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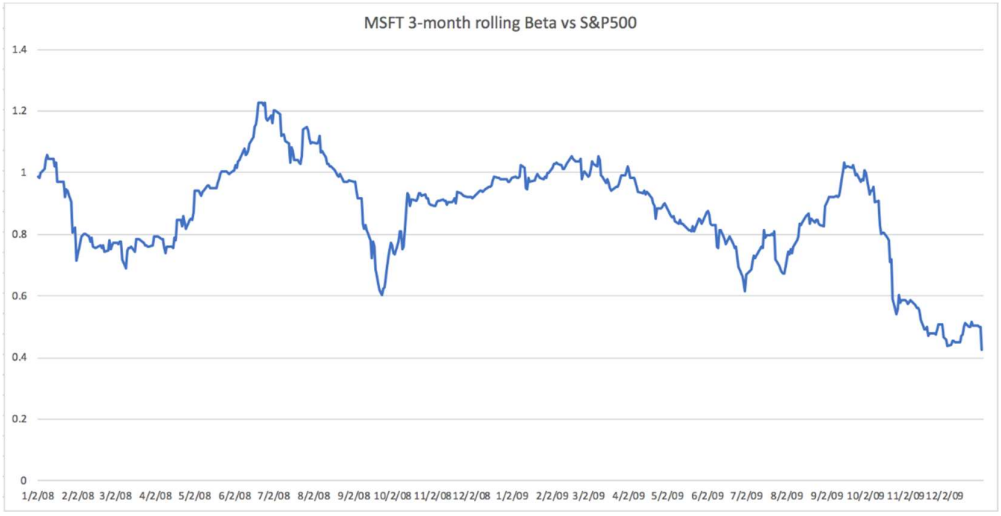
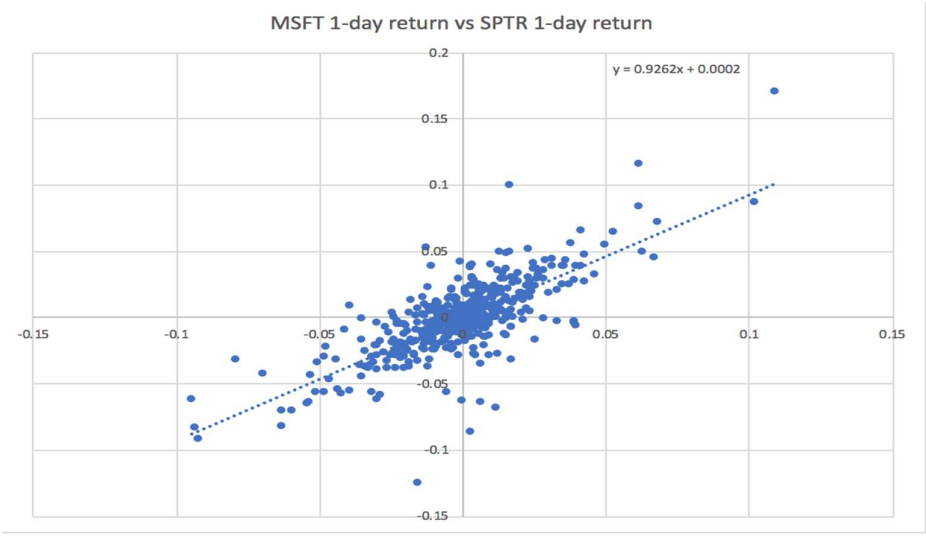
Project C: Portfolio and Risk Management

Q1) We used the data from "crispy04" to examine the CAPM beta between "the market" and a Dow stock for the period 1/1/2008 to 12/31/2009. The stock we picked was Microsoft Corporation (MSFT) since this stock was present in the Dow for the entire period given.

a) To plot a time series plot of the 3-month rolling beta of the stock vs. the S&P 500 we pulled the data from the tables in the crispy04 database and used the stored, pre-computed values after filtering for the dates and stock we needed. We then plotted the 3-month rolling beta vs the S&P 500, which is shown below –

