

CAPM and other Statistics for HSI Components Version 1.1

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[†]Itself

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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.

¹Wikipedia

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 ($R_m - r_f$).²

```
## Warning message: cannot open: HTTP status was '404 Not Found'
```

```
## Error: cannot open URL 'http://chart.yahoo.com/table.csv?s=0011.HK&a=0&b=01&c=2009&d=1&e=21&f=2012&g=d&
```

2.1 HSI Components CAPM with HSI as benchmark

CAPM - Combined

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

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

##	HSI Components	to HSI	NA	NA	NA	NA
## Alpha	0.0000	0.0002	0.0004	0.0006	-0.0005	
## Beta	0.9887	0.1470	0.3776	1.1118	1.1205	
## Beta+	0.9551	0.0428	0.2765	1.1132	1.2116	
## Beta-	0.9691	0.1876	0.4105	1.0884	1.3108	
## R-squared	0.6386	0.0791	0.1786	0.4942	0.5602	
## Annualized Alpha	-0.0005	0.0506	0.1085	0.1674	-0.1237	
## Correlation	0.7991	0.2812	0.4226	0.7030	0.7485	
## Correlation p-value	0.0000	0.0000	0.0000	0.0000	0.0000	
## Tracking Error	0.1933	0.2572	0.2654	0.2938	0.2599	
## Active Premium	-0.0224	-0.0652	0.0140	0.1467	-0.1643	
## Information Ratio	-0.1157	-0.2535	0.0528	0.4995	-0.6320	
## Treynor Ratio	0.1092	0.4435	0.3824	0.2492	-0.0302	

##	NA	NA	NA	NA	NA	NA	NA
## Alpha	0.0003	-0.0003	0.0001	0.0005	0.0002	-0.0002	0.0003
## Beta	0.1142	0.6389	1.0189	0.9476	1.0040	1.1363	0.7846
## Beta+	0.0599	0.7033	1.0488	0.8642	0.9684	1.0594	0.8523
## Beta-	0.1265	0.6732	0.9918	0.9871	0.9792	1.1640	0.7225
## R-squared	0.0280	0.4525	0.5563	0.5266	0.6420	0.5026	0.3840
## Annualized Alpha	0.0885	-0.0751	0.0203	0.1322	0.0586	-0.0501	0.0766
## Correlation	0.1673	0.6727	0.7459	0.7257	0.8012	0.7089	0.6197
## Correlation p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## Tracking Error	0.2892	0.2053	0.2365	0.2339	0.1949	0.2959	0.2643
## Active Premium	-0.0396	-0.1389	-0.0066	0.1094	0.0444	-0.0900	0.0223
## Information Ratio	-0.1369	-0.6763	-0.0279	0.4678	0.2280	-0.3043	0.0843
## Treynor Ratio	0.7947	-0.0133	0.1215	0.2530	0.1741	0.0355	0.1945

##	NA	NA	NA	NA	NA	NA	NA
## Alpha	0.0005	0.0003	0.0002	0.0002	0.0004	0.0011	0.0003
## Beta	0.9397	0.5092	1.1656	1.0924	1.3103	0.4311	1.0805
## Beta+	1.0194	0.4303	1.1350	1.2457	1.2566	0.2039	1.0318
## Beta-	0.9269	0.5028	1.2061	0.9902	1.2203	0.5133	0.9838
## R-squared	0.4624	0.3377	0.5152	0.4635	0.5371	0.0965	0.4034
## Annualized Alpha	0.1249	0.0739	0.0492	0.0545	0.1133	0.3051	0.0749
## Correlation	0.6800	0.5811	0.7178	0.6808	0.7329	0.3106	0.6351
## Correlation p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## Tracking Error	0.2638	0.2250	0.2970	0.3064	0.3263	0.3735	0.3422

²<http://www.investopedia.com/terms/c/capm.asp>

## Active Premium	0.0919	0.0029	0.0216	0.0171	0.0970	0.1782	0.0251
## Information Ratio	0.3484	0.0130	0.0727	0.0557	0.2973	0.4772	0.0732
## Treynor Ratio	0.2365	0.2618	0.1304	0.1350	0.1735	0.7157	0.1438
##	NA	NA	NA	NA	NA	NA	NA
## Alpha	0.0006	0.0005	0.0012	-0.0015	0.0004	0.0004	0.0005
## Beta	0.8783	0.7658	0.3479	0.9372	0.9548	1.1593	0.9712
## Beta+	0.7771	0.7316	0.2640	0.7359	0.8076	1.2461	0.9501
## Beta-	0.9059	0.7546	0.3856	1.1415	0.9919	1.1114	0.8687
## R-squared	0.3689	0.3175	0.0712	0.2130	0.5569	0.7042	0.2039
## Annualized Alpha	0.1698	0.1412	0.3537	-0.3136	0.1194	0.0952	0.1319
## Correlation	0.6074	0.5635	0.2669	0.4616	0.7463	0.8392	0.4515
## Correlation p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## Tracking Error	0.3002	0.2981	0.3678	0.4684	0.2216	0.1996	0.5008
## Active Premium	0.1206	0.0783	0.2203	-0.4406	0.0993	0.1011	-0.0317
## Information Ratio	0.4017	0.2628	0.5990	-0.9407	0.4482	0.5062	-0.0632
## Treynor Ratio	0.2857	0.2725	1.0080	-0.3310	0.2406	0.1996	0.0933
##	NA	NA	NA	NA	NA	NA	NA
## Alpha	0.0001	0.0015	0.0003	-0.0001	0.0002	0.0006	0.0000
## Beta	1.1872	0.9321	0.7066	0.5556	1.1005	1.2817	1.0621
## Beta+	1.3471	0.9699	0.5460	0.4279	1.0187	1.1947	1.0036
## Beta-	0.9332	0.7783	0.6527	0.6650	1.1005	1.2530	1.0333
## R-squared	0.4722	0.3531	0.2544	0.1775	0.7251	0.6846	0.7004
## Annualized Alpha	0.0210	0.4513	0.0907	-0.0258	0.0466	0.1642	-0.0003
## Correlation	0.6871	0.5942	0.5044	0.4213	0.8515	0.8274	0.8369
## Correlation p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## Tracking Error	0.3298	0.3279	0.3231	0.3316	0.1780	0.2376	0.1813
## Active Premium	-0.0179	0.4151	0.0103	-0.1282	0.0445	0.1816	-0.0127
## Information Ratio	-0.0542	1.2659	0.0320	-0.3866	0.2498	0.7642	-0.0700
## Treynor Ratio	0.0948	0.5784	0.1973	0.0039	0.1589	0.2434	0.1108
##	NA	NA	NA	NA	NA	NA	NA
## Alpha	-0.0004	0.0013	0.0005	0.0003	0.0002	0.0008	-0.0001
## Beta	0.7100	0.4622	1.2140	1.1649	1.3296	0.8235	1.1285
## Beta+	0.7037	0.3646	1.1391	1.2268	1.3379	0.8160	1.0994
## Beta-	0.7315	0.4064	1.1488	0.7915	1.4536	1.0492	1.0515
## R-squared	0.5187	0.1181	0.6465	0.3608	0.4887	0.4116	0.6864
## Annualized Alpha	-0.0870	0.3838	0.1208	0.0762	0.0553	0.2124	-0.0347
## Correlation	0.7202	0.3436	0.8041	0.6007	0.6991	0.6416	0.8285
## Correlation p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## Tracking Error	0.1931	0.3559	0.2398	0.4052	0.3636	0.2431	0.2010
## Active Premium	-0.1430	0.2701	0.1243	0.0088	0.0206	0.1848	-0.0484
## Information Ratio	-0.7408	0.7589	0.5182	0.0216	0.0566	0.7601	-0.2408
## Treynor Ratio	-0.0178	0.8545	0.2098	0.1194	0.1135	0.1319	0.0726
##	NA	NA	NA	NA	NA	NA	NA
## Alpha	0.0016	0.0001	0.0002	0.0008	-0.0005	-0.0005	-0.0004
## Beta	0.8285	1.4968	1.3302	0.8775	1.5411	1.0966	1.1944
## Beta+	0.7827	1.4061	1.3770	0.8875	1.5876	1.0691	1.1587
## Beta-	0.8885	1.4436	1.2228	0.8511	1.4078	1.0589	1.2113
## R-squared	0.2234	0.6638	0.6221	0.4431	0.6178	0.6383	0.7275
## Annualized Alpha	0.5012	0.0323	0.0514	0.2300	-0.1223	-0.1247	-0.0944
## Correlation	0.4727	0.8147	0.7887	0.6657	0.7860	0.7989	0.8529
## Correlation p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## Tracking Error	0.4039	0.3055	0.2828	0.2576	0.3450	0.2160	0.1966
## Active Premium	0.4114	0.0330	0.0457	0.2005	-0.1487	-0.1555	-0.1087
## Information Ratio	1.0187	0.1080	0.1616	0.7783	-0.4310	-0.7198	-0.5529
## Treynor Ratio	0.6540	0.1091	0.1324	0.3771	-0.0119	-0.0229	0.0181
##	NA						
## Alpha	0.0002						

## Beta	1.0330
## Beta+	0.9561
## Beta-	1.0079
## R-squared	0.6314
## Annualized Alpha	0.0393
## Correlation	0.7946
## Correlation p-value	0.0000
## Tracking Error	0.2053
## Active Premium	0.0235
## Information Ratio	0.1143
## Treynor Ratio	0.1489

CAPM - Distinct for each stock

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

##	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	0.989	0.147	0.378	1.112	1.121	0.114
## Beta+	0.955	0.043	0.276	1.113	1.212	0.060
## Beta-	0.969	0.188	0.410	1.088	1.311	0.126
## R-squared	0.639	0.079	0.179	0.494	0.560	0.028
## Annualized Alpha	0.000	0.051	0.108	0.167	-0.124	0.088
## Correlation	0.799	0.281	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	0.265	0.294	0.260	0.289
## Active Premium	-0.022	-0.065	0.014	0.147	-0.164	-0.040
## Information Ratio	-0.116	-0.254	0.053	0.500	-0.632	-0.137
## Treynor Ratio	0.109	0.444	0.382	0.249	-0.030	0.795
##	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	0.864	0.968	1.059	0.852
## Beta-	0.673	0.992	0.987	0.979	1.164	0.722
## R-squared	0.452	0.556	0.527	0.642	0.503	0.384
## Annualized Alpha	-0.075	0.020	0.132	0.059	-0.050	0.077
## Correlation	0.673	0.746	0.726	0.801	0.709	0.620
## Correlation p-value	0.000	0.000	0.000	0.000	0.000	0.000
## Tracking Error	0.205	0.236	0.234	0.195	0.296	0.264
## Active Premium	-0.139	-0.007	0.109	0.044	-0.090	0.022
## Information Ratio	-0.676	-0.028	0.468	0.228	-0.304	0.084
## Treynor Ratio	-0.013	0.122	0.253	0.174	0.036	0.194
##	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	1.166	1.092	1.310	0.431
## Beta+	1.019	0.430	1.135	1.246	1.257	0.204
## Beta-	0.927	0.503	1.206	0.990	1.220	0.513
## R-squared	0.462	0.338	0.515	0.464	0.537	0.096
## Annualized Alpha	0.125	0.074	0.049	0.054	0.113	0.305
## Correlation	0.680	0.581	0.718	0.681	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	0.306	0.326	0.374
## Active Premium	0.092	0.003	0.022	0.017	0.097	0.178
## Information Ratio	0.348	0.013	0.073	0.056	0.297	0.477
## Treynor Ratio	0.236	0.262	0.130	0.135	0.174	0.716
##	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	1.081	0.878	0.766	0.348	0.937	0.955
## Beta+	1.032	0.777	0.732	0.264	0.736	0.808
## Beta-	0.984	0.906	0.755	0.386	1.141	0.992
## R-squared	0.403	0.369	0.318	0.071	0.213	0.557
## Annualized Alpha	0.075	0.170	0.141	0.354	-0.314	0.119
## Correlation	0.635	0.607	0.564	0.267	0.462	0.746
## Correlation p-value	0.000	0.000	0.000	0.000	0.000	0.000
## Tracking Error	0.342	0.300	0.298	0.368	0.468	0.222
## Active Premium	0.025	0.121	0.078	0.220	-0.441	0.099
## Information Ratio	0.073	0.402	0.263	0.599	-0.941	0.448
## Treynor Ratio	0.144	0.286	0.272	1.008	-0.331	0.241
##	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	0.971	1.187	0.932	0.707	0.556
## Beta+	1.246	0.950	1.347	0.970	0.546	0.428
## Beta-	1.111	0.869	0.933	0.778	0.653	0.665
## R-squared	0.704	0.204	0.472	0.353	0.254	0.178
## Annualized Alpha	0.095	0.132	0.021	0.451	0.091	-0.026
## Correlation	0.839	0.452	0.687	0.594	0.504	0.421
## Correlation p-value	0.000	0.000	0.000	0.000	0.000	0.000
## Tracking Error	0.200	0.501	0.330	0.328	0.323	0.332
## Active Premium	0.101	-0.032	-0.018	0.415	0.010	-0.128
## Information Ratio	0.506	-0.063	-0.054	1.266	0.032	-0.387
## Treynor Ratio	0.200	0.093	0.095	0.578	0.197	0.004
##	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	1.101	1.282	1.062	0.710	0.462	1.214
## Beta+	1.019	1.195	1.004	0.704	0.365	1.139
## Beta-	1.101	1.253	1.033	0.732	0.406	1.149
## R-squared	0.725	0.685	0.700	0.519	0.118	0.646
## Annualized Alpha	0.047	0.164	0.000	-0.087	0.384	0.121
## Correlation	0.852	0.827	0.837	0.720	0.344	0.804
## Correlation p-value	0.000	0.000	0.000	0.000	0.000	0.000
## Tracking Error	0.178	0.238	0.181	0.193	0.356	0.240
## Active Premium	0.044	0.182	-0.013	-0.143	0.270	0.124
## Information Ratio	0.250	0.764	-0.070	-0.741	0.759	0.518
## Treynor Ratio	0.159	0.243	0.111	-0.018	0.854	0.210
##	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	1.165	1.330	0.824	1.129	0.828	1.497
## Beta+	1.227	1.338	0.816	1.099	0.783	1.406
## Beta-	0.792	1.454	1.049	1.052	0.888	1.444
## R-squared	0.361	0.489	0.412	0.686	0.223	0.664
## Annualized Alpha	0.076	0.055	0.212	-0.035	0.501	0.032
## Correlation	0.601	0.699	0.642	0.828	0.473	0.815
## Correlation p-value	0.000	0.000	0.000	0.000	0.000	0.000
## Tracking Error	0.405	0.364	0.243	0.201	0.404	0.306
## Active Premium	0.009	0.021	0.185	-0.048	0.411	0.033
## Information Ratio	0.022	0.057	0.760	-0.241	1.019	0.108
## Treynor Ratio	0.119	0.114	0.132	0.073	0.654	0.109
##	2318.HK	2388.HK	2600.HK	2628.HK	3328.HK	3988.HK
## Alpha	0.000	0.001	0.000	0.000	0.000	0.000
## Beta	1.330	0.878	1.541	1.097	1.194	1.033
## Beta+	1.377	0.888	1.588	1.069	1.159	0.956
## Beta-	1.223	0.851	1.408	1.059	1.211	1.008
## R-squared	0.622	0.443	0.618	0.638	0.728	0.631
## Annualized Alpha	0.051	0.230	-0.122	-0.125	-0.094	0.039
## Correlation	0.789	0.666	0.786	0.799	0.853	0.795
## Correlation p-value	0.000	0.000	0.000	0.000	0.000	0.000
## Tracking Error	0.283	0.258	0.345	0.216	0.197	0.205
## Active Premium	0.046	0.200	-0.149	-0.156	-0.109	0.024
## Information Ratio	0.162	0.778	-0.431	-0.720	-0.553	0.114
## Treynor Ratio	0.132	0.377	-0.012	-0.023	0.018	0.149

3 HSI Components Risk

3.1 Correlation

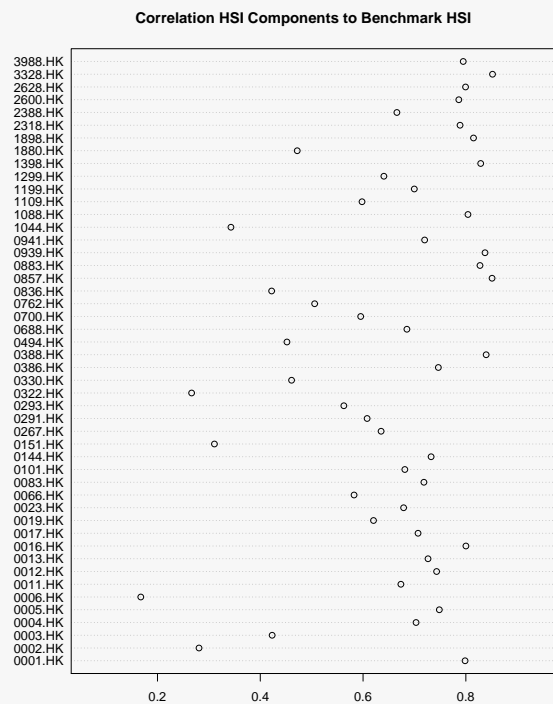
Correlation Combined

##	Correlation	p-value	Lower CI	Upper CI
## HSI Components to HSI	0.0371	0.566	-0.1288	0.2009

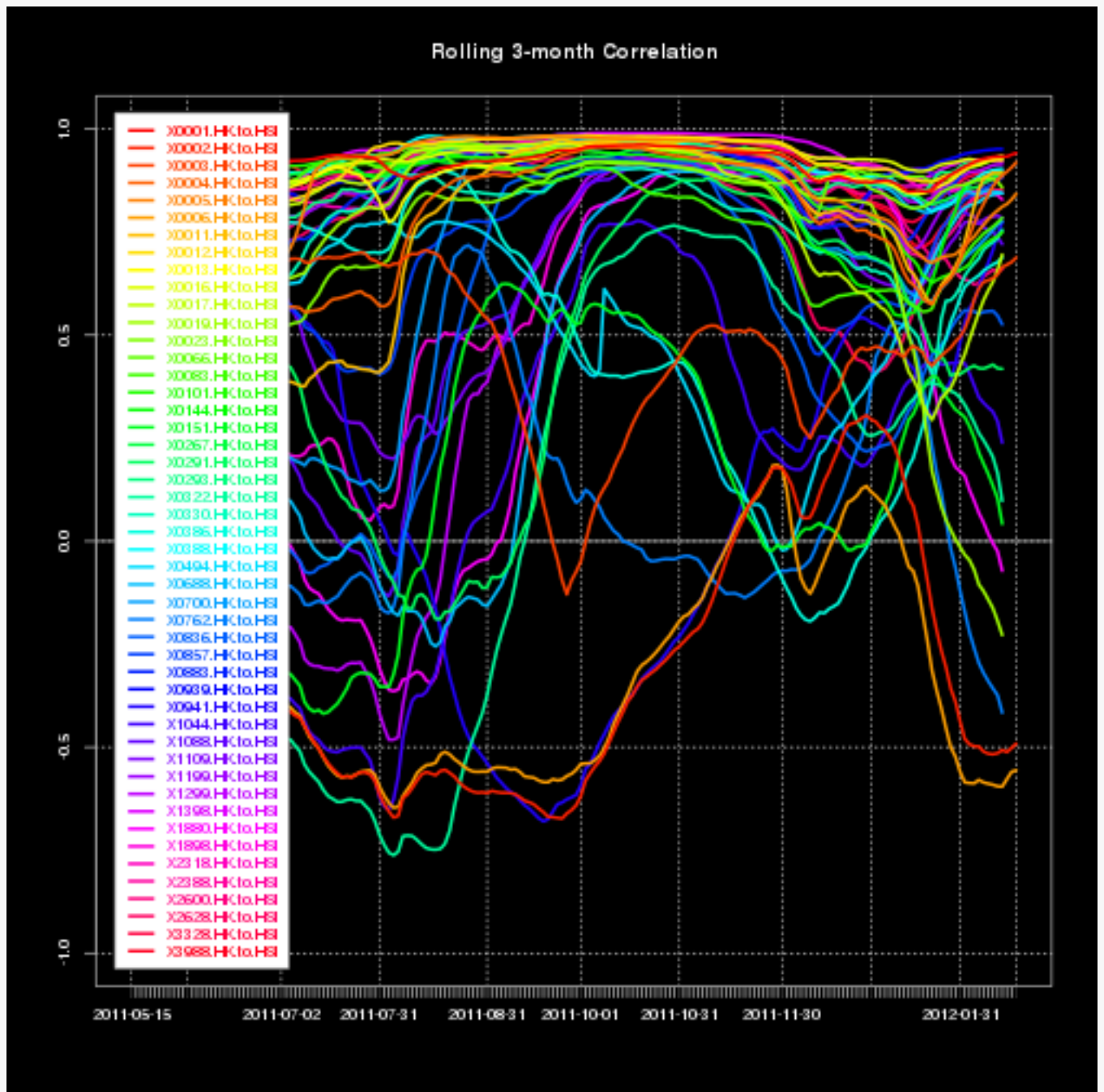
Correlation - Distinct

##	Correlation	p-value	Lower CI	Upper CI
## 0001.HK	0.7985	0	0.7624	0.8296
## 0002.HK	0.2808	0	0.1935	0.3637
## 0003.HK	0.4231	0	0.3442	0.4960
## 0004.HK	0.7031	0	0.6532	0.7470
## 0005.HK	0.7484	0	0.7047	0.7863
## 0006.HK	0.1675	0	0.0763	0.2558
## 0011.HK	0.6736	0	0.6197	0.7211
## 0012.HK	0.7431	0	0.6986	0.7819
## 0013.HK	0.7264	0	0.6796	0.7673
## 0016.HK	0.8001	0	0.7642	0.8311
## 0017.HK	0.7070	0	0.6575	0.7504
## 0019.HK	0.6203	0	0.5600	0.6742
## 0023.HK	0.6789	0	0.6257	0.7258
## 0066.HK	0.5825	0	0.5179	0.6405
## 0083.HK	0.7184	0	0.6704	0.7604
## 0101.HK	0.6813	0	0.6284	0.7279
## 0144.HK	0.7324	0	0.6864	0.7725
## 0151.HK	0.3108	0	0.2247	0.3920
## 0267.HK	0.6351	0	0.5764	0.6872
## 0291.HK	0.6079	0	0.5462	0.6632
## 0293.HK	0.5626	0	0.4959	0.6227
## 0322.HK	0.2664	0	0.1783	0.3503
## 0330.HK	0.4609	0	0.3848	0.5307
## 0386.HK	0.7465	0	0.7026	0.7848
## 0388.HK	0.8395	0	0.8099	0.8649
## 0494.HK	0.4519	0	0.3745	0.5230
## 0688.HK	0.6853	0	0.6329	0.7314
## 0700.HK	0.5954	0	0.5323	0.6520
## 0762.HK	0.5058	0	0.4337	0.5715
## 0836.HK	0.4221	0	0.3430	0.4952
## 0857.HK	0.8510	0	0.8233	0.8747
## 0883.HK	0.8275	0	0.7959	0.8546
## 0939.HK	0.8373	0	0.8073	0.8630
## 0941.HK	0.7198	0	0.6720	0.7616
## 1044.HK	0.3429	0	0.2588	0.4218
## 1088.HK	0.8041	0	0.7688	0.8345
## 1109.HK	0.5980	0	0.5351	0.6543
## 1199.HK	0.6997	0	0.6492	0.7440
## 1299.HK	0.6405	0	0.5474	0.7180
## 1398.HK	0.8289	0	0.7976	0.8558
## 1880.HK	0.4719	0	0.3967	0.5408
## 1898.HK	0.8149	0	0.7813	0.8438
## 2318.HK	0.7887	0	0.7510	0.8213
## 2388.HK	0.6658	0	0.6109	0.7143
## 2600.HK	0.7863	0	0.7482	0.8192
## 2628.HK	0.7994	0	0.7634	0.8305

