**Project 2: Multifactor model for daily stock returns¶**

##### ***Shizheng Li¶***

In [1]:

**import** **pandas** **as** **pd**  
%**pylab** inline  
**import** **matplotlib.pyplot** **as** **plt**  
**import** **numpy** **as** **np**

Populating the interactive namespace from numpy and matplotlib

In [2]:

**import** **sys**  
print(sys.version)  
print(pd.version.version)  
print(np.version.version)

3.4.3 |Anaconda 2.3.0 (64-bit)| (default, Mar 6 2015, 12:06:10) [MSC v.1600 64 bit (AMD64)]  
0.16.2  
1.9.2

In [3]:

rawfactorcsv = pd.read\_csv('./factor\_loading.csv')  
rawfactorcsv.rename(columns = {name: name.strip() **for** name **in** rawfactorcsv.columns}, inplace=**True**) *#columns names have trailing spaces*

In [4]:

*#Sort by CAPITALIZAION, pick first 1000 stocks, and set TICKER to be the index*  
sortedfactorcsv = rawfactorcsv.sort(columns='CAPITALIZATION', ascending=**False**)  
sortedfactorcsv = sortedfactorcsv.set\_index('TICKER', verify\_integrity=**True**).iloc[:1000]

In [5]:

*#Only pick 12 factors, and clear the trailing spaces in the ticker*  
factors = sortedfactorcsv[['VOLTILTY','MOMENTUM','SIZE','SIZENONL','TRADEACT','GROWTH','EARNYLD','VALUE','EARNVAR','LEVERAGE', 'CURRSEN','YIELD']]  
factors = factors.rename(index={sym:sym.strip() **for** sym **in** factors.index})

In [6]:

factors

Out[6]:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **VOLTILTY** | **MOMENTUM** | **SIZE** | **SIZENONL** | **TRADEACT** | **GROWTH** | **EARNYLD** | **VALUE** | **EARNVAR** | **LEVERAGE** | **CURRSEN** | **YIELD** |
| **TICKER** |  |  |  |  |  |  |  |  |  |  |  |  |
| **AAPL** | 0.152 | -1.227 | 1.849 | 0.197 | 0.823 | 1.505 | 0.763 | -0.334 | 0.155 | -1.264 | 0.376 | 0.142 |
| **XOM** | -1.107 | -0.560 | 1.835 | 0.197 | -0.599 | -0.078 | 0.850 | 0.016 | -0.102 | -1.552 | -0.021 | 0.286 |
| **GOOG** | -0.807 | 0.234 | 1.573 | 0.197 | -0.462 | 0.774 | -0.308 | -0.436 | -0.280 | -1.164 | 0.583 | -1.050 |
| **MSFT** | 0.287 | -0.580 | 1.495 | 0.197 | -0.694 | 0.044 | 0.556 | -0.418 | -0.175 | -1.426 | -0.067 | 0.423 |
| **JNJ** | -0.735 | 0.159 | 1.486 | 0.197 | -0.464 | -0.280 | -0.078 | -0.426 | -0.551 | -1.370 | 0.273 | 0.455 |
| **GE** | -0.023 | -0.565 | 1.455 | 0.197 | -0.312 | -0.972 | 0.239 | 0.280 | -0.469 | 1.077 | -0.589 | 0.563 |
| **WMT** | -1.073 | -0.554 | 1.465 | 0.197 | -0.875 | -0.364 | 0.281 | -0.274 | -0.520 | -0.659 | -0.454 | 0.676 |
| **CVX** | -0.931 | -0.278 | 1.431 | 0.197 | -0.610 | -0.394 | 1.135 | 0.488 | 0.188 | -1.131 | -0.285 | 0.489 |
| **WFC** | 0.110 | -0.004 | 1.388 | 0.197 | -0.123 | 0.641 | 0.705 | 0.689 | 0.198 | -0.066 | -1.052 | 0.329 |
| **CHL** | -0.850 | -1.114 | 1.328 | 0.197 | -1.718 | -0.586 | 0.927 | 0.475 | 0.196 | -0.769 | 0.338 | 0.472 |
| **PG** | -0.820 | -0.110 | 1.353 | 0.197 | -0.563 | -0.795 | -0.163 | -0.321 | -0.538 | -0.798 | 0.106 | 0.472 |
| **NSRGF** | -0.900 | -0.325 | 1.355 | 0.197 | -2.059 | -0.023 | 0.887 | -0.561 | -0.937 | -0.465 | 0.545 | -0.026 |
| **NSRGY** | -0.941 | -0.378 | 1.350 | 0.197 | -1.790 | -0.493 | -0.082 | -0.273 | -0.302 | -0.726 | 0.580 | 1.007 |
| **TM** | -0.141 | 0.458 | 1.318 | 0.197 | -1.677 | -0.125 | 0.416 | 0.572 | 0.370 | -0.278 | 0.113 | -0.067 |
| **IBM** | -1.221 | -0.717 | 1.340 | 0.197 | -0.446 | -0.306 | 0.689 | -0.893 | -0.532 | -0.605 | 0.580 | -0.070 |
| **ITCTY** | -0.243 | 1.509 | 1.287 | 0.197 | -1.460 | -0.025 | 1.104 | 0.159 | -0.496 | -0.402 | -0.410 | 0.628 |
| **NVS** | -0.830 | -0.198 | 1.257 | 0.197 | -1.505 | -0.061 | 0.254 | -0.105 | -0.241 | -0.790 | 0.485 | 0.222 |
| **HBC** | -0.153 | -0.161 | 1.323 | 0.197 | -1.646 | -0.598 | 0.939 | 1.275 | 3.255 | 0.589 | 0.980 | 1.326 |
| **JPM** | 0.082 | 0.428 | 1.320 | 0.197 | 0.322 | -0.175 | 1.180 | 1.561 | 0.383 | 1.007 | -0.573 | 0.262 |
| **PFE** | -0.266 | -0.009 | 1.262 | 0.197 | 0.257 | 0.223 | 0.194 | 0.070 | -0.349 | -0.775 | 0.243 | 1.170 |
| **T** | -0.774 | -0.820 | 1.241 | 0.197 | -0.317 | -0.429 | 0.046 | 0.276 | -0.269 | -0.116 | -0.217 | 1.389 |
| **CICHY** | 0.358 | -0.812 | 1.196 | 0.197 | -2.155 | -0.182 | 1.219 | 0.633 | -0.466 | -0.843 | 0.096 | 0.337 |
| **RHHBY** | -0.499 | 0.198 | 1.168 | 0.197 | -1.867 | -0.550 | 0.092 | -0.883 | -0.494 | -0.338 | 0.222 | -0.362 |
| **CICHF** | 1.165 | -0.727 | 1.193 | 0.197 | -1.929 | -0.182 | 1.218 | 0.633 | -0.465 | -0.842 | 1.340 | 0.337 |
| **KO** | -0.810 | -0.625 | 1.195 | 0.197 | -0.593 | 0.232 | -0.161 | -0.611 | -0.460 | -0.580 | 0.442 | 0.393 |
| **VOD** | -0.438 | -0.539 | 1.039 | 0.197 | -1.436 | -1.845 | 0.105 | 1.037 | 1.403 | -0.144 | 0.053 | 3.030 |
| **BAC** | 1.635 | 0.590 | 1.100 | 0.197 | 1.780 | 0.834 | 0.015 | 2.908 | 1.208 | 1.211 | -0.877 | -0.787 |
| **ORCL** | -0.053 | -0.613 | 1.076 | 0.197 | -0.655 | 0.011 | 0.580 | -0.291 | -0.277 | -0.409 | -0.092 | -0.454 |
| **BUD** | -0.533 | -0.031 | 1.083 | 0.197 | -1.419 | 0.532 | -0.191 | -0.366 | -0.246 | -0.162 | 0.431 | -0.318 |
| **AHBIF** | -0.277 | -0.193 | 1.080 | 0.197 | -2.163 | -0.639 | 0.884 | -0.215 | -0.807 | -0.661 | 0.969 | -0.318 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **HFC** | 0.721 | 0.559 | -1.036 | -0.004 | 1.824 | 1.634 | 1.924 | 0.764 | 1.675 | -0.189 | 1.127 | 0.224 |
| **AGNC** | 0.720 | -1.006 | -1.064 | -0.012 | 1.340 | 3.529 | 2.429 | 2.369 | 1.293 | 0.609 | -0.364 | 3.830 |
| **TIAOF** | 2.136 | -1.711 | -1.093 | -0.022 | -2.595 | -0.692 | -1.216 | -0.728 | 1.164 | 1.784 | 0.621 | 0.911 |
| **JMPLY** | -0.155 | -0.177 | -1.075 | -0.016 | -2.421 | -0.167 | -0.037 | -0.288 | 0.048 | 0.220 | 0.559 | 0.122 |
| **SRHGY** | 0.467 | -1.119 | -1.004 | 0.006 | -1.943 | -0.435 | 0.018 | -0.254 | -0.261 | 0.858 | 0.323 | 0.018 |
| **NCMGY** | 2.164 | -3.405 | -1.097 | -0.023 | -2.184 | -0.172 | -0.945 | 0.886 | 0.978 | 0.914 | 0.726 | -0.052 |
| **ISCHY** | 1.872 | -2.689 | -0.964 | 0.017 | -1.729 | -0.173 | 0.187 | -0.300 | 0.008 | 0.186 | 2.200 | 0.133 |
| **MAEOY** | -0.733 | -0.403 | -1.062 | -0.012 | -0.375 | -0.129 | -2.176 | 0.739 | -0.241 | 0.753 | 0.219 | 0.696 |
| **LLTC** | -0.084 | -0.126 | -1.020 | 0.001 | -0.358 | -0.177 | -0.266 | -0.921 | -0.362 | 0.419 | 0.133 | 0.290 |
| **MKC** | -0.863 | -0.116 | -1.022 | 0.001 | -0.538 | -0.188 | -0.316 | -0.627 | -0.525 | -0.359 | 0.563 | -0.035 |
| **BKEAY** | 0.854 | -0.602 | -1.089 | -0.020 | -2.613 | 0.174 | 0.538 | 1.348 | 0.024 | -0.196 | 1.272 | 0.191 |
| **TAP** | -0.144 | -0.435 | -1.046 | -0.007 | 0.304 | -0.600 | 0.311 | 1.402 | -0.444 | 0.283 | -0.140 | 0.072 |
| **DO** | -0.403 | -0.952 | -1.027 | -0.001 | 0.687 | -0.468 | 0.728 | 0.280 | 0.093 | -0.412 | 1.159 | -0.691 |
| **LH** | -0.873 | -0.432 | -1.059 | -0.011 | 0.678 | 0.102 | 0.306 | -0.264 | -0.558 | 0.352 | -0.244 | -1.050 |
| **SINGY** | -0.154 | -1.309 | -1.012 | 0.004 | -2.368 | -0.035 | 0.839 | 0.293 | 1.428 | 1.650 | -0.161 | -0.673 |
| **ISCHF** | 1.871 | -2.881 | -0.965 | 0.017 | -1.822 | -0.173 | 0.187 | -0.300 | 0.009 | 0.187 | 3.235 | 0.133 |
| **HSIC** | -0.665 | 0.214 | -1.054 | -0.009 | -1.201 | -0.140 | -0.264 | -0.303 | -0.535 | -0.387 | 0.433 | -1.050 |
| **BTLCY** | 0.484 | -0.698 | -1.044 | -0.006 | -2.502 | -0.651 | -0.499 | -0.070 | 0.261 | 0.800 | 0.677 | -0.662 |
| **IRE** | 3.260 | -0.502 | -1.266 | -0.090 | -1.933 | -1.851 | -2.077 | 3.723 | 0.429 | 2.871 | 0.567 | 0.098 |
| **NDVLY** | 2.114 | -0.439 | -1.025 | 0.000 | -2.488 | -0.652 | -0.491 | -0.072 | 0.254 | 0.794 | 0.759 | -0.660 |
| **LKQ** | 0.000 | 0.570 | -1.167 | -0.049 | -1.184 | 0.395 | -0.449 | -0.410 | -0.314 | 0.450 | 0.472 | -1.050 |
| **BKEAF** | 0.533 | -0.946 | -1.107 | -0.027 | -2.659 | -0.056 | 0.224 | 0.898 | 0.371 | -0.147 | 1.505 | 0.113 |
| **ADT** | 0.750 | -0.060 | -1.078 | -0.017 | 1.275 | 0.167 | -0.327 | 0.573 | -0.198 | 0.187 | -0.009 | -0.446 |
| **VOPKY** | -0.635 | -0.058 | -1.083 | -0.018 | -0.990 | -0.173 | 0.467 | -0.170 | -0.477 | 0.106 | -0.472 | -0.288 |
| **CGEMY** | 0.821 | -0.067 | -1.080 | -0.017 | -2.300 | 0.373 | 0.001 | -0.542 | -0.330 | 0.222 | 0.072 | -0.535 |
| **MGM** | 2.784 | 0.714 | -1.149 | -0.042 | 1.663 | -1.997 | -2.749 | 0.452 | 2.576 | 2.897 | -0.355 | -1.050 |
| **WGP** | 0.274 | 0.413 | -1.091 | -0.021 | -0.963 | 0.369 | -1.251 | -0.770 | -0.121 | 0.354 | 0.571 | 0.180 |
| **ZODFY** | 0.231 | 1.535 | -1.121 | -0.032 | -1.330 | -0.070 | 0.367 | -0.055 | -0.379 | 0.247 | -0.076 | -0.228 |
| **EQIX** | -0.022 | -0.635 | -1.071 | -0.014 | 1.170 | 0.758 | -1.216 | -0.376 | -0.160 | 0.999 | -0.057 | -1.050 |
| **AUY** | 2.926 | -1.704 | -1.156 | -0.045 | 1.076 | -0.763 | -0.308 | 1.747 | 1.196 | -0.076 | 1.712 | 0.030 |

1000 rows × 12 columns

In [7]:

stocks = factors.index  
stocks

Out[7]:

Index(['AAPL', 'XOM', 'GOOG', 'MSFT', 'JNJ', 'GE', 'WMT', 'CVX', 'WFC', 'CHL',   
 ...  
 'LKQ', 'BKEAF', 'ADT', 'VOPKY', 'CGEMY', 'MGM', 'WGP', 'ZODFY', 'EQIX',  
 'AUY'],  
 dtype='object', name='TICKER', length=1000)

Actually there are lots of symbols missing in price data, only 616 has data.... missing are on OTC markets...