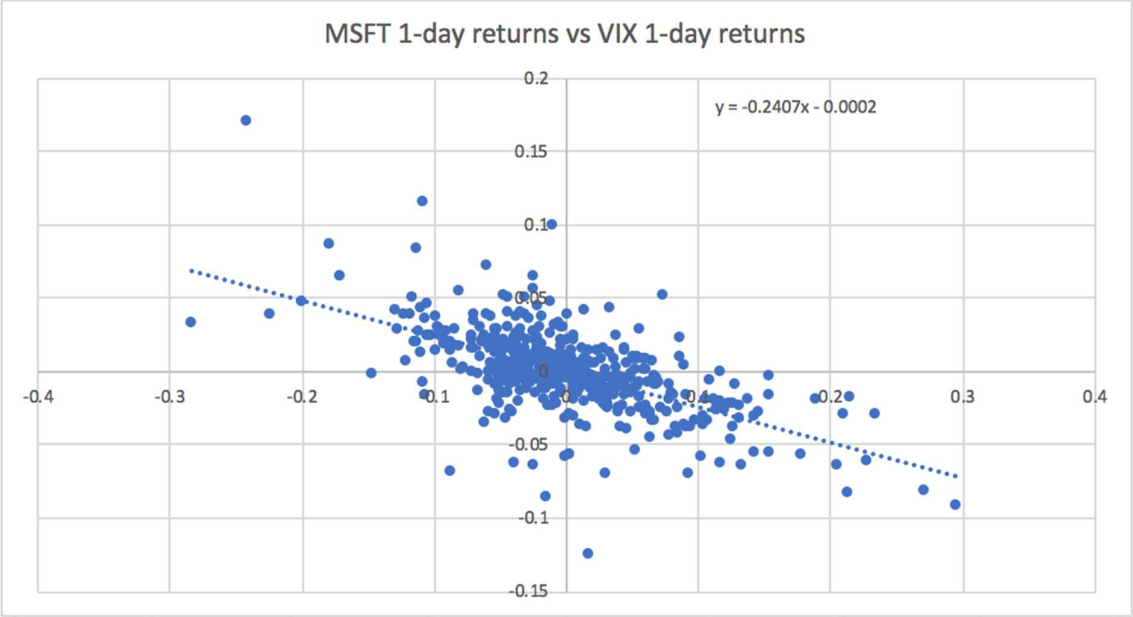


b) A scatter plot of 1-day stock returns vs. the SPTR (S&P500 total return index) 1-day returns along with a line of best fit (OLS regression) and its slope equation is provided below –

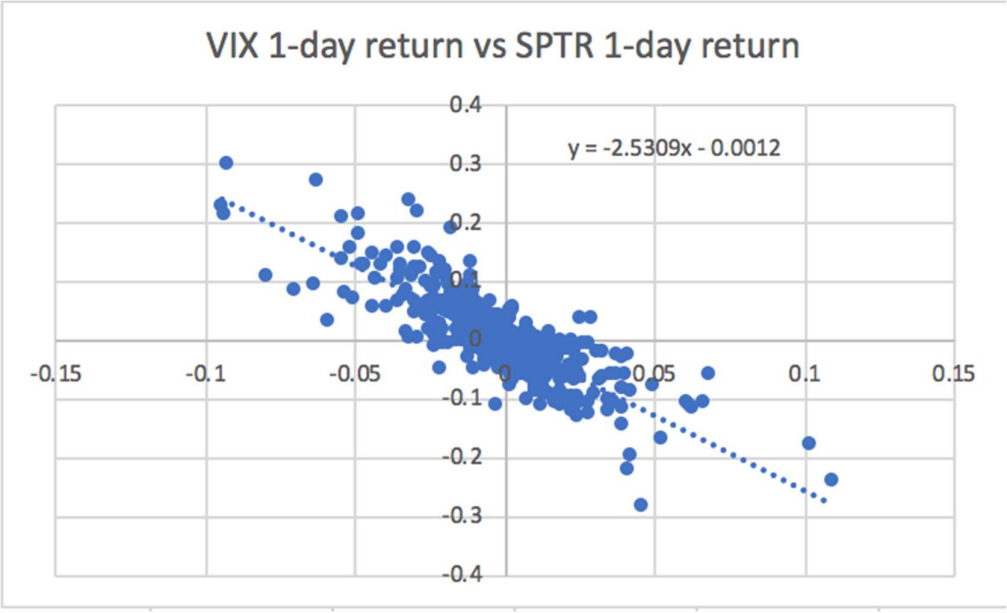


The graph above shows that MSFT 1-day returns have a positive correlation to SPTR 1-day returns with a coefficient of 0.9262, which means that MSFT returns are correlated to the market. This means that MSFT's Beta should be close to the market beta and should move in line with market risk, which is in line with the 3-month rolling Beta line chart above.