##	3328.HK	0.8519	0	0.8243	0.8754
##	3988.HK	0.7949	0	0.7582	0.8266



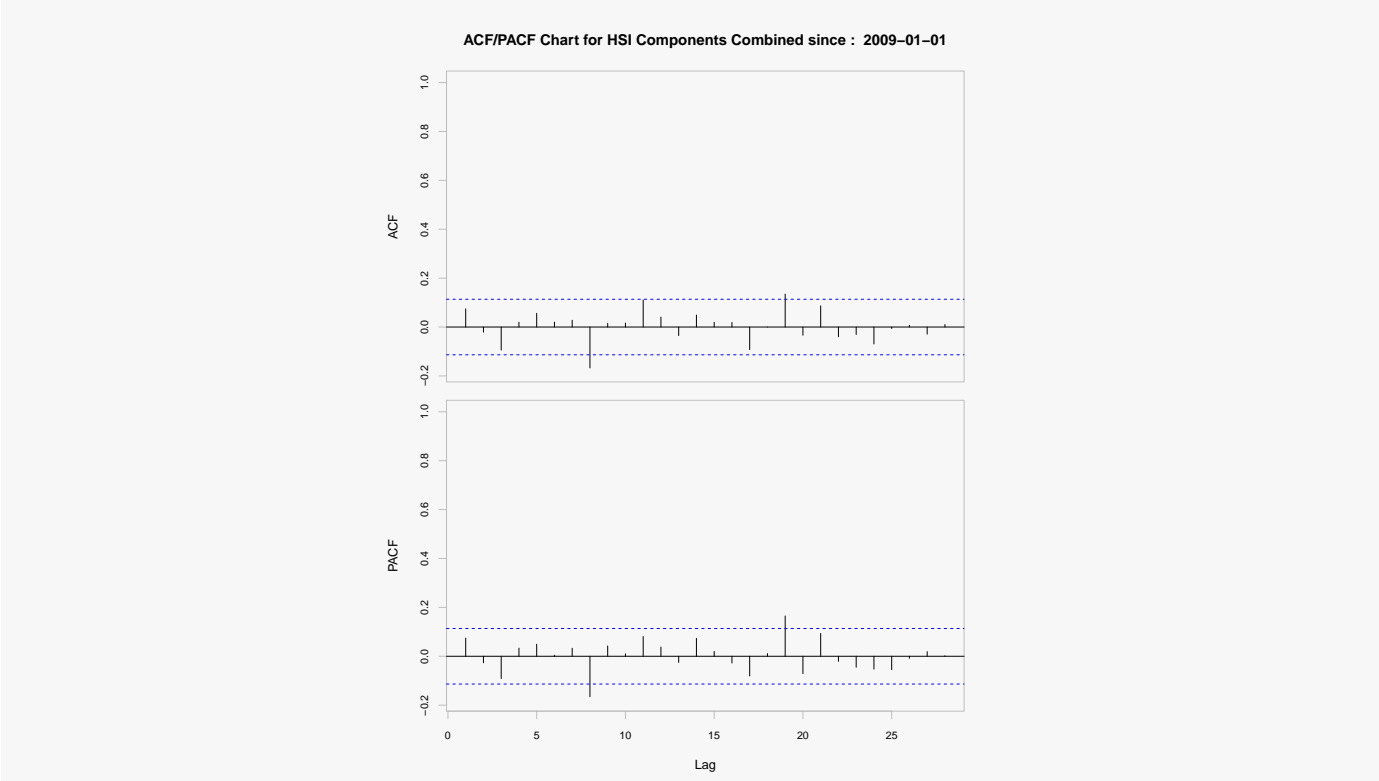
3 Month Rolling Correlation



3.2 Autocorrelation Coefficients - Combined

Autocorrelation Combined

##	rho1	rho2	rho3	rho4	rho5	rho6	Q(6)	p-value
## daily.returns	0.0743	-0.0211	-0.0942	0.0195	0.0562	0.0201		0.4328



3.3 Downside Risk - Combined

Downside Risk Combined

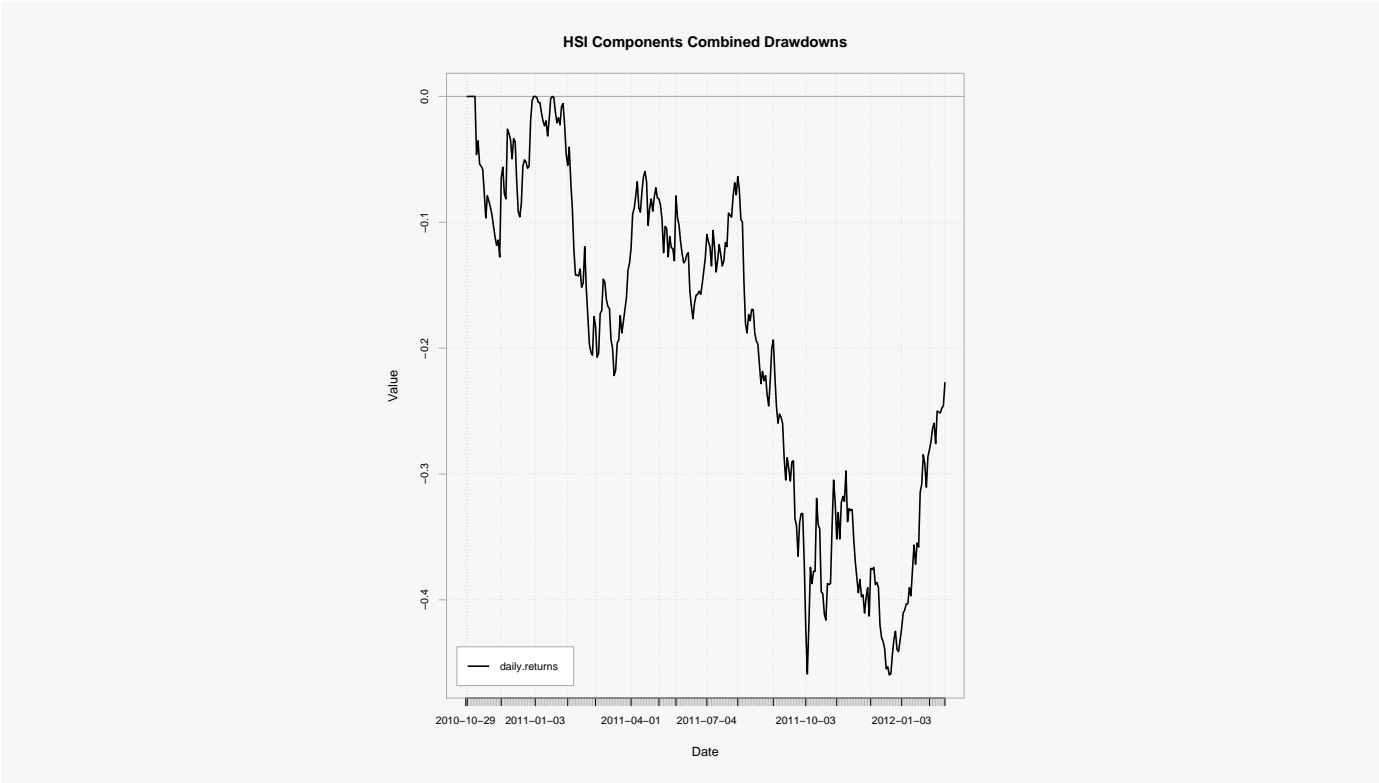
##	HSI Components	dailyReturn
## Semi Deviation		0.0224
## Gain Deviation		0.0181
## Loss Deviation		0.0153
## Downside Deviation (MAR=210%)		0.0260
## Downside Deviation (Rf=0%)		0.0227
## Downside Deviation (0%)		0.0227
## Maximum Drawdown		0.4597
## Historical VaR (95%)		-0.0361
## Historical ES (95%)		-0.0511
## Modified VaR (95%)		-0.0369
## Modified ES (95%)		-0.0474

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	255	218	NA
## 2	2010-11-09	2010-11-30	2010-12-31	-0.1276	38	16	22
## 3	2011-01-04	2011-01-13	2011-01-18	-0.0315	11	8	3



3.5 Downside Deviation - Combined

Downside Deviation Combined

##	HSI Components
## Downside Deviation (MAR = 0%)	0.02274

3.6 Autocorrelation Coefficients - Distinct

##	rho1	rho2	rho3	rho4	rho5	rho6	Q(6)	p-value
## X0001.HK	0.0520	-0.0627	0.0183	-0.0330	0.0117	0.0120		0.3677
## X0002.HK	-0.1239	-0.0461	-0.0067	0.0197	0.0152	-0.0290		0.0218
## X0003.HK	-0.0979	-0.0146	-0.0206	0.0485	0.0141	0.0280		0.1019
## X0004.HK	0.0062	-0.0327	-0.0301	-0.0296	0.0908	-0.0360		0.1358
## X0005.HK	-0.0242	-0.0228	0.0601	0.0336	-0.0478	0.0298		0.3152
## X0006.HK	-0.0845	-0.0618	0.0139	-0.0228	0.0048	-0.0746		0.0358
## X0011.HK	0.1155	0.0162	-0.0185	0.0028	-0.0475	-0.0807		0.0071
## X0012.HK	0.0750	-0.0279	-0.0517	-0.0060	0.0458	0.0041		0.1890
## X0013.HK	0.0012	0.0315	0.0117	-0.0137	0.0244	-0.0258		0.9185
## X0016.HK	0.0510	-0.0579	0.0228	-0.0046	0.0409	0.0156		0.3644
## X0017.HK	0.0781	0.0195	0.0119	0.0285	0.0502	-0.0186		0.2365
## X0019.HK	0.0412	0.0465	-0.0260	-0.1041	-0.0056	0.0176		0.0568
## X0023.HK	0.0881	-0.0057	-0.0084	-0.0072	-0.0494	-0.0380		0.1634
## X0066.HK	-0.0736	-0.0009	0.0534	-0.0219	-0.0071	-0.0158		0.3178
## X0083.HK	0.1006	-0.0584	-0.0378	0.0055	0.0453	-0.0005		0.0390
## X0101.HK	-0.0718	-0.0209	0.0151	-0.0414	-0.0592	0.0214		0.1761
## X0144.HK	0.0620	-0.0081	0.0007	-0.0515	-0.1042	0.0023		0.0346
## X0151.HK	-0.0179	-0.0265	-0.0863	-0.1023	0.0117	-0.0009		0.0213
## X0267.HK	0.1223	0.0374	-0.0544	-0.0216	0.0426	0.0427		0.0057
## X0291.HK	-0.0354	-0.0199	0.0063	-0.0445	0.0110	-0.0041		0.8133
## X0293.HK	0.0251	-0.0459	-0.0681	-0.0545	0.0746	0.0714		0.0118
## X0322.HK	-0.0114	0.0356	-0.0909	-0.0018	-0.0154	-0.0229		0.2291
## X0330.HK	0.0451	0.1289	-0.0113	0.0433	-0.0043	-0.0180		0.0121
## X0386.HK	-0.0223	-0.0252	-0.0396	-0.0160	-0.0088	0.0329		0.7829
## X0388.HK	0.0974	-0.0120	0.0316	-0.0112	0.0084	-0.0145		0.1990
## X0494.HK	-0.0111	-0.0314	-0.0128	-0.0235	-0.0114	0.0080		0.9560
## X0688.HK	0.0791	-0.0600	-0.0570	-0.0437	-0.0028	0.0078		0.0680
## X0700.HK	0.0208	-0.0962	0.0008	-0.0888	0.0048	0.0367		0.0208
## X0762.HK	-0.0494	-0.0731	-0.0336	-0.0626	0.0340	-0.0282		0.0711
## X0836.HK	-0.0535	-0.0387	-0.0017	0.0032	-0.0106	-0.0165		0.7172
## X0857.HK	0.0437	-0.0155	0.0378	-0.0030	-0.0061	0.0042		0.8297
## X0883.HK	0.0434	-0.0514	-0.0119	-0.0261	-0.0562	0.0016		0.3558
## X0939.HK	0.0013	0.0040	0.0192	-0.0572	-0.0308	-0.0341		0.6085
## X0941.HK	-0.0163	-0.0174	0.0057	-0.0944	0.0044	-0.0251		0.2437
## X1044.HK	-0.0330	-0.0473	-0.0979	-0.0593	-0.0412	0.0154		0.0243
## X1088.HK	0.0473	-0.0029	-0.0265	-0.0344	0.0277	-0.0359		0.5664
## X1109.HK	0.0279	-0.0255	-0.0556	-0.0875	0.0149	-0.0021		0.1394
## X1199.HK	0.0701	0.0489	-0.0032	-0.0659	0.0100	0.0338		0.1226
## X1299.HK	-0.0136	-0.0857	0.0174	-0.0778	-0.1101	-0.0056		0.2030
## X1398.HK	0.0194	-0.0023	0.0602	-0.0224	-0.0184	-0.0408		0.5339
## X1880.HK	0.0081	-0.0862	-0.0848	-0.0252	-0.0379	-0.0356		0.0290
## X1898.HK	0.0935	0.0160	-0.0010	0.0054	-0.0464	-0.0204		0.1724
## X2318.HK	0.0667	-0.0460	-0.0691	-0.0384	0.0702	0.0068		0.0313
## X2388.HK	0.0721	0.0266	0.0560	-0.0008	-0.0387	-0.0155		0.2108
## X2600.HK	0.0660	-0.0323	-0.0335	0.0046	0.0075	0.0015		0.5273
## X2628.HK	-0.0028	-0.0187	0.0363	-0.0566	-0.0073	-0.0058		0.6937

## X3328.HK	0.0227	0.0337	-0.0074	-0.0596	0.0053	-0.0172	0.6292
## X3988.HK	0.0391	-0.0218	0.0387	-0.0432	-0.0075	-0.0703	0.2320

3.7 Downside Deviation - Distinct

##	0001.HK	0002.HK	0003.HK	0004.HK	0005.HK
## Downside Deviation (MAR = 0%)	0.0192	0.0089	0.0155	0.0242	0.0255
##	0006.HK	0011.HK	0012.HK	0013.HK	0016.HK
## Downside Deviation (MAR = 0%)	0.0111	0.0151	0.0214	0.0192	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%)	0.0253	0.027	0.0218	0.0256	0.0228
##	0293.HK	0322.HK	0330.HK	0386.HK	0388.HK
## Downside Deviation (MAR = 0%)	0.0214	0.0201	0.0354	0.0207	0.0199
##	0494.HK	0688.HK	0700.HK	0762.HK	0836.HK
## Downside Deviation (MAR = 0%)	0.0384	0.0261	0.0247	0.0228	0.0204
##	0857.HK	0883.HK	0939.HK	0941.HK	1044.HK
## Downside Deviation (MAR = 0%)	0.0211	0.0241	0.021	0.016	0.0204
##	1088.HK	1109.HK	1199.HK	1299.HK	1398.HK
## Downside Deviation (MAR = 0%)	0.0245	0.0291	0.029	0.0199	0.0217
##	1880.HK	1898.HK	2318.HK	2388.HK	2600.HK
## Downside Deviation (MAR = 0%)	0.0273	0.0301	0.0269	0.0199	0.0299
##	2628.HK	3328.HK	3988.HK		
## Downside Deviation (MAR = 0%)	0.022	0.0226	0.0219		

4 General Statistics

Statistics Distinct

##	Observations	NAs	Minimum	Quartile 1	Median	Arithmetic Mean
## X0001.HK.Close	777	12	56.00	91.350	98.100	100.019
## X0002.HK.Close	777	12	51.10	52.600	57.350	59.233
## X0003.HK.Close	777	12	10.78	17.220	18.140	17.601
## X0004.HK.Close	777	12	15.20	36.950	41.700	41.808
## X0005.HK.Close	777	12	33.00	65.900	78.900	74.886
## X0006.HK.Close	777	12	41.10	43.500	47.200	49.015
## X0011.HK.Close	774	15	67.00	102.525	110.500	109.441
## X0012.HK.Close	774	15	23.75	42.638	48.425	46.925
## X0013.HK.Close	774	15	36.40	52.600	57.950	63.997
## X0016.HK.Close	774	15	55.80	100.125	111.000	108.137
## X0017.HK.Close	774	15	6.20	9.595	13.490	12.717
## X0019.HK.Close	774	15	42.90	84.562	92.475	92.565
## X0023.HK.Close	774	15	12.34	26.625	28.950	28.195
## X0066.HK.Close	774	15	16.14	25.150	26.850	26.029
## X0083.HK.Close	774	15	5.60	11.880	13.600	13.068
## X0101.HK.Close	774	15	13.66	25.650	29.025	28.606
## X0144.HK.Close	774	15	12.20	23.050	26.350	25.951
## X0151.HK.Close	774	15	2.77	4.662	6.175	5.826
## X0267.HK.Close	774	15	7.18	14.220	17.290	17.081
## X0291.HK.Close	774	15	10.66	23.812	27.900	26.071
## X0293.HK.Close	774	15	6.98	12.570	14.770	15.171
## X0322.HK.Close	774	15	8.27	16.225	19.200	18.178
## X0330.HK.Close	774	15	7.93	31.587	42.450	39.188
## X0386.HK.Close	774	15	3.65	6.190	6.785	6.816
## X0388.HK.Close	774	15	54.60	122.800	136.150	136.525
## X0494.HK.Close	764	25	11.60	16.915	31.975	29.113
## X0688.HK.Close	774	15	9.41	14.245	15.440	15.201
## X0700.HK.Close	783	6	41.80	127.450	155.400	147.771
## X0762.HK.Close	781	8	8.31	9.630	10.980	11.893
## X0836.HK.Close	774	15	11.10	14.220	15.360	15.438
## X0857.HK.Close	774	15	5.10	8.682	9.375	9.305
## X0883.HK.Close	774	15	6.08	11.110	13.220	13.558
## X0939.HK.Close	774	15	3.66	5.610	6.260	6.116
## X0941.HK.Close	774	15	63.00	73.250	75.850	75.635
## X1044.HK.Close	786	3	24.25	47.250	58.750	56.131
## X1088.HK.Close	774	15	13.90	29.962	33.225	31.634
## X1109.HK.Close	774	15	7.50	12.880	14.560	14.399
## X1199.HK.Close	774	15	5.40	9.393	10.950	11.119
## X1299.HK.Close	321	468	19.86	22.700	24.000	24.392
## X1398.HK.Close	774	15	3.03	4.970	5.725	5.462
## X1880.HK.Close	774	15	2.98	7.992	11.830	11.026
## X1898.HK.Close	774	15	4.43	9.473	10.580	10.444
## X2318.HK.Close	774	15	30.35	57.913	64.350	65.394
## X2388.HK.Close	774	15	6.30	16.685	18.430	18.712
## X2600.HK.Close	774	15	3.20	5.600	7.020	6.673
## X2628.HK.Close	774	15	17.24	25.625	30.450	29.654
## X3328.HK.Close	774	15	4.17	6.223	8.000	7.594
## X3988.HK.Close	774	15	1.84	3.058	3.930	3.663
##	Geometric Mean	Quartile 3	Maximum	SE Mean	LCL Mean	(0.95)
## X0001.HK.Close	98.657	113.900	135.70	0.5821		98.876
## X0002.HK.Close	58.879	64.100	75.00	0.2369		58.768
## X0003.HK.Close	17.466	18.980	21.00	0.0749		17.454
## X0004.HK.Close	40.087	51.200	62.00	0.3976		41.027

## X0005.HK.Close	73.853	83.100	98.00	0.4234	74.055
## X0006.HK.Close	48.658	53.800	64.80	0.2190	48.585
## X0011.HK.Close	108.673	117.600	134.00	0.4553	108.547
## X0012.HK.Close	46.108	53.150	60.50	0.2957	46.344
## X0013.HK.Close	62.055	77.925	95.90	0.5758	62.866
## X0016.HK.Close	106.410	118.700	146.30	0.6503	106.860
## X0017.HK.Close	12.258	15.315	18.54	0.1193	12.483
## X0019.HK.Close	90.123	108.950	136.40	0.7189	91.153
## X0023.HK.Close	27.656	32.150	35.90	0.1825	27.837
## X0066.HK.Close	25.804	28.250	31.15	0.1173	25.799
## X0083.HK.Close	12.803	14.800	18.56	0.0897	12.892
## X0101.HK.Close	28.010	32.350	40.30	0.2013	28.211
## X0144.HK.Close	25.410	28.900	37.55	0.1824	25.593
## X0151.HK.Close	5.673	6.968	8.19	0.0492	5.729
## X0267.HK.Close	16.587	20.600	24.40	0.1429	16.800
## X0291.HK.Close	25.056	30.750	35.25	0.2359	25.608
## X0293.HK.Close	14.642	18.290	24.05	0.1459	14.884
## X0322.HK.Close	17.533	20.900	25.95	0.1621	17.860
## X0330.HK.Close	35.284	50.263	64.30	0.5295	38.148
## X0386.HK.Close	6.734	7.620	9.64	0.0393	6.739
## X0388.HK.Close	132.633	160.575	197.50	1.0819	134.401
## X0494.HK.Close	26.695	38.650	51.90	0.4189	28.291
## X0688.HK.Close	15.073	16.640	19.44	0.0704	15.063
## X0700.HK.Close	137.592	180.800	225.00	1.6881	144.457
## X0762.HK.Close	11.664	14.300	17.40	0.0902	11.716
## X0836.HK.Close	15.354	16.635	20.15	0.0600	15.321
## X0857.HK.Close	9.200	10.160	12.36	0.0505	9.206
## X0883.HK.Close	13.119	16.640	20.95	0.1242	13.314
## X0939.HK.Close	6.048	6.808	8.28	0.0337	6.050
## X0941.HK.Close	75.531	78.088	91.45	0.1438	75.353
## X1044.HK.Close	53.948	68.000	78.25	0.5109	55.128
## X1088.HK.Close	30.979	35.250	40.80	0.2095	31.223
## X1109.HK.Close	14.160	16.340	20.00	0.0934	14.216
## X1199.HK.Close	10.882	12.700	16.76	0.0848	10.952
## X1299.HK.Close	24.317	26.150	29.55	0.1097	24.177
## X1398.HK.Close	5.398	5.980	7.03	0.0309	5.401
## X1880.HK.Close	10.269	14.240	17.54	0.1384	10.755
## X1898.HK.Close	10.209	11.760	15.86	0.0785	10.290
## X2318.HK.Close	63.915	76.300	94.30	0.4839	64.444
## X2388.HK.Close	17.925	22.900	28.95	0.1840	18.351
## X2600.HK.Close	6.453	7.870	10.66	0.0624	6.550
## X2628.HK.Close	29.026	34.500	41.00	0.2145	29.233
## X3328.HK.Close	7.443	8.700	10.56	0.0556	7.485
## X3988.HK.Close	3.603	4.140	5.00	0.0255	3.613
##	UCL Mean (0.95)	Variance	Stdev	Skewness	Kurtosis
## X0001.HK.Close	101.161	263.2383	16.2246	-0.1012	-0.1388
## X0002.HK.Close	59.698	43.6119	6.6039	0.3708	-1.2374
## X0003.HK.Close	17.748	4.3565	2.0872	-1.6225	2.0681
## X0004.HK.Close	42.588	122.8354	11.0831	-0.4761	-0.2081
## X0005.HK.Close	75.718	139.2774	11.8016	-0.7764	0.1956
## X0006.HK.Close	49.445	37.2657	6.1046	0.6388	-0.8205
## X0011.HK.Close	110.335	160.4655	12.6675	-0.5227	-0.0099
## X0012.HK.Close	47.505	67.6955	8.2277	-0.8819	0.2492
## X0013.HK.Close	65.127	256.6481	16.0202	0.3564	-1.0203
## X0016.HK.Close	109.413	327.3212	18.0920	-0.8457	0.6423
## X0017.HK.Close	12.951	11.0094	3.3180	-0.5284	-0.9270
## X0019.HK.Close	93.976	400.0416	20.0010	-0.4539	0.0024