In [8]:

**from** **os** **import** listdir  
pricefiles = listdir('./price\_data\_2013/')

In [9]:

prices\_date = {}  
**for** pricefile **in** pricefiles:  
 pricecsv = pd.read\_csv('./price\_data\_2013/' + pricefile, sep = "**\t**")  
 pricecsv.set\_index('ticker', verify\_integrity=**True**, inplace=**True**)   
 t = pricefile.split('.')[1]  
 *#only pick the stocks that are in 1000 stocks list, only use adjClose column, drop NaN rows (ticker in stocks but not in price files)*  
 prices\_date[t] = pricecsv.loc[stocks].dropna()['adjClose']

In [10]:

pricecsv.loc[stocks]

Out[10]:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **symid** | **open** | **high** | **low** | **close** | **volume** | **adjClose** |
| **TICKER** |  |  |  |  |  |  |  |
| **AAPL** | 108 | 478.45 | 489.1400 | 478.3810 | 488.03 | 12638665 | 488.03 |
| **XOM** | 627 | 85.90 | 86.3400 | 85.7800 | 86.00 | 11888460 | 86.00 |
| **GOOG** | 8302 | 880.25 | 887.6700 | 880.0500 | 887.63 | 1685208 | 887.63 |
| **MSFT** | 171 | 33.34 | 33.6100 | 33.3000 | 33.58 | 36718733 | 33.58 |
| **JNJ** | 421 | 86.52 | 87.4900 | 86.2600 | 87.47 | 6320028 | 87.47 |
| **GE** | 378 | 23.94 | 24.2200 | 23.9000 | 24.17 | 28989664 | 24.17 |
| **WMT** | 618 | 73.86 | 73.8900 | 73.3200 | 73.59 | 5683089 | 73.59 |
| **CVX** | 315 | 121.19 | 121.7400 | 120.8400 | 121.32 | 4703384 | 121.32 |
| **WFC** | 611 | 41.34 | 41.5699 | 41.0900 | 41.49 | 12776689 | 41.49 |
| **CHL** | 5731 | 56.46 | 56.9500 | 56.4300 | 56.80 | 734662 | 56.80 |
| **PG** | 513 | 75.50 | 76.5000 | 75.4400 | 76.16 | 8082469 | 76.16 |
| **NSRGF** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **NSRGY** | 8140 | 69.49 | 69.7900 | 69.2200 | 69.77 | 395000 | 69.77 |
| **TM** | 6813 | 128.03 | 128.4700 | 126.7300 | 127.32 | 305661 | 127.32 |
| **IBM** | 409 | 185.22 | 186.6500 | 184.6500 | 186.38 | 2682184 | 186.38 |
| **ITCTY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **NVS** | 6434 | 76.70 | 76.8980 | 76.4100 | 76.72 | 891229 | 76.72 |
| **HBC** | 6111 | 54.50 | 54.6920 | 54.4315 | 54.66 | 1067962 | 54.66 |
| **JPM** | 425 | 51.70 | 52.0900 | 51.4500 | 51.96 | 19187967 | 51.96 |
| **PFE** | 511 | 28.55 | 28.9480 | 28.5200 | 28.89 | 23519660 | 28.89 |
| **T** | 572 | 33.81 | 34.2400 | 33.7600 | 34.06 | 16759768 | 34.06 |
| **CICHY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **RHHBY** | 8155 | 67.93 | 67.9300 | 67.4600 | 67.73 | 286300 | 67.73 |
| **CICHF** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **KO** | 434 | 37.98 | 38.0900 | 37.6200 | 37.95 | 13195990 | 37.95 |
| **VOD** | 6896 | 35.18 | 35.3600 | 35.1101 | 35.36 | 9674582 | 35.36 |
| **BAC** | 253 | 13.85 | 13.9200 | 13.8100 | 13.90 | 57631044 | 13.90 |
| **ORCL** | 177 | 33.20 | 33.5500 | 33.0600 | 33.50 | 16300287 | 33.50 |
| **BUD** | 277 | 97.75 | 98.7100 | 97.4200 | 98.69 | 1643643 | 98.69 |
| **AHBIF** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **...** | ... | ... | ... | ... | ... | ... | ... |
| **HFC** | 1648 | 42.00 | 42.8000 | 41.7100 | 41.83 | 3778262 | 41.83 |
| **AGNC** | 15425 | 22.46 | 22.8900 | 22.4400 | 22.87 | 4680581 | 22.87 |
| **TIAOF** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **JMPLY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **SRHGY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **NCMGY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **ISCHY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **MAEOY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **LLTC** | 163 | 39.77 | 40.0600 | 39.4900 | 39.82 | 1349987 | 39.82 |
| **MKC** | 471 | 64.74 | 64.9800 | 64.5000 | 64.88 | 966411 | 64.88 |
| **BKEAY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **TAP** | 6823 | 50.15 | 50.9400 | 49.8900 | 50.94 | 909180 | 50.94 |
| **DO** | 1273 | 62.13 | 63.2100 | 62.1300 | 62.41 | 952578 | 62.41 |
| **LH** | 1895 | 99.23 | 99.4600 | 98.5800 | 98.95 | 638027 | 98.95 |
| **SINGY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **ISCHF** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **HSIC** | 152 | 103.37 | 105.4800 | 103.1900 | 105.20 | 665455 | 105.20 |
| **BTLCY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **IRE** | 6152 | 11.40 | 11.6200 | 11.3200 | 11.53 | 324744 | 11.53 |
| **NDVLY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **LKQ** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **BKEAF** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **ADT** | 40307 | 40.72 | 41.0400 | 40.4400 | 40.48 | 2494151 | 40.48 |
| **VOPKY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **CGEMY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **MGM** | 1996 | 20.51 | 20.8200 | 20.4500 | 20.74 | 6501690 | 20.74 |
| **WGP** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **ZODFY** | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **EQIX** | 3836 | 183.11 | 185.4400 | 179.8300 | 181.92 | 842821 | 181.92 |
| **AUY** | 8492 | 10.07 | 10.2400 | 10.0300 | 10.08 | 6736669 | 10.08 |

1000 rows × 7 columns

In [11]:

pricesDF = pd.DataFrame(prices\_date).T

In [12]:

pricesDF

Out[12]:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **A** | **AAPL** | **AAUKY** | **ABB** | **ABBV** | **ABC** | **ABT** | **ABV** | **ABX** | **ACE** | **...** | **WY** | **WYNN** | **XEL** | **XLNX** | **XOM** | **XRX** | **YHOO** | **YUM** | **ZMH** | **ZTS** |
| **20130903** | 46.93 | 488.58 | 11.97 | 21.58 | 42.59 | 57.39 | 32.93 | 34.57 | 19.51 | 88.28 | ... | 27.10 | 141.68 | 27.49 | 44.62 | 87.15 | 10.12 | 27.78 | 70.00 | 78.91 | 29.43 |
| **20130904** | 47.87 | 498.76 | 11.98 | 22.00 | 43.13 | 58.13 | 33.46 | 34.35 | 19.41 | 88.23 | ... | 27.10 | 141.38 | 27.34 | 45.84 | 87.76 | 10.01 | 28.07 | 69.63 | 79.44 | 29.69 |
| **20130905** | 47.68 | 495.27 | 12.31 | 21.99 | 43.51 | 58.15 | 33.74 | 35.20 | 18.91 | 88.19 | ... | 27.76 | 142.69 | 27.27 | 46.11 | 87.35 | 10.06 | 28.23 | 69.84 | 79.60 | 30.33 |
| **20130906** | 47.43 | 498.22 | 12.34 | 22.23 | 43.89 | 58.24 | 33.50 | 35.38 | 19.08 | 88.19 | ... | 28.51 | 143.43 | 27.37 | 46.18 | 87.25 | 10.03 | 28.17 | 69.61 | 79.88 | 30.61 |
| **20130909** | 47.95 | 506.18 | 12.50 | 22.61 | 44.43 | 58.66 | 33.80 | 36.16 | 19.20 | 89.50 | ... | 28.95 | 145.35 | 27.46 | 46.33 | 88.04 | 10.08 | 29.23 | 71.48 | 80.70 | 30.59 |
| **20130910** | 48.55 | 494.65 | 12.79 | 22.82 | 44.78 | 59.37 | 34.09 | 36.70 | 18.44 | 90.01 | ... | 28.78 | 149.24 | 27.72 | 46.97 | 87.82 | 10.22 | 29.48 | 71.53 | 80.85 | 30.95 |
| **20130911** | 48.96 | 467.83 | 12.68 | 23.05 | 44.95 | 60.49 | 34.75 | 37.21 | 18.64 | 92.22 | ... | 28.43 | 150.87 | 27.64 | 46.96 | 88.84 | 10.29 | 29.19 | 72.21 | 80.84 | 31.33 |
| **20130912** | 48.62 | 472.69 | 12.73 | 23.04 | 44.70 | 60.46 | 34.76 | 37.10 | 17.61 | 91.05 | ... | 28.32 | 149.65 | 27.56 | 47.11 | 87.98 | 10.14 | 29.65 | 72.39 | 81.24 | 31.08 |
| **20130913** | 48.46 | 464.90 | 12.47 | 22.91 | 44.89 | 60.28 | 34.87 | 37.02 | 17.72 | 91.67 | ... | 28.39 | 150.35 | 27.64 | 47.25 | 88.40 | 10.45 | 29.26 | 72.53 | 81.89 | 31.05 |
| **20130916** | 48.74 | 450.12 | 12.52 | 23.13 | 45.82 | 60.95 | 35.01 | 37.07 | 18.14 | 92.40 | ... | 28.77 | 149.98 | 27.40 | 47.50 | 88.67 | 10.40 | 29.62 | 72.65 | 82.82 | 31.85 |
| **20130917** | 48.87 | 455.18 | 12.52 | 23.24 | 47.60 | 61.59 | 34.97 | 37.36 | 18.33 | 92.80 | ... | 28.58 | 150.76 | 27.10 | 47.99 | 88.94 | 10.40 | 30.00 | 72.74 | 83.15 | 32.38 |
| **20130918** | 49.32 | 464.65 | 12.91 | 23.93 | 47.95 | 61.49 | 35.67 | 38.90 | 20.14 | 94.35 | ... | 29.29 | 152.98 | 27.94 | 47.71 | 89.58 | 10.36 | 30.44 | 73.62 | 83.76 | 32.72 |
| **20130919** | 50.98 | 472.30 | 13.02 | 24.03 | 47.40 | 62.23 | 35.34 | 39.23 | 19.44 | 95.35 | ... | 29.27 | 154.56 | 27.83 | 47.78 | 89.28 | 10.24 | 31.03 | 72.73 | 83.51 | 32.51 |
| **20130920** | 52.15 | 466.98 | 12.63 | 23.78 | 47.84 | 61.65 | 35.29 | 39.10 | 18.50 | 94.99 | ... | 28.81 | 155.07 | 27.75 | 47.12 | 88.66 | 10.14 | 30.91 | 72.09 | 83.11 | 32.19 |
| **20130923** | 51.67 | 490.73 | 12.57 | 23.68 | 47.10 | 61.57 | 35.12 | 39.02 | 18.35 | 94.33 | ... | 28.26 | 155.03 | 28.20 | 46.60 | 87.75 | 10.08 | 30.26 | 71.81 | 83.92 | 31.58 |
| **20130924** | 51.60 | 489.10 | 12.37 | 23.76 | 45.98 | 60.91 | 34.36 | 39.02 | 18.56 | 94.66 | ... | 28.35 | 156.12 | 28.14 | 46.72 | 87.36 | 10.31 | 31.27 | 72.06 | 83.83 | 31.48 |
| **20130925** | 51.83 | 481.53 | 12.63 | 23.80 | 45.33 | 61.01 | 33.67 | 38.58 | 18.67 | 95.27 | ... | 28.53 | 157.61 | 27.86 | 46.70 | 87.14 | 10.42 | 31.34 | 71.60 | 81.70 | 31.06 |
| **20130926** | 52.09 | 486.22 | 12.55 | 23.74 | 45.00 | 61.16 | 33.66 | 39.01 | 18.53 | 94.67 | ... | 28.82 | 159.74 | 27.88 | 46.79 | 87.07 | 10.38 | 32.75 | 72.37 | 82.24 | 31.58 |
| **20130927** | 51.63 | 482.75 | 12.38 | 23.81 | 44.33 | 61.28 | 33.14 | 38.66 | 18.53 | 94.32 | ... | 28.93 | 158.00 | 27.69 | 46.54 | 86.90 | 10.37 | 33.55 | 72.13 | 82.30 | 31.15 |
| **20130930** | 51.25 | 476.75 | 12.28 | 23.59 | 44.73 | 61.10 | 33.19 | 38.35 | 18.62 | 93.56 | ... | 28.63 | 158.01 | 27.61 | 46.86 | 86.04 | 10.29 | 33.16 | 71.39 | 82.14 | 31.12 |
| **20131001** | 51.90 | 488.03 | 11.98 | 23.71 | 45.80 | 62.48 | 33.78 | 38.36 | 18.03 | 94.02 | ... | 29.13 | 160.07 | 27.79 | 47.26 | 86.00 | 10.49 | 34.32 | 71.58 | 82.41 | 31.78 |

21 rows × 619 columns

In [13]:

*#Columns with NaN prices*  
pd.isnull(pricesDF).any(0).nonzero()[0]

Out[13]:

array([ 26, 87, 95, 153, 160, 242, 262, 313, 342, 348, 431, 474, 587], dtype=int64)

In [14]:

pricesDF.iloc[:, 87]

Out[14]:

20130903 31.85  
20130904 32.15  
20130905 NaN  
20130906 32.61  
20130909 33.10  
20130910 33.71  
20130911 33.78  
20130912 33.51  
20130913 33.38  
20130916 33.75  
20130917 33.80  
20130918 34.80  
20130919 34.59  
20130920 34.26  
20130923 34.36  
20130924 34.40  
20130925 34.65  
20130926 34.23  
20130927 NaN  
20130930 33.85  
20131001 34.30  
Name: BNPQY, dtype: float64

In [15]:

*#Drop those NaN columns*  
pricesDF.dropna(1, inplace=**True**)

In [16]:

returnDF = pricesDF.pct\_change()