c) A scatter plot of 1-day stock returns vs. the VIX (CBOE implied volatility index) 1-day returns along with regression line and its slope equation is provided below –



While there is a correlation between MSFT 1-day returns and VIX 1-day returns, there is also a correlation between VIX returns and SPTR returns. The graph is provided below –



As a result, we should not consider VIX as an additional factor as part of the linear regression model since the two factors (VIX and SPTR) will be correlated and cause a bias in the resulting regression.

Q2) Integrity Check:

1. Missing Data: None
2. Outliers: 3 sigma away: 8 observations, removed for analysis

Trade Date	Long	Short	Grand Total
01/02/2001	10.53%	1.69%	12.22%
01/04/2001	-1.47%	-4.80%	-6.27%
03/21/2001	-0.52%	5.66%	5.14%
04/05/2001	10.29%	-2.46%	7.83%
04/10/2001	6.57%	-0.93%	5.64%
04/23/2001	0.38%	5.36%	5.74%
10/17/2001	1.22%	4.30%	5.52%
11/12/2002	3.13%	1.96%	5.09%

a) Annualized Return**: 100.48%, Volatility: 22.45%, Sharpe Ratio: 4.47**

b) CAPM –

	Value	*Standard Error*	*t Stat*
CAPM Alpha	**0.40%**	0.0004	8.9280
Market Beta	**0.1028**	0.0370	2.7824
R Square	**0.0077**		

According to CAPM, alpha should be zero, whereas in this case the alpha, although a small value, exists and since the t-stat is >2, the value is statistically significant.
The market beta, being close to zero says that the long short strategy is almost market-neutral.

c) Fama-French –

	Value	*Standard Error*	*t Stat*
F-F Alpha	**0.41%**	0.0004	9.0235
Market Beta	0.0751	0.0471	1.5958
SMB Co-efficient	-0.1440	0.0806	-1.7870
HML Co-efficient	-0.0089	0.1043	-0.0848
MOM Co-efficient	-0.0419	0.0609	-0.6881
R Square	**0.0118**		

The Fama-French model gives similar alpha.
The market beta still is close to zero, and hence almost signifies market-neutrality. Looking at the t-stat values for the others factors the results say that the dependence on these factors is not significant.

d) Considering the benchmark for defining winners as days with return greater than zero. There are 69% winners and 31% losers with the median return of winners as 1.002% and median return of losers as -0.802%.

e)

Total Days	996	
Losers	1373	**69%**
Winners	623	**31%**

Median Winners	**1.002%**
Median Losers	**-0.802%**

f) Considering the fact that the Global Financial Crisis took place between 2005 and 2009, the fund is not expected to generate similar returns during that period. It is expected that the period will have great volatility associated with it. Also, there is a possibility that if the shorted stocks are of the industries/regions impacted by the crisis, they will generate excess returns, whereas if the stocks that are held long fall in the same category, will lose money. The magnitude of the gain and loss depends on the weight of the respective impacted stocks in the portfolio.