## X0023.HK.Close	28.554	25.7925	5.0786	-1.2151	1.0367
## X0066.HK.Close	26.259	10.6478	3.2631	-1.3672	1.2124
## X0083.HK.Close	13.244	6.2328	2.4966	-1.0202	0.7336
## X0101.HK.Close	29.001	31.3637	5.6003	-0.5253	-0.0007
## X0144.HK.Close	26.309	25.7460	5.0741	-0.5217	0.3100
## X0151.HK.Close	5.922	1.8754	1.3695	-0.5375	-0.8207
## X0267.HK.Close	17.361	15.8124	3.9765	-0.4408	-0.5939
## X0291.HK.Close	26.534	43.0707	6.5628	-1.0124	-0.1123
## X0293.HK.Close	15.457	16.4772	4.0592	0.1220	-0.7495
## X0322.HK.Close	18.497	20.3342	4.5093	-0.7962	-0.1999
## X0330.HK.Close	40.227	217.0336	14.7321	-0.7010	-0.5027
## X0386.HK.Close	6.893	1.1925	1.0920	-0.4116	0.4933
## X0388.HK.Close	138.649	905.9650	30.0993	-0.5599	0.3037
## X0494.HK.Close	29.935	134.0478	11.5779	0.0003	-1.4370
## X0688.HK.Close	15.339	3.8326	1.9577	-0.7312	0.0846
## X0700.HK.Close	151.085	2231.3457	47.2371	-0.7072	-0.2749
## X0762.HK.Close	12.070	6.3500	2.5199	0.7117	-0.9342
## X0836.HK.Close	15.556	2.7840	1.6685	0.1506	-0.3175
## X0857.HK.Close	9.404	1.9702	1.4036	-0.7206	0.7086
## X0883.HK.Close	13.802	11.9372	3.4550	-0.0692	-0.7406
## X0939.HK.Close	6.182	0.8779	0.9370	-0.7314	0.0548
## X0941.HK.Close	75.918	15.9979	3.9997	0.0059	0.7431
## X1044.HK.Close	57.134	205.1339	14.3225	-0.7475	-0.5810
## X1088.HK.Close	32.045	33.9687	5.8283	-1.3754	1.4009
## X1109.HK.Close	14.582	6.7592	2.5999	-0.4263	-0.1795
## X1199.HK.Close	11.285	5.5685	2.3598	0.0731	-0.5250
## X1299.HK.Close	24.608	3.8642	1.9658	0.2862	-1.0141
## X1398.HK.Close	5.523	0.7402	0.8604	-0.9535	0.3620
## X1880.HK.Close	11.298	14.8179	3.8494	-0.4450	-0.9238
## X1898.HK.Close	10.598	4.7673	2.1834	-0.5180	0.3157
## X2318.HK.Close	66.344	181.2311	13.4622	-0.2071	-0.3278
## X2388.HK.Close	19.073	26.2072	5.1193	-0.4139	-0.2478
## X2600.HK.Close	6.795	3.0174	1.7371	-0.4156	-0.7588
## X2628.HK.Close	30.076	35.6228	5.9685	-0.3740	-0.9653
## X3328.HK.Close	7.703	2.3885	1.5455	-0.4687	-0.9136
## X3988.HK.Close	3.713	0.5046	0.7104	-0.7984	-0.3496

4.1 Higher Moments - Distinct

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

##      0001.HK 0002.HK 0003.HK 0004.HK 0005.HK 0006.HK 0011.HK
## CoSkewness    0.0000 0.0000 0.0000 0.000 0.000 0.0000 0.0000
## CoKurtosis    0.0000 0.0000 0.0000 0.000 0.000 0.0000 0.0000
## Beta CoVariance 0.9887 0.1470 0.3776 1.112 1.121 0.1142 0.6389
## Beta CoSkewness 1.0147 -0.5969 -0.4611 1.870 0.930 -0.1960 0.9730
## Beta CoKurtosis 0.9986 0.0865 0.3595 1.120 1.280 0.0890 0.7197
##      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 0.9476 1.0040 1.1363 0.7846 0.9397 0.5092
## Beta CoSkewness 2.075 0.0604 1.3891 0.5787 1.4467 1.8985 0.2137
## Beta CoKurtosis 1.075 0.9007 0.9864 1.1280 0.7974 0.9847 0.4532
##      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 1.166 1.092 1.310 0.4311 1.0805 0.8783 0.7658
## Beta CoSkewness 1.250 2.874 1.483 -1.5339 1.2888 0.1324 1.0505
## Beta CoKurtosis 1.172 1.166 1.208 0.3369 0.9848 0.7634 0.7537
##      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 0.3479 0.9372 0.9548 1.159 0.9712 1.187 0.9321
## Beta CoSkewness -0.1987 -0.8195 -0.1085 1.822 2.1768 3.879 1.6679
## Beta CoKurtosis 0.3078 0.8984 0.8895 1.145 0.9754 1.263 0.8976
##      0762.HK 0836.HK 0857.HK 0883.HK 0939.HK 0941.HK 1044.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 0.7066 0.5556 1.1005 1.282 1.0621 0.7100 0.4622
## Beta CoSkewness -0.5716 -0.8457 0.5149 0.849 0.5854 0.6943 0.0193
## Beta CoKurtosis 0.5420 0.4930 1.0089 1.209 1.0421 0.7032 0.3954
##      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 1.2140 1.165 1.3296 0.8235 1.129 0.8285 1.4968
## Beta CoSkewness 0.9615 3.502 0.6742 1.7711 1.002 0.1898 0.9424
## Beta CoKurtosis 1.0928 1.141 1.2568 0.9855 1.067 0.7701 1.3887
##      2318.HK 2388.HK 2600.HK 2628.HK 3328.HK 3988.HK
## CoSkewness    0.000 0.0000 0.000 0.0000 0.000 0.0000
## CoKurtosis    0.000 0.0000 0.000 0.0000 0.000 0.0000
## Beta CoVariance 1.330 0.8775 1.541 1.0966 1.194 1.0330
## Beta CoSkewness 2.125 0.8244 2.216 0.8932 0.979 0.2574
## Beta CoKurtosis 1.319 0.8493 1.449 1.0404 1.185 0.9703
```

4.2 Higher Moments - Combined

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

```
##           HSI Components to HSI Combined
## CoSkewness           0.0000
## CoKurtosis           0.0000
## Beta CoVariance      1.1862
## Beta CoSkewness      0.5333
## Beta CoKurtosis      1.1227
```

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  4.9066 1.45706 1.19903 1.17907 1.03522 1.00086
## Proportion of Variance 0.5016 0.04423 0.02995 0.02896 0.02233 0.02087
## Cumulative Proportion 0.5016 0.54579 0.57574 0.60470 0.62703 0.64790
##               Comp.7  Comp.8  Comp.9  Comp.10  Comp.11  Comp.12
## Standard deviation  0.96681 0.94794 0.9191 0.89138 0.86338 0.84734
## Proportion of Variance 0.01947 0.01872 0.0176 0.01655 0.01553 0.01496
## Cumulative Proportion 0.66737 0.68609 0.7037 0.72024 0.73577 0.75073
##               Comp.13  Comp.14  Comp.15  Comp.16  Comp.17  Comp.18
## Standard deviation  0.81867 0.80649 0.76816 0.76044 0.7495 0.7165
## Proportion of Variance 0.01396 0.01355 0.01229 0.01205 0.0117 0.0107
## Cumulative Proportion 0.76469 0.77824 0.79054 0.80258 0.8143 0.8250
##               Comp.19  Comp.20  Comp.21  Comp.22  Comp.23  Comp.24
## Standard deviation  0.70818 0.70525 0.684286 0.655126 0.651147 0.644673
## Proportion of Variance 0.01045 0.01036 0.009755 0.008941 0.008833 0.008658
## Cumulative Proportion 0.83543 0.84579 0.855546 0.864488 0.873321 0.881979
##               Comp.25  Comp.26  Comp.27  Comp.28  Comp.29
## Standard deviation  0.628331 0.619046 0.604338 0.595665 0.576395
## Proportion of Variance 0.008225 0.007984 0.007609 0.007392 0.006921
## Cumulative Proportion 0.890204 0.898188 0.905797 0.913189 0.920110
##               Comp.30  Comp.31  Comp.32  Comp.33  Comp.34
## Standard deviation  0.565976 0.560333 0.534623 0.525917 0.511776
## Proportion of Variance 0.006674 0.006541 0.005955 0.005762 0.005457
## Cumulative Proportion 0.926784 0.933325 0.939280 0.945042 0.950498
##               Comp.35  Comp.36  Comp.37  Comp.38  Comp.39
## Standard deviation  0.500133 0.494197 0.479970 0.461842 0.450242
## Proportion of Variance 0.005211 0.005088 0.004799 0.004444 0.004223
## Cumulative Proportion 0.955709 0.960798 0.965597 0.970041 0.974264
##               Comp.40  Comp.41  Comp.42  Comp.43  Comp.44
## Standard deviation  0.436812 0.420521 0.391239 0.388305 0.371300
## Proportion of Variance 0.003975 0.003684 0.003189 0.003141 0.002872
## Cumulative Proportion 0.978239 0.981923 0.985112 0.988253 0.991126
##               Comp.45  Comp.46  Comp.47  Comp.48
## Standard deviation  0.348307 0.327956 0.323140 0.304434
## Proportion of Variance 0.002527 0.002241 0.002175 0.001931
## Cumulative Proportion 0.993653 0.995894 0.998069 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      -0.169  0.153      -0.103      0.118
## X0002.HK      0.470      0.133  0.161      0.257
## X0003.HK      0.347      0.290 -0.126      0.142
## X0004.HK -0.161      -0.133
## X0005.HK -0.166
## X0006.HK      0.484      0.138      0.368      0.190
## X0011.HK -0.154      -0.149  0.230  0.109      0.182 -0.165
## X0012.HK -0.160      -0.178  0.108      -0.179      0.191
## X0013.HK -0.165      -0.124  0.131
## X0016.HK -0.172      -0.170      -0.127 -0.105  0.197
## X0017.HK -0.145      -0.227      -0.176  0.248
## X0019.HK -0.124      0.284      -0.165 -0.105 -0.225 -0.187
## X0023.HK -0.152      0.128  0.182      0.216 -0.293
## X0066.HK -0.140  0.148      0.199      -0.169      -0.245
```

##	X0083.HK	-0.154		-0.225			-0.103		0.248
##	X0101.HK	-0.153		-0.198		0.113		0.151	
##	X0144.HK	-0.152			-0.108	0.139	0.108	-0.160	0.118
##	X0151.HK		-0.107	0.471	0.241	-0.121	-0.195	-0.168	0.262
##	X0267.HK	-0.160				-0.124			
##	X0291.HK	-0.128				0.112	0.168	-0.232	0.111
##	X0293.HK	-0.130	-0.119		0.114	0.228	0.117	-0.284	-0.257
##	X0322.HK		-0.124	0.423	0.404			0.257	0.187
##	X0330.HK					-0.424	-0.292	0.512	-0.159
##	X0386.HK	-0.138	0.239	0.118	-0.177	-0.213	0.131	-0.215	-0.112
##	X0388.HK	-0.172				-0.146			
##	X0494.HK				-0.108	-0.295	0.230	0.377	0.306
##	X0688.HK	-0.154	-0.190		-0.132		0.149		
##	X0700.HK	-0.137		0.131		0.253	0.170		-0.196
##	X0762.HK	-0.126	0.140	0.261	-0.147		0.144	-0.173	-0.111
##	X0836.HK			-0.101	0.144	-0.660	0.332		0.176
##	X0857.HK	-0.156	0.167		-0.158	-0.114		-0.153	
##	X0883.HK	-0.167			-0.146				
##	X0939.HK	-0.174						-0.158	
##	X0941.HK	-0.123	0.300	0.130				-0.130	-0.180
##	X1044.HK	-0.102	-0.118	0.322	0.174	0.194	0.169	0.142	-0.188
##	X1088.HK	-0.165		0.104					
##	X1109.HK	-0.153	-0.227		-0.101		0.140		
##	X1199.HK	-0.156			-0.220		0.109	-0.120	0.103
##	X1299.HK	-0.132				0.362		0.310	-0.101
##	X1398.HK	-0.180			-0.116			-0.105	
##	X1880.HK	-0.130		0.115		0.303	0.219		
##	X1898.HK	-0.160				-0.196	0.109	0.120	-0.150
##	X2318.HK	-0.168			-0.108		-0.111	-0.101	
##	X2388.HK	-0.162				0.125			-0.231
##	X2600.HK	-0.159			-0.153				
##	X2628.HK	-0.160			-0.113		-0.190		
##	X3328.HK	-0.174			-0.141				
##	X3988.HK	-0.175					-0.111	0.125	
##		Comp.10	Comp.11	Comp.12	Comp.13	Comp.14	Comp.15	Comp.16	Comp.17
##	X0001.HK					0.112		0.107	
##	X0002.HK	-0.125			0.187			-0.231	
##	X0003.HK		0.311		-0.300			0.123	-0.126
##	X0004.HK					0.228		-0.193	0.234
##	X0005.HK			0.202				0.114	
##	X0006.HK	-0.194	-0.359				-0.231	0.149	
##	X0011.HK		0.115			0.102			
##	X0012.HK			-0.111	0.180		-0.106	-0.204	
##	X0013.HK	0.140			-0.182	0.106	0.113		
##	X0016.HK								
##	X0017.HK			0.330		-0.170		-0.176	-0.154
##	X0019.HK		-0.417	-0.188	-0.275		-0.108	-0.125	-0.141
##	X0023.HK			-0.144		0.100	0.161	0.201	
##	X0066.HK	0.121	0.133		0.101			0.299	0.211
##	X0083.HK				0.284		-0.179		
##	X0101.HK	0.127		-0.112	-0.112	-0.115		-0.191	
##	X0144.HK	0.168		0.131			0.254	0.179	
##	X0151.HK			0.111	-0.167	0.240	-0.122		
##	X0267.HK		-0.105			0.132	0.208		0.101
##	X0291.HK	-0.162	0.187	-0.464		-0.415	0.205	-0.119	
##	X0293.HK	0.175	-0.228			-0.168	0.184		
##	X0322.HK	-0.160		0.152	0.212	-0.293	0.337		0.115

## X0330.HK		0.242	0.108	0.156			-0.133	-0.128
## X0386.HK	0.110			-0.160				0.176
## X0388.HK			0.121					0.158
## X0494.HK	0.552	-0.167	-0.335			0.104		-0.192
## X0688.HK	-0.336	0.110	-0.138		0.185			
## X0700.HK	0.107				0.258	0.163	0.141	
## X0762.HK				0.288	0.149		-0.458	-0.183
## X0836.HK		-0.311		0.154		-0.146	0.216	
## X0857.HK	0.133		-0.107	-0.109		0.134		0.300
## X0883.HK						0.107		0.114
## X0939.HK					-0.240			-0.231
## X0941.HK		0.214	-0.168	0.192	0.105	0.148	0.106	-0.319
## X1044.HK	0.310	0.115	-0.213	0.142		-0.555		0.213
## X1088.HK				-0.175	0.146			
## X1109.HK	-0.313		-0.236		0.192			
## X1199.HK			0.213				0.242	0.104
## X1299.HK	0.102	0.295	0.227	-0.147		-0.120	-0.157	
## X1398.HK	-0.111				-0.236			-0.109
## X1880.HK				-0.399	0.120			-0.280
## X1898.HK		-0.114		-0.134				
## X2318.HK		-0.168				-0.102	-0.101	
## X2388.HK			0.117	-0.107	-0.129			-0.156
## X2600.HK	-0.136						-0.159	0.218
## X2628.HK							0.107	0.296
## X3328.HK					-0.140	-0.196	0.106	
## X3988.HK				0.122	-0.266		0.175	-0.170
##	Comp. 18	Comp. 19	Comp. 20	Comp. 21	Comp. 22	Comp. 23	Comp. 24	Comp. 25
## X0001.HK			0.107			0.140		0.150
## X0002.HK	0.168							0.152
## X0003.HK	-0.419	0.204	-0.109	-0.160	0.227			0.191
## X0004.HK	0.146			-0.141	-0.165	0.136	-0.213	
## X0005.HK	-0.123		-0.157		0.209	0.249	-0.137	
## X0006.HK	-0.115					0.127		-0.159
## X0011.HK	-0.107	0.164	0.160			-0.157		-0.210
## X0012.HK				0.102				
## X0013.HK			0.109		-0.162	0.167		0.323
## X0016.HK				0.150			0.165	
## X0017.HK			-0.130			-0.191		
## X0019.HK		0.119	-0.323	0.123	-0.112		0.262	-0.109
## X0023.HK		0.213		0.132	0.158	0.114		-0.267
## X0066.HK	0.329	-0.140	-0.155	-0.132		-0.276		
## X0083.HK				0.121	0.176		0.136	-0.140
## X0101.HK	-0.130	-0.288	0.265			-0.170		-0.360
## X0144.HK		0.355		0.162	-0.150	-0.101	-0.115	-0.115
## X0151.HK		0.108	0.258				-0.181	-0.190
## X0267.HK			-0.115		0.199		0.181	
## X0291.HK	0.176	0.193		-0.337	-0.115	0.173	0.124	
## X0293.HK	-0.358				0.170		-0.465	
## X0322.HK		-0.227	-0.111	0.125				
## X0330.HK	-0.133	-0.148	0.124			0.125	0.185	
## X0386.HK					-0.114	-0.273		
## X0388.HK				-0.221			-0.146	0.195
## X0494.HK			-0.161					
## X0688.HK	-0.126		-0.119	0.113		-0.163		0.230
## X0700.HK	-0.315	-0.191	0.190	-0.375	-0.103	-0.126	0.418	
## X0762.HK		0.277		-0.279	0.178			
## X0836.HK				-0.172				

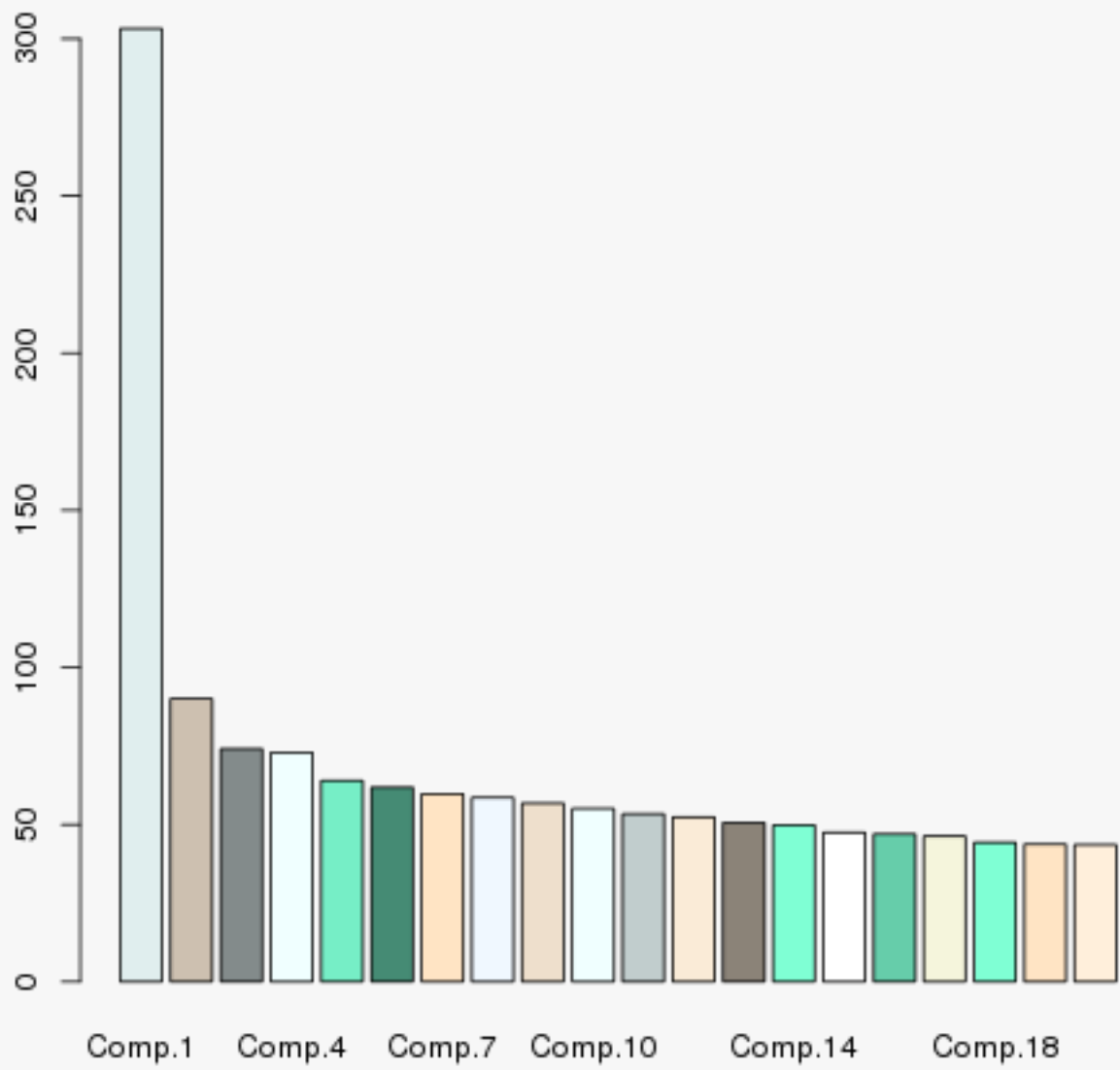
## X0857.HK			0.121	0.244	0.132			0.121
## X0883.HK			0.112	0.195	0.284	0.264	0.202	0.219
## X0939.HK						-0.116		
## X0941.HK	-0.225	-0.179	0.157	-0.336			-0.215	
## X1044.HK			0.150					0.118
## X1088.HK	0.124	0.314	0.171				-0.122	
## X1109.HK	-0.132	-0.124			-0.155	-0.120		0.178
## X1199.HK	0.169	0.143	-0.175		0.125			
## X1299.HK		-0.332		-0.363	0.187	0.143		-0.105
## X1398.HK								
## X1880.HK	0.370	-0.324	-0.151		0.424			
## X1898.HK			0.152	0.224			0.125	0.160
## X2318.HK	-0.129	-0.147		-0.168		0.235		
## X2388.HK		0.118	0.178	-0.144	-0.124		-0.152	0.317
## X2600.HK		0.163	-0.105			-0.425		-0.175
## X2628.HK	-0.127	-0.278	-0.167	-0.192		0.209	-0.218	-0.102
## X3328.HK					0.123			
## X3988.HK			0.111					
##	Comp. 26	Comp. 27	Comp. 28	Comp. 29	Comp. 30	Comp. 31	Comp. 32	Comp. 33
## X0001.HK			-0.106	0.129				-0.159
## X0002.HK			0.133		-0.356		-0.224	0.274
## X0003.HK		0.154				-0.212		
## X0004.HK	0.220	0.265			0.309	-0.201		0.119
## X0005.HK		-0.242	0.157	0.145	-0.298		-0.133	
## X0006.HK			-0.153		0.261		0.143	-0.165
## X0011.HK	-0.112		0.130		0.323	0.196	-0.297	
## X0012.HK	-0.128		-0.276	0.230	-0.110		-0.248	
## X0013.HK		-0.169	-0.244	0.243	-0.122		0.278	
## X0016.HK						-0.165		-0.337
## X0017.HK		-0.146	0.262	-0.251			0.429	0.148
## X0019.HK	0.168		0.204		-0.191			
## X0023.HK	0.175		0.152				0.267	
## X0066.HK			-0.318	-0.124	-0.153	0.126	0.118	
## X0083.HK	-0.114	-0.219		-0.131		0.245		
## X0101.HK		0.281	0.172		-0.229	-0.147	0.132	
## X0144.HK	-0.297	0.166		0.318		0.152		0.166
## X0151.HK	0.219		-0.157	-0.312			-0.128	
## X0267.HK	-0.445	0.363	-0.135	-0.227	0.158		0.121	0.119
## X0291.HK		-0.181		-0.101				
## X0293.HK			-0.284	-0.234				
## X0322.HK				0.172				-0.188
## X0330.HK	0.147			0.207		0.114		-0.109
## X0386.HK		-0.117	-0.104		0.147	0.250		-0.198
## X0388.HK				0.145	0.214		-0.103	
## X0494.HK							-0.132	
## X0688.HK				-0.150		0.123		
## X0700.HK		-0.118	0.125					
## X0762.HK							0.252	-0.268
## X0836.HK			0.183			-0.165	-0.119	0.128
## X0857.HK	0.229		0.145	-0.124	0.107			
## X0883.HK	0.216	0.118						0.287
## X0939.HK		0.176	-0.108					0.120
## X0941.HK		-0.105	0.186		0.192	-0.198		0.132
## X1044.HK	-0.126	0.104		0.136		-0.132	0.175	
## X1088.HK	-0.230	-0.101			-0.316	0.128	0.202	
## X1109.HK					-0.135	0.138		-0.107
## X1199.HK		0.278		-0.152	-0.205	-0.223	-0.144	-0.353