In [17]:

returnDF

Out[17]:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **A** | **AAPL** | **AAUKY** | **ABB** | **ABBV** | **ABC** | **ABT** | **ABV** | **ABX** | **ACE** | **...** | **WY** | **WYNN** | **XEL** | **XLNX** | **XOM** | **XRX** | **YHOO** | **YUM** | **ZMH** | **ZTS** |
| **20130903** | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **20130904** | 0.020030 | 0.020836 | 0.000835 | 0.019462 | 0.012679 | 0.012894 | 0.016095 | -0.006364 | -0.005126 | -0.000566 | ... | 0.000000 | -0.002117 | -0.005457 | 0.027342 | 0.006999 | -0.010870 | 0.010439 | -0.005286 | 0.006717 | 0.008835 |
| **20130905** | -0.003969 | -0.006997 | 0.027546 | -0.000455 | 0.008811 | 0.000344 | 0.008368 | 0.024745 | -0.025760 | -0.000453 | ... | 0.024354 | 0.009266 | -0.002560 | 0.005890 | -0.004672 | 0.004995 | 0.005700 | 0.003016 | 0.002014 | 0.021556 |
| **20130906** | -0.005243 | 0.005956 | 0.002437 | 0.010914 | 0.008734 | 0.001548 | -0.007113 | 0.005114 | 0.008990 | 0.000000 | ... | 0.027017 | 0.005186 | 0.003667 | 0.001518 | -0.001145 | -0.002982 | -0.002125 | -0.003293 | 0.003518 | 0.009232 |
| **20130909** | 0.010964 | 0.015977 | 0.012966 | 0.017094 | 0.012303 | 0.007212 | 0.008955 | 0.022046 | 0.006289 | 0.014854 | ... | 0.015433 | 0.013386 | 0.003288 | 0.003248 | 0.009054 | 0.004985 | 0.037629 | 0.026864 | 0.010265 | -0.000653 |
| **20130910** | 0.012513 | -0.022778 | 0.023200 | 0.009288 | 0.007878 | 0.012104 | 0.008580 | 0.014934 | -0.039583 | 0.005698 | ... | -0.005872 | 0.026763 | 0.009468 | 0.013814 | -0.002499 | 0.013889 | 0.008553 | 0.000699 | 0.001859 | 0.011769 |
| **20130911** | 0.008445 | -0.054220 | -0.008600 | 0.010079 | 0.003796 | 0.018865 | 0.019361 | 0.013896 | 0.010846 | 0.024553 | ... | -0.012161 | 0.010922 | -0.002886 | -0.000213 | 0.011615 | 0.006849 | -0.009837 | 0.009507 | -0.000124 | 0.012278 |
| **20130912** | -0.006944 | 0.010388 | 0.003943 | -0.000434 | -0.005562 | -0.000496 | 0.000288 | -0.002956 | -0.055258 | -0.012687 | ... | -0.003869 | -0.008086 | -0.002894 | 0.003194 | -0.009680 | -0.014577 | 0.015759 | 0.002493 | 0.004948 | -0.007980 |
| **20130913** | -0.003291 | -0.016480 | -0.020424 | -0.005642 | 0.004251 | -0.002977 | 0.003165 | -0.002156 | 0.006246 | 0.006809 | ... | 0.002472 | 0.004678 | 0.002903 | 0.002972 | 0.004774 | 0.030572 | -0.013153 | 0.001934 | 0.008001 | -0.000965 |
| **20130916** | 0.005778 | -0.031792 | 0.004010 | 0.009603 | 0.020717 | 0.011115 | 0.004015 | 0.001351 | 0.023702 | 0.007963 | ... | 0.013385 | -0.002461 | -0.008683 | 0.005291 | 0.003054 | -0.004785 | 0.012303 | 0.001654 | 0.011357 | 0.025765 |
| **20130917** | 0.002667 | 0.011241 | 0.000000 | 0.004756 | 0.038848 | 0.010500 | -0.001143 | 0.007823 | 0.010474 | 0.004329 | ... | -0.006604 | 0.005201 | -0.010949 | 0.010316 | 0.003045 | 0.000000 | 0.012829 | 0.001239 | 0.003985 | 0.016641 |
| **20130918** | 0.009208 | 0.020805 | 0.031150 | 0.029690 | 0.007353 | -0.001624 | 0.020017 | 0.041221 | 0.098745 | 0.016703 | ... | 0.024843 | 0.014725 | 0.030996 | -0.005835 | 0.007196 | -0.003846 | 0.014667 | 0.012098 | 0.007336 | 0.010500 |
| **20130919** | 0.033658 | 0.016464 | 0.008521 | 0.004179 | -0.011470 | 0.012034 | -0.009251 | 0.008483 | -0.034757 | 0.010599 | ... | -0.000683 | 0.010328 | -0.003937 | 0.001467 | -0.003349 | -0.011583 | 0.019382 | -0.012089 | -0.002985 | -0.006418 |
| **20130920** | 0.022950 | -0.011264 | -0.029954 | -0.010404 | 0.009283 | -0.009320 | -0.001415 | -0.003314 | -0.048354 | -0.003776 | ... | -0.015716 | 0.003300 | -0.002875 | -0.013813 | -0.006944 | -0.009766 | -0.003867 | -0.008800 | -0.004790 | -0.009843 |
| **20130923** | -0.009204 | 0.050859 | -0.004751 | -0.004205 | -0.015468 | -0.001298 | -0.004817 | -0.002046 | -0.008108 | -0.006948 | ... | -0.019091 | -0.000258 | 0.016216 | -0.011036 | -0.010264 | -0.005917 | -0.021029 | -0.003884 | 0.009746 | -0.018950 |
| **20130924** | -0.001355 | -0.003322 | -0.015911 | 0.003378 | -0.023779 | -0.010720 | -0.021640 | 0.000000 | 0.011444 | 0.003498 | ... | 0.003185 | 0.007031 | -0.002128 | 0.002575 | -0.004444 | 0.022817 | 0.033377 | 0.003481 | -0.001072 | -0.003167 |
| **20130925** | 0.004457 | -0.015477 | 0.021019 | 0.001684 | -0.014137 | 0.001642 | -0.020081 | -0.011276 | 0.005927 | 0.006444 | ... | 0.006349 | 0.009544 | -0.009950 | -0.000428 | -0.002518 | 0.010669 | 0.002239 | -0.006384 | -0.025409 | -0.013342 |
| **20130926** | 0.005016 | 0.009740 | -0.006334 | -0.002521 | -0.007280 | 0.002459 | -0.000297 | 0.011146 | -0.007499 | -0.006298 | ... | 0.010165 | 0.013514 | 0.000718 | 0.001927 | -0.000803 | -0.003839 | 0.044990 | 0.010754 | 0.006610 | 0.016742 |
| **20130927** | -0.008831 | -0.007137 | -0.013546 | 0.002949 | -0.014889 | 0.001962 | -0.015449 | -0.008972 | 0.000000 | -0.003697 | ... | 0.003817 | -0.010893 | -0.006815 | -0.005343 | -0.001952 | -0.000963 | 0.024427 | -0.003316 | 0.000730 | -0.013616 |
| **20130930** | -0.007360 | -0.012429 | -0.008078 | -0.009240 | 0.009023 | -0.002937 | 0.001509 | -0.008019 | 0.004857 | -0.008058 | ... | -0.010370 | 0.000063 | -0.002889 | 0.006876 | -0.009896 | -0.007715 | -0.011624 | -0.010259 | -0.001944 | -0.000963 |
| **20131001** | 0.012683 | 0.023660 | -0.024430 | 0.005087 | 0.023921 | 0.022586 | 0.017776 | 0.000261 | -0.031686 | 0.004917 | ... | 0.017464 | 0.013037 | 0.006519 | 0.008536 | -0.000465 | 0.019436 | 0.034982 | 0.002661 | 0.003287 | 0.021208 |

21 rows × 606 columns

In [18]:

returnDF.dropna(inplace=**True**) *#Drop first row, all NaN*

In [19]:

*#Only keep stocks that have price data in factor loading matrix, and reorder the matrix according to the ordering in return data*  
factors\_trim = factors.loc[returnDF.columns]  
factors\_trim

Out[19]:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **VOLTILTY** | **MOMENTUM** | **SIZE** | **SIZENONL** | **TRADEACT** | **GROWTH** | **EARNYLD** | **VALUE** | **EARNVAR** | **LEVERAGE** | **CURRSEN** | **YIELD** |
| **A** | 0.144 | -0.506 | -0.653 | 0.076 | 0.823 | -0.245 | 0.186 | -0.164 | -0.244 | -0.036 | 0.653 | -0.505 |
| **AAPL** | 0.152 | -1.227 | 1.849 | 0.197 | 0.823 | 1.505 | 0.763 | -0.334 | 0.155 | -1.264 | 0.376 | 0.142 |
| **AAUKY** | 1.777 | -2.338 | -0.155 | 0.102 | -2.148 | -1.541 | 0.982 | 2.547 | 2.964 | 0.185 | 0.977 | 0.039 |
| **ABB** | 0.153 | -0.360 | 0.250 | 0.104 | -1.565 | -0.274 | 0.184 | -0.179 | -0.467 | -0.477 | 0.116 | 0.223 |
| **ABBV** | 0.244 | 0.356 | 0.511 | 0.115 | -0.160 | 0.575 | 0.433 | -1.012 | -0.511 | 0.635 | 0.041 | 0.652 |
| **ABC** | -0.241 | 0.634 | -0.755 | 0.061 | 1.042 | 0.055 | 0.034 | -0.614 | -0.479 | -0.597 | 0.212 | -0.236 |
| **ABT** | -0.436 | -0.268 | 0.335 | 0.106 | -0.282 | -0.626 | -0.112 | 0.221 | -0.371 | -0.081 | 0.334 | 0.099 |
| **ABV** | 0.068 | -0.329 | 0.264 | 0.104 | -1.211 | -0.275 | -0.438 | -0.436 | -0.262 | -0.719 | 1.078 | -0.254 |
| **ABX** | 3.166 | -2.928 | -0.579 | 0.084 | 1.621 | 0.145 | 0.597 | 2.615 | 3.957 | 0.625 | 0.833 | 0.631 |
| **ACE** | -0.674 | 0.017 | -0.123 | 0.102 | -0.390 | -0.523 | 0.889 | 1.443 | -0.274 | -0.706 | -0.669 | 0.128 |
| **ACN** | -0.297 | -0.081 | 0.204 | 0.103 | -0.170 | 0.019 | 0.086 | -0.895 | -0.453 | -0.806 | 0.525 | -0.551 |
| **ACT** | -0.032 | 1.343 | -0.572 | 0.084 | 1.290 | 0.026 | -0.356 | -0.494 | -0.313 | 0.695 | 0.477 | -1.050 |
| **ADBE** | 0.122 | 0.137 | -0.327 | 0.099 | -0.648 | -0.008 | -0.696 | -0.326 | -0.390 | -0.233 | -0.222 | -1.050 |
| **ADI** | -0.250 | -0.021 | -0.662 | 0.074 | -0.354 | 0.065 | -0.261 | -0.347 | -0.309 | -0.616 | 0.630 | 0.367 |
| **ADM** | -0.254 | 0.271 | -0.317 | 0.099 | -0.003 | -0.474 | 0.320 | 1.155 | -0.211 | -0.301 | 0.029 | 0.077 |
| **ADP** | -0.766 | 0.065 | -0.034 | 0.102 | -1.150 | -0.355 | -0.383 | -0.637 | -0.549 | -1.625 | -0.189 | 0.242 |
| **ADS** | -0.425 | 0.637 | -0.999 | 0.007 | 1.698 | 1.298 | -0.249 | -0.989 | -0.344 | 1.820 | 0.010 | -1.050 |
| **ADT** | 0.750 | -0.060 | -1.078 | -0.017 | 1.275 | 0.167 | -0.327 | 0.573 | -0.198 | 0.187 | -0.009 | -0.446 |
| **AEG** | 1.344 | 0.358 | -0.609 | 0.081 | -1.878 | -0.528 | 0.774 | 5.000 | 2.791 | 0.188 | -0.226 | 0.867 |
| **AEP** | -0.666 | -0.390 | -0.366 | 0.097 | 0.275 | -0.674 | 0.210 | 0.831 | -0.463 | 0.732 | 0.502 | 1.048 |
| **AES** | 0.660 | -1.054 | -1.034 | -0.003 | 0.146 | -0.480 | -0.244 | 0.291 | -0.048 | 2.906 | 1.332 | -0.329 |
| **AET** | 0.209 | 0.862 | -0.310 | 0.099 | 0.934 | -0.747 | 0.867 | 0.106 | -0.429 | -0.351 | 0.918 | -0.308 |
| **AFL** | 0.115 | 0.084 | -0.182 | 0.101 | 0.034 | 0.081 | 1.060 | 0.478 | -0.402 | -0.680 | -1.000 | 0.201 |
| **AGN** | 0.128 | -0.427 | -0.229 | 0.101 | 0.428 | -0.352 | -0.339 | -0.516 | -0.302 | -0.570 | 0.380 | -0.831 |
| **AGNC** | 0.720 | -1.006 | -1.064 | -0.012 | 1.340 | 3.529 | 2.429 | 2.369 | 1.293 | 0.609 | -0.364 | 3.830 |
| **AGU** | 0.253 | -1.321 | -0.798 | 0.054 | 0.481 | 0.296 | 1.261 | 0.445 | 0.143 | 0.015 | 0.855 | -0.034 |
| **AIG** | 2.012 | 0.193 | 0.458 | 0.111 | 1.351 | -2.119 | -1.228 | 3.120 | 0.163 | 1.049 | -3.609 | -1.050 |
| **AIQUY** | -0.243 | -0.417 | 0.089 | 0.102 | -2.186 | -0.397 | -0.217 | -0.185 | -0.570 | -0.235 | 0.414 | -0.111 |
| **AKZOY** | 0.459 | -0.581 | -0.685 | 0.072 | -2.110 | -1.459 | -1.288 | 0.665 | 0.609 | -0.229 | 0.134 | 1.042 |
| **ALL** | -0.033 | 0.215 | -0.322 | 0.099 | 0.242 | -0.770 | 0.814 | 1.372 | 0.401 | -0.561 | -0.386 | 0.039 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **VRTX** | 0.854 | 1.075 | -0.549 | 0.086 | -0.604 | 1.728 | -2.483 | -0.983 | 0.873 | -0.166 | 0.475 | -1.050 |
| **VRX** | 0.495 | 2.150 | -0.134 | 0.102 | -0.225 | 0.498 | -0.235 | -0.793 | 0.513 | 1.369 | 0.295 | -1.050 |
| **VTR** | 0.138 | -0.638 | -0.484 | 0.091 | -0.005 | 1.188 | -0.939 | 0.248 | -0.255 | 0.625 | -0.097 | 0.951 |
| **VZ** | -0.584 | -0.224 | 1.020 | 0.197 | -0.343 | -0.545 | -0.415 | -0.463 | -0.238 | -0.084 | -0.237 | 1.063 |
| **WAG** | 0.368 | 0.169 | 0.198 | 0.103 | 0.261 | -0.166 | 0.139 | -0.027 | -0.455 | -0.198 | 0.113 | 0.243 |
| **WBK** | -0.029 | -0.169 | 0.647 | 0.128 | -2.011 | -0.312 | 0.417 | 0.197 | -0.614 | -0.697 | 0.174 | 0.284 |
| **WDC** | 1.016 | 0.825 | -0.662 | 0.075 | 0.285 | 1.141 | 1.810 | 0.326 | 0.314 | -0.184 | 0.479 | -0.082 |
| **WEC** | -0.694 | -0.253 | -0.983 | 0.012 | 0.029 | -0.555 | -0.037 | 0.068 | -0.458 | 0.185 | 0.039 | 0.605 |
| **WFC** | 0.110 | -0.004 | 1.388 | 0.197 | -0.123 | 0.641 | 0.705 | 0.689 | 0.198 | -0.066 | -1.052 | 0.329 |
| **WFM** | 0.260 | 0.565 | -0.433 | 0.094 | -0.443 | 0.545 | -0.815 | -0.609 | -0.434 | -0.531 | 0.120 | 0.058 |
| **WFT** | 0.911 | -1.122 | -0.928 | 0.026 | 1.276 | -0.319 | -0.698 | 1.257 | 0.668 | 0.727 | 0.360 | -1.050 |
| **WHR** | 1.060 | 1.261 | -0.934 | 0.025 | 1.759 | -0.702 | 0.491 | 0.027 | -0.214 | -0.081 | -0.674 | -0.046 |
| **WIT** | 0.957 | -0.262 | -0.410 | 0.095 | -1.947 | 0.071 | -0.280 | -0.505 | -0.348 | -0.333 | 0.046 | 0.336 |
| **WLP** | -0.164 | 0.635 | -0.267 | 0.100 | 0.367 | -0.429 | 1.143 | 1.562 | -0.306 | 0.056 | 0.691 | -0.022 |
| **WM** | -0.568 | -0.150 | -0.470 | 0.092 | -0.364 | -0.705 | -0.171 | -0.201 | -0.331 | 0.693 | -0.073 | 0.788 |
| **WMB** | 0.006 | -0.570 | -0.340 | 0.098 | 1.060 | -1.142 | -0.726 | -0.552 | -0.009 | 0.797 | 0.596 | 0.930 |
| **WMT** | -1.073 | -0.554 | 1.465 | 0.197 | -0.875 | -0.364 | 0.281 | -0.274 | -0.520 | -0.659 | -0.454 | 0.676 |
| **WPPGY** | -0.321 | 0.307 | -0.318 | 0.099 | -1.999 | -0.248 | 0.233 | 0.110 | -0.467 | 0.021 | 0.042 | 0.808 |
| **WPZ** | -0.088 | -0.413 | -0.427 | 0.095 | -1.298 | 1.693 | -0.426 | 0.102 | 0.109 | 0.578 | 1.254 | 2.721 |
| **WU** | 0.603 | -1.091 | -0.978 | 0.013 | 1.427 | 0.142 | 0.701 | -0.873 | -0.437 | 0.951 | -0.104 | 0.370 |
| **WY** | 0.273 | -0.214 | -0.607 | 0.081 | 0.849 | -0.517 | -0.622 | -0.421 | 1.828 | 0.297 | -0.626 | 0.271 |
| **WYNN** | 0.329 | 0.489 | -0.755 | 0.061 | 0.244 | -0.006 | -0.357 | -1.205 | -0.167 | 2.977 | 0.857 | 0.404 |
| **XEL** | -0.618 | -0.465 | -0.678 | 0.072 | -0.099 | -0.404 | 0.168 | 0.595 | -0.546 | 0.386 | -0.029 | 0.786 |
| **XLNX** | 0.226 | 0.393 | -0.821 | 0.049 | 0.182 | -0.084 | -0.304 | -0.444 | -0.383 | -0.148 | -0.245 | 0.101 |
| **XOM** | -1.107 | -0.560 | 1.835 | 0.197 | -0.599 | -0.078 | 0.850 | 0.016 | -0.102 | -1.552 | -0.021 | 0.286 |
| **XRX** | 0.827 | -0.224 | -0.847 | 0.044 | 0.376 | -0.242 | 1.238 | 1.682 | -0.211 | 0.567 | 0.256 | 0.203 |
| **YHOO** | 1.096 | 0.759 | -0.140 | 0.102 | 0.683 | 0.127 | 0.298 | 0.253 | 0.153 | -0.540 | 0.487 | -1.050 |
| **YUM** | -0.591 | -0.238 | -0.083 | 0.102 | 0.415 | -0.103 | -0.327 | -0.956 | -0.439 | 0.178 | 0.131 | 0.085 |
| **ZMH** | -0.211 | 0.021 | -0.722 | 0.066 | 0.118 | -0.167 | 0.194 | 0.072 | -0.517 | -0.457 | 0.399 | -0.476 |
| **ZTS** | 0.364 | 0.305 | -0.678 | 0.073 | 0.837 | 0.973 | -0.429 | -0.358 | 0.206 | -0.357 | 0.062 | -0.628 |