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Q3) Integrity Check:

1. Missing Values: None
2. Outliers: 3 sigma away: 25 observations, removed for analysis

Trade Date	Long	Short	Grand Total
08/10/2007	3.66%	3.11%	6.77%
03/24/2008	5.39%	0.46%	5.85%
07/16/2008	10.20%	-0.55%	9.65%
09/18/2008	3.08%	-9.74%	-6.66%
09/19/2008	8.86%	-0.67%	8.19%
09/29/2008	-1.51%	7.35%	5.84%
10/13/2008	10.58%	-4.89%	5.68%
10/15/2008	1.36%	13.16%	14.52%
11/24/2008	10.29%	-4.14%	6.15%
11/25/2008	8.20%	-2.26%	5.93%
11/26/2008	1.09%	-8.96%	-7.87%
12/01/2008	-4.87%	13.38%	8.51%
12/08/2008	6.20%	0.63%	6.84%
12/11/2008	-6.40%	-0.20%	-6.60%
12/31/2008	10.50%	-2.84%	7.65%
01/22/2009	-6.61%	-1.05%	-7.66%
02/10/2009	1.54%	9.49%	11.02%
02/27/2009	-7.83%	0.52%	-7.31%
03/11/2009	4.78%	1.72%	6.50%
03/12/2009	5.76%	-11.11%	-5.35%
03/18/2009	10.16%	-3.49%	6.66%
03/19/2009	7.77%	0.98%	8.76%
04/01/2009	6.34%	0.29%	6.63%
04/14/2009	2.32%	6.40%	8.72%
04/20/2009	-2.23%	9.49%	7.26%

a) The performance measures are in the table below:

	Long	Short	Long-Short
Sharpe Ratio	**(1.62)**	**3.03**	**1.10**
Annualized Vol	**26.101%**	**21.717%**	**20.946%**
Annualized Return	**(42.265%)**	**65.697%**	**23.105%**

b) CAPM - R square : **0.0047**

	Value	*Standard Error*	*t Stat*
CAPM Alpha	**0.07%**	0.0004	1.7523
Market Beta	0.0647	0.0265	2.4394

c) Considering the benchmark for defining winners as days with return greater than zero. There are 53% winners and 47% losers with the median return of winners as 0.249% and median return of losers as -1.212%.

Total Days	1234	
Losers	578	**47%**
Winners	656	**53%**

Median Winners	**0.249%**
Median Losers	**-1.212%**

d) Based on the values the portfolio managers strategy did not change over time, since the stocks that were longed produced a significant negative return, which is due to the Global Financial Crisis.

e) Manufacturing – Return Contribution-0.0843%, **Annual: 21%,** fraction contribution: 48.2%

			Annual Return	21%						
			% Contribution	48.2%						
	0.0045%	-0.0026%	0.0372%	0.0843%	0.0251%	-0.0046%	0.0223%	0.0032%	0.0081%	0.1747%
TradeDate	Agriculture, Fore	Construction	Finance, Insuran	Manufacturing	Mining	Retail Trade	Services	Transportation, (	Wholesale Trade	Grand Total
01/03/2006			-0.04%	0.65%	0.18%	0.19%	-0.45%	0.37%	0.36%	1.26%
01/04/2006			0.10%	0.63%	0.05%	0.04%	0.38%	0.33%	-0.09%	1.44%
01/05/2006		0.05%	0.03%	0.39%	0.24%	-0.06%	-0.05%	-0.13%	-0.09%	0.37%
01/06/2006			0.27%	-0.71%	-0.26%	0.08%	0.50%	0.13%	-0.10%	-0.10%

f) Based on integrity checks

a. With NA column – Sector with the greatest contribution: **NA** Return Contribution- 0.0773%, **Annual: 19%,** fraction contribution: **44.3%**

Annualized Return	19%											
% Contribution	44.3%											
	0.0773%	0.0167%	-0.0054%	0.0316%	0.0024%	0.0069%	-0.0006%	0.0232%	0.0236%	-0.0087%	0.0108%	0.1747%
TradeDate	NA	Energy	Materials	Industrials	Consumer Discre	Consumer Staple	Health Care	Financials	Information Tech	Telecommunicat	Utilities	Grand Total
01/03/2006	0.62%	0.22%	-0.01%	0.13%	0.23%	-0.06%	0.20%	-0.01%	-0.13%		0.08%	1.26%
01/04/2006	0.82%	0.01%	0.07%	0.00%	0.10%	-0.04%	-0.05%	0.08%	0.35%	0.08%	0.03%	1.44%
01/05/2006	0.64%	0.22%	0.15%	-0.18%	0.04%	0.11%	-0.37%	-0.05%	-0.19%			0.37%
01/06/2006	0.14%	-0.45%	-0.01%	0.10%	0.15%	-0.14%	0.03%	0.21%	-0.09%	-0.02%		-0.10%

b. Without NA column – Sector with the greatest contribution: **Industrials** Return Contribution- 0.0316%, **Annual: 8%,** fraction contribution: **32.5%**