## X1299.HK			-0.193	-0.206				0.129
## X1398.HK			-0.107					
## X1880.HK				0.135				
## X1898.HK	-0.312	-0.244	-0.159	-0.258		-0.441		
## X2318.HK	-0.115	0.158		0.110		0.104		
## X2388.HK			0.282				-0.188	-0.337
## X2600.HK	0.156	-0.286		0.213		-0.373		0.127
## X2628.HK	-0.286	-0.124	0.187			0.102		
## X3328.HK				0.106				0.187
## X3988.HK		0.139				0.117	0.112	
##	Comp.34	Comp.35	Comp.36	Comp.37	Comp.38	Comp.39	Comp.40	Comp.41
## X0001.HK	0.146	-0.133			0.242	-0.179		0.331
## X0002.HK		0.107		-0.149	0.138	-0.185		
## X0003.HK		0.181	-0.112					
## X0004.HK	-0.325		-0.239		0.190	0.261	0.112	
## X0005.HK	-0.300	-0.387	0.299	0.191	0.191			-0.161
## X0006.HK		-0.188						
## X0011.HK	0.142	-0.292	-0.218	0.109			-0.345	
## X0012.HK		-0.167	0.122	-0.311	-0.207			-0.266
## X0013.HK			0.111	0.141			-0.298	
## X0016.HK	0.146		-0.129			-0.128	0.316	
## X0017.HK	0.111	-0.105		-0.251			-0.140	-0.156
## X0019.HK			-0.123	0.118				
## X0023.HK		0.198	0.266	-0.313		-0.186		-0.106
## X0066.HK	0.104			0.148		0.292		-0.155
## X0083.HK	-0.261	0.482		0.199		0.128		0.236
## X0101.HK			0.106	0.347	0.155		-0.103	
## X0144.HK	0.232	0.161			0.278		0.148	-0.193
## X0151.HK	0.123		0.145					
## X0267.HK	-0.127	-0.239	0.317					0.230
## X0291.HK		-0.153						
## X0293.HK			-0.123					
## X0322.HK			-0.102			0.150		
## X0330.HK								
## X0386.HK	-0.263			-0.148	0.217	-0.144	-0.197	
## X0388.HK	-0.220	0.178		0.174	-0.206	-0.472	0.102	-0.209
## X0494.HK								
## X0688.HK			-0.126	0.111	0.192		-0.142	
## X0700.HK			-0.103				0.134	-0.142
## X0762.HK	0.165		-0.119	0.124	0.116			
## X0836.HK								
## X0857.HK			0.133			0.131	0.123	-0.231
## X0883.HK	0.246		-0.145	0.249	-0.123			0.110
## X0939.HK	-0.157	-0.109		0.231	-0.159	-0.127		0.150
## X0941.HK				0.121	-0.174		-0.127	
## X1044.HK								
## X1088.HK	-0.237		-0.278		-0.448	0.119	0.159	0.143
## X1109.HK								-0.134
## X1199.HK			-0.101	-0.118	-0.193		-0.407	0.108
## X1299.HK							0.223	
## X1398.HK				-0.124			0.159	-0.135
## X1880.HK								
## X1898.HK		0.132	-0.106	0.124	0.234			-0.284
## X2318.HK	0.179	0.349	0.212		-0.148	0.254	-0.288	-0.177
## X2388.HK			0.268			0.365	0.172	0.189
## X2600.HK	0.226		0.221		-0.175			0.302
## X2628.HK	0.351		-0.153			-0.222	0.160	0.141

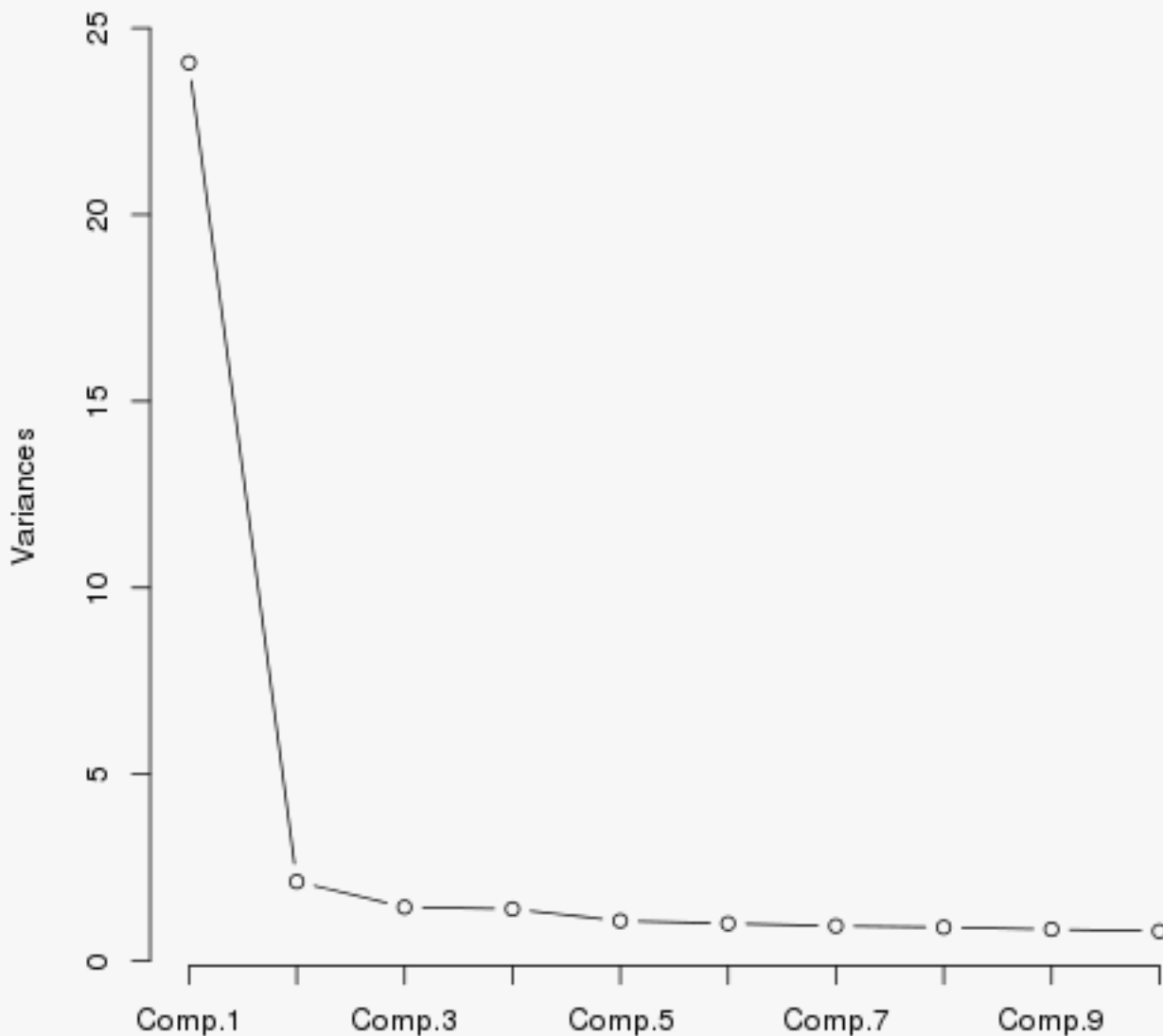
##	X3328.HK	-0.101	-0.102	-0.286	-0.358	0.261	0.137	-0.166	0.213
##	X3988.HK						-0.156		
##		Comp.42	Comp.43	Comp.44	Comp.45	Comp.46	Comp.47	Comp.48	
##	X0001.HK	0.180		0.370		0.121	-0.503	-0.121	
##	X0002.HK		0.194						
##	X0003.HK								
##	X0004.HK		0.161	-0.180					
##	X0005.HK	0.149	0.150						
##	X0006.HK		-0.162						
##	X0011.HK	-0.134	0.200			0.107			
##	X0012.HK		-0.277	-0.180	-0.292				
##	X0013.HK	-0.257					0.409		
##	X0016.HK		0.277	-0.123	0.360		0.408	0.271	
##	X0017.HK	0.116							
##	X0019.HK	-0.133			-0.135				
##	X0023.HK	0.152		-0.108	-0.169			0.138	
##	X0066.HK	0.122							
##	X0083.HK	-0.176						-0.125	
##	X0101.HK	0.105	-0.223						
##	X0144.HK								
##	X0151.HK								
##	X0267.HK				0.102	-0.138			
##	X0291.HK								
##	X0293.HK								
##	X0322.HK								
##	X0330.HK								
##	X0386.HK	0.245		-0.337					
##	X0388.HK	0.143	-0.277	0.250	0.116	-0.225			
##	X0494.HK								
##	X0688.HK	0.144			-0.291	-0.506		0.160	
##	X0700.HK		-0.128						
##	X0762.HK								
##	X0836.HK								
##	X0857.HK	-0.399	0.107	0.431					
##	X0883.HK	0.229	-0.284	-0.314	0.119				
##	X0939.HK		0.192		-0.393	0.407		0.394	
##	X0941.HK				0.120			-0.127	
##	X1044.HK		0.114						
##	X1088.HK	0.169					-0.105		
##	X1109.HK	-0.165	-0.160		0.295	0.528		-0.136	
##	X1199.HK				-0.131				
##	X1299.HK		-0.104						
##	X1398.HK	0.227	0.171	0.106	-0.106		0.280	-0.722	
##	X1880.HK	-0.102	0.109						
##	X1898.HK					0.117	-0.144		
##	X2318.HK	0.271	0.260	0.166	0.187		-0.101	0.166	
##	X2388.HK		-0.156	-0.141					
##	X2600.HK								
##	X2628.HK	-0.129		-0.174	-0.287				
##	X3328.HK		-0.342	0.255	0.257		0.230	0.221	
##	X3988.HK	-0.405	0.213	-0.298	0.309	-0.341	-0.373		
##									
##		Comp.1	Comp.2	Comp.3	Comp.4	Comp.5	Comp.6	Comp.7	Comp.8
##	SS loadings	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
##	Proportion Var	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
##	Cumulative Var	0.021	0.042	0.062	0.083	0.104	0.125	0.146	0.167
##		Comp.9	Comp.10	Comp.11	Comp.12	Comp.13	Comp.14	Comp.15	

## SS loadings	1.000	1.000	1.000	1.000	1.000	1.000	1.000
## Proportion Var	0.021	0.021	0.021	0.021	0.021	0.021	0.021
## Cumulative Var	0.187	0.208	0.229	0.250	0.271	0.292	0.312
##	Comp.16	Comp.17	Comp.18	Comp.19	Comp.20	Comp.21	Comp.22
## SS loadings	1.000	1.000	1.000	1.000	1.000	1.000	1.000
## Proportion Var	0.021	0.021	0.021	0.021	0.021	0.021	0.021
## Cumulative Var	0.333	0.354	0.375	0.396	0.417	0.437	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	0.687	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	0.937	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 n factors. The eigen vectors are rescaled by the sqrt of the eigen values to produce the component loadings more typical in factor analysis.⁶

Rotation Methods⁷ 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).

⁶from 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 -0.05  0.06 -0.14 -0.06 0.81 0.19
## X3988.HK  48 0.86  0.01  0.06 -0.10  0.01 0.75 0.25
## X0939.HK  33 0.86 -0.01  0.11 -0.11  0.00 0.76 0.24
## X3328.HK  47 0.85 -0.04  0.02 -0.17  0.03 0.76 0.24
## X0001.HK   1 0.85 -0.03 -0.20  0.18 -0.06 0.80 0.20
## X0388.HK  25 0.85 -0.08 -0.08  0.06 -0.04 0.73 0.27
## X0016.HK  10 0.84  0.00 -0.20  0.10 -0.09 0.77 0.23
## X2318.HK  43 0.83 -0.12  0.01 -0.13 -0.06 0.72 0.28
## X0883.HK  32 0.82  0.06  0.10 -0.17 -0.03 0.71 0.29
## X0005.HK   5 0.81  0.01  0.01 -0.11 -0.02 0.68 0.32
## X0013.HK   9 0.81 -0.05 -0.15  0.16 -0.04 0.71 0.29
## X1088.HK  36 0.81  0.06  0.12 -0.09  0.07 0.69 0.31
## X2388.HK  44 0.80 -0.04  0.00  0.07 -0.13 0.66 0.34
## X0004.HK   4 0.79 -0.13 -0.16  0.06 -0.05 0.67 0.33
## X0012.HK   8 0.79  0.01 -0.21  0.13 -0.01 0.68 0.32
## X2628.HK  46 0.79  0.02  0.05 -0.13 -0.01 0.64 0.36
## X0267.HK  19 0.79 -0.13  0.07  0.06  0.10 0.65 0.35
## X1898.HK  42 0.78 -0.01  0.03 -0.12 -0.01 0.63 0.37
## X2600.HK  45 0.78 -0.09  0.01 -0.18 -0.04 0.65 0.35
## X1199.HK  38 0.77 -0.02 -0.03 -0.26  0.05 0.66 0.34
## X0857.HK  31 0.76  0.24  0.10 -0.19  0.12 0.70 0.30
## X0011.HK   7 0.76  0.00 -0.18  0.27 -0.11 0.69 0.31
## X0083.HK  15 0.76 -0.04 -0.27  0.07 -0.04 0.65 0.35
## X0688.HK  27 0.75 -0.28 -0.02 -0.16 -0.07 0.68 0.32
## X0101.HK  16 0.75  0.02 -0.24  0.05  0.03 0.62 0.38
## X1109.HK  37 0.75 -0.33 -0.03 -0.12  0.02 0.69 0.31
## X0144.HK  17 0.75  0.00  0.05 -0.13  0.10 0.59 0.41
## X0023.HK  13 0.75  0.02 -0.02  0.15 -0.19 0.61 0.39
## X0017.HK  11 0.71 -0.10 -0.27  0.07  0.04 0.60 0.40
## X0066.HK  14 0.69  0.22 -0.09  0.24  0.02 0.58 0.42
## X0386.HK  24 0.68  0.35  0.14 -0.21  0.22 0.70 0.30
## X0700.HK  28 0.67 -0.09  0.16 -0.10 -0.26 0.56 0.44
## X1299.HK  39 0.65 -0.01  0.00  0.06  0.04 0.43 0.57
## X1880.HK  41 0.64 -0.12  0.14 -0.08 -0.08 0.45 0.55
## X0293.HK  21 0.64 -0.17 -0.09  0.13 -0.04 0.46 0.54
## X0291.HK  20 0.63 -0.03 -0.07  0.04  0.00 0.40 0.60
## X0762.HK  29 0.62  0.20  0.31 -0.17  0.09 0.56 0.44
## X0019.HK  12 0.61 -0.02 -0.01  0.34  0.04 0.49 0.51
## X0941.HK  34 0.60  0.44  0.16 -0.03  0.07 0.58 0.42
## X1044.HK  35 0.50 -0.17  0.39  0.20 -0.20 0.51 0.49
## X0494.HK  26 0.47  0.02  0.03 -0.13 -0.07 0.25 0.75
## X0330.HK  23 0.45 -0.14 -0.03 -0.06  0.44 0.42 0.58
## X0006.HK   6 0.20  0.71 -0.02 -0.09 -0.14 0.57 0.43
## X0002.HK   2 0.41  0.68  0.02  0.16 -0.17 0.69 0.31
## X0003.HK   3 0.46  0.51 -0.03  0.34  0.13 0.60 0.40
## X0151.HK  18 0.45 -0.16  0.56  0.28  0.13 0.64 0.36
## X0322.HK  22 0.33 -0.18  0.51  0.48  0.00 0.63 0.37
## X0836.HK  30 0.39 -0.04 -0.12  0.17  0.68 0.66 0.34
##
##      PC1  PC2  PC3  PC4  PC5
## SS loadings 24.07 2.12 1.44 1.39 1.07
```

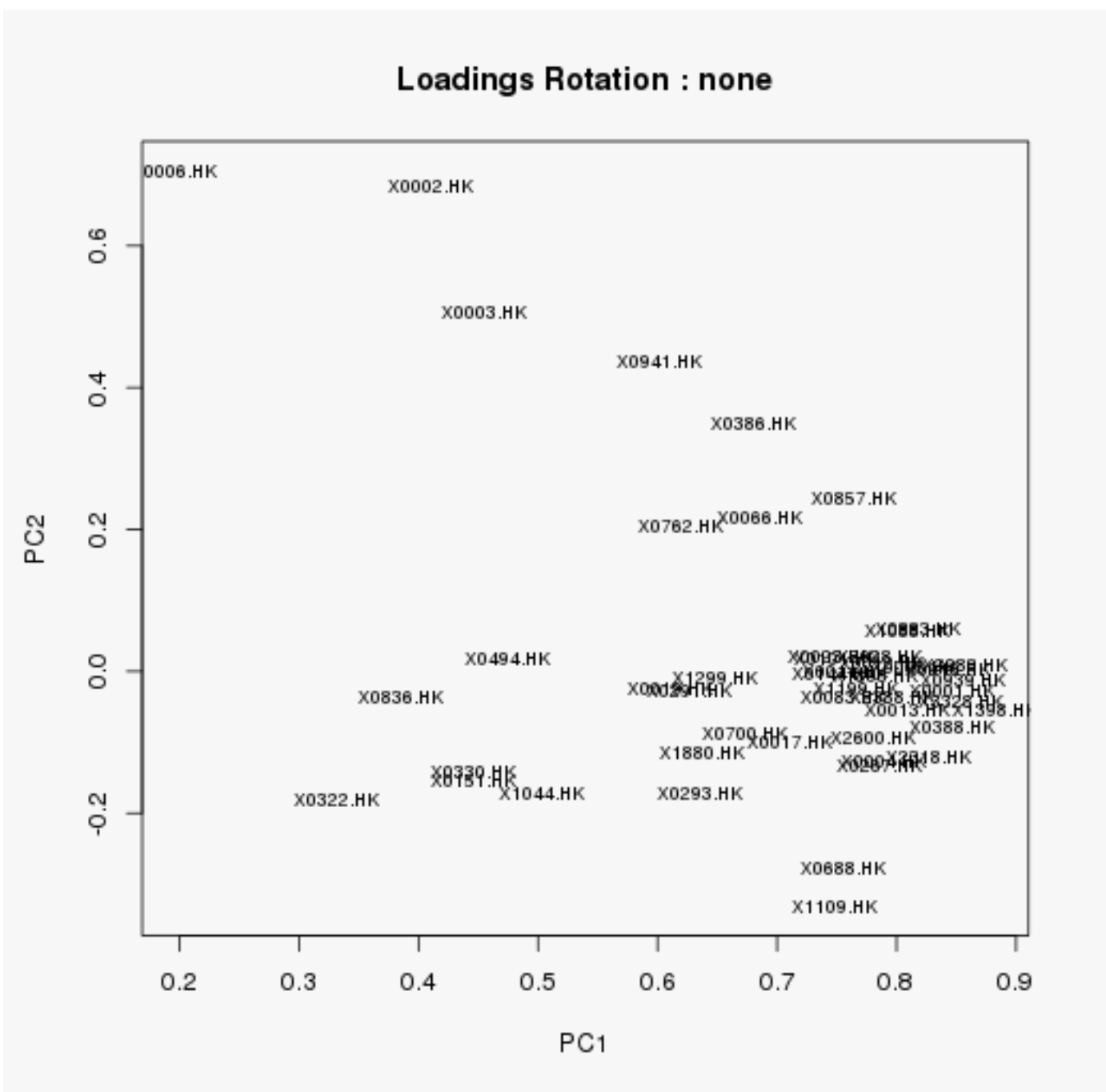
```

## Proportion Var  0.50 0.04 0.03 0.03 0.02
## Cumulative Var  0.50 0.55 0.58 0.60 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 41.11 0.3
## The degrees of freedom for the model are 898 and the objective function was 6.47
## 0.3The number of observations was 311 with Chi Square = 1875 with prob < 4.1e-71
## 0.3
## Fit based upon off diagonal values = 0.99

##          PC1          PC2
## X0001.HK 0.8470 -0.0270931
## X0002.HK 0.4107  0.6847039
## X0003.HK 0.4556  0.5061185
## X0004.HK 0.7888 -0.1268691
## X0005.HK 0.8140  0.0051068
## X0006.HK 0.1962  0.7056289
## X0011.HK 0.7566 -0.0006383
## X0012.HK 0.7873  0.0126118
## X0013.HK 0.8095 -0.0531362
## X0016.HK 0.8438  0.0034188
## X0017.HK 0.7105 -0.0983431
## X0019.HK 0.6099 -0.0229067
## X0023.HK 0.7454  0.0221132
## X0066.HK 0.6854  0.2157397
## X0083.HK 0.7560 -0.0353666
## X0101.HK 0.7492  0.0167056
## X0144.HK 0.7477 -0.0037675
## X0151.HK 0.4458 -0.1554312
## X0267.HK 0.7851 -0.1338092
## X0291.HK 0.6259 -0.0266267
## X0293.HK 0.6359 -0.1729196
## X0322.HK 0.3312 -0.1808705
## X0330.HK 0.4461 -0.1404710
## X0386.HK 0.6793  0.3487265
## X0388.HK 0.8457 -0.0788502
## X0494.HK 0.4739  0.0172768
## X0688.HK 0.7545 -0.2773207
## X0700.HK 0.6722 -0.0869588
## X0762.HK 0.6191  0.2042328
## X0836.HK 0.3859 -0.0361670
## X0857.HK 0.7646  0.2428152
## X0883.HK 0.8179  0.0610982
## X0939.HK 0.8557 -0.0127088
## X0941.HK 0.6020  0.4376477
## X1044.HK 0.5028 -0.1712557
## X1088.HK 0.8091  0.0581286
## X1109.HK 0.7489 -0.3311717
## X1199.HK 0.7658 -0.0230547
## X1299.HK 0.6476 -0.0079834
## X1398.HK 0.8830 -0.0547920
## X1880.HK 0.6373 -0.1156912
## X1898.HK 0.7827 -0.0063552
## X2318.HK 0.8261 -0.1205348
## X2388.HK 0.7967 -0.0371692
## X2600.HK 0.7797 -0.0935673

```