606 rows × 12 columns

**Cross-sectional regression:¶**

Note that we have heteroskedasticity in error terms, so first need to estimate the variance of the error term. We assume the error terms for each stock are uncorrelated, so the covariance matrix of the error terms will be diagnal. There are multiple ways to estimate error variance, I use two of them.

1. Method 1: Perform OLS on every day, compute the residual $\hat{\epsilon}$ on every day, then use the sample variance of the residuals $\hat{\epsilon}$ across days as the estimate of the error variance, and perform Weighted Least Square using weights 1/variance\_estimate
2. Method 2: Perform OLS on every day, then run the OLS linear regression below for every day $$log(\hat{\epsilon}^2) = g\_0 + BG + e$$ where $\hat{\epsilon}$ is the residual from OLS, $B$ is the factor loading matrix, used as the predictor of log variance (taking log to make sure estimated variance always non-negative). Then compute the fitted value of log variance: $B\hat{G}$, this gives the estimate of log variance on every day, take expontial to get the estimate of variance every day then average over days. Then, perform WLS using weights 1/variance\_estimate.

Comparing the estimated factor return using the two methods, they have similar trends over time, although the magnitudes are a bit different.

In [20]:

**import** **numpy.linalg**

In [21]:

*#returnDF is T by N, so need transpose, T = 20 days, N = 600+ stocks, P = 12 factors*  
*#Do OLS for all days*  
OLS\_factor\_result = np.linalg.lstsq(factors\_trim.values, returnDF.values.T)

In [22]:

OLS\_factor\_returns = OLS\_factor\_result[0]  
  
OLS\_factor\_returns.shape *#P by T*

Out[22]:

(12, 20)

In [23]:

*#Note the dimensions: N-by-T - N-by-P \* P-by-T*  
OLS\_residues = returnDF.values.T - factors\_trim.values.dot(OLS\_factor\_returns)

Method One:

In [24]:

var\_est = np.var(OLS\_residues, 1, ddof = 1)

In [25]:

var\_est

Out[25]:

array([ 1.44518523e-04, 5.39859969e-04, 2.34743233e-04,  
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 5.54227784e-05, 5.11699934e-05, 9.38993502e-05])

In [26]:

WLS\_weights = 1/var\_est

In [27]:

**import** **statsmodels.api** **as** **sm**

In [28]:

WLS\_results = {}  
**for** row **in** returnDF.iterrows(): *#row[1] is the Series, row[0] is the row name*  
 WLS\_model = sm.WLS(row[1].values, factors\_trim.values, weights = WLS\_weights)  
 WLS\_results[row[0]] = WLS\_model.fit()

In [29]:

WLS\_factor\_return = {day: WLS\_results[day].params **for** day **in** WLS\_results}

In [30]:

WLS\_factor\_returnDF = pd.DataFrame(data = WLS\_factor\_return, index = factors\_trim.columns).T

In [31]:

WLS\_factor\_returnDF

Out[31]:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **VOLTILTY** | **MOMENTUM** | **SIZE** | **SIZENONL** | **TRADEACT** | **GROWTH** | **EARNYLD** | **VALUE** | **EARNVAR** | **LEVERAGE** | **CURRSEN** | **YIELD** |
| **20130904** | 0.003483 | 0.000320 | -0.006277 | 0.073501 | -0.000366 | -0.000801 | 0.001535 | -0.000593 | -0.000477 | -0.001964 | -0.001174 | -0.002722 |
| **20130905** | 0.001126 | -0.001040 | -0.001827 | 0.017043 | -0.000406 | 0.000130 | 0.001700 | 0.000807 | 0.001140 | -0.001041 | -0.000187 | -0.002142 |
| **20130906** | 0.000320 | -0.003265 | -0.001042 | 0.008561 | -0.001409 | 0.001257 | -0.000894 | 0.000387 | 0.000083 | 0.000832 | 0.002041 | 0.000418 |
| **20130909** | 0.004940 | -0.002400 | -0.006689 | 0.095159 | -0.001685 | -0.000425 | -0.001394 | -0.000320 | 0.000514 | -0.000302 | -0.001211 | -0.000891 |
| **20130910** | 0.003873 | 0.000170 | -0.006074 | 0.079307 | -0.002314 | 0.000548 | 0.001092 | -0.000424 | -0.001436 | 0.000680 | -0.003243 | -0.000714 |
| **20130911** | 0.000407 | 0.000462 | -0.001052 | 0.039700 | -0.000141 | -0.000824 | 0.000380 | -0.001431 | -0.000425 | 0.000054 | 0.000133 | -0.001778 |
| **20130912** | -0.002955 | 0.001647 | 0.003681 | -0.042802 | 0.000083 | -0.001007 | -0.000643 | -0.000616 | 0.000737 | -0.000211 | -0.000446 | -0.000337 |
| **20130913** | 0.000615 | 0.000744 | -0.001247 | 0.026042 | 0.000216 | -0.001102 | 0.001003 | -0.000282 | -0.000867 | 0.000489 | -0.000514 | 0.000578 |
| **20130916** | 0.000584 | 0.000621 | -0.004949 | 0.061225 | -0.001092 | -0.001461 | 0.001311 | -0.000402 | -0.001276 | -0.000207 | -0.001045 | -0.000478 |
| **20130917** | 0.001857 | -0.000038 | -0.002213 | 0.038706 | 0.000984 | -0.001011 | 0.000337 | -0.000283 | -0.002382 | 0.001049 | 0.000491 | -0.000907 |
| **20130918** | 0.002672 | -0.005419 | -0.006798 | 0.123627 | -0.003368 | 0.001623 | -0.003592 | 0.000187 | 0.000632 | 0.002153 | 0.000494 | 0.002433 |
| **20130919** | -0.000850 | 0.001588 | 0.000737 | -0.018058 | -0.000319 | 0.000022 | -0.001258 | -0.001949 | -0.000583 | -0.000066 | 0.000506 | 0.000814 |
| **20130920** | -0.001049 | 0.003338 | 0.004777 | -0.071163 | -0.000817 | -0.000285 | 0.001331 | -0.000902 | 0.000079 | -0.001137 | -0.000166 | -0.000197 |
| **20130923** | -0.000956 | -0.003013 | 0.001673 | -0.050108 | -0.001357 | -0.000168 | 0.000434 | 0.000223 | -0.001379 | 0.001055 | 0.000865 | 0.002233 |
| **20130924** | 0.001822 | 0.002364 | -0.001166 | -0.012428 | -0.000079 | 0.000554 | 0.001266 | -0.000409 | 0.000878 | -0.000939 | -0.000356 | 0.001495 |
| **20130925** | 0.002435 | -0.000583 | 0.001237 | -0.019081 | 0.000246 | 0.000861 | 0.001179 | -0.000032 | 0.001811 | -0.000670 | -0.000973 | -0.000042 |
| **20130926** | -0.000008 | 0.001164 | -0.001530 | 0.034793 | -0.000666 | -0.000098 | -0.001517 | -0.001595 | 0.000138 | 0.000992 | 0.001249 | -0.000757 |
| **20130927** | -0.000782 | 0.002224 | 0.002876 | -0.038532 | -0.001277 | 0.000089 | 0.001134 | -0.000425 | 0.000639 | 0.000412 | 0.000109 | -0.000868 |
| **20130930** | -0.001122 | 0.000906 | 0.000687 | -0.048069 | 0.000216 | 0.000638 | -0.000656 | -0.000470 | -0.000056 | 0.000308 | -0.000614 | 0.000489 |
| **20131001** | 0.002588 | 0.001000 | -0.005442 | 0.072091 | 0.000010 | 0.000009 | 0.000599 | -0.000089 | 0.000159 | 0.000732 | 0.000201 | -0.001320 |

In [32]:

**for** factor **in** WLS\_factor\_returnDF:  
 plt.figure()  
 plt.plot(WLS\_factor\_returnDF[factor])  
 plt.title(factor)  
 plt.xlabel("Days")  
 plt.ylabel("Factor Return")

In [33]:

**for** day **in** sorted(WLS\_results):  
 print(day)  
 print(WLS\_results[day].summary())

20130904  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.447  
Model: WLS Adj. R-squared: 0.436  
Method: Least Squares F-statistic: 40.02  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.38e-68  
Time: 21:56:00 Log-Likelihood: 1905.0  
No. Observations: 606 AIC: -3786.  
Df Residuals: 594 BIC: -3733.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0035 0.001 4.453 0.000 0.002 0.005  
x2 0.0003 0.001 0.467 0.640 -0.001 0.002  
x3 -0.0063 0.001 -10.713 0.000 -0.007 -0.005  
x4 0.0735 0.004 18.030 0.000 0.065 0.082  
x5 -0.0004 0.000 -0.844 0.399 -0.001 0.000  
x6 -0.0008 0.001 -1.338 0.181 -0.002 0.000  
x7 0.0015 0.001 2.360 0.019 0.000 0.003  
x8 -0.0006 0.000 -1.193 0.233 -0.002 0.000  
x9 -0.0005 0.001 -0.712 0.476 -0.002 0.001  
x10 -0.0020 0.001 -3.881 0.000 -0.003 -0.001  
x11 -0.0012 0.001 -1.832 0.068 -0.002 8.48e-05  
x12 -0.0027 0.001 -4.714 0.000 -0.004 -0.002  
==============================================================================  
Omnibus: 5.324 Durbin-Watson: 1.946  
Prob(Omnibus): 0.070 Jarque-Bera (JB): 6.931  
Skew: 0.032 Prob(JB): 0.0313  
Kurtosis: 3.520 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130905  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.132  
Model: WLS Adj. R-squared: 0.114  
Method: Least Squares F-statistic: 7.529  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 4.97e-13  
Time: 21:56:00 Log-Likelihood: 1931.7  
No. Observations: 606 AIC: -3839.  
Df Residuals: 594 BIC: -3787.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0011 0.001 1.504 0.133 -0.000 0.003  
x2 -0.0010 0.001 -1.585 0.113 -0.002 0.000  
x3 -0.0018 0.001 -3.258 0.001 -0.003 -0.001  
x4 0.0170 0.004 4.369 0.000 0.009 0.025  
x5 -0.0004 0.000 -0.978 0.328 -0.001 0.000  
x6 0.0001 0.001 0.227 0.820 -0.001 0.001  
x7 0.0017 0.001 2.730 0.007 0.000 0.003  
x8 0.0008 0.000 1.695 0.091 -0.000 0.002  
x9 0.0011 0.001 1.779 0.076 -0.000 0.002  
x10 -0.0010 0.000 -2.150 0.032 -0.002 -9.02e-05  
x11 -0.0002 0.001 -0.304 0.761 -0.001 0.001  
x12 -0.0021 0.001 -3.877 0.000 -0.003 -0.001  
==============================================================================  
Omnibus: 18.113 Durbin-Watson: 1.843  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 19.930  
Skew: 0.370 Prob(JB): 4.70e-05  
Kurtosis: 3.491 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130906  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.188  
Model: WLS Adj. R-squared: 0.172  
Method: Least Squares F-statistic: 11.46  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 7.10e-21  
Time: 21:56:00 Log-Likelihood: 1999.3  
No. Observations: 606 AIC: -3975.  
Df Residuals: 594 BIC: -3922.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0003 0.001 0.478 0.633 -0.001 0.002  
x2 -0.0033 0.001 -5.563 0.000 -0.004 -0.002  
x3 -0.0010 0.001 -2.078 0.038 -0.002 -5.71e-05  
x4 0.0086 0.003 2.453 0.014 0.002 0.015  
x5 -0.0014 0.000 -3.799 0.000 -0.002 -0.001  
x6 0.0013 0.001 2.454 0.014 0.000 0.002  
x7 -0.0009 0.001 -1.605 0.109 -0.002 0.000  
x8 0.0004 0.000 0.909 0.363 -0.000 0.001  
x9 8.346e-05 0.001 0.146 0.884 -0.001 0.001  
x10 0.0008 0.000 1.922 0.055 -1.83e-05 0.002  
x11 0.0020 0.001 3.718 0.000 0.001 0.003  
x12 0.0004 0.000 0.847 0.397 -0.001 0.001  
==============================================================================  
Omnibus: 28.308 Durbin-Watson: 1.970  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 32.916  
Skew: 0.479 Prob(JB): 7.12e-08  
Kurtosis: 3.621 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130909  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.616  
Model: WLS Adj. R-squared: 0.609  
Method: Least Squares F-statistic: 79.50  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 5.20e-115  
Time: 21:56:00 Log-Likelihood: 1955.9  
No. Observations: 606 AIC: -3888.  
Df Residuals: 594 BIC: -3835.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0049 0.001 6.868 0.000 0.004 0.006  
x2 -0.0024 0.001 -3.807 0.000 -0.004 -0.001  
x3 -0.0067 0.001 -12.417 0.000 -0.008 -0.006  
x4 0.0952 0.004 25.389 0.000 0.088 0.103  
x5 -0.0017 0.000 -4.229 0.000 -0.002 -0.001  
x6 -0.0004 0.001 -0.773 0.440 -0.002 0.001  
x7 -0.0014 0.001 -2.330 0.020 -0.003 -0.000  
x8 -0.0003 0.000 -0.699 0.485 -0.001 0.001  
x9 0.0005 0.001 0.834 0.404 -0.001 0.002  
x10 -0.0003 0.000 -0.649 0.517 -0.001 0.001  
x11 -0.0012 0.001 -2.054 0.040 -0.002 -5.29e-05  
x12 -0.0009 0.001 -1.678 0.094 -0.002 0.000  
==============================================================================  
Omnibus: 7.517 Durbin-Watson: 1.984  
Prob(Omnibus): 0.023 Jarque-Bera (JB): 10.792  
Skew: -0.056 Prob(JB): 0.00454  
Kurtosis: 3.644 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130910  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.477  
Model: WLS Adj. R-squared: 0.466  
Method: Least Squares F-statistic: 45.06  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.63e-75  
Time: 21:56:00 Log-Likelihood: 1881.9  
No. Observations: 606 AIC: -3740.  
Df Residuals: 594 BIC: -3687.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0039 0.001 4.766 0.000 0.002 0.005  
x2 0.0002 0.001 0.239 0.811 -0.001 0.002  
x3 -0.0061 0.001 -9.980 0.000 -0.007 -0.005  
x4 0.0793 0.004 18.727 0.000 0.071 0.088  
x5 -0.0023 0.000 -5.141 0.000 -0.003 -0.001  
x6 0.0005 0.001 0.882 0.378 -0.001 0.002  
x7 0.0011 0.001 1.615 0.107 -0.000 0.002  
x8 -0.0004 0.001 -0.821 0.412 -0.001 0.001  
x9 -0.0014 0.001 -2.064 0.039 -0.003 -6.94e-05  
x10 0.0007 0.001 1.293 0.196 -0.000 0.002  
x11 -0.0032 0.001 -4.868 0.000 -0.005 -0.002  
x12 -0.0007 0.001 -1.190 0.234 -0.002 0.000  
==============================================================================  
Omnibus: 5.286 Durbin-Watson: 2.085  
Prob(Omnibus): 0.071 Jarque-Bera (JB): 6.574  
Skew: -0.071 Prob(JB): 0.0374  
Kurtosis: 3.490 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130911  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.200  
Model: WLS Adj. R-squared: 0.184  
Method: Least Squares F-statistic: 12.37  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.16e-22  
Time: 21:56:00 Log-Likelihood: 1941.4  
No. Observations: 606 AIC: -3859.  
Df Residuals: 594 BIC: -3806.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0004 0.001 0.552 0.581 -0.001 0.002  
x2 0.0005 0.001 0.715 0.475 -0.001 0.002  
x3 -0.0011 0.001 -1.906 0.057 -0.002 3.18e-05  
x4 0.0397 0.004 10.340 0.000 0.032 0.047  
x5 -0.0001 0.000 -0.346 0.730 -0.001 0.001  
x6 -0.0008 0.001 -1.463 0.144 -0.002 0.000  
x7 0.0004 0.001 0.620 0.535 -0.001 0.002  
x8 -0.0014 0.000 -3.054 0.002 -0.002 -0.001  
x9 -0.0004 0.001 -0.674 0.501 -0.002 0.001  
x10 5.41e-05 0.000 0.114 0.910 -0.001 0.001  
x11 0.0001 0.001 0.219 0.826 -0.001 0.001  
x12 -0.0018 0.001 -3.270 0.001 -0.003 -0.001  
==============================================================================  
Omnibus: 2.038 Durbin-Watson: 2.085  
Prob(Omnibus): 0.361 Jarque-Bera (JB): 2.024  
Skew: 0.029 Prob(JB): 0.364  
Kurtosis: 3.277 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130912  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.320  
Model: WLS Adj. R-squared: 0.306  
Method: Least Squares F-statistic: 23.31  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.21e-42  
Time: 21:56:00 Log-Likelihood: 2014.5  
No. Observations: 606 AIC: -4005.  
Df Residuals: 594 BIC: -3952.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0030 0.001 -4.525 0.000 -0.004 -0.002  
x2 0.0016 0.001 2.876 0.004 0.001 0.003  
x3 0.0037 0.000 7.527 0.000 0.003 0.005  
x4 -0.0428 0.003 -12.578 0.000 -0.049 -0.036  
x5 8.292e-05 0.000 0.229 0.819 -0.001 0.001  
x6 -0.0010 0.000 -2.016 0.044 -0.002 -2.6e-05  
x7 -0.0006 0.001 -1.184 0.237 -0.002 0.000  
x8 -0.0006 0.000 -1.483 0.139 -0.001 0.000  
x9 0.0007 0.001 1.318 0.188 -0.000 0.002  
x10 -0.0002 0.000 -0.500 0.617 -0.001 0.001  
x11 -0.0004 0.001 -0.832 0.406 -0.001 0.001  
x12 -0.0003 0.000 -0.700 0.484 -0.001 0.001  
==============================================================================  
Omnibus: 26.037 Durbin-Watson: 1.973  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 44.667  
Skew: 0.307 Prob(JB): 2.00e-10  
Kurtosis: 4.180 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130913  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.153  
Model: WLS Adj. R-squared: 0.136  
Method: Least Squares F-statistic: 8.953  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 6.76e-16  
Time: 21:56:00 Log-Likelihood: 2050.2  
No. Observations: 606 AIC: -4076.  
Df Residuals: 594 BIC: -4024.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0006 0.001 0.998 0.319 -0.001 0.002  
x2 0.0007 0.001 1.379 0.168 -0.000 0.002  
x3 -0.0012 0.000 -2.704 0.007 -0.002 -0.000  
x4 0.0260 0.003 8.118 0.000 0.020 0.032  
x5 0.0002 0.000 0.634 0.526 -0.000 0.001  
x6 -0.0011 0.000 -2.340 0.020 -0.002 -0.000  
x7 0.0010 0.001 1.960 0.051 -2.2e-06 0.002  
x8 -0.0003 0.000 -0.719 0.472 -0.001 0.000  
x9 -0.0009 0.001 -1.645 0.100 -0.002 0.000  
x10 0.0005 0.000 1.228 0.220 -0.000 0.001  
x11 -0.0005 0.001 -1.019 0.309 -0.002 0.000  
x12 0.0006 0.000 1.272 0.204 -0.000 0.001  
==============================================================================  
Omnibus: 6.240 Durbin-Watson: 1.853  
Prob(Omnibus): 0.044 Jarque-Bera (JB): 6.514  
Skew: 0.181 Prob(JB): 0.0385  
Kurtosis: 3.356 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130916  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.474  
Model: WLS Adj. R-squared: 0.464  
Method: Least Squares F-statistic: 44.66  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 5.65e-75  
Time: 21:56:00 Log-Likelihood: 2017.4  
No. Observations: 606 AIC: -4011.  
Df Residuals: 594 BIC: -3958.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0006 0.001 0.900 0.369 -0.001 0.002  
x2 0.0006 0.001 1.091 0.276 -0.000 0.002  
x3 -0.0049 0.000 -10.170 0.000 -0.006 -0.004  
x4 0.0612 0.003 18.081 0.000 0.055 0.068  
x5 -0.0011 0.000 -3.034 0.003 -0.002 -0.000  
x6 -0.0015 0.000 -2.940 0.003 -0.002 -0.000  
x7 0.0013 0.001 2.427 0.016 0.000 0.002  
x8 -0.0004 0.000 -0.973 0.331 -0.001 0.000  
x9 -0.0013 0.001 -2.293 0.022 -0.002 -0.000  
x10 -0.0002 0.000 -0.492 0.623 -0.001 0.001  
x11 -0.0010 0.001 -1.962 0.050 -0.002 1.13e-06  
x12 -0.0005 0.000 -0.996 0.320 -0.001 0.000  
==============================================================================  
Omnibus: 13.404 Durbin-Watson: 2.015  
Prob(Omnibus): 0.001 Jarque-Bera (JB): 17.784  
Skew: 0.226 Prob(JB): 0.000138  
Kurtosis: 3.707 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130917  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.275  
Model: WLS Adj. R-squared: 0.260  
Method: Least Squares F-statistic: 18.75  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.22e-34  
Time: 21:56:00 Log-Likelihood: 2056.6  
No. Observations: 606 AIC: -4089.  
Df Residuals: 594 BIC: -4036.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0019 0.001 3.050 0.002 0.001 0.003  
x2 -3.803e-05 0.001 -0.071 0.943 -0.001 0.001  
x3 -0.0022 0.000 -4.850 0.000 -0.003 -0.001  
x4 0.0387 0.003 12.194 0.000 0.032 0.045  
x5 0.0010 0.000 2.915 0.004 0.000 0.002  
x6 -0.0010 0.000 -2.171 0.030 -0.002 -9.64e-05  
x7 0.0003 0.001 0.665 0.506 -0.001 0.001  
x8 -0.0003 0.000 -0.730 0.466 -0.001 0.000  
x9 -0.0024 0.001 -4.566 0.000 -0.003 -0.001  
x10 0.0010 0.000 2.662 0.008 0.000 0.002  
x11 0.0005 0.000 0.983 0.326 -0.000 0.001  
x12 -0.0009 0.000 -2.018 0.044 -0.002 -2.44e-05  
==============================================================================  
Omnibus: 8.526 Durbin-Watson: 1.871  
Prob(Omnibus): 0.014 Jarque-Bera (JB): 13.215  
Skew: 0.006 Prob(JB): 0.00135  
