           23.30
##            X3328.HK.Close
## 2009-01-02            5.91
## 2012-02-06            6.45
##            X3988.HK.Close
## 2009-01-02            2.17
## 2012-02-06            3.39
```

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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