```
## X2628.HK 0.7862 0.0215040
## X3328.HK 0.8541 -0.0424729
## X3988.HK 0.8576 0.0075686
```



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  0.15  0.19  0.08  0.81  0.19
## X3328.HK  47 0.69  0.47  0.14  0.12  0.16  0.76  0.24
## X0883.HK  32 0.69  0.39  0.24  0.15  0.09  0.71  0.29
## X1199.HK  38 0.68  0.39  0.12  0.01  0.16  0.66  0.34
## X0939.HK  33 0.68  0.44  0.19  0.22  0.13  0.76  0.24
## X3988.HK  48 0.65  0.47  0.20  0.18  0.15  0.75  0.25
## X2600.HK  45 0.65  0.45  0.07  0.10  0.08  0.65  0.35
## X2318.HK  43 0.65  0.51  0.07  0.15  0.08  0.72  0.28
## X0857.HK  31 0.64  0.28  0.39  0.09  0.22  0.70  0.30
## X0688.HK  27 0.63  0.50 -0.10  0.13  0.06  0.68  0.32
## X1088.HK  36 0.63  0.39  0.25  0.22  0.19  0.69  0.31
## X2628.HK  46 0.63  0.42  0.19  0.14  0.11  0.64  0.36
## X0005.HK   5 0.62  0.48  0.19  0.13  0.12  0.68  0.32
## X1898.HK  42 0.61  0.44  0.17  0.14  0.12  0.63  0.37
## X0386.HK  24 0.60  0.15  0.47  0.07  0.29  0.70  0.30
## X0762.HK  29 0.60  0.09  0.34  0.24  0.14  0.56  0.44
## X1109.HK  37 0.60  0.51 -0.15  0.15  0.15  0.69  0.31
## X0144.HK  17 0.60  0.38  0.16  0.13  0.22  0.59  0.41
## X0700.HK  28 0.57  0.38  0.08  0.24 -0.16  0.56  0.44
## X1880.HK  41 0.53  0.34  0.04  0.23  0.02  0.45  0.55
## X0267.HK  19 0.51  0.49  0.08  0.30  0.24  0.65  0.35
## X0494.HK  26 0.41  0.25  0.12  0.06  0.00  0.25  0.75
## X0001.HK   1 0.39  0.75  0.20  0.15  0.13  0.80  0.20
## X0011.HK   7 0.27  0.73  0.22  0.19  0.07  0.69  0.31
## X0016.HK  10 0.44  0.72  0.21  0.09  0.09  0.77  0.23
## X0013.HK   9 0.40  0.69  0.16  0.17  0.13  0.71  0.29
## X0083.HK  15 0.38  0.68  0.14  0.02  0.13  0.65  0.35
## X0012.HK   8 0.38  0.68  0.21  0.09  0.16  0.68  0.32
## X0004.HK   4 0.45  0.66  0.07  0.12  0.12  0.67  0.33
## X0017.HK  11 0.35  0.65  0.07  0.02  0.21  0.60  0.40
## X0388.HK  25 0.51  0.64  0.14  0.18  0.12  0.73  0.27
## X0101.HK  16 0.39  0.63  0.19  0.02  0.19  0.62  0.38
## X0023.HK  13 0.39  0.59  0.23  0.24 -0.03  0.61  0.39
## X2388.HK  44 0.49  0.58  0.17  0.23  0.02  0.66  0.34
## X0293.HK  21 0.32  0.56  0.01  0.19  0.10  0.46  0.54
## X0066.HK  14 0.25  0.55  0.40  0.17  0.17  0.58  0.42
## X0019.HK  12 0.17  0.53  0.18  0.33  0.18  0.49  0.51
## X0291.HK  20 0.37  0.47  0.13  0.12  0.13  0.40  0.60
## X1299.HK  39 0.39  0.43  0.16  0.19  0.16  0.43  0.57
## X0002.HK   2 0.12  0.22  0.78  0.06 -0.09  0.69  0.31
## X0006.HK   6 0.13 -0.01  0.71 -0.17 -0.13  0.57  0.43
## X0003.HK   3 0.02  0.32  0.64  0.17  0.23  0.60  0.40
## X0941.HK  34 0.43  0.19  0.57  0.15  0.14  0.58  0.42
## X0322.HK  22 0.06  0.16  0.02  0.77  0.06  0.63  0.37
## X0151.HK  18 0.27  0.09  0.04  0.72  0.18  0.64  0.36
## X1044.HK  35 0.32  0.27  0.02  0.57 -0.12  0.51  0.49
```

```

## X0836.HK    30 0.09  0.24  0.06  0.08  0.76 0.66 0.34
## X0330.HK    23 0.33  0.21 -0.05  0.06  0.51 0.42 0.58
##
##              PC1   PC4  PC2  PC3  PC5
## SS loadings    11.48 10.78 3.40 2.64 1.80
## Proportion Var  0.24  0.22 0.07 0.06 0.04
## Cumulative Var  0.24  0.46 0.53 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 41.11 0.3
## The degrees of freedom for the model are 898 and the objective function was 6.47
## 0.3The number of observations was 311 with Chi Square = 1875 with prob < 4.1e-71
## 0.3
## Fit based upon off diagonal values = 0.99

##              PC1           PC4
## X0001.HK 0.38739 0.754221
## X0002.HK 0.11868 0.224672
## X0003.HK 0.01809 0.322920
## X0004.HK 0.45321 0.656722
## X0005.HK 0.61937 0.475893
## X0006.HK 0.13294 -0.005283
## X0011.HK 0.27101 0.726519
## X0012.HK 0.37584 0.681524
## X0013.HK 0.39668 0.689272
## X0016.HK 0.44053 0.717026
## X0017.HK 0.35238 0.651522
## X0019.HK 0.17500 0.534193
## X0023.HK 0.39033 0.592234
## X0066.HK 0.25090 0.545549
## X0083.HK 0.38369 0.683327
## X0101.HK 0.39418 0.627813
## X0144.HK 0.59744 0.376228
## X0151.HK 0.27345 0.087674
## X0267.HK 0.50957 0.492346
## X0291.HK 0.36977 0.465854
## X0293.HK 0.32186 0.559099
## X0322.HK 0.05514 0.160351
## X0330.HK 0.32757 0.211541
## X0386.HK 0.60157 0.151143
## X0388.HK 0.50810 0.638307
## X0494.HK 0.41125 0.246385
## X0688.HK 0.62800 0.501394
## X0700.HK 0.57471 0.375767
## X0762.HK 0.60101 0.088045
## X0836.HK 0.09303 0.242788
## X0857.HK 0.64265 0.282081
## X0883.HK 0.68599 0.393442
## X0939.HK 0.67766 0.442932
## X0941.HK 0.42572 0.186651
## X1044.HK 0.32432 0.267716
## X1088.HK 0.62700 0.386413
## X1109.HK 0.59919 0.506435
## X1199.HK 0.68154 0.391275
## X1299.HK 0.39024 0.432242
## X1398.HK 0.70535 0.497402

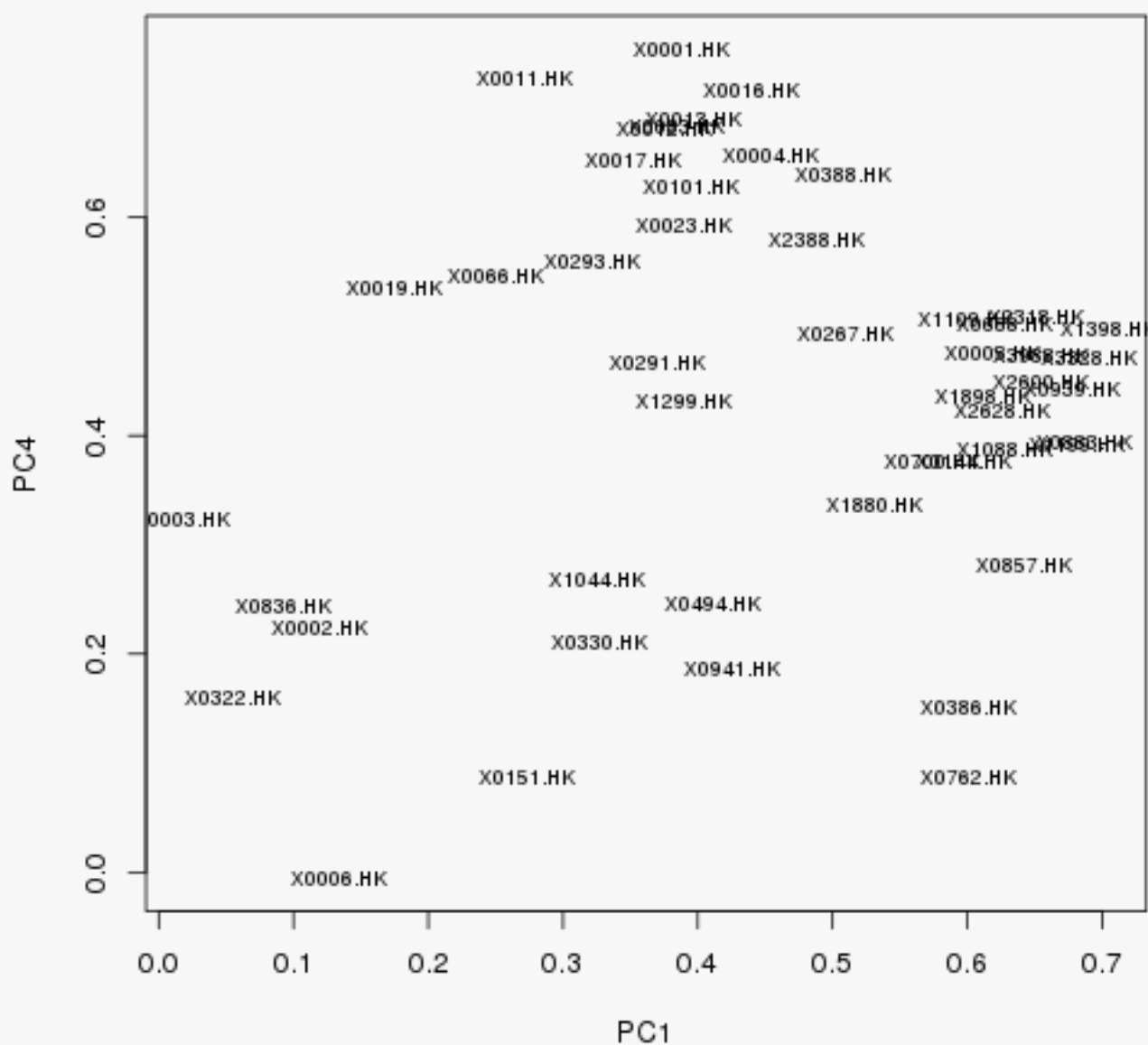
```

```

## X1880.HK 0.53143 0.336095
## X1898.HK 0.61147 0.436549
## X2318.HK 0.65181 0.508003
## X2388.HK 0.48719 0.579196
## X2600.HK 0.65400 0.448146
## X2628.HK 0.62615 0.421655
## X3328.HK 0.69088 0.471352
## X3988.HK 0.65431 0.473734

```

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 -0.05 0.06 -0.14 -0.06 0.81 0.19
## X3988.HK  48 0.86  0.01 0.06 -0.10  0.01 0.75 0.25
## X0939.HK  33 0.86 -0.01 0.11 -0.11  0.00 0.76 0.24
## X3328.HK  47 0.85 -0.04 0.02 -0.17  0.03 0.76 0.24
## X0001.HK   1 0.85 -0.03 -0.20  0.18 -0.06 0.80 0.20
## X0388.HK  25 0.85 -0.08 -0.08  0.06 -0.04 0.73 0.27
## X0016.HK  10 0.84  0.00 -0.20  0.10 -0.09 0.77 0.23
## X2318.HK  43 0.83 -0.12 0.01 -0.13 -0.06 0.72 0.28
## X0883.HK  32 0.82  0.06 0.10 -0.17 -0.03 0.71 0.29
## X0005.HK   5 0.81  0.01 0.01 -0.11 -0.02 0.68 0.32
## X0013.HK   9 0.81 -0.05 -0.15  0.16 -0.04 0.71 0.29
## X1088.HK  36 0.81  0.06 0.12 -0.09  0.07 0.69 0.31
## X2388.HK  44 0.80 -0.04 0.00  0.07 -0.13 0.66 0.34
## X0004.HK   4 0.79 -0.13 -0.16  0.06 -0.05 0.67 0.33
## X0012.HK   8 0.79  0.01 -0.21  0.13 -0.01 0.68 0.32
## X2628.HK  46 0.79  0.02 0.05 -0.13 -0.01 0.64 0.36
## X0267.HK  19 0.79 -0.13 0.07  0.06  0.10 0.65 0.35
## X1898.HK  42 0.78 -0.01 0.03 -0.12 -0.01 0.63 0.37
## X2600.HK  45 0.78 -0.09 0.01 -0.18 -0.04 0.65 0.35
## X1199.HK  38 0.77 -0.02 -0.03 -0.26  0.05 0.66 0.34
## X0857.HK  31 0.76  0.24 0.10 -0.19  0.12 0.70 0.30
## X0011.HK   7 0.76  0.00 -0.18  0.27 -0.11 0.69 0.31
## X0083.HK  15 0.76 -0.04 -0.27  0.07 -0.04 0.65 0.35
## X0688.HK  27 0.75 -0.28 -0.02 -0.16 -0.07 0.68 0.32
## X0101.HK  16 0.75  0.02 -0.24  0.05  0.03 0.62 0.38
## X1109.HK  37 0.75 -0.33 -0.03 -0.12  0.02 0.69 0.31
## X0144.HK  17 0.75  0.00 0.05 -0.13  0.10 0.59 0.41
## X0023.HK  13 0.75  0.02 -0.02  0.15 -0.19 0.61 0.39
## X0017.HK  11 0.71 -0.10 -0.27  0.07  0.04 0.60 0.40
## X0066.HK  14 0.69  0.22 -0.09  0.24  0.02 0.58 0.42
## X0386.HK  24 0.68  0.35 0.14 -0.21  0.22 0.70 0.30
## X0700.HK  28 0.67 -0.09 0.16 -0.10 -0.26 0.56 0.44
## X1299.HK  39 0.65 -0.01 0.00  0.06  0.04 0.43 0.57
## X1880.HK  41 0.64 -0.12 0.14 -0.08 -0.08 0.45 0.55
## X0293.HK  21 0.64 -0.17 -0.09  0.13 -0.04 0.46 0.54
## X0291.HK  20 0.63 -0.03 -0.07  0.04  0.00 0.40 0.60
## X0762.HK  29 0.62  0.20 0.31 -0.17  0.09 0.56 0.44
## X0019.HK  12 0.61 -0.02 -0.01  0.34  0.04 0.49 0.51
## X0941.HK  34 0.60  0.44 0.16 -0.03  0.07 0.58 0.42
## X1044.HK  35 0.50 -0.17 0.39  0.20 -0.20 0.51 0.49
## X0494.HK  26 0.47  0.02 0.03 -0.13 -0.07 0.25 0.75
## X0330.HK  23 0.45 -0.14 -0.03 -0.06  0.44 0.42 0.58
## X0006.HK   6 0.20  0.71 -0.02 -0.09 -0.14 0.57 0.43
## X0002.HK   2 0.41  0.68 0.02  0.16 -0.17 0.69 0.31
## X0003.HK   3 0.46  0.51 -0.03  0.34  0.13 0.60 0.40
## X0151.HK  18 0.45 -0.16 0.56  0.28  0.13 0.64 0.36
## X0322.HK  22 0.33 -0.18 0.51  0.48  0.00 0.63 0.37
## X0836.HK  30 0.39 -0.04 -0.12  0.17  0.68 0.66 0.34
```

```

##
##          PC1  PC2  PC3  PC4  PC5
## SS loadings    24.07 2.12 1.44 1.39 1.07
## Proportion Var  0.50 0.04 0.03 0.03 0.02
## Cumulative Var  0.50 0.55 0.58 0.60 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 41.11 0.3
## The degrees of freedom for the model are 898 and the objective function was 6.47
## 0.3The number of observations was 311 with Chi Square = 1875 with prob < 4.1e-71
## 0.3
## Fit based upon off diagonal values = 0.99

##          PC1          PC2
## X0001.HK 0.8470 -0.0270931
## X0002.HK 0.4107  0.6847039
## X0003.HK 0.4556  0.5061185
## X0004.HK 0.7888 -0.1268691
## X0005.HK 0.8140  0.0051068
## X0006.HK 0.1962  0.7056289
## X0011.HK 0.7566 -0.0006383
## X0012.HK 0.7873  0.0126118
## X0013.HK 0.8095 -0.0531362
## X0016.HK 0.8438  0.0034188
## X0017.HK 0.7105 -0.0983431
## X0019.HK 0.6099 -0.0229067
## X0023.HK 0.7454  0.0221132
## X0066.HK 0.6854  0.2157397
## X0083.HK 0.7560 -0.0353666
## X0101.HK 0.7492  0.0167056
## X0144.HK 0.7477 -0.0037675
## X0151.HK 0.4458 -0.1554312
## X0267.HK 0.7851 -0.1338092
## X0291.HK 0.6259 -0.0266267
## X0293.HK 0.6359 -0.1729196
## X0322.HK 0.3312 -0.1808705
## X0330.HK 0.4461 -0.1404710
## X0386.HK 0.6793  0.3487265
## X0388.HK 0.8457 -0.0788502
## X0494.HK 0.4739  0.0172768
## X0688.HK 0.7545 -0.2773207
## X0700.HK 0.6722 -0.0869588
## X0762.HK 0.6191  0.2042328
## X0836.HK 0.3859 -0.0361670
## X0857.HK 0.7646  0.2428152
## X0883.HK 0.8179  0.0610982
## X0939.HK 0.8557 -0.0127088
## X0941.HK 0.6020  0.4376477
## X1044.HK 0.5028 -0.1712557
## X1088.HK 0.8091  0.0581286
## X1109.HK 0.7489 -0.3311717
## X1199.HK 0.7658 -0.0230547
## X1299.HK 0.6476 -0.0079834
## X1398.HK 0.8830 -0.0547920
## X1880.HK 0.6373 -0.1156912
## X1898.HK 0.7827 -0.0063552

```

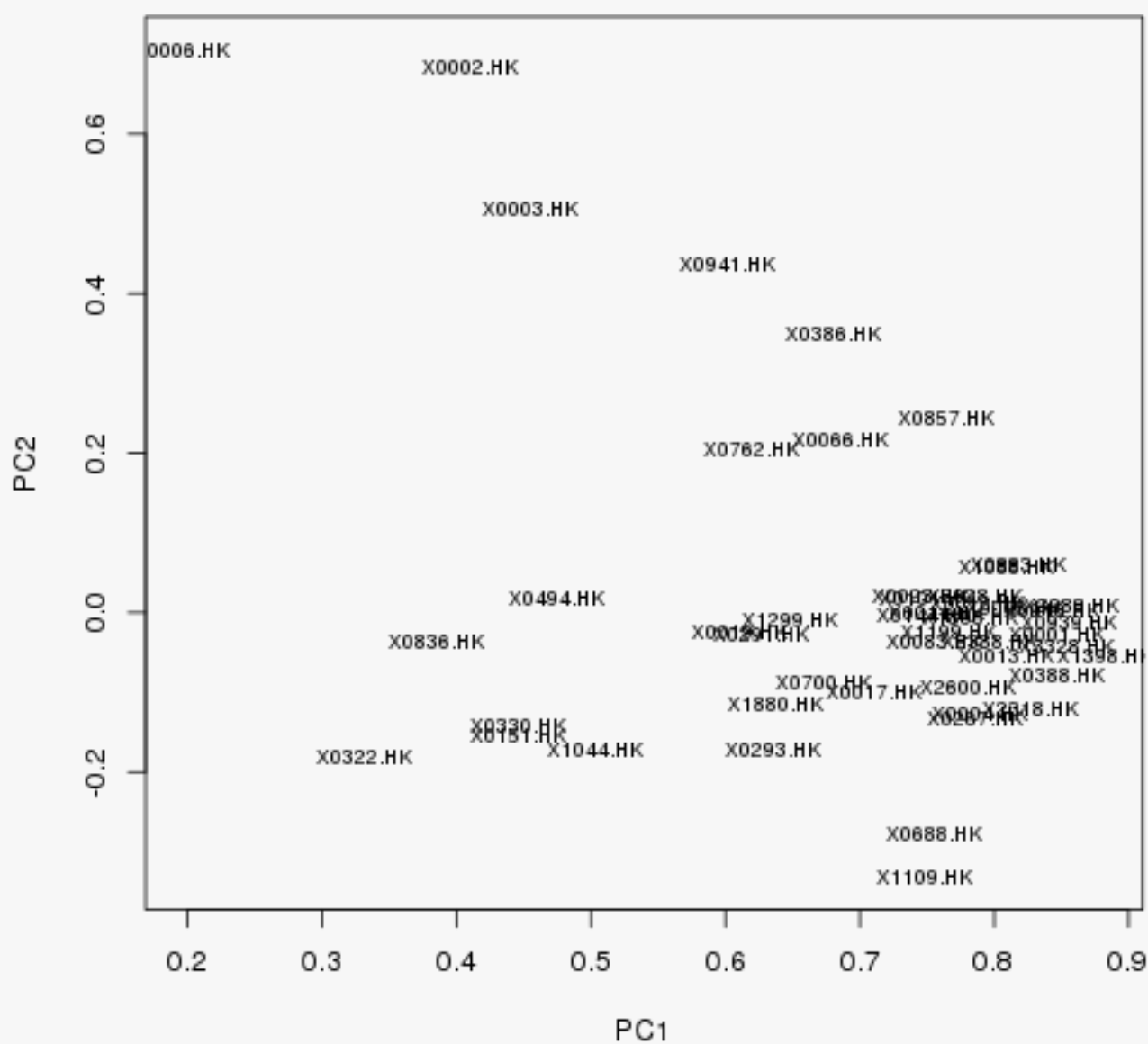


```

## X2318.HK 0.8261 -0.1205348
## X2388.HK 0.7967 -0.0371692
## X2600.HK 0.7797 -0.0935673
## X2628.HK 0.7862 0.0215040
## X3328.HK 0.8541 -0.0424729
## X3988.HK 0.8576 0.0075686

```

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 -0.06 -0.09  0.07 -0.05 0.81 0.19
## X3988.HK  48 0.86  0.01 -0.05  0.07  0.02 0.75 0.25
## X0939.HK  33 0.86 -0.01 -0.06  0.12  0.01 0.76 0.24
## X3328.HK  47 0.86 -0.04 -0.11  0.03  0.03 0.76 0.24
## X0001.HK   1 0.85 -0.03  0.23 -0.20 -0.11 0.80 0.20
## X0388.HK  25 0.85 -0.08  0.11 -0.07 -0.07 0.73 0.27
## X0016.HK  10 0.85  0.00  0.14 -0.20 -0.12 0.77 0.23
## X2318.HK  43 0.83 -0.12 -0.08  0.01 -0.06 0.72 0.28
## X0883.HK  32 0.82  0.06 -0.13  0.10 -0.01 0.71 0.29
## X0005.HK   5 0.82  0.00 -0.06  0.01 -0.01 0.68 0.32
## X0013.HK   9 0.81 -0.05  0.20 -0.14 -0.08 0.71 0.29
## X1088.HK  36 0.81  0.07 -0.04  0.14  0.08 0.69 0.31
## X2388.HK  44 0.80 -0.04  0.11  0.00 -0.14 0.66 0.34
## X0004.HK   4 0.79 -0.13  0.10 -0.16 -0.08 0.67 0.33
## X0012.HK   8 0.79  0.01  0.17 -0.21 -0.05 0.68 0.32
## X0267.HK  19 0.79 -0.12  0.12  0.09  0.09 0.65 0.35
## X2628.HK  46 0.79  0.02 -0.09  0.05  0.00 0.64 0.36
## X1898.HK  42 0.78 -0.01 -0.07  0.04  0.00 0.63 0.37
## X2600.HK  45 0.78 -0.10 -0.13  0.01 -0.04 0.65 0.35
## X1199.HK  38 0.77 -0.03 -0.21 -0.02  0.06 0.66 0.34
## X0857.HK  31 0.76  0.25 -0.14  0.12  0.15 0.70 0.30
## X0083.HK  15 0.76 -0.04  0.11 -0.27 -0.08 0.65 0.35
## X0011.HK   7 0.76  0.00  0.31 -0.18 -0.16 0.69 0.31
## X0688.HK  27 0.76 -0.28 -0.11 -0.02 -0.09 0.68 0.32
## X0101.HK  16 0.75  0.02  0.10 -0.23  0.00 0.62 0.38
## X1109.HK  37 0.75 -0.33 -0.06 -0.02  0.00 0.69 0.31
## X0144.HK  17 0.75  0.00 -0.08  0.06  0.11 0.59 0.41
## X0023.HK  13 0.75  0.02  0.18 -0.02 -0.21 0.61 0.39
## X0017.HK  11 0.71 -0.10  0.12 -0.26  0.00 0.60 0.40
## X0066.HK  14 0.69  0.23  0.27 -0.08  0.00 0.58 0.42
## X0386.HK  24 0.68  0.36 -0.17  0.16  0.27 0.70 0.30
## X0700.HK  28 0.67 -0.10 -0.08  0.15 -0.25 0.56 0.44
## X1299.HK  39 0.65  0.00  0.10  0.01  0.03 0.43 0.57
## X0293.HK  21 0.64 -0.17  0.17 -0.09 -0.08 0.46 0.54
## X1880.HK  41 0.64 -0.12 -0.05  0.14 -0.07 0.45 0.55
## X0291.HK  20 0.63 -0.02  0.08 -0.07 -0.01 0.40 0.60
## X0762.HK  29 0.62  0.21 -0.14  0.33  0.14 0.56 0.44
## X0019.HK  12 0.61 -0.01  0.37  0.00  0.01 0.49 0.51
## X0941.HK  34 0.60  0.45  0.00  0.17  0.11 0.58 0.42
## X1044.HK  35 0.50 -0.17  0.22  0.39 -0.20 0.51 0.49
## X0494.HK  26 0.47  0.01 -0.10  0.03 -0.06 0.25 0.75
## X0330.HK  23 0.45 -0.12  0.00 -0.01  0.43 0.42 0.58
## X0006.HK   6 0.19  0.70 -0.11 -0.02 -0.10 0.57 0.43
## X0002.HK   2 0.41  0.68  0.15  0.02 -0.14 0.69 0.31
## X0003.HK   3 0.46  0.53  0.36 -0.01  0.13 0.60 0.40
## X0322.HK  22 0.33 -0.16  0.50  0.52 -0.01 0.63 0.37
## X0151.HK  18 0.44 -0.13  0.32  0.58  0.15 0.64 0.36
## X0836.HK  30 0.39  0.01  0.24 -0.08  0.66 0.66 0.34
```

```

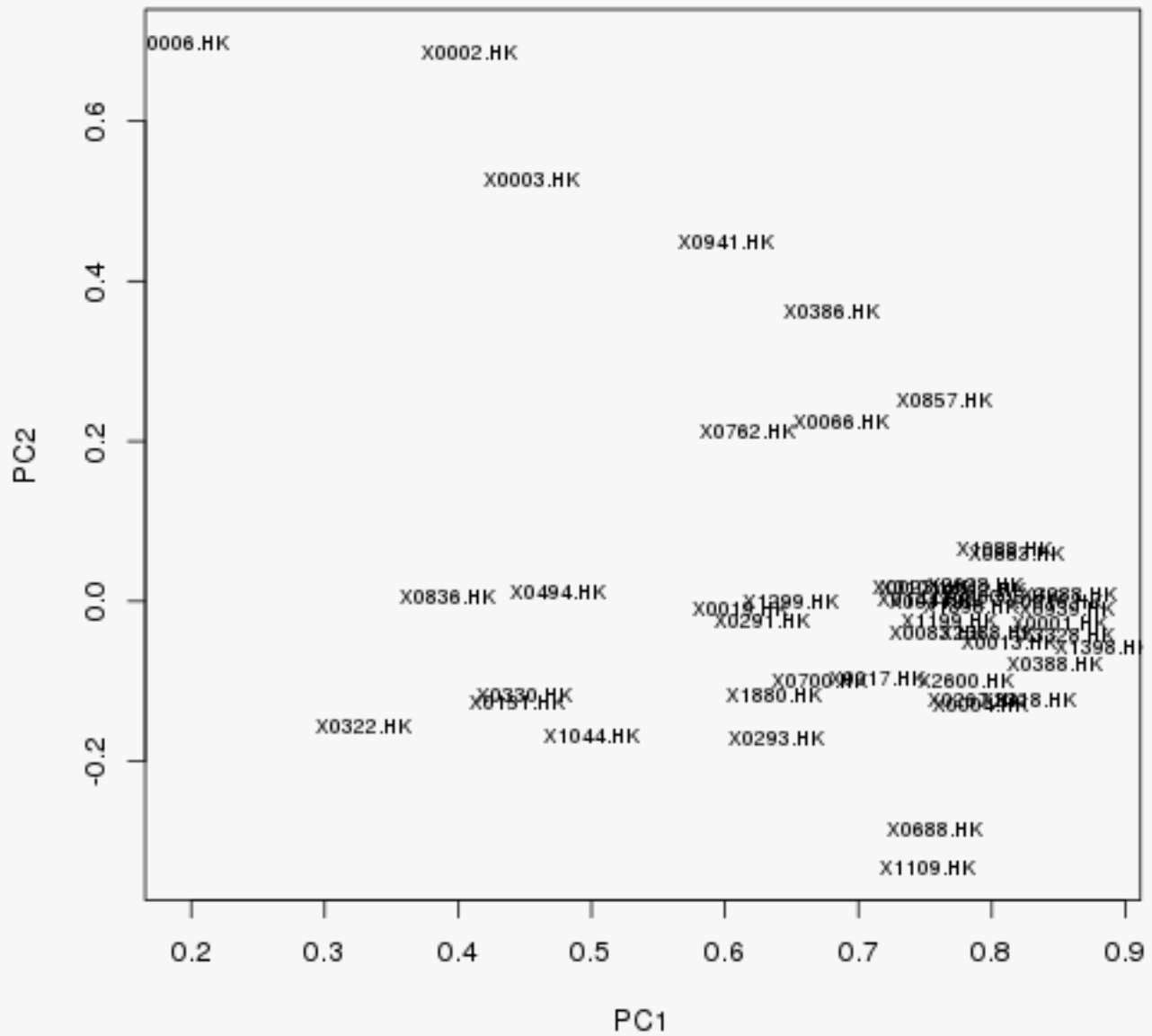
##
##          PC1  PC2  PC4  PC3  PC5
## SS loadings    24.07 2.13 1.39 1.44 1.07
## Proportion Var  0.50 0.04 0.03 0.03 0.02
## Cumulative Var  0.50 0.55 0.57 0.60 0.63
##
## With component correlations of
##      PC1  PC2  PC4  PC3  PC5
## PC1  1.00  0.00 -0.06  0.00  0.00
## PC2  0.00  1.00 -0.01 -0.01 -0.11
## PC4 -0.06 -0.01  1.00 -0.01  0.02
## PC3  0.00 -0.01 -0.01  1.00 -0.14
## PC5  0.00 -0.11  0.02 -0.14  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 41.11 0.3
## The degrees of freedom for the model are 898 and the objective function was 6.47
## 0.3The number of observations was 311 with Chi Square = 1875 with prob < 4.1e-71
## 0.3
## Fit based upon off diagonal values = 0.99

##          PC1          PC2
## X0001.HK 0.8498 -0.0263534
## X0002.HK 0.4077  0.6848190
## X0003.HK 0.4556  0.5265781
## X0004.HK 0.7916 -0.1286603
## X0005.HK 0.8152  0.0043611
## X0006.HK 0.1932  0.6983255
## X0011.HK 0.7587  0.0002508
## X0012.HK 0.7903  0.0142703
## X0013.HK 0.8121 -0.0511344
## X0016.HK 0.8464  0.0004554
## X0017.HK 0.7145 -0.0970026
## X0019.HK 0.6115 -0.0088822
## X0023.HK 0.7457  0.0186119
## X0066.HK 0.6867  0.2254443
## X0083.HK 0.7594 -0.0382325
## X0101.HK 0.7525  0.0179961
## X0144.HK 0.7492  0.0021591
## X0151.HK 0.4435 -0.1276925
## X0267.HK 0.7870 -0.1223871
## X0291.HK 0.6277 -0.0244414
## X0293.HK 0.6382 -0.1715235
## X0322.HK 0.3286 -0.1563806
## X0330.HK 0.4503 -0.1174414
## X0386.HK 0.6792  0.3619180
## X0388.HK 0.8479 -0.0781946
## X0494.HK 0.4740  0.0124162
## X0688.HK 0.7565 -0.2845307
## X0700.HK 0.6708 -0.0988385
## X0762.HK 0.6174  0.2137678
## X0836.HK 0.3918  0.0053392
## X0857.HK 0.7648  0.2500445
## X0883.HK 0.8181  0.0597832
## X0939.HK 0.8562 -0.0104102
## X0941.HK 0.6005  0.4480755