Kurtosis: 3.723 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130918  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.646  
Model: WLS Adj. R-squared: 0.639  
Method: Least Squares F-statistic: 90.33  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 2.63e-125  
Time: 21:56:00 Log-Likelihood: 1777.0  
No. Observations: 606 AIC: -3530.  
Df Residuals: 594 BIC: -3477.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0027 0.001 2.766 0.006 0.001 0.005  
x2 -0.0054 0.001 -6.397 0.000 -0.007 -0.004  
x3 -0.0068 0.001 -9.395 0.000 -0.008 -0.005  
x4 0.1236 0.005 24.553 0.000 0.114 0.134  
x5 -0.0034 0.001 -6.293 0.000 -0.004 -0.002  
x6 0.0016 0.001 2.197 0.028 0.000 0.003  
x7 -0.0036 0.001 -4.470 0.000 -0.005 -0.002  
x8 0.0002 0.001 0.304 0.761 -0.001 0.001  
x9 0.0006 0.001 0.764 0.445 -0.001 0.002  
x10 0.0022 0.001 3.446 0.001 0.001 0.003  
x11 0.0005 0.001 0.624 0.533 -0.001 0.002  
x12 0.0024 0.001 3.412 0.001 0.001 0.004  
==============================================================================  
Omnibus: 3.027 Durbin-Watson: 1.890  
Prob(Omnibus): 0.220 Jarque-Bera (JB): 2.675  
Skew: 0.080 Prob(JB): 0.263  
Kurtosis: 2.716 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130919  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.145  
Model: WLS Adj. R-squared: 0.128  
Method: Least Squares F-statistic: 8.408  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 8.41e-15  
Time: 21:56:00 Log-Likelihood: 1892.1  
No. Observations: 606 AIC: -3760.  
Df Residuals: 594 BIC: -3707.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0009 0.001 -1.064 0.288 -0.002 0.001  
x2 0.0016 0.001 2.266 0.024 0.000 0.003  
x3 0.0007 0.001 1.231 0.219 -0.000 0.002  
x4 -0.0181 0.004 -4.337 0.000 -0.026 -0.010  
x5 -0.0003 0.000 -0.721 0.471 -0.001 0.001  
x6 2.248e-05 0.001 0.037 0.971 -0.001 0.001  
x7 -0.0013 0.001 -1.893 0.059 -0.003 4.7e-05  
x8 -0.0019 0.001 -3.835 0.000 -0.003 -0.001  
x9 -0.0006 0.001 -0.853 0.394 -0.002 0.001  
x10 -6.649e-05 0.001 -0.129 0.898 -0.001 0.001  
x11 0.0005 0.001 0.772 0.440 -0.001 0.002  
x12 0.0008 0.001 1.380 0.168 -0.000 0.002  
==============================================================================  
Omnibus: 6.439 Durbin-Watson: 2.024  
Prob(Omnibus): 0.040 Jarque-Bera (JB): 7.859  
Skew: -0.119 Prob(JB): 0.0197  
Kurtosis: 3.505 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130920  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.477  
Model: WLS Adj. R-squared: 0.466  
Method: Least Squares F-statistic: 45.08  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.54e-75  
Time: 21:56:00 Log-Likelihood: 1949.4  
No. Observations: 606 AIC: -3875.  
Df Residuals: 594 BIC: -3822.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0010 0.001 -1.443 0.150 -0.002 0.000  
x2 0.0033 0.001 5.237 0.000 0.002 0.005  
x3 0.0048 0.001 8.774 0.000 0.004 0.006  
x4 -0.0712 0.004 -18.782 0.000 -0.079 -0.064  
x5 -0.0008 0.000 -2.030 0.043 -0.002 -2.65e-05  
x6 -0.0003 0.001 -0.513 0.608 -0.001 0.001  
x7 0.0013 0.001 2.201 0.028 0.000 0.003  
x8 -0.0009 0.000 -1.950 0.052 -0.002 6.31e-06  
x9 7.874e-05 0.001 0.126 0.899 -0.001 0.001  
x10 -0.0011 0.000 -2.417 0.016 -0.002 -0.000  
x11 -0.0002 0.001 -0.279 0.781 -0.001 0.001  
x12 -0.0002 0.001 -0.366 0.714 -0.001 0.001  
==============================================================================  
Omnibus: 0.347 Durbin-Watson: 2.139  
Prob(Omnibus): 0.841 Jarque-Bera (JB): 0.209  
Skew: 0.006 Prob(JB): 0.901  
Kurtosis: 3.090 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130923  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.339  
Model: WLS Adj. R-squared: 0.326  
Method: Least Squares F-statistic: 25.43  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 3.15e-46  
Time: 21:56:00 Log-Likelihood: 2004.4  
No. Observations: 606 AIC: -3985.  
Df Residuals: 594 BIC: -3932.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0010 0.001 -1.441 0.150 -0.002 0.000  
x2 -0.0030 0.001 -5.177 0.000 -0.004 -0.002  
x3 0.0017 0.000 3.365 0.001 0.001 0.003  
x4 -0.0501 0.003 -14.483 0.000 -0.057 -0.043  
x5 -0.0014 0.000 -3.690 0.000 -0.002 -0.001  
x6 -0.0002 0.001 -0.331 0.741 -0.001 0.001  
x7 0.0004 0.001 0.787 0.432 -0.001 0.002  
x8 0.0002 0.000 0.529 0.597 -0.001 0.001  
x9 -0.0014 0.001 -2.425 0.016 -0.002 -0.000  
x10 0.0011 0.000 2.457 0.014 0.000 0.002  
x11 0.0009 0.001 1.590 0.112 -0.000 0.002  
x12 0.0022 0.000 4.557 0.000 0.001 0.003  
==============================================================================  
Omnibus: 4.952 Durbin-Watson: 1.982  
Prob(Omnibus): 0.084 Jarque-Bera (JB): 5.573  
Skew: 0.112 Prob(JB): 0.0616  
Kurtosis: 3.413 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130924  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.113  
Model: WLS Adj. R-squared: 0.095  
Method: Least Squares F-statistic: 6.309  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.44e-10  
Time: 21:56:00 Log-Likelihood: 1985.4  
No. Observations: 606 AIC: -3947.  
Df Residuals: 594 BIC: -3894.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0018 0.001 2.659 0.008 0.000 0.003  
x2 0.0024 0.001 3.936 0.000 0.001 0.004  
x3 -0.0012 0.001 -2.273 0.023 -0.002 -0.000  
x4 -0.0124 0.004 -3.481 0.001 -0.019 -0.005  
x5 -7.905e-05 0.000 -0.208 0.835 -0.001 0.001  
x6 0.0006 0.001 1.058 0.291 -0.000 0.002  
x7 0.0013 0.001 2.222 0.027 0.000 0.002  
x8 -0.0004 0.000 -0.939 0.348 -0.001 0.000  
x9 0.0009 0.001 1.496 0.135 -0.000 0.002  
x10 -0.0009 0.000 -2.119 0.035 -0.002 -6.85e-05  
x11 -0.0004 0.001 -0.635 0.526 -0.001 0.001  
x12 0.0015 0.001 2.957 0.003 0.001 0.002  
==============================================================================  
Omnibus: 21.186 Durbin-Watson: 1.980  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 50.271  
Skew: 0.056 Prob(JB): 1.21e-11  
Kurtosis: 4.407 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130925  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.179  
Model: WLS Adj. R-squared: 0.163  
Method: Least Squares F-statistic: 10.81  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.37e-19  
Time: 21:56:00 Log-Likelihood: 1987.1  
No. Observations: 606 AIC: -3950.  
Df Residuals: 594 BIC: -3897.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0024 0.001 3.565 0.000 0.001 0.004  
x2 -0.0006 0.001 -0.973 0.331 -0.002 0.001  
x3 0.0012 0.001 2.419 0.016 0.000 0.002  
x4 -0.0191 0.004 -5.360 0.000 -0.026 -0.012  
x5 0.0002 0.000 0.651 0.515 -0.000 0.001  
x6 0.0009 0.001 1.647 0.100 -0.000 0.002  
x7 0.0012 0.001 2.074 0.038 6.27e-05 0.002  
x8 -3.232e-05 0.000 -0.074 0.941 -0.001 0.001  
x9 0.0018 0.001 3.096 0.002 0.001 0.003  
x10 -0.0007 0.000 -1.516 0.130 -0.002 0.000  
x11 -0.0010 0.001 -1.737 0.083 -0.002 0.000  
x12 -4.167e-05 0.001 -0.083 0.934 -0.001 0.001  
==============================================================================  
Omnibus: 20.710 Durbin-Watson: 1.931  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 40.056  
Skew: -0.188 Prob(JB): 2.00e-09  
Kurtosis: 4.202 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130926  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.267  
Model: WLS Adj. R-squared: 0.253  
Method: Least Squares F-statistic: 18.08  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 2.06e-33  
Time: 21:56:00 Log-Likelihood: 2045.0  
No. Observations: 606 AIC: -4066.  
Df Residuals: 594 BIC: -4013.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -7.669e-06 0.001 -0.012 0.990 -0.001 0.001  
x2 0.0012 0.001 2.138 0.033 9.47e-05 0.002  
x3 -0.0015 0.000 -3.291 0.001 -0.002 -0.001  
x4 0.0348 0.003 10.752 0.000 0.028 0.041  
x5 -0.0007 0.000 -1.935 0.053 -0.001 1e-05  
x6 -9.808e-05 0.000 -0.207 0.836 -0.001 0.001  
x7 -0.0015 0.001 -2.937 0.003 -0.003 -0.001  
x8 -0.0016 0.000 -4.040 0.000 -0.002 -0.001  
x9 0.0001 0.001 0.260 0.795 -0.001 0.001  
x10 0.0010 0.000 2.471 0.014 0.000 0.002  
x11 0.0012 0.001 2.453 0.014 0.000 0.002  
x12 -0.0008 0.000 -1.652 0.099 -0.002 0.000  
==============================================================================  
Omnibus: 35.273 Durbin-Watson: 1.922  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 105.691  
Skew: -0.187 Prob(JB): 1.12e-23  
Kurtosis: 5.011 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130927  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.276  
Model: WLS Adj. R-squared: 0.261  
Method: Least Squares F-statistic: 18.84  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 8.60e-35  
Time: 21:56:00 Log-Likelihood: 2055.7  
No. Observations: 606 AIC: -4087.  
Df Residuals: 594 BIC: -4034.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0008 0.001 -1.281 0.201 -0.002 0.000  
x2 0.0022 0.001 4.158 0.000 0.001 0.003  
x3 0.0029 0.000 6.295 0.000 0.002 0.004  
x4 -0.0385 0.003 -12.119 0.000 -0.045 -0.032  
x5 -0.0013 0.000 -3.780 0.000 -0.002 -0.001  
x6 8.854e-05 0.000 0.190 0.850 -0.001 0.001  
x7 0.0011 0.001 2.234 0.026 0.000 0.002  
x8 -0.0004 0.000 -1.095 0.274 -0.001 0.000  
x9 0.0006 0.001 1.223 0.222 -0.000 0.002  
x10 0.0004 0.000 1.045 0.297 -0.000 0.001  
x11 0.0001 0.001 0.218 0.828 -0.001 0.001  
x12 -0.0009 0.000 -1.928 0.054 -0.002 1.64e-05  
==============================================================================  
Omnibus: 58.382 Durbin-Watson: 2.132  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 177.107  
Skew: 0.441 Prob(JB): 3.48e-39  
Kurtosis: 5.497 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130930  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.398  
Model: WLS Adj. R-squared: 0.386  
Method: Least Squares F-statistic: 32.76  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 6.47e-58  
Time: 21:56:00 Log-Likelihood: 2098.7  
No. Observations: 606 AIC: -4173.  
Df Residuals: 594 BIC: -4121.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0011 0.001 -1.974 0.049 -0.002 -5.7e-06  
x2 0.0009 0.000 1.820 0.069 -7.19e-05 0.002  
x3 0.0007 0.000 1.614 0.107 -0.000 0.002  
x4 -0.0481 0.003 -16.232 0.000 -0.054 -0.042  
x5 0.0002 0.000 0.687 0.492 -0.000 0.001  
x6 0.0006 0.000 1.468 0.143 -0.000 0.001  
x7 -0.0007 0.000 -1.387 0.166 -0.002 0.000  
x8 -0.0005 0.000 -1.302 0.194 -0.001 0.000  
x9 -5.592e-05 0.000 -0.115 0.909 -0.001 0.001  
x10 0.0003 0.000 0.838 0.402 -0.000 0.001  
x11 -0.0006 0.000 -1.318 0.188 -0.002 0.000  
x12 0.0005 0.000 1.165 0.245 -0.000 0.001  
==============================================================================  
Omnibus: 8.844 Durbin-Watson: 2.066  
Prob(Omnibus): 0.012 Jarque-Bera (JB): 13.911  
Skew: -0.001 Prob(JB): 0.000954  
Kurtosis: 3.742 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20131001  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.471  
Model: WLS Adj. R-squared: 0.461  
Method: Least Squares F-statistic: 44.11  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 3.12e-74  
Time: 21:56:00 Log-Likelihood: 1960.3  
No. Observations: 606 AIC: -3897.  
Df Residuals: 594 BIC: -3844.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0026 0.001 3.624 0.000 0.001 0.004  
x2 0.0010 0.001 1.597 0.111 -0.000 0.002  
x3 -0.0054 0.001 -10.177 0.000 -0.006 -0.004  
x4 0.0721 0.004 19.373 0.000 0.065 0.079  
x5 9.757e-06 0.000 0.025 0.980 -0.001 0.001  
x6 8.815e-06 0.001 0.016 0.987 -0.001 0.001  
x7 0.0006 0.001 1.009 0.313 -0.001 0.002  
x8 -8.853e-05 0.000 -0.195 0.845 -0.001 0.001  
x9 0.0002 0.001 0.260 0.795 -0.001 0.001  
x10 0.0007 0.000 1.585 0.113 -0.000 0.002  
x11 0.0002 0.001 0.344 0.731 -0.001 0.001  
x12 -0.0013 0.001 -2.505 0.013 -0.002 -0.000  
==============================================================================  
Omnibus: 1.571 Durbin-Watson: 1.936  
Prob(Omnibus): 0.456 Jarque-Bera (JB): 1.393  
Skew: 0.103 Prob(JB): 0.498  
Kurtosis: 3.113 Cond. No. 13.8  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Method Two:

In [40]:

log\_resi\_var = np.log(OLS\_residues\*\*2)

In [47]:

residual\_var\_pred = sm.add\_constant(factors\_trim.values) *# add constant term in regression*  
OLS\_resi\_var\_result = np.linalg.lstsq(residual\_var\_pred, log\_resi\_var)

In [67]:

OLS\_resi\_var\_result[0].shape *#P \* T*

Out[67]:

(13, 20)

In [60]:

*#fitted value, take exp, then average over days*  
var\_est2 = np.mean(np.exp(residual\_var\_pred.dot(OLS\_resi\_var\_result[0])), axis = 1)

In [61]:

var\_est2.shape

Out[61]:

(606,)

In [62]:

WLS\_weights2 = 1/var\_est2  
WLS\_results2 = {}  
**for** row **in** returnDF.iterrows(): *#row[1] is the Series, row[0] is the row name*  
 WLS\_model2 = sm.WLS(row[1].values, factors\_trim.values, weights = WLS\_weights2)  
 WLS\_results2[row[0]] = WLS\_model2.fit()  
   
WLS\_factor\_return2 = {day: WLS\_results2[day].params **for** day **in** WLS\_results2}  
WLS\_factor\_returnDF2 = pd.DataFrame(data = WLS\_factor\_return2, index = factors\_trim.columns).T

In [63]:

WLS\_factor\_returnDF2

Out[63]:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **VOLTILTY** | **MOMENTUM** | **SIZE** | **SIZENONL** | **TRADEACT** | **GROWTH** | **EARNYLD** | **VALUE** | **EARNVAR** | **LEVERAGE** | **CURRSEN** | **YIELD** |
| **20130904** | 0.004684 | 0.000066 | -0.005439 | 0.075282 | 0.000485 | -0.000612 | 0.001378 | -0.000299 | -0.000699 | -0.002434 | -0.001006 | -0.002444 |
| **20130905** | 0.001199 | -0.001176 | -0.002601 | 0.018207 | -0.000439 | -0.000116 | 0.001170 | 0.000868 | 0.001771 | -0.000944 | 0.000142 | -0.002049 |
| **20130906** | 0.001275 | -0.003542 | -0.000969 | 0.010108 | -0.001886 | 0.001542 | -0.000705 | 0.000228 | -0.000428 | 0.001252 | 0.002272 | 0.000648 |
| **20130909** | 0.008027 | -0.001262 | -0.005898 | 0.093891 | -0.002209 | -0.000762 | -0.002677 | -0.000756 | 0.001340 | -0.002937 | -0.002014 | 0.002208 |
| **20130910** | 0.003607 | 0.000388 | -0.004909 | 0.078294 | -0.002247 | 0.000417 | 0.000913 | 0.000130 | -0.001423 | 0.000630 | -0.002950 | -0.001228 |
| **20130911** | 0.000467 | 0.000360 | -0.000891 | 0.033975 | -0.000316 | -0.001530 | 0.000346 | -0.001054 | -0.001324 | -0.000024 | -0.000100 | -0.002349 |
| **20130912** | -0.002281 | 0.001320 | 0.003555 | -0.040224 | 0.000089 | -0.001174 | -0.000750 | -0.000633 | 0.000571 | -0.000859 | -0.000735 | -0.000227 |
| **20130913** | 0.001073 | 0.000914 | -0.001212 | 0.025890 | 0.000072 | -0.001299 | 0.001681 | -0.000531 | -0.001111 | 0.000451 | 0.000275 | 0.000843 |
| **20130916** | 0.000948 | 0.000810 | -0.004805 | 0.059473 | -0.001053 | -0.001649 | 0.001412 | -0.000552 | -0.001464 | -0.000178 | -0.001085 | -0.000813 |
| **20130917** | 0.001480 | -0.000478 | -0.002403 | 0.039735 | 0.000808 | -0.000209 | 0.000101 | -0.000364 | -0.001993 | 0.000996 | -0.000238 | -0.001368 |
| **20130918** | 0.003406 | -0.006517 | -0.008254 | 0.132100 | -0.003460 | 0.001424 | -0.004173 | -0.000570 | 0.001054 | 0.001264 | -0.000623 | 0.002167 |
| **20130919** | -0.002305 | 0.001501 | 0.000291 | -0.018114 | -0.000394 | 0.000585 | -0.001652 | -0.002337 | 0.000459 | -0.000411 | 0.000249 | 0.000970 |
| **20130920** | -0.001416 | 0.003316 | 0.005162 | -0.072708 | -0.000801 | -0.000322 | 0.001586 | -0.000695 | -0.000081 | -0.000967 | 0.000115 | -0.000744 |
| **20130923** | -0.001200 | -0.003397 | 0.001741 | -0.047143 | -0.001046 | -0.000172 | 0.000433 | 0.000209 | -0.001372 | 0.001158 | 0.001320 | 0.001951 |
| **20130924** | 0.001846 | 0.003424 | -0.001510 | -0.011354 | -0.000687 | 0.000585 | 0.001786 | -0.000427 | 0.001569 | -0.001350 | -0.001185 | 0.001670 |
| **20130925** | 0.002108 | -0.000455 | 0.001668 | -0.020094 | 0.000378 | 0.000617 | 0.000973 | -0.000149 | 0.001737 | -0.000404 | -0.001697 | 0.000145 |
| **20130926** | -0.000530 | 0.001537 | -0.001041 | 0.034519 | -0.001034 | -0.000436 | -0.002322 | -0.001195 | 0.000668 | 0.000334 | 0.001772 | -0.000929 |
| **20130927** | -0.001076 | 0.002412 | 0.003228 | -0.038567 | -0.001134 | -0.000296 | 0.000764 | 0.000183 | 0.000084 | 0.000345 | 0.000243 | -0.001417 |
| **20130930** | -0.000515 | 0.000469 | 0.000598 | -0.049156 | 0.000138 | 0.000229 | -0.000358 | -0.000694 | -0.000159 | 0.000530 | -0.000497 | 0.000411 |
| **20131001** | 0.003418 | 0.000892 | -0.005247 | 0.076100 | -0.000158 | 0.000130 | 0.000364 | -0.000450 | 0.000596 | 0.000710 | 0.000110 | -0.000898 |