```

```
## X1044.HK 0.5001 -0.1673086
## X1088.HK 0.8096 0.0653249
## X1109.HK 0.7518 -0.3324374
## X1199.HK 0.7676 -0.0256272
## X1299.HK 0.6490 -0.0013364
## X1398.HK 0.8838 -0.0572922
## X1880.HK 0.6372 -0.1174735
## X1898.HK 0.7837 -0.0062379
## X2318.HK 0.8275 -0.1244928
## X2388.HK 0.7975 -0.0392937
## X2600.HK 0.7810 -0.0982928
## X2628.HK 0.7870 0.0211548
## X3328.HK 0.8557 -0.0423437
## X3988.HK 0.8587 0.0098205
```

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	0.88	-0.22	0.00	0.09	-0.06	0.68	0.32
##	X1109.HK	37	0.85	-0.29	0.03	0.08	0.05	0.69	0.31
##	X0016.HK	10	0.84	0.11	-0.04	-0.18	0.02	0.77	0.23
##	X2318.HK	43	0.84	-0.04	0.03	0.11	-0.03	0.72	0.28
##	X0004.HK	4	0.83	-0.04	-0.01	-0.13	0.04	0.67	0.33
##	X1398.HK	40	0.83	0.03	0.07	0.16	-0.03	0.81	0.19
##	X0001.HK	1	0.82	0.09	0.02	-0.24	0.06	0.80	0.20
##	X0388.HK	25	0.81	0.02	0.06	-0.08	0.04	0.73	0.27
##	X0083.HK	15	0.81	0.04	-0.12	-0.18	0.07	0.65	0.35
##	X2600.HK	45	0.80	-0.03	-0.01	0.16	-0.02	0.65	0.35
##	X3328.HK	47	0.79	0.03	0.01	0.18	0.06	0.76	0.24
##	X0013.HK	9	0.77	0.06	0.05	-0.19	0.07	0.71	0.29
##	X0017.HK	11	0.76	-0.04	-0.11	-0.17	0.15	0.60	0.40
##	X1199.HK	38	0.75	0.01	-0.10	0.24	0.06	0.66	0.34
##	X0012.HK	8	0.75	0.11	-0.04	-0.19	0.10	0.68	0.32
##	X2388.HK	44	0.74	0.08	0.13	-0.07	-0.06	0.66	0.34
##	X0005.HK	5	0.74	0.08	0.02	0.12	0.02	0.68	0.32
##	X3988.HK	48	0.73	0.10	0.08	0.15	0.05	0.75	0.25
##	X0101.HK	16	0.73	0.09	-0.11	-0.13	0.14	0.62	0.38
##	X0939.HK	33	0.72	0.08	0.13	0.18	0.02	0.76	0.24
##	X0011.HK	7	0.71	0.13	0.08	-0.31	0.02	0.69	0.31
##	X0700.HK	28	0.70	0.02	0.15	0.10	-0.27	0.56	0.44
##	X1898.HK	42	0.70	0.07	0.04	0.14	0.03	0.63	0.37
##	X0883.HK	32	0.70	0.14	0.05	0.22	-0.02	0.71	0.29
##	X2628.HK	46	0.69	0.10	0.04	0.16	0.02	0.64	0.36
##	X0023.HK	13	0.68	0.16	0.14	-0.15	-0.11	0.61	0.39
##	X0293.HK	21	0.65	-0.09	0.09	-0.16	0.03	0.46	0.54
##	X0267.HK	19	0.62	-0.04	0.21	0.03	0.16	0.65	0.35
##	X0144.HK	17	0.61	0.05	0.05	0.19	0.14	0.59	0.41
##	X1088.HK	36	0.60	0.15	0.14	0.19	0.10	0.69	0.31
##	X1880.HK	41	0.60	-0.04	0.16	0.13	-0.08	0.45	0.55
##	X0291.HK	20	0.57	0.04	0.03	-0.05	0.07	0.40	0.60
##	X1299.HK	39	0.52	0.07	0.11	-0.01	0.11	0.43	0.57
##	X0857.HK	31	0.50	0.31	0.02	0.30	0.15	0.70	0.30
##	X0494.HK	26	0.46	0.06	-0.01	0.12	-0.06	0.25	0.75
##	X0066.HK	14	0.44	0.34	0.10	-0.18	0.15	0.58	0.42
##	X0019.HK	12	0.40	0.10	0.27	-0.24	0.15	0.49	0.51
##	X0002.HK	2	0.05	0.82	0.04	-0.07	-0.09	0.69	0.31
##	X0006.HK	6	-0.04	0.77	-0.18	0.11	-0.12	0.57	0.43
##	X0003.HK	3	-0.02	0.63	0.16	-0.17	0.26	0.60	0.40
##	X0941.HK	34	0.20	0.53	0.12	0.20	0.11	0.58	0.42
##	X0386.HK	24	0.31	0.40	0.02	0.37	0.24	0.70	0.30
##	X0322.HK	22	-0.07	-0.02	0.82	-0.12	0.02	0.63	0.37
##	X0151.HK	18	-0.01	-0.02	0.76	0.11	0.12	0.64	0.36
##	X1044.HK	35	0.33	-0.03	0.55	-0.02	-0.21	0.51	0.49
##	X0762.HK	29	0.29	0.28	0.21	0.38	0.07	0.56	0.44
##	X0836.HK	30	0.01	-0.06	0.07	0.01	0.80	0.66	0.34
##	X0330.HK	23	0.27	-0.16	0.02	0.16	0.49	0.42	0.58

```

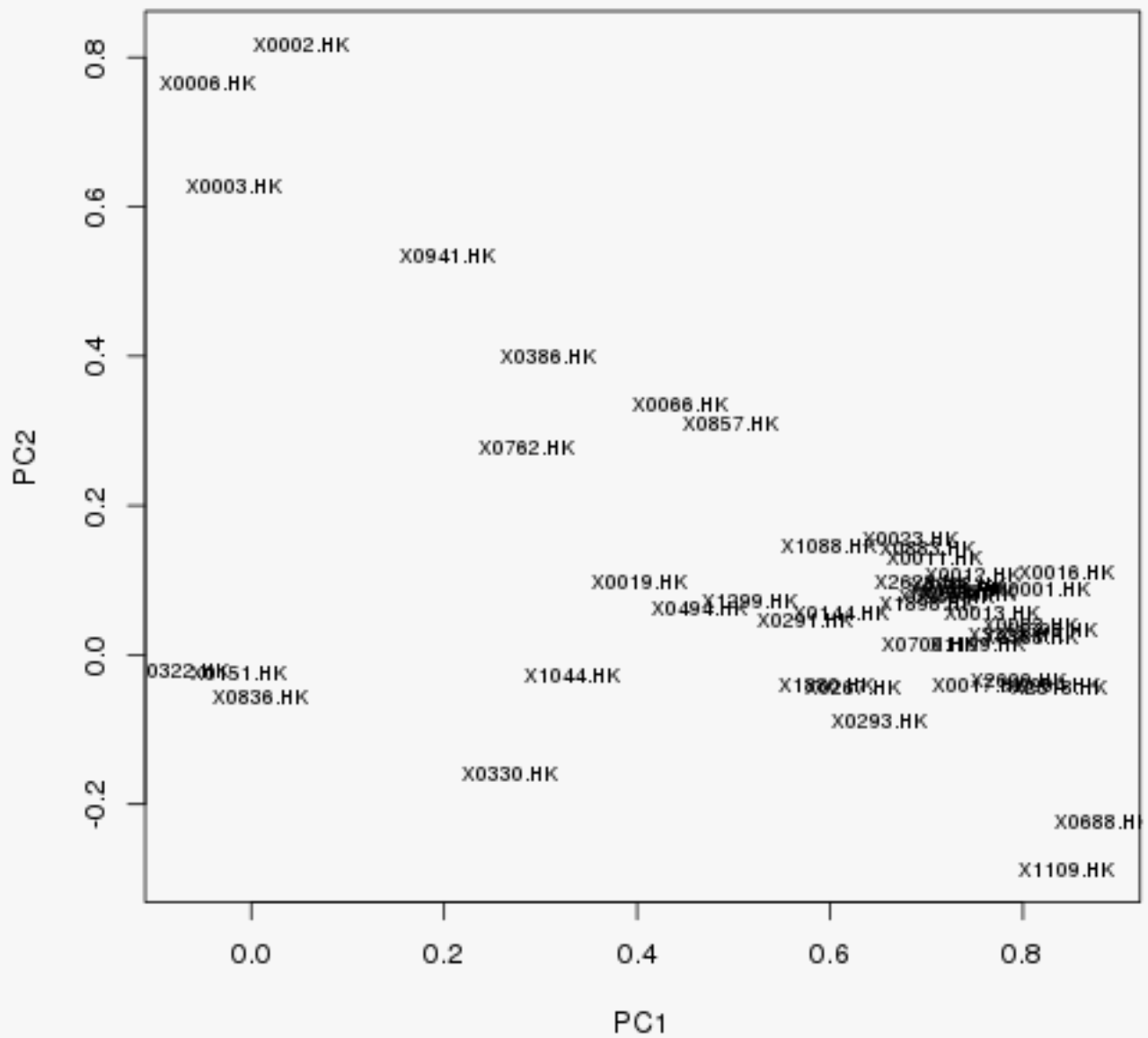
##
##          PC1  PC2  PC3  PC4  PC5
## SS loadings    20.68 3.33 2.64 1.55 1.90
## Proportion Var  0.43 0.07 0.06 0.03 0.04
## Cumulative Var  0.43 0.50 0.56 0.59 0.63
##
## With component correlations of
##      PC1  PC2  PC3  PC4  PC5
## PC1 1.00 0.39 0.44 0.14 0.39
## PC2 0.39 1.00 0.15 0.04 0.19
## PC3 0.44 0.15 1.00 0.07 0.16
## PC4 0.14 0.04 0.07 1.00 -0.01
## PC5 0.39 0.19 0.16 -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 41.11 0.3
## The degrees of freedom for the model are 898 and the objective function was 6.47
## 0.3The number of observations was 311 with Chi Square = 1875 with prob < 4.1e-71
## 0.3
## Fit based upon off diagonal values = 0.99

##          PC1          PC2
## X0001.HK  0.818983  0.08862
## X0002.HK  0.052024  0.81756
## X0003.HK -0.019219  0.62727
## X0004.HK  0.829183 -0.04188
## X0005.HK  0.742162  0.08431
## X0006.HK -0.044741  0.76568
## X0011.HK  0.708537  0.12928
## X0012.HK  0.748872  0.10774
## X0013.HK  0.768235  0.05539
## X0016.HK  0.844915  0.10895
## X0017.HK  0.756231 -0.03968
## X0019.HK  0.401517  0.09796
## X0023.HK  0.684500  0.15562
## X0066.HK  0.444438  0.33553
## X0083.HK  0.807893  0.04103
## X0101.HK  0.731399  0.08748
## X0144.HK  0.611627  0.05473
## X0151.HK -0.012337 -0.02332
## X0267.HK  0.624752 -0.04304
## X0291.HK  0.574454  0.04476
## X0293.HK  0.651011 -0.08897
## X0322.HK -0.071689 -0.02195
## X0330.HK  0.267143 -0.15990
## X0386.HK  0.306980  0.40003
## X0388.HK  0.808668  0.02294
## X0494.HK  0.463598  0.06238
## X0688.HK  0.883229 -0.22419
## X0700.HK  0.702231  0.01549
## X0762.HK  0.285110  0.27865
## X0836.HK  0.009219 -0.05532
## X0857.HK  0.496056  0.30992
## X0883.HK  0.700281  0.14407
## X0939.HK  0.721061  0.07980
## X0941.HK  0.202895  0.53468

```

##	X1044.HK	0.333230	-0.02634
##	X1088.HK	0.597965	0.14573
##	X1109.HK	0.846042	-0.28700
##	X1199.HK	0.752472	0.01340
##	X1299.HK	0.516442	0.07305
##	X1398.HK	0.828266	0.03478
##	X1880.HK	0.595905	-0.03898
##	X1898.HK	0.701398	0.06910
##	X2318.HK	0.836876	-0.04459
##	X2388.HK	0.743468	0.08095
##	X2600.HK	0.796106	-0.03250
##	X2628.HK	0.694621	0.09777
##	X3328.HK	0.791762	0.02550
##	X3988.HK	0.734167	0.09561

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  0.78  0.14 -0.04 -0.16  0.04 0.66 0.34
## X0883.HK  32  0.74  0.11  0.10  0.00 -0.05 0.71 0.29
## X0762.HK  29  0.73 -0.32  0.22  0.17  0.04 0.56 0.44
## X3328.HK  47  0.72  0.22 -0.03 -0.05  0.03 0.76 0.24
## X1398.HK  40  0.72  0.25 -0.01  0.02 -0.06 0.81 0.19
## X0857.HK  31  0.71 -0.04  0.25 -0.05  0.10 0.70 0.30
## X0386.HK  24  0.71 -0.22  0.34 -0.05  0.20 0.70 0.30
## X2600.HK  45  0.70  0.24 -0.08 -0.06 -0.05 0.65 0.35
## X0939.HK  33  0.69  0.17  0.03  0.08 -0.01 0.76 0.24
## X2318.HK  43  0.65  0.31 -0.09 -0.02 -0.05 0.72 0.28
## X0688.HK  27  0.65  0.34 -0.26 -0.04 -0.07 0.68 0.32
## X2628.HK  46  0.64  0.19  0.05 -0.02 -0.02 0.64 0.36
## X3988.HK  48  0.64  0.23  0.05  0.02  0.02 0.75 0.25
## X1088.HK  36  0.63  0.10  0.09  0.09  0.07 0.69 0.31
## X0144.HK  17  0.62  0.12  0.00  0.00  0.11 0.59 0.41
## X1898.HK  42  0.61  0.22  0.03 -0.01  0.00 0.63 0.37
## X0005.HK   5  0.61  0.27  0.04 -0.03 -0.01 0.68 0.32
## X0700.HK  28  0.60  0.19 -0.01  0.12 -0.30 0.56 0.44
## X1109.HK  37  0.60  0.34 -0.33  0.00  0.04 0.69 0.31
## X1880.HK  41  0.55  0.12 -0.07  0.13 -0.09 0.45 0.55
## X0494.HK  26  0.45  0.10  0.04 -0.05 -0.08 0.25 0.75
## X0267.HK  19  0.40  0.29 -0.09  0.19  0.14 0.65 0.35
## X0011.HK   7 -0.06  0.81  0.12  0.06 -0.03 0.69 0.31
## X0001.HK   1  0.11  0.79  0.07 -0.02  0.02 0.80 0.20
## X0083.HK  15  0.18  0.72  0.02 -0.17  0.03 0.65 0.35
## X0016.HK  10  0.22  0.72  0.09 -0.09 -0.03 0.77 0.23
## X0012.HK   8  0.14  0.70  0.09 -0.08  0.06 0.68 0.32
## X0017.HK  11  0.15  0.69 -0.06 -0.15  0.12 0.60 0.40
## X0013.HK   9  0.16  0.68  0.03  0.02  0.03 0.71 0.29
## X0004.HK   4  0.28  0.63 -0.07 -0.05  0.01 0.67 0.33
## X0101.HK  16  0.21  0.62  0.06 -0.15  0.10 0.62 0.38
## X0023.HK  13  0.18  0.56  0.14  0.11 -0.15 0.61 0.39
## X0293.HK  21  0.13  0.55 -0.11  0.08  0.02 0.46 0.54
## X0388.HK  25  0.35  0.55 -0.01  0.02  0.00 0.73 0.27
## X0066.HK  14 -0.02  0.53  0.32  0.07  0.09 0.58 0.42
## X0019.HK  12 -0.14  0.53  0.08  0.27  0.13 0.49 0.51
## X2388.HK  44  0.34  0.48  0.06  0.09 -0.10 0.66 0.34
## X0291.HK  20  0.25  0.40  0.02  0.00  0.04 0.40 0.60
## X1299.HK  39  0.27  0.31  0.04  0.08  0.08 0.43 0.57
## X0002.HK   2 -0.06  0.20  0.82 -0.01 -0.17 0.69 0.31
## X0006.HK   6  0.15 -0.06  0.77 -0.24 -0.19 0.57 0.43
## X0003.HK   3 -0.29  0.31  0.62  0.14  0.20 0.60 0.40
## X0941.HK  34  0.41 -0.08  0.50  0.07  0.05 0.58 0.42
## X0322.HK  22 -0.19 -0.01 -0.04  0.88  0.03 0.63 0.37
## X0151.HK  18  0.17 -0.25 -0.06  0.81  0.13 0.64 0.36
## X1044.HK  35  0.21  0.08 -0.04  0.57 -0.21 0.51 0.49
## X0836.HK  30 -0.08  0.11 -0.11  0.06  0.81 0.66 0.34
## X0330.HK  23  0.33  0.01 -0.22  0.00  0.50 0.42 0.58
##
```

```

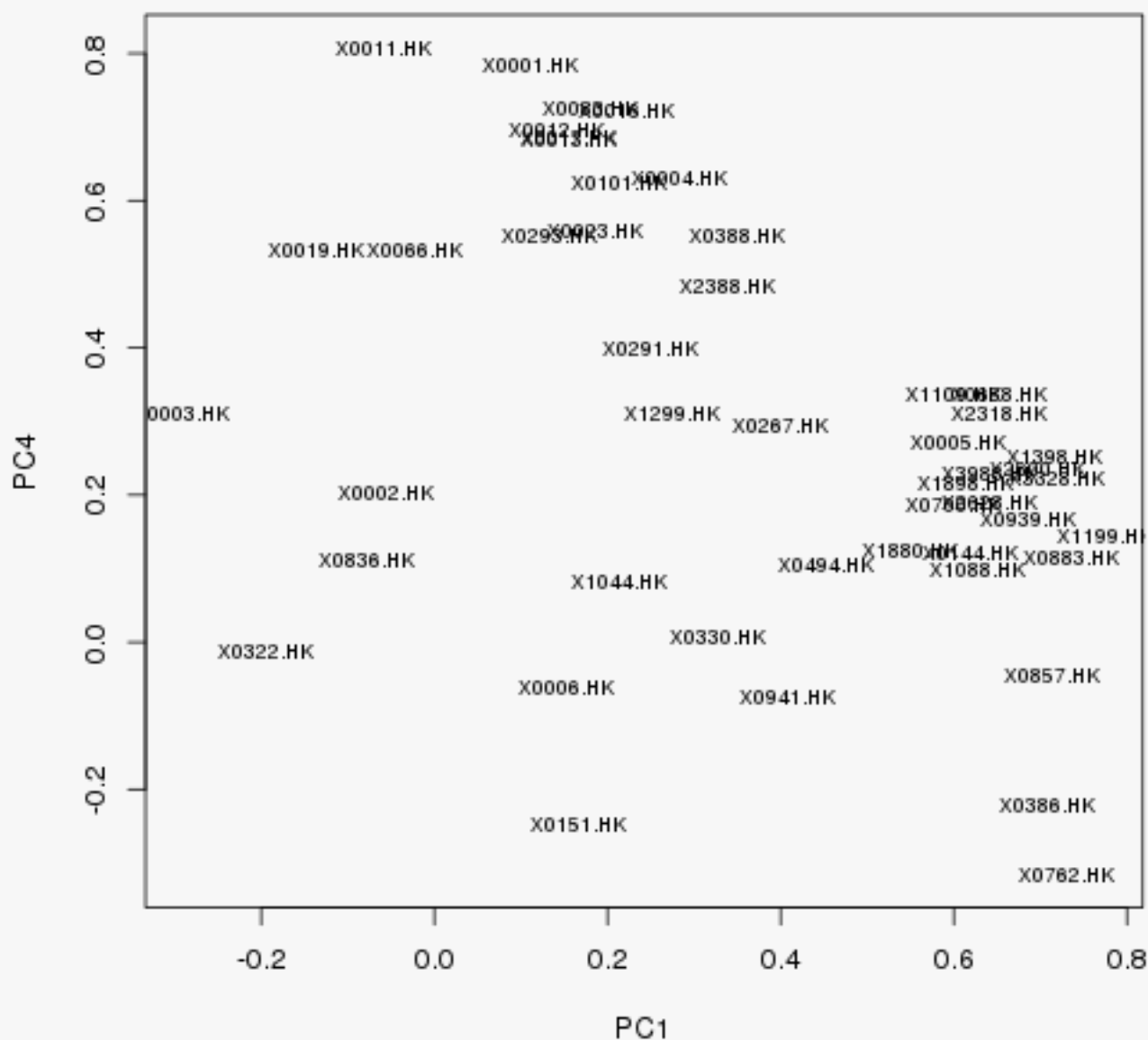
##          PC1  PC4  PC2  PC3  PC5
## SS loadings    13.24 10.52 2.77 2.13 1.44
## Proportion Var  0.28  0.22 0.06 0.04 0.03
## Cumulative Var  0.28  0.49 0.55 0.60 0.63
##
## With component correlations of
##      PC1  PC4  PC2  PC3  PC5
## PC1 1.00 0.74 0.38 0.53 0.40
## PC4 0.74 1.00 0.31 0.53 0.38
## PC2 0.38 0.31 1.00 0.22 0.31
## PC3 0.53 0.53 0.22 1.00 0.21
## PC5 0.40 0.38 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 41.11 0.3
## The degrees of freedom for the model are 898 and the objective function was 6.47
## 0.3The number of observations was 311 with Chi Square = 1875 with prob < 4.1e-71
## 0.3
## Fit based upon off diagonal values = 0.99