In [64]:

**for** factor **in** WLS\_factor\_returnDF2:  
 plt.figure()  
 plt.plot(WLS\_factor\_returnDF2[factor])  
 plt.title(factor)  
 plt.xlabel("Days")  
 plt.ylabel("Factor Return")

In [65]:

**for** day **in** sorted(WLS\_results2):  
 print(day)  
 print(WLS\_results2[day].summary())

20130904  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.340  
Model: WLS Adj. R-squared: 0.326  
Method: Least Squares F-statistic: 25.45  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 2.94e-46  
Time: 22:34:39 Log-Likelihood: 1820.9  
No. Observations: 606 AIC: -3618.  
Df Residuals: 594 BIC: -3565.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0047 0.001 4.644 0.000 0.003 0.007  
x2 6.601e-05 0.001 0.079 0.937 -0.002 0.002  
x3 -0.0054 0.001 -7.153 0.000 -0.007 -0.004  
x4 0.0753 0.005 14.657 0.000 0.065 0.085  
x5 0.0005 0.001 0.899 0.369 -0.001 0.002  
x6 -0.0006 0.001 -0.831 0.406 -0.002 0.001  
x7 0.0014 0.001 1.782 0.075 -0.000 0.003  
x8 -0.0003 0.001 -0.475 0.635 -0.002 0.001  
x9 -0.0007 0.001 -0.842 0.400 -0.002 0.001  
x10 -0.0024 0.001 -3.998 0.000 -0.004 -0.001  
x11 -0.0010 0.001 -1.228 0.220 -0.003 0.001  
x12 -0.0024 0.001 -3.357 0.001 -0.004 -0.001  
==============================================================================  
Omnibus: 219.204 Durbin-Watson: 1.883  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 3130.948  
Skew: -1.190 Prob(JB): 0.00  
Kurtosis: 13.878 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130905  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.112  
Model: WLS Adj. R-squared: 0.094  
Method: Least Squares F-statistic: 6.240  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.98e-10  
Time: 22:34:39 Log-Likelihood: 1863.7  
No. Observations: 606 AIC: -3703.  
Df Residuals: 594 BIC: -3650.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0012 0.001 1.275 0.203 -0.001 0.003  
x2 -0.0012 0.001 -1.519 0.129 -0.003 0.000  
x3 -0.0026 0.001 -3.671 0.000 -0.004 -0.001  
x4 0.0182 0.005 3.804 0.000 0.009 0.028  
x5 -0.0004 0.001 -0.873 0.383 -0.001 0.001  
x6 -0.0001 0.001 -0.169 0.866 -0.001 0.001  
x7 0.0012 0.001 1.625 0.105 -0.000 0.003  
x8 0.0009 0.001 1.479 0.140 -0.000 0.002  
x9 0.0018 0.001 2.291 0.022 0.000 0.003  
x10 -0.0009 0.001 -1.664 0.097 -0.002 0.000  
x11 0.0001 0.001 0.186 0.853 -0.001 0.002  
x12 -0.0020 0.001 -3.020 0.003 -0.003 -0.001  
==============================================================================  
Omnibus: 135.335 Durbin-Watson: 1.843  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 529.361  
Skew: 0.977 Prob(JB): 1.12e-115  
Kurtosis: 7.141 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130906  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.187  
Model: WLS Adj. R-squared: 0.171  
Method: Least Squares F-statistic: 11.39  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 9.77e-21  
Time: 22:34:39 Log-Likelihood: 1965.8  
No. Observations: 606 AIC: -3908.  
Df Residuals: 594 BIC: -3855.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0013 0.001 1.605 0.109 -0.000 0.003  
x2 -0.0035 0.001 -5.415 0.000 -0.005 -0.002  
x3 -0.0010 0.001 -1.618 0.106 -0.002 0.000  
x4 0.0101 0.004 2.500 0.013 0.002 0.018  
x5 -0.0019 0.000 -4.442 0.000 -0.003 -0.001  
x6 0.0015 0.001 2.660 0.008 0.000 0.003  
x7 -0.0007 0.001 -1.159 0.247 -0.002 0.000  
x8 0.0002 0.000 0.460 0.646 -0.001 0.001  
x9 -0.0004 0.001 -0.655 0.513 -0.002 0.001  
x10 0.0013 0.000 2.613 0.009 0.000 0.002  
x11 0.0023 0.001 3.522 0.000 0.001 0.004  
x12 0.0006 0.001 1.130 0.259 -0.000 0.002  
==============================================================================  
Omnibus: 116.958 Durbin-Watson: 1.997  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 325.681  
Skew: 0.949 Prob(JB): 1.90e-71  
Kurtosis: 6.049 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130909  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.153  
Model: WLS Adj. R-squared: 0.136  
Method: Least Squares F-statistic: 8.934  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 7.36e-16  
Time: 22:34:39 Log-Likelihood: 1336.6  
No. Observations: 606 AIC: -2649.  
Df Residuals: 594 BIC: -2596.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0080 0.002 3.579 0.000 0.004 0.012  
x2 -0.0013 0.002 -0.683 0.495 -0.005 0.002  
x3 -0.0059 0.002 -3.488 0.001 -0.009 -0.003  
x4 0.0939 0.011 8.220 0.000 0.071 0.116  
x5 -0.0022 0.001 -1.842 0.066 -0.005 0.000  
x6 -0.0008 0.002 -0.465 0.642 -0.004 0.002  
x7 -0.0027 0.002 -1.557 0.120 -0.006 0.001  
x8 -0.0008 0.001 -0.540 0.590 -0.004 0.002  
x9 0.0013 0.002 0.726 0.468 -0.002 0.005  
x10 -0.0029 0.001 -2.169 0.030 -0.006 -0.000  
x11 -0.0020 0.002 -1.105 0.269 -0.006 0.002  
x12 0.0022 0.002 1.364 0.173 -0.001 0.005  
==============================================================================  
Omnibus: 1371.610 Durbin-Watson: 1.989  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 4508761.171  
Skew: -18.791 Prob(JB): 0.00  
Kurtosis: 423.895 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130910  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.366  
Model: WLS Adj. R-squared: 0.353  
Method: Least Squares F-statistic: 28.59  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 2.17e-51  
Time: 22:34:39 Log-Likelihood: 1816.0  
No. Observations: 606 AIC: -3608.  
Df Residuals: 594 BIC: -3555.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0036 0.001 3.547 0.000 0.002 0.006  
x2 0.0004 0.001 0.463 0.643 -0.001 0.002  
x3 -0.0049 0.001 -6.404 0.000 -0.006 -0.003  
x4 0.0783 0.005 15.121 0.000 0.068 0.088  
x5 -0.0022 0.001 -4.132 0.000 -0.003 -0.001  
x6 0.0004 0.001 0.562 0.575 -0.001 0.002  
x7 0.0009 0.001 1.172 0.242 -0.001 0.002  
x8 0.0001 0.001 0.205 0.837 -0.001 0.001  
x9 -0.0014 0.001 -1.701 0.089 -0.003 0.000  
x10 0.0006 0.001 1.026 0.305 -0.001 0.002  
x11 -0.0030 0.001 -3.572 0.000 -0.005 -0.001  
x12 -0.0012 0.001 -1.673 0.095 -0.003 0.000  
==============================================================================  
Omnibus: 101.385 Durbin-Watson: 2.089  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 668.390  
Skew: -0.540 Prob(JB): 7.26e-146  
Kurtosis: 8.030 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130911  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.149  
Model: WLS Adj. R-squared: 0.132  
Method: Least Squares F-statistic: 8.700  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 2.17e-15  
Time: 22:34:39 Log-Likelihood: 1894.6  
No. Observations: 606 AIC: -3765.  
Df Residuals: 594 BIC: -3712.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0005 0.001 0.523 0.601 -0.001 0.002  
x2 0.0004 0.001 0.490 0.625 -0.001 0.002  
x3 -0.0009 0.001 -1.323 0.186 -0.002 0.000  
x4 0.0340 0.005 7.471 0.000 0.025 0.043  
x5 -0.0003 0.000 -0.661 0.509 -0.001 0.001  
x6 -0.0015 0.001 -2.347 0.019 -0.003 -0.000  
x7 0.0003 0.001 0.505 0.614 -0.001 0.002  
x8 -0.0011 0.001 -1.889 0.059 -0.002 4.17e-05  
x9 -0.0013 0.001 -1.803 0.072 -0.003 0.000  
x10 -2.399e-05 0.001 -0.045 0.965 -0.001 0.001  
x11 -9.967e-05 0.001 -0.137 0.891 -0.002 0.001  
x12 -0.0023 0.001 -3.644 0.000 -0.004 -0.001  
==============================================================================  
Omnibus: 48.767 Durbin-Watson: 2.091  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 229.189  
Skew: -0.088 Prob(JB): 1.71e-50  
Kurtosis: 6.008 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130912  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.218  
Model: WLS Adj. R-squared: 0.202  
Method: Least Squares F-statistic: 13.81  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.93e-25  
Time: 22:34:39 Log-Likelihood: 1936.0  
No. Observations: 606 AIC: -3848.  
Df Residuals: 594 BIC: -3795.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0023 0.001 -2.734 0.006 -0.004 -0.001  
x2 0.0013 0.001 1.921 0.055 -2.92e-05 0.003  
x3 0.0036 0.001 5.653 0.000 0.002 0.005  
x4 -0.0402 0.004 -9.469 0.000 -0.049 -0.032  
x5 8.892e-05 0.000 0.199 0.842 -0.001 0.001  
x6 -0.0012 0.001 -1.927 0.054 -0.002 2.25e-05  
x7 -0.0007 0.001 -1.172 0.242 -0.002 0.001  
x8 -0.0006 0.001 -1.215 0.225 -0.002 0.000  
x9 0.0006 0.001 0.832 0.406 -0.001 0.002  
x10 -0.0009 0.001 -1.706 0.089 -0.002 0.000  
x11 -0.0007 0.001 -1.085 0.278 -0.002 0.001  
x12 -0.0002 0.001 -0.377 0.706 -0.001 0.001  
==============================================================================  
Omnibus: 135.579 Durbin-Watson: 1.941  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 742.395  
Skew: 0.870 Prob(JB): 6.18e-162  
Kurtosis: 8.136 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130913  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.145  
Model: WLS Adj. R-squared: 0.128  
Method: Least Squares F-statistic: 8.416  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 8.10e-15  
Time: 22:34:39 Log-Likelihood: 2017.7  
No. Observations: 606 AIC: -4011.  
Df Residuals: 594 BIC: -3959.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0011 0.001 1.471 0.142 -0.000 0.003  
x2 0.0009 0.001 1.523 0.128 -0.000 0.002  
x3 -0.0012 0.001 -2.206 0.028 -0.002 -0.000  
x4 0.0259 0.004 6.975 0.000 0.019 0.033  
x5 7.182e-05 0.000 0.184 0.854 -0.001 0.001  
x6 -0.0013 0.001 -2.440 0.015 -0.002 -0.000  
x7 0.0017 0.001 3.009 0.003 0.001 0.003  
x8 -0.0005 0.000 -1.166 0.244 -0.001 0.000  
x9 -0.0011 0.001 -1.853 0.064 -0.002 6.66e-05  
x10 0.0005 0.000 1.025 0.306 -0.000 0.001  
x11 0.0003 0.001 0.465 0.642 -0.001 0.001  
x12 0.0008 0.001 1.602 0.110 -0.000 0.002  
==============================================================================  
Omnibus: 30.349 Durbin-Watson: 1.865  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 53.518  
Skew: 0.347 Prob(JB): 2.39e-12  
Kurtosis: 4.279 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130916  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.388  
Model: WLS Adj. R-squared: 0.376  
Method: Least Squares F-statistic: 31.37  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 8.91e-56  
Time: 22:34:39 Log-Likelihood: 1975.4  
No. Observations: 606 AIC: -3927.  
Df Residuals: 594 BIC: -3874.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0009 0.001 1.213 0.226 -0.001 0.002  
x2 0.0008 0.001 1.259 0.209 -0.000 0.002  
x3 -0.0048 0.001 -8.153 0.000 -0.006 -0.004  
x4 0.0595 0.004 14.940 0.000 0.052 0.067  
x5 -0.0011 0.000 -2.520 0.012 -0.002 -0.000  
x6 -0.0016 0.001 -2.890 0.004 -0.003 -0.001  
x7 0.0014 0.001 2.357 0.019 0.000 0.003  
x8 -0.0006 0.000 -1.130 0.259 -0.002 0.000  
x9 -0.0015 0.001 -2.278 0.023 -0.003 -0.000  
x10 -0.0002 0.000 -0.378 0.706 -0.001 0.001  
x11 -0.0011 0.001 -1.709 0.088 -0.002 0.000  
x12 -0.0008 0.001 -1.441 0.150 -0.002 0.000  
==============================================================================  
Omnibus: 37.855 Durbin-Watson: 2.040  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 84.090  
Skew: 0.349 Prob(JB): 5.50e-19  
Kurtosis: 4.686 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130917  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.216  
Model: WLS Adj. R-squared: 0.200  
Method: Least Squares F-statistic: 13.61  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 4.74e-25  
Time: 22:34:39 Log-Likelihood: 2006.0  
No. Observations: 606 AIC: -3988.  
Df Residuals: 594 BIC: -3935.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0015 0.001 1.992 0.047 2.05e-05 0.003  
x2 -0.0005 0.001 -0.782 0.435 -0.002 0.001  
x3 -0.0024 0.001 -4.288 0.000 -0.004 -0.001  
x4 0.0397 0.004 10.499 0.000 0.032 0.047  
x5 0.0008 0.000 2.032 0.043 2.72e-05 0.002  
x6 -0.0002 0.001 -0.386 0.700 -0.001 0.001  
x7 0.0001 0.001 0.177 0.859 -0.001 0.001  
x8 -0.0004 0.000 -0.783 0.434 -0.001 0.001  
x9 -0.0020 0.001 -3.261 0.001 -0.003 -0.001  
x10 0.0010 0.000 2.220 0.027 0.000 0.002  
x11 -0.0002 0.001 -0.394 0.693 -0.001 0.001  
x12 -0.0014 0.001 -2.550 0.011 -0.002 -0.000  
==============================================================================  
Omnibus: 47.314 Durbin-Watson: 1.881  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 159.298  
Skew: 0.288 Prob(JB): 2.56e-35  
Kurtosis: 5.445 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130918  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.560  
Model: WLS Adj. R-squared: 0.551  
Method: Least Squares F-statistic: 63.06  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.23e-97  
Time: 22:34:39 Log-Likelihood: 1696.0  
No. Observations: 606 AIC: -3368.  
Df Residuals: 594 BIC: -3315.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0034 0.001 2.748 0.006 0.001 0.006  
x2 -0.0065 0.001 -6.385 0.000 -0.009 -0.005  
x3 -0.0083 0.001 -8.833 0.000 -0.010 -0.006  
x4 0.1321 0.006 20.930 0.000 0.120 0.144  
x5 -0.0035 0.001 -5.222 0.000 -0.005 -0.002  
x6 0.0014 0.001 1.574 0.116 -0.000 0.003  
x7 -0.0042 0.001 -4.392 0.000 -0.006 -0.002  
x8 -0.0006 0.001 -0.737 0.462 -0.002 0.001  
x9 0.0011 0.001 1.034 0.302 -0.001 0.003  
x10 0.0013 0.001 1.689 0.092 -0.000 0.003  
x11 -0.0006 0.001 -0.618 0.537 -0.003 0.001  
x12 0.0022 0.001 2.423 0.016 0.000 0.004  
==============================================================================  
Omnibus: 46.890 Durbin-Watson: 1.867  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 205.761  
Skew: 0.118 Prob(JB): 2.09e-45  
Kurtosis: 5.845 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130919  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.127  
Model: WLS Adj. R-squared: 0.110  
Method: Least Squares F-statistic: 7.210  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 2.18e-12  
Time: 22:34:39 Log-Likelihood: 1821.1  
No. Observations: 606 AIC: -3618.  
Df Residuals: 594 BIC: -3565.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0023 0.001 -2.286 0.023 -0.004 -0.000  
x2 0.0015 0.001 1.808 0.071 -0.000 0.003  
x3 0.0003 0.001 0.383 0.702 -0.001 0.002  
x4 -0.0181 0.005 -3.528 0.000 -0.028 -0.008  
x5 -0.0004 0.001 -0.730 0.465 -0.001 0.001  
x6 0.0006 0.001 0.795 0.427 -0.001 0.002  
x7 -0.0017 0.001 -2.138 0.033 -0.003 -0.000  
x8 -0.0023 0.001 -3.710 0.000 -0.004 -0.001  
x9 0.0005 0.001 0.553 0.580 -0.001 0.002  
x10 -0.0004 0.001 -0.676 0.499 -0.002 0.001  
x11 0.0002 0.001 0.303 0.762 -0.001 0.002  
x12 0.0010 0.001 1.333 0.183 -0.000 0.002  
==============================================================================  
Omnibus: 70.313 Durbin-Watson: 2.061  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 392.505  
Skew: -0.314 Prob(JB): 5.87e-86  
Kurtosis: 6.892 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130920  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.408  
Model: WLS Adj. R-squared: 0.396  
Method: Least Squares F-statistic: 34.17  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 4.61e-60  
Time: 22:34:39 Log-Likelihood: 1904.8  
No. Observations: 606 AIC: -3786.  
Df Residuals: 594 BIC: -3733.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0014 0.001 -1.612 0.108 -0.003 0.000  
x2 0.0033 0.001 4.584 0.000 0.002 0.005  
x3 0.0052 0.001 7.796 0.000 0.004 0.006  
x4 -0.0727 0.004 -16.258 0.000 -0.081 -0.064  
x5 -0.0008 0.000 -1.705 0.089 -0.002 0.000  
x6 -0.0003 0.001 -0.502 0.616 -0.002 0.001  
x7 0.0016 0.001 2.356 0.019 0.000 0.003  
x8 -0.0007 0.001 -1.266 0.206 -0.002 0.000  
x9 -8.09e-05 0.001 -0.112 0.911 -0.001 0.001  
x10 -0.0010 0.001 -1.825 0.069 -0.002 7.39e-05  
x11 0.0001 0.001 0.161 0.872 -0.001 0.002  
x12 -0.0007 0.001 -1.174 0.241 -0.002 0.001  
==============================================================================  
Omnibus: 37.225 Durbin-Watson: 2.110  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 102.728  
Skew: -0.256 Prob(JB): 4.93e-23  
Kurtosis: 4.951 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130923  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.261  
Model: WLS Adj. R-squared: 0.246  
Method: Least Squares F-statistic: 17.51  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 2.22e-32  
Time: 22:34:39 Log-Likelihood: 1945.9  
No. Observations: 606 AIC: -3868.  
Df Residuals: 594 BIC: -3815.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0012 0.001 -1.462 0.144 -0.003 0.000  
x2 -0.0034 0.001 -5.027 0.000 -0.005 -0.002  
x3 0.0017 0.001 2.814 0.005 0.001 0.003  
x4 -0.0471 0.004 -11.282 0.000 -0.055 -0.039  
x5 -0.0010 0.000 -2.384 0.017 -0.002 -0.000  
x6 -0.0002 0.001 -0.288 0.774 -0.001 0.001  
x7 0.0004 0.001 0.688 0.492 -0.001 0.002  
x8 0.0002 0.001 0.407 0.684 -0.001 0.001  
x9 -0.0014 0.001 -2.033 0.043 -0.003 -4.63e-05  
x10 0.0012 0.000 2.338 0.020 0.000 0.002  
x11 0.0013 0.001 1.980 0.048 1.05e-05 0.003  
x12 0.0020 0.001 3.294 0.001 0.001 0.003  
==============================================================================  
Omnibus: 57.699 Durbin-Watson: 2.000  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 222.832  
Skew: 0.343 Prob(JB): 4.10e-49  
Kurtosis: 5.891 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130924  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.097  
Model: WLS Adj. R-squared: 0.079  
Method: Least Squares F-statistic: 5.329  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.34e-08  
Time: 22:34:39 Log-Likelihood: 1838.8  
No. Observations: 606 AIC: -3654.  
Df Residuals: 594 BIC: -3601.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0018 0.001 1.884 0.060 -7.8e-05 0.004  
x2 0.0034 0.001 4.246 0.000 0.002 0.005  
x3 -0.0015 0.001 -2.045 0.041 -0.003 -5.95e-05  
x4 -0.0114 0.005 -2.277 0.023 -0.021 -0.002  
x5 -0.0007 0.001 -1.312 0.190 -0.002 0.000  
x6 0.0006 0.001 0.818 0.413 -0.001 0.002  
x7 0.0018 0.001 2.379 0.018 0.000 0.003  
x8 -0.0004 0.001 -0.698 0.486 -0.002 0.001  
x9 0.0016 0.001 1.948 0.052 -1.31e-05 0.003  
x10 -0.0013 0.001 -2.283 0.023 -0.003 -0.000  
x11 -0.0012 0.001 -1.490 0.137 -0.003 0.000  
x12 0.0017 0.001 2.363 0.018 0.000 0.003  
==============================================================================  
Omnibus: 280.995 Durbin-Watson: 2.014  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 16347.251  
Skew: -1.226 Prob(JB): 0.00  
Kurtosis: 28.326 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130925  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.120  
Model: WLS Adj. R-squared: 0.102  
Method: Least Squares F-statistic: 6.744  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.91e-11  
Time: 22:34:39 Log-Likelihood: 1897.6  
No. Observations: 606 AIC: -3771.  
Df Residuals: 594 BIC: -3718.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0021 0.001 2.372 0.018 0.000 0.004  
x2 -0.0005 0.001 -0.622 0.534 -0.002 0.001  
x3 0.0017 0.001 2.490 0.013 0.000 0.003  
x4 -0.0201 0.005 -4.440 0.000 -0.029 -0.011  
x5 0.0004 0.000 0.796 0.426 -0.001 0.001  
x6 0.0006 0.001 0.950 0.342 -0.001 0.002  
x7 0.0010 0.001 1.429 0.154 -0.000 0.002  
x8 -0.0001 0.001 -0.268 0.789 -0.001 0.001  
x9 0.0017 0.001 2.376 0.018 0.000 0.003  
x10 -0.0004 0.001 -0.753 0.452 -0.001 0.001  
x11 -0.0017 0.001 -2.350 0.019 -0.003 -0.000  
x12 0.0001 0.001 0.227 0.821 -0.001 0.001  
==============================================================================  
Omnibus: 155.431 Durbin-Watson: 1.965  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 1249.250  
Skew: -0.896 Prob(JB): 5.36e-272  
Kurtosis: 9.802 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130926  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.183  
Model: WLS Adj. R-squared: 0.167  
Method: Least Squares F-statistic: 11.10  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 3.66e-20  
Time: 22:34:39 Log-Likelihood: 1909.7  
No. Observations: 606 AIC: -3795.  
Df Residuals: 594 BIC: -3742.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0005 0.001 -0.608 0.543 -0.002 0.001  
x2 0.0015 0.001 2.142 0.033 0.000 0.003  
x3 -0.0010 0.001 -1.585 0.114 -0.002 0.000  
x4 0.0345 0.004 7.781 0.000 0.026 0.043  
x5 -0.0010 0.000 -2.219 0.027 -0.002 -0.000  
x6 -0.0004 0.001 -0.686 0.493 -0.002 0.001  
x7 -0.0023 0.001 -3.477 0.001 -0.004 -0.001  
x8 -0.0012 0.001 -2.196 0.028 -0.002 -0.000  
x9 0.0007 0.001 0.933 0.351 -0.001 0.002  
x10 0.0003 0.001 0.635 0.526 -0.001 0.001  
x11 0.0018 0.001 2.504 0.013 0.000 0.003  
x12 -0.0009 0.001 -1.477 0.140 -0.002 0.000  
==============================================================================  
Omnibus: 537.139 Durbin-Watson: 1.944  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 57029.038  
Skew: -3.344 Prob(JB): 0.00  
Kurtosis: 50.052 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130927  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.196  
Model: WLS Adj. R-squared: 0.180  
Method: Least Squares F-statistic: 12.09  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 4.08e-22  
Time: 22:34:39 Log-Likelihood: 1963.6  
No. Observations: 606 AIC: -3903.  
Df Residuals: 594 BIC: -3850.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0011 0.001 -1.350 0.178 -0.003 0.000  
x2 0.0024 0.001 3.675 0.000 0.001 0.004  
x3 0.0032 0.001 5.372 0.000 0.002 0.004  
x4 -0.0386 0.004 -9.503 0.000 -0.047 -0.031  
x5 -0.0011 0.000 -2.662 0.008 -0.002 -0.000  
x6 -0.0003 0.001 -0.509 0.611 -0.001 0.001  
x7 0.0008 0.001 1.251 0.211 -0.000 0.002  
x8 0.0002 0.000 0.369 0.713 -0.001 0.001  
x9 8.406e-05 0.001 0.128 0.898 -0.001 0.001  
x10 0.0003 0.000 0.716 0.474 -0.001 0.001  
x11 0.0002 0.001 0.375 0.708 -0.001 0.002  
x12 -0.0014 0.001 -2.463 0.014 -0.003 -0.000  
==============================================================================  
Omnibus: 253.344 Durbin-Watson: 2.044  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 7866.357  
Skew: 1.205 Prob(JB): 0.00  
Kurtosis: 20.485 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20130930  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.344  
Model: WLS Adj. R-squared: 0.331  
Method: Least Squares F-statistic: 25.97  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 3.95e-47  
Time: 22:34:39 Log-Likelihood: 2079.8  
No. Observations: 606 AIC: -4136.  
Df Residuals: 594 BIC: -4083.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 -0.0005 0.001 -0.782 0.434 -0.002 0.001  
x2 0.0005 0.001 0.866 0.387 -0.001 0.002  
x3 0.0006 0.000 1.206 0.228 -0.000 0.002  
x4 -0.0492 0.003 -14.672 0.000 -0.056 -0.043  
x5 0.0001 0.000 0.391 0.696 -0.001 0.001  
x6 0.0002 0.000 0.478 0.633 -0.001 0.001  
x7 -0.0004 0.001 -0.711 0.477 -0.001 0.001  
x8 -0.0007 0.000 -1.689 0.092 -0.002 0.000  
x9 -0.0002 0.001 -0.294 0.768 -0.001 0.001  
x10 0.0005 0.000 1.336 0.182 -0.000 0.001  
x11 -0.0005 0.001 -0.929 0.353 -0.002 0.001  
x12 0.0004 0.000 0.865 0.387 -0.001 0.001  
==============================================================================  
Omnibus: 26.445 Durbin-Watson: 2.087  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 63.386  
Skew: 0.172 Prob(JB): 1.72e-14  
Kurtosis: 4.547 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
20131001  
 WLS Regression Results   
==============================================================================  
Dep. Variable: y R-squared: 0.411  
Model: WLS Adj. R-squared: 0.399  
Method: Least Squares F-statistic: 34.52  
Date: Fri, 28 Aug 2015 Prob (F-statistic): 1.39e-60  
Time: 22:34:39 Log-Likelihood: 1914.3  
No. Observations: 606 AIC: -3805.  
Df Residuals: 594 BIC: -3752.  
Df Model: 12   
Covariance Type: nonrobust   
==============================================================================  
 coef std err t P>|t| [95.0% Conf. Int.]  
------------------------------------------------------------------------------  
x1 0.0034 0.001 3.953 0.000 0.002 0.005  
x2 0.0009 0.001 1.253 0.211 -0.001 0.002  
x3 -0.0052 0.001 -8.049 0.000 -0.007 -0.004  
x4 0.0761 0.004 17.285 0.000 0.067 0.085  
x5 -0.0002 0.000 -0.342 0.732 -0.001 0.001  
x6 0.0001 0.001 0.205 0.838 -0.001 0.001  
x7 0.0004 0.001 0.550 0.583 -0.001 0.002  
x8 -0.0004 0.001 -0.833 0.405 -0.002 0.001  
x9 0.0006 0.001 0.838 0.402 -0.001 0.002  
x10 0.0007 0.001 1.360 0.174 -0.000 0.002  
x11 0.0001 0.001 0.157 0.876 -0.001 0.001  
x12 -0.0009 0.001 -1.438 0.151 -0.002 0.000  
==============================================================================  
Omnibus: 25.988 Durbin-Watson: 1.948  
Prob(Omnibus): 0.000 Jarque-Bera (JB): 46.852  
Skew: 0.289 Prob(JB): 6.70e-11  
Kurtosis: 4.234 Cond. No. 14.0  
==============================================================================  
  
Warnings:  
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.