##          PC1          PC4
## X0001.HK  0.10939  0.785021
## X0002.HK -0.05678  0.201461
## X0003.HK -0.29090  0.310460
## X0004.HK  0.28361  0.629935
## X0005.HK  0.60562  0.271391
## X0006.HK  0.15162 -0.062494
## X0011.HK -0.05787  0.807423
## X0012.HK  0.14045  0.696051
## X0013.HK  0.15568  0.682821
## X0016.HK  0.22137  0.723247
## X0017.HK  0.15401  0.685274
## X0019.HK -0.13586  0.531057
## X0023.HK  0.18451  0.560087
## X0066.HK -0.02300  0.531155
## X0083.HK  0.18014  0.723862
## X0101.HK  0.21306  0.623253
## X0144.HK  0.61899  0.121348
## X0151.HK  0.16612 -0.249205
## X0267.HK  0.39870  0.293442
## X0291.HK  0.25047  0.397638
## X0293.HK  0.13266  0.552325
## X0322.HK -0.19418 -0.013534
## X0330.HK  0.32716  0.007398
## X0386.HK  0.70867 -0.222783
## X0388.HK  0.34919  0.550867
## X0494.HK  0.45257  0.104564
## X0688.HK  0.65102  0.337372
## X0700.HK  0.60087  0.188067
## X0762.HK  0.73021 -0.315674
## X0836.HK -0.07809  0.112886
## X0857.HK  0.71242 -0.043867
## X0883.HK  0.73691  0.114403
## X0939.HK  0.68516  0.166010
## X0941.HK  0.40735 -0.075452
## X1044.HK  0.21226  0.082320

```

## X1088.HK	0.62768	0.097793
## X1109.HK	0.59908	0.337789
## X1199.HK	0.77560	0.143559
## X1299.HK	0.27447	0.311140
## X1398.HK	0.71643	0.250325
## X1880.HK	0.55083	0.124057
## X1898.HK	0.61335	0.217015
## X2318.HK	0.65124	0.310199
## X2388.HK	0.33979	0.482966
## X2600.HK	0.69627	0.235487
## X2628.HK	0.64150	0.189334
## X3328.HK	0.71827	0.222242
## X3988.HK	0.64094	0.228254

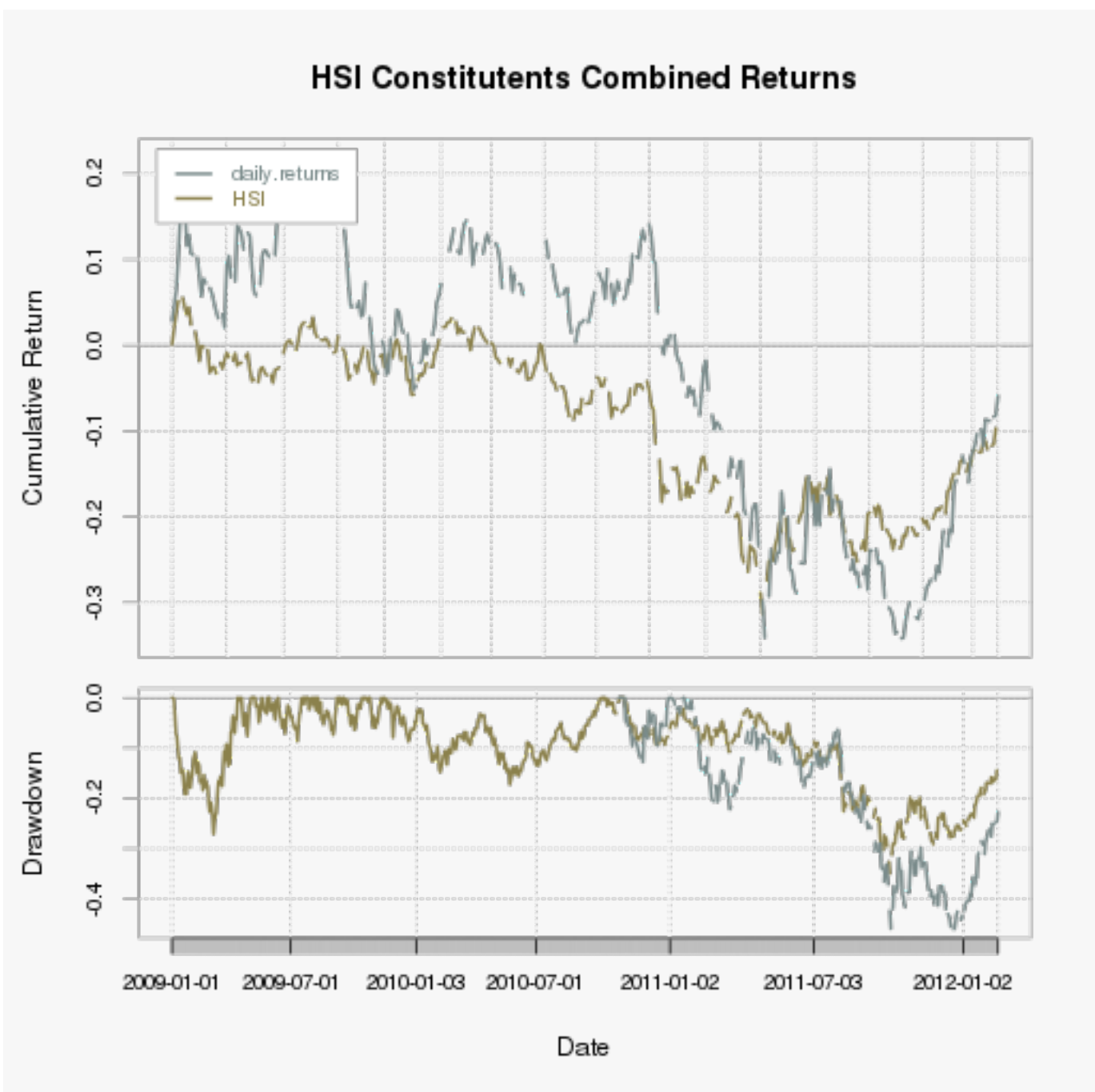
Loadings Rotation : promax



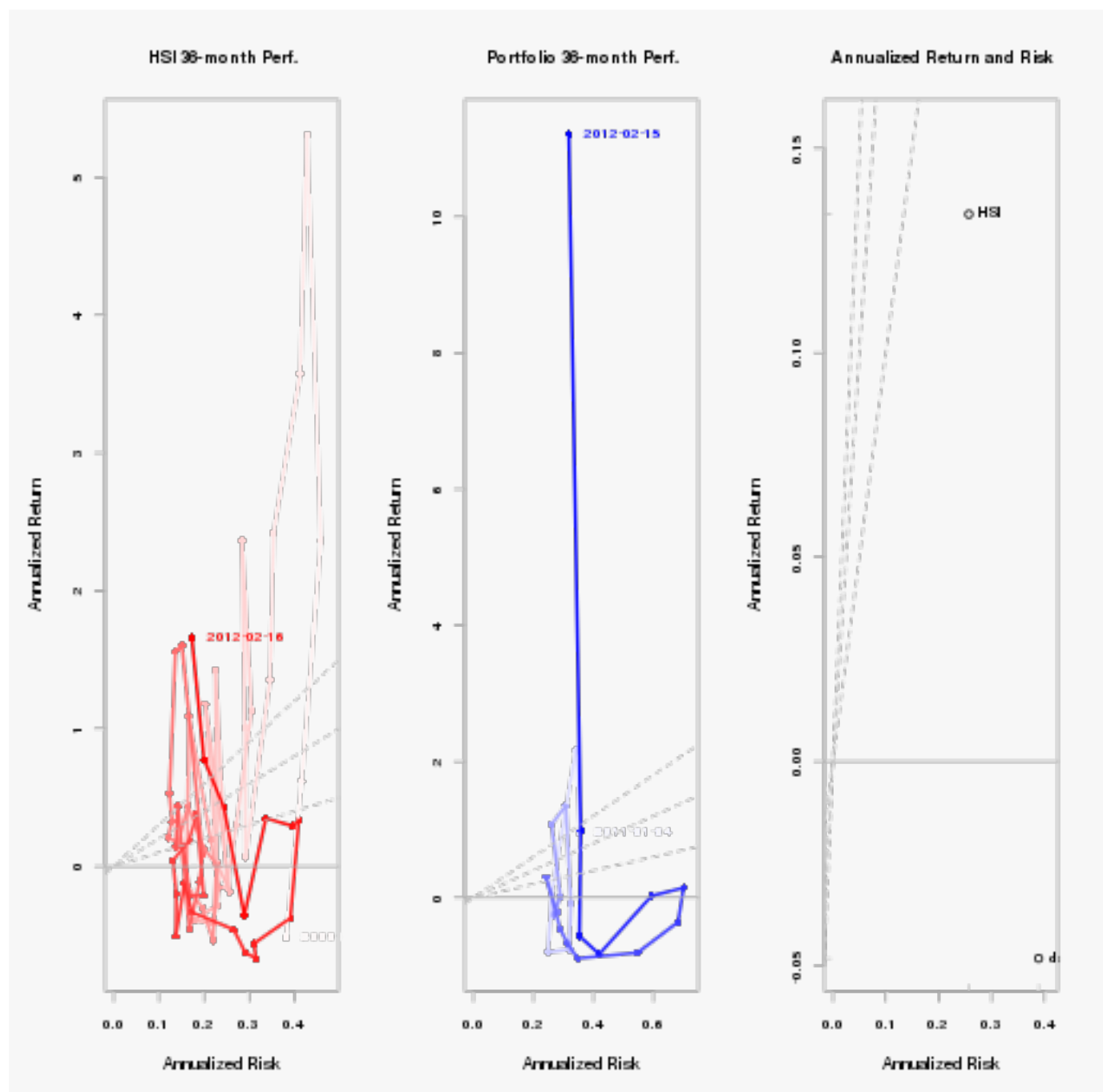
PCA is a science in itself and can not be fully covered and even less interpreted in this paper. The factors produced by principal component analysis are conceptualized as being linear combinations of the variables whereas the factors produced by common factor analysis are conceptualized as being latent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

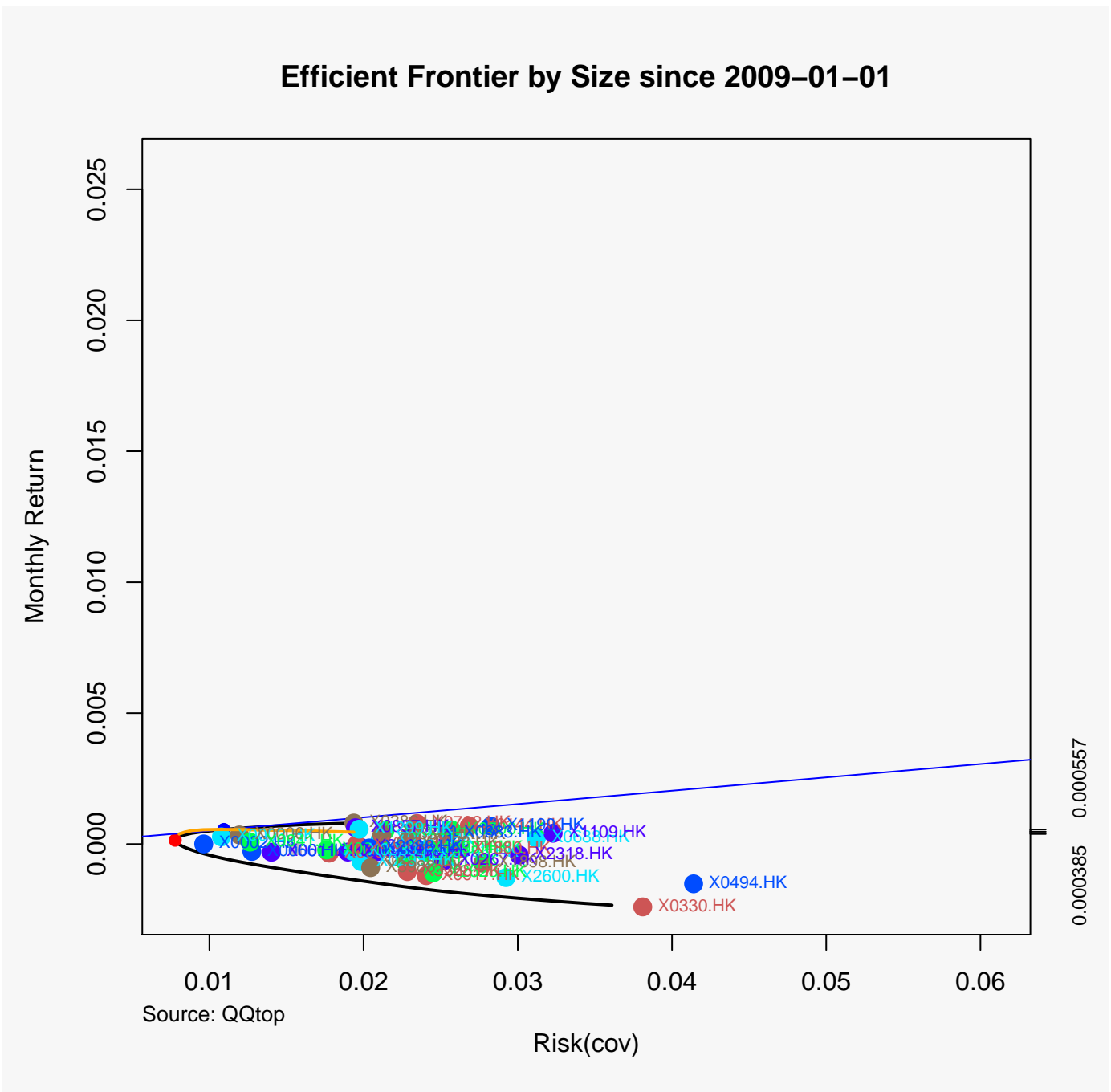
6.1 Performance Chart



6.2 Performance SnailTrail Chart



6.3 HSI Components Frontier



```
##
## 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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 25	0.0000	0.4281	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 37	0.0000	0.3456	0.1569	0.0000	0.0000	0.1615	0.0487	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 13	0.0000	0.0000	0.2606	0.1008	0.0000	0.0000	0.0000	0.0000
## 25	0.0000	0.0000	0.1207	0.0807	0.0000	0.0340	0.0000	0.0000
## 37	0.0000	0.0000	0.0000	0.0000	0.0000	0.0863	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	0.9257	0.0000
## 13	0.0000	0.0000	0.0000	0.0000	0.0384	0.0000	0.3424	0.0000
## 25	0.0000	0.0000	0.0000	0.0000	0.0757	0.0000	0.1573	0.0000
## 37	0.0000	0.0039	0.0000	0.0000	0.0463	0.0336	0.0173	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	0.0743	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 13	0.0000	0.0927	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 25	0.0000	0.0424	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 37	0.0000	0.0000	0.0000	0.0000	0.0000	0.0348	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	0.0191	0.0460	0.0000	0.0000	0.0000	0.0000	0.0000
## 49	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
##	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	0.0000	0.1287	0.0363	0.0000
## 25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0407	0.0136	0.0068
## 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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 25	0.0000	0.1820	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 37	0.0000	0.3471	0.1454	0.0000	0.0000	0.1463	0.0533	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
## 13	0.0000	0.0000	0.2091	0.0493	0.0000	0.0000	0.0000	0.0000
## 25	0.0000	0.0000	0.1605	0.0746	0.0000	0.0217	0.0000	0.0000
## 37	0.0000	0.0000	0.0000	0.0000	0.0000	0.0938	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	0.9735	0.0000
## 13	0.0000	0.0000	0.0000	0.0000	0.0188	0.0000	0.5106	0.0000
## 25	0.0000	0.0000	0.0000	0.0000	0.0702	0.0000	0.3496	0.0000
## 37	0.0000	0.0036	0.0000	0.0000	0.0555	0.0288	0.0293	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	0.0265	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

```

## 13  0.0000  0.0910  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 25  0.0000  0.0664  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
## 37  0.0000  0.0000  0.0000  0.0000  0.0000  0.0316  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  0.0188  0.0466  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  0.0000  0.0954  0.0259  0.0000
## 25   0.0000  0.0000  0.0000  0.0000  0.0000  0.0509  0.0165  0.0075
## 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 -0.0023 -0.0023  0.0361  0.0361  0.0953  0.0521
## 13 -0.0015 -0.0015  0.0216  0.0216  0.0554  0.0386
## 25 -0.0008 -0.0008  0.0128  0.0128  0.0321  0.0270
## 37  0.0000  0.0000  0.0079  0.0079  0.0184  0.0132
## 49  0.0008  0.0008  0.0194  0.0194  0.0412  0.0302
##
## Description:
## Tue Feb 21 20:04:56 2012 by user:

```

7 HSI Components Ratios

7.1 Sharpe Ratio - Combined

```
##                                daily.returns
## Annualized StdDev Sharpe (Rf=0%, p=95%):      -0.1239
## Annualized VaR Sharpe (Rf=0%, p=95%):         -1.3050
## Annualized ES Sharpe (Rf=0%, p=95%):          -1.0164
```

7.2 Sharpe - Distinct

##	X0001.HK	X0002.HK	X0003.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.4207	0.558	0.6852
## Annualized VaR Sharpe (Rf=0%, p=95%):	4.4910	5.628	6.5660
## Annualized ES Sharpe (Rf=0%, p=95%):	3.4872	3.945	2.8097
##	X0004.HK	X0005.HK	X0006.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.708	-0.0687	0.4993
## Annualized VaR Sharpe (Rf=0%, p=95%):	7.744	-0.7184	5.1244
## Annualized ES Sharpe (Rf=0%, p=95%):	6.065	-0.3491	3.6558
##	X0011.HK	X0012.HK	X0013.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	-0.0266	0.4535	0.7272
## Annualized VaR Sharpe (Rf=0%, p=95%):	-0.3062	5.0507	7.9847
## Annualized ES Sharpe (Rf=0%, p=95%):	-0.2889	4.0406	6.1632
##	X0016.HK	X0017.HK	X0019.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.6247	0.147	0.4872
## Annualized VaR Sharpe (Rf=0%, p=95%):	6.6904	1.550	4.8451
## Annualized ES Sharpe (Rf=0%, p=95%):	5.2199	1.081	2.8686
##	X0023.HK	X0066.HK	X0083.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.5832	0.6247	0.4081
## Annualized VaR Sharpe (Rf=0%, p=95%):	7.2076	7.3170	4.3163
## Annualized ES Sharpe (Rf=0%, p=95%):	7.0304	6.2208	3.1430
##	X0101.HK	X0144.HK	X0151.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.390	0.4875	0.8339
## Annualized VaR Sharpe (Rf=0%, p=95%):	4.271	5.2397	8.9125
## Annualized ES Sharpe (Rf=0%, p=95%):	3.384	4.1547	6.7610
##	X0267.HK	X0291.HK	X0293.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.3395	0.6981	0.5746
## Annualized VaR Sharpe (Rf=0%, p=95%):	3.9402	7.5632	6.0186
## Annualized ES Sharpe (Rf=0%, p=95%):	3.3520	6.0432	4.4849
##	X0322.HK	X0330.HK	X0386.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	1.029	-0.5819	0.6878
## Annualized VaR Sharpe (Rf=0%, p=95%):	14.075	-5.3825	7.0842
## Annualized ES Sharpe (Rf=0%, p=95%):	14.075	-2.8732	5.3186
##	X0388.HK	X0494.HK	X0688.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.6592	0.161	0.2458
## Annualized VaR Sharpe (Rf=0%, p=95%):	7.4742	2.143	2.8482
## Annualized ES Sharpe (Rf=0%, p=95%):	6.0713	2.143	2.4367
##	X0700.HK	X0762.HK	X0836.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	1.347	0.4053	0.0163
## Annualized VaR Sharpe (Rf=0%, p=95%):	14.261	4.4878	0.1669
## Annualized ES Sharpe (Rf=0%, p=95%):	10.568	3.5593	0.1325
##	X0857.HK	X0883.HK	X0939.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.507	0.7925	0.3759
## Annualized VaR Sharpe (Rf=0%, p=95%):	5.104	8.3159	3.7293
## Annualized ES Sharpe (Rf=0%, p=95%):	3.858	6.2119	2.5815
##	X0941.HK	X1044.HK	X1088.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.0008	1.140	0.679
## Annualized VaR Sharpe (Rf=0%, p=95%):	0.0083	12.610	6.877
## Annualized ES Sharpe (Rf=0%, p=95%):	0.0063	9.793	5.265
##	X1109.HK	X1199.HK	X1299.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.2783	0.316	0.4038
## Annualized VaR Sharpe (Rf=0%, p=95%):	3.2636	3.482	4.1721
## Annualized ES Sharpe (Rf=0%, p=95%):	2.8027	2.786	2.6025
##	X1398.HK	X1880.HK	X1898.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):	0.2431	1.163	0.3314
## Annualized VaR Sharpe (Rf=0%, p=95%):	2.7345	13.211	3.2452

```

## Annualized ES Sharpe (Rf=0%, p=95%):      2.2244    10.428    2.1985
##                                           X2318.HK X2388.HK X2600.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):    0.4208    0.9679   -0.0387
## Annualized VaR Sharpe (Rf=0%, p=95%):      4.4628   11.1029   -0.4120
## Annualized ES Sharpe (Rf=0%, p=95%):      3.1895    8.9700   -0.3262
##                                           X2628.HK X3328.HK X3988.HK
## Annualized StdDev Sharpe (Rf=0%, p=95%):   -0.0623    0.0417    0.4498
## Annualized VaR Sharpe (Rf=0%, p=95%):     -0.6200    0.4202    4.7276
## Annualized ES Sharpe (Rf=0%, p=95%):     -0.4346    0.3094    3.4203

```

7.3 Information Ratio - Combined

```
## [1] "Information Ratio : 0.2475"
```

7.4 Information Ratio - Distinct

```

##           X0001.HK X0002.HK X0003.HK X0004.HK X0005.HK
## Information Ratio: HSI -0.0026 -0.2165  0.0678  0.3229 -0.3396
##           X0006.HK X0011.HK X0012.HK X0013.HK X0016.HK
## Information Ratio: HSI -0.1579 -0.4243  0.0597  0.2661  0.1605
##           X0017.HK X0019.HK X0023.HK X0066.HK X0083.HK
## Information Ratio: HSI -0.1515  0.0591  0.1637  0.0194  0.0743
##           X0101.HK X0144.HK X0151.HK X0267.HK X0291.HK
## Information Ratio: HSI  0.0543  0.1698  0.3689  0.0275  0.2728
##           X0293.HK X0322.HK X0330.HK X0386.HK X0388.HK
## Information Ratio: HSI  0.1547  0.5115 -0.7678  0.22  0.2287
##           X0494.HK X0688.HK X0700.HK X0762.HK X0836.HK
## Information Ratio: HSI -0.0611 -0.0495  0.8664  0.027 -0.3039
##           X0857.HK X0883.HK X0939.HK X0941.HK X1044.HK
## Information Ratio: HSI  0.0807  0.3803 -0.0293 -0.3739  0.6386
##           X1088.HK X1109.HK X1199.HK X1299.HK X1398.HK
## Information Ratio: HSI  0.2825  0.0083  0.036  0.5216 -0.1158
##           X1880.HK X1898.HK X2318.HK X2388.HK X2600.HK
## Information Ratio: HSI  0.7724  0.0407  0.095  0.4783 -0.2703
##           X2628.HK X3328.HK X3988.HK
## Information Ratio: HSI -0.3556 -0.2777  0.0394

```

8 HSI Components Table Latest Quotes

[1] "Date : 2012-02-21 02:59:00"

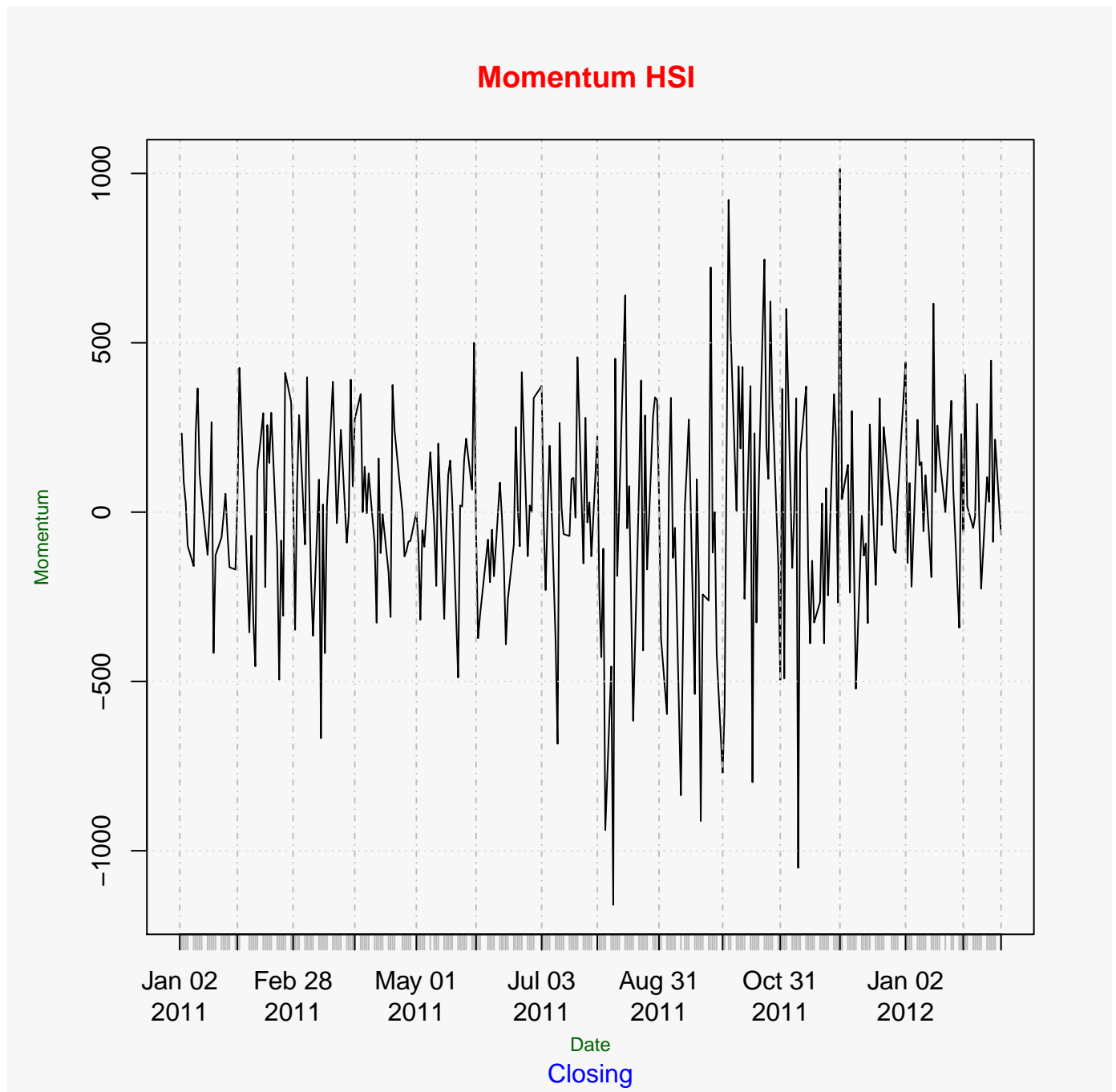
##	Name	Bid	Ask	Change	52-week Range
## 0001.HK	CHEUNG KONG	114.60	114.70	0.80	79.10 - 137.60
## 0002.HK	CLP HOLDINGS	66.45	66.50	1.10	59.85 - 75.20
## 0003.HK	HK & CHINA GAS	19.06	19.10	0.08	16.70 - 19.68
## 0004.HK	WHARF HOLDINGS	47.55	47.70	-0.55	33.15 - 63.80
## 0005.HK	HSBC HOLDINGS	71.65	71.70	0.90	56.35 - 90.50
## 0006.HK	POWER ASSETS	55.60	55.65	0.15	48.10 - 64.80
## 0011.HK	HANG SENG BANK	102.30	102.40	0.10	84.40 - 134.40
## 0012.HK	HENDERSON LAND	47.70	47.85	-0.05	33.20 - 61.50
## 0013.HK	HUTCHISON	77.80	77.85	0.05	53.60 - 97.45
## 0016.HK	SHK PPT	119.50	119.60	0.80	85.45 - 147.00
## 0017.HK	NEW WORLD DEV	10.36	10.38	0.04	7.00 - 17.98
## 0019.HK	SWIRE PACIFIC A	87.30	87.50	-0.35	79.30 - 137.20
## 0023.HK	BANK OF E ASIA	30.20	30.40	0.35	21.85 - 36.60
## 0066.HK	MTR CORPORATION	26.85	26.90	0.20	22.45 - 31.55
## 0083.HK	SINO LAND	13.92	14.04	0.10	9.33 - 18.90
## 0101.HK	HANG LUNG PPT	29.25	29.30	-0.50	20.85 - 40.50
## 0144.HK	CHINA MER HOLD	27.60	27.65	-0.60	19.00 - 37.60
## 0151.HK	WANT WANT CHINA	7.26	7.29	-0.05	5.68 - 8.30
## 0267.HK	CITIC PACIFIC	14.40	14.42	0.08	10.26 - 24.60
## 0291.HK	CHINA RESOURCES	28.85	28.90	-0.10	24.10 - 35.50
## 0293.HK	CATHAY PAC AIR	15.24	15.26	-0.30	11.80 - 24.10
## 0322.HK	TINGYI	22.00	22.05	-0.25	17.32 - 26.00
## 0330.HK	ESPRIT HOLDINGS	14.60	14.66	0.22	7.55 - 39.45
## 0386.HK	SINOPEC CORP	8.75	8.76	-0.09	6.22 - 8.90
## 0388.HK	HKEX	146.30	146.40	0.50	99.15 - 198.60
## 0494.HK	LI & FUNG	17.98	18.00	0.02	10.82 - 51.95
## 0688.HK	CHINA OVERSEAS	15.94	15.96	-0.02	9.99 - 17.86
## 0700.HK	TENCENT	193.90	194.20	-0.90	139.90 - 230.80
## 0762.HK	CHINA UNICOM	14.48	14.50	0.32	10.24 - 17.68
## 0836.HK	CHINA RES POWER	15.04	15.14	0.02	10.82 - 16.44
## 0857.HK	PETROCHINA	11.44	11.46	-0.06	8.59 - 12.50
## 0883.HK	CNOOC	17.34	17.36	-0.52	11.20 - 21.30
## 0939.HK	CCB	6.58	6.59	0.04	4.41 - 8.47
## 0941.HK	CHINA MOBILE	81.45	81.50	0.80	68.05 - 83.80
## 1044.HK	HENGAN INT'L	70.20	70.45	0.20	54.10 - 75.40
## 1088.HK	CHINA SHENHUA	35.45	35.50	-0.10	27.10 - 40.20
## 1109.HK	CHINA RES LAND	14.66	14.72	-0.22	7.28 - 17.24
## 1199.HK	COSCO PACIFIC	12.32	12.40	-0.36	7.52 - 17.16
## 1299.HK	AIA	27.05	27.10	0.25	19.84 - 29.90
## 1398.HK	ICBC	5.61	5.62	0.05	3.46 - 6.90
## 1880.HK	BELLE INT'L	12.38	12.40	-0.12	11.56 - 17.54
## 1898.HK	CHINA COAL	10.06	10.10	-0.04	6.59 - 15.08
## 2318.HK	PING AN	67.10	67.15	0.40	37.35 - 96.25
## 2388.HK	BOC HONG KONG	21.90	21.95	-0.10	14.24 - 29.40
## 2600.HK	CHALCO	4.11	4.12	-0.05	3.20 - 8.30
## 2628.HK	CHINA LIFE	23.75	23.80	-0.10	17.04 - 36.90
## 3328.HK	BANKCOMM	6.29	6.30	-0.08	4.15 - 9.53
## 3988.HK	BANK OF CHINA	3.37	3.38	0.03	2.20 - 5.02

9 Hang Seng Index

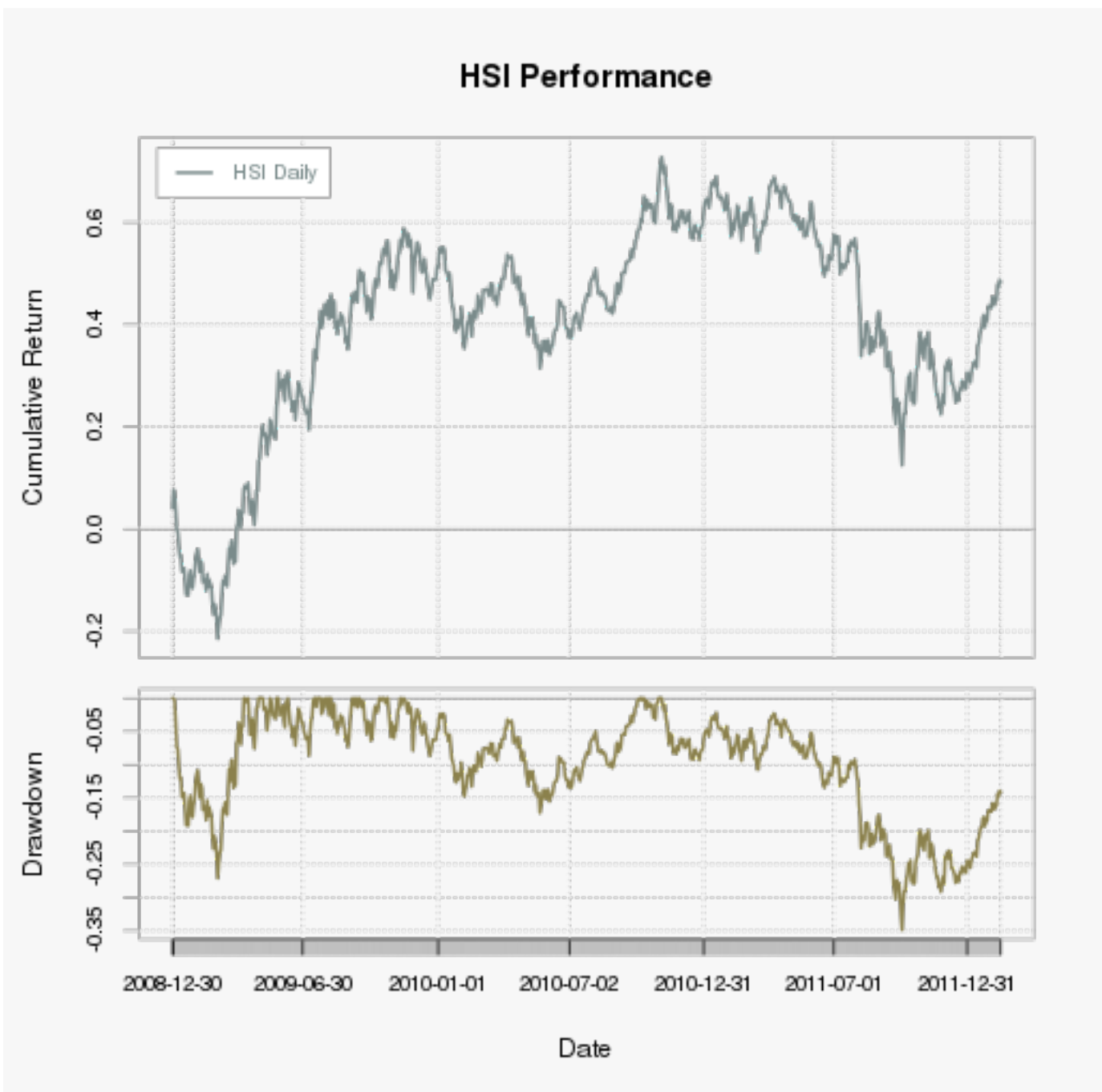
Latest Hang Seng Index

	Trade Time	Name	Last	Change	Days Range	52-week Range
^HSI	2012-02-21 03:01:00	HANG SENG INDEX	21479	53.93	21221.391 – 21480.34	16170.30 – 24468.60

9.1 Hang Seng Index - Momentum



9.2 HSI Performance



9.3 HSI Ratios

```
##          RSI
## 2012-02-06 69.93
## 2012-02-07 73.71
## 2012-02-08 73.45
## 2012-02-09 66.59
## 2012-02-12 68.06
## 2012-02-13 68.50
## 2012-02-14 74.13
## 2012-02-15 71.43
## 2012-02-16 73.92
## 2012-02-19 71.82

##          macd signal
## 2012-02-06 2.523  2.279
## 2012-02-07 2.597  2.343
## 2012-02-08 2.620  2.398
## 2012-02-09 2.519  2.422
## 2012-02-12 2.451  2.428
## 2012-02-13 2.380  2.419
## 2012-02-14 2.470  2.429
## 2012-02-15 2.476  2.438
## 2012-02-16 2.534  2.457
## 2012-02-19 2.522  2.470

## [1] "BBands"

##          dn  mavg    up  pctB
## 2012-02-06 18629 19927 21226 0.7973
## 2012-02-07 18749 20035 21320 0.8826
## 2012-02-08 18874 20135 21396 0.8469
## 2012-02-09 19011 20217 21423 0.7352
## 2012-02-12 19184 20306 21429 0.7588
## 2012-02-13 19361 20392 21423 0.7550
## 2012-02-14 19606 20510 21413 0.9734
## 2012-02-15 19725 20592 21459 0.8952
## 2012-02-16 19835 20682 21529 0.9779
## 2012-02-19 19922 20756 21591 0.9006

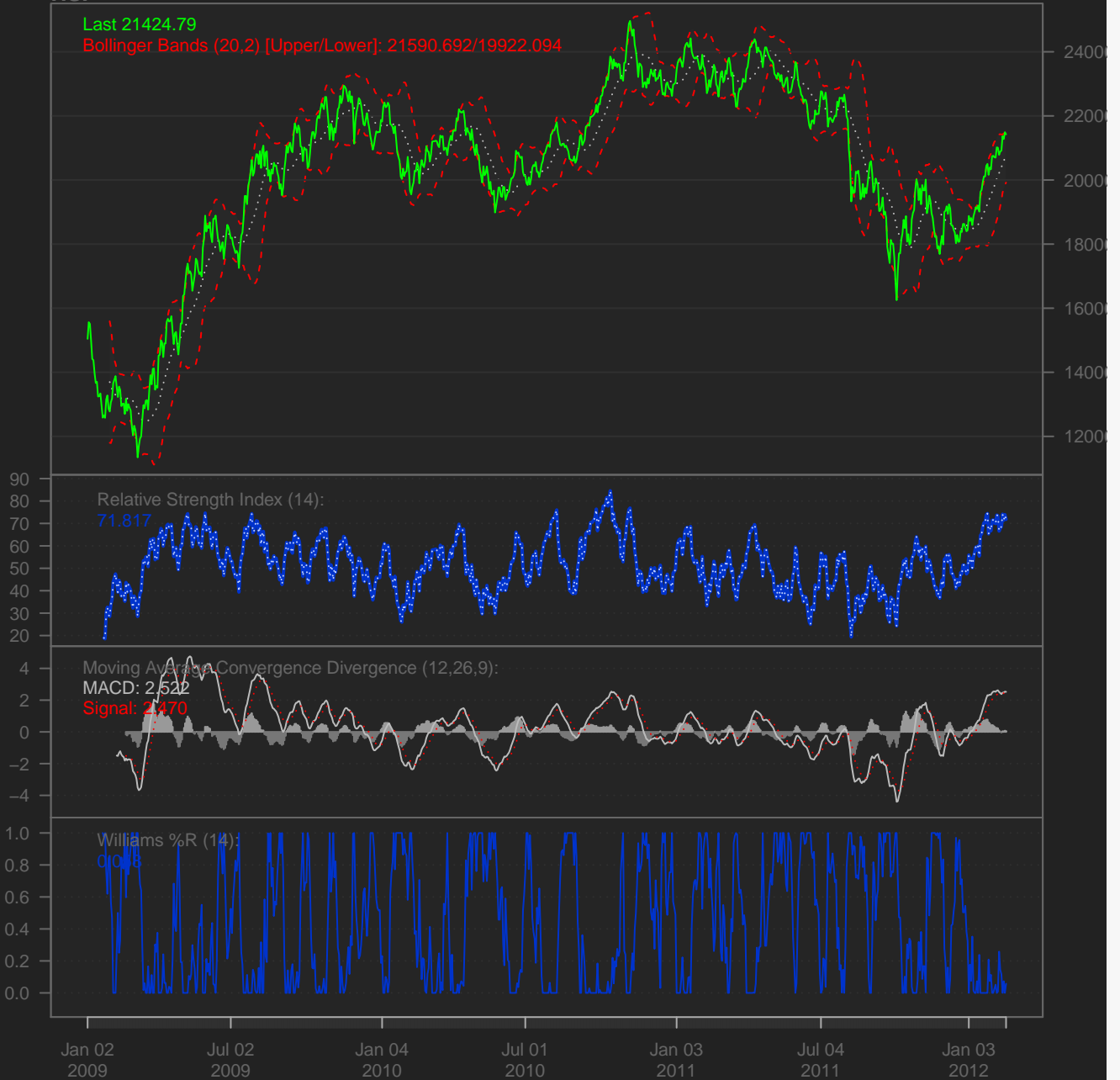
##          WPR %
## 2012-02-06  5.12
## 2012-02-07  0.00
## 2012-02-08  0.79
## 2012-02-09 25.83
## 2012-02-12 14.43
## 2012-02-13 11.73
## 2012-02-14  0.00
## 2012-02-15  7.30
## 2012-02-16  0.00
## 2012-02-19  5.77
```

CI
HSI

[2009-01-02/2012-02-20]

Last 21424.79

Bollinger Bands (20,2) [Upper/Lower]: 21590.692/19922.094



9.4 HSI Volatility



9.5 HSI Statistics

```
##                                     HSI-Daily HSI-Monthly
## Annualized StdDev Sharpe (Rf=0%, p=95%):      0.521      0.4896
## Annualized VaR Sharpe (Rf=0%, p=95%):        5.357      1.1865
## Annualized ES Sharpe (Rf=0%, p=95%):         3.943      0.9293

##           HSI-Daily HSI-Monthly
## Skewness   0.1125      0.08415

##           HSI-Daily HSI-Monthly
## Kurtosis   1.417      -0.09598
```

```
##           Index           HSI Daily
## Min.      :2008-12-31   Min.      :-0.05661
## 1st Qu.:2009-10-12   1st Qu.: -0.00802
## Median :2010-07-26   Median : 0.00030
## Mean      :2010-07-25   Mean      : 0.00063
## 3rd Qu.:2011-05-04   3rd Qu.: 0.01019
## Max.      :2012-02-18   Max.      : 0.07415

##           Index           HSI Monthly
## Min.      :2009-01-28   Min.      :-0.14329
## 1st Qu.:2009-11-05   1st Qu.: -0.01913
## Median :2010-08-13   Median : 0.00817
## Mean      :2010-08-13   Mean      : 0.01169
## 3rd Qu.:2011-05-21   3rd Qu.: 0.04308
## Max.      :2012-02-18   Max.      : 0.17074
```

10 Dataset First and Last Rows Info

```
##          X0001.HK.Close
## 2009-01-02          76.9
## 2012-02-20          113.7
##          X0002.HK.Close
## 2009-01-02          52.4
## 2012-02-20          65.6
##          X0003.HK.Close
## 2009-01-02          12.08
## 2012-02-20          19.02
##          X0004.HK.Close
## 2009-01-02          22.00
## 2012-02-20          48.25
##          X0005.HK.Close
## 2009-01-02          77.00
## 2012-02-20          70.85
##          X0006.HK.Close
## 2009-01-02          42.75
## 2012-02-20          55.50
##          X0011.HK.Close
## 2009-01-02          104.7
## 2012-02-20           NA
##          X0012.HK.Close
## 2009-01-02          30.35
## 2012-02-20           NA
##          X0013.HK.Close
## 2009-01-02          39.85
## 2012-02-20           NA
##          X0016.HK.Close
## 2009-01-02          67.3
## 2012-02-20           NA
##          X0017.HK.Close
## 2009-01-02           8.18
## 2012-02-20           NA
##          X0019.HK.Close
## 2009-01-02          55.75
## 2012-02-20           NA
##          X0023.HK.Close
## 2009-01-02          16.68
## 2012-02-20           NA
##          X0066.HK.Close
## 2009-01-02          18.08
## 2012-02-20           NA
##          X0083.HK.Close
## 2009-01-02           8.36
## 2012-02-20           NA
##          X0101.HK.Close
## 2009-01-02          18.36
## 2012-02-20           NA
##          X0144.HK.Close
## 2009-01-02          15.4
## 2012-02-20           NA
##          X0151.HK.Close
## 2009-01-02           3.17
## 2012-02-20           NA
##          X0267.HK.Close
```

##	2009-01-02	10.2
##	2012-02-20	NA
##	X0291.HK.Close	
##	2009-01-02	14
##	2012-02-20	NA
##	X0293.HK.Close	
##	2009-01-02	8.91
##	2012-02-20	NA
##	X0322.HK.Close	
##	2009-01-02	8.98
##	2012-02-20	NA
##	X0330.HK.Close	
##	2009-01-02	44.8
##	2012-02-20	NA
##	X0386.HK.Close	
##	2009-01-02	4.96
##	2012-02-20	NA
##	X0388.HK.Close	
##	2009-01-02	76.6
##	2012-02-20	NA
##	X0494.HK.Close	
##	2009-01-02	14.04
##	2012-02-20	NA
##	X0688.HK.Close	
##	2009-01-02	11.22
##	2012-02-20	NA
##	X0700.HK.Close	
##	2009-01-01	50
##	2012-02-20	NA
##	X0762.HK.Close	
##	2009-01-01	9.63
##	2012-02-20	NA
##	X0836.HK.Close	
##	2009-01-02	15.12
##	2012-02-20	NA
##	X0857.HK.Close	
##	2009-01-02	7.2
##	2012-02-20	NA
##	X0883.HK.Close	
##	2009-01-02	7.59
##	2012-02-20	NA
##	X0939.HK.Close	
##	2009-01-02	4.52
##	2012-02-20	NA
##	X0941.HK.Close	
##	2009-01-02	81.2
##	2012-02-20	NA
##	X1044.HK.Close	
##	2009-01-01	24.9
##	2012-02-20	NA
##	X1088.HK.Close	
##	2009-01-02	17.4
##	2012-02-20	NA
##	X1109.HK.Close	
##	2009-01-02	9.9
##	2012-02-20	NA
##	X1199.HK.Close	

##	2009-01-02	8.07
##	2012-02-20	NA
##	X1299.HK.Close	
##	2010-10-29	23.1
##	2012-02-20	NA
##	X1398.HK.Close	
##	2009-01-02	4.3
##	2012-02-20	NA
##	X1880.HK.Close	
##	2009-01-02	3.5
##	2012-02-20	NA
##	X1898.HK.Close	
##	2009-01-02	6.55
##	2012-02-20	NA
##	X2318.HK.Close	
##	2009-01-02	39.6
##	2012-02-20	NA
##	X2388.HK.Close	
##	2009-01-02	9.06
##	2012-02-20	NA
##	X2600.HK.Close	
##	2009-01-02	4.55
##	2012-02-20	NA
##	X2628.HK.Close	
##	2009-01-02	24.75
##	2012-02-20	NA
##	X3328.HK.Close	
##	2009-01-02	5.91
##	2012-02-20	NA
##	X3988.HK.Close	
##	2009-01-02	2.17
##	2012-02-20	NA

11 Notes

This paper was generated using R and following R libraries :

qmao XML quantmod PerformanceAnalytics

fPortfolio fBasic grid gridExtra knitr

Market Data Source : yahoo.finance

Currently this paper is automatically generated with a daily cron job.

Generating this document takes about 200 secs. on an i7 CPU

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Improvements and changes without further notice.

This is the End !