Annualized Return	4%	-1%	8%	1%	2%	0%	6%	6%	-2%	3%	
% Contribution			32.5%								
	0.0167%	-0.0054%	0.0316%	0.0024%	0.0069%	-0.0006%	0.0232%	0.0236%	-0.0087%	0.0108%	0.0974%
TradeDate	Energy	Materials	Industrials	Consumer Discre	Consumer Staple	Health Care	Financials	Information Tech	Telecommunicat	Utilities	Grand Total
01/03/2006	0.22%	-0.01%	0.13%	0.23%	-0.06%	0.20%	-0.01%	-0.13%		0.08%	0.64%
01/04/2006	0.01%	0.07%	0.00%	0.10%	-0.04%	-0.05%	0.08%	0.35%	0.08%	0.03%	0.62%
01/05/2006	0.22%	0.15%	-0.18%	0.04%	0.11%	-0.37%	-0.05%	-0.19%			-0.27%
01/06/2006	-0.45%	-0.01%	0.10%	0.15%	-0.14%	0.03%	0.21%	-0.09%	-0.02%		-0.24%

Q4) We used the data on the history of portfolio exposures, measured primarily by aggregating security weights to do our analysis below –

a) The highest and lowest net exposure (along with the mean and standard deviation) over the period 2005-2009 for each GICS sector is provided below –

Row Labels	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	NA	Telecommunication Services	Utilities	Grand Total
Mean	-0.78%	-0.07%	-0.41%	-0.33%	-1.04%	-0.98%	-1.35%	-0.49%	5.22%	-0.06%	-0.05%	-0.33%
Standard Deviation	6.35%	2.38%	4.83%	7.45%	6.58%	4.73%	6.59%	2.93%	8.37%	1.17%	0.81%	0.84%
Min	-24.00%	-8.00%	-23.26%	-48.72%	-22.22%	-18.99%	-23.60%	-12.68%	-22.22%	-5.13%	-4.76%	-5.41%
Max	19.40%	9.23%	30.99%	33.33%	24.14%	16.28%	24.10%	16.90%	30.99%	4.21%	3.53%	2.99%

Consumer Staples, Telecommunication services and Utilities stayed within +- 10% of portfolio weight throughout, as shown from the above table. This was calculated by checking whether the min and max exposure was within the +- 10% limit.

b) Data for 9/15/2008 is provided below –

Row Labels	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	NA	Telecommunication Services	Utilities	Grand Total	Portfolio Return
9/15/08	-8.45%	-1.41%	-7.04%	-2.82%	7.04%	-2.82%	5.63%	0.00%	11.27%	0.00%	0.00%	1.41%	-8.06%
9/15/2008 Long	9.86%	0.00%	1.41%	13.89%	21.13%	5.63%	15.49%	1.41%	36.62%	0.00%	0.00%	100.00%	-10.32%
9/15/2008 short	-18.31%	-1.41%	-8.45%	-16.67%	-14.08%	-8.45%	-9.86%	-1.41%	-25.35%	0.00%	0.00%	-98.59%	-5.75%

Portfolio NA was the most unbalanced on 9/15/2008 as we can see from the data above. The total exposure was 11.27%, long exposure was 36.62% and short exposure was -25.35%. The day's portfolio return was -8.06%.

c) Data for 2/27/2007 is provided below –

Row Labels	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	NA	Telecommunication Services	Utilities	Grand Total	Portfolio Return
2/27/07	1.22%	2.44%	-1.22%	1.22%	0.00%	4.88%	-14.63%	0.00%	6.10%	1.22%	0.00%	1.22%	-4.41%
2/27/2007 Long	10.98%	1.23%	1.22%	7.32%	12.20%	10.98%	13.41%	3.66%	34.15%	2.44%	0.00%	100.00%	-4.09%
2/27/2007 short	-9.76%	-4.94%	-2.44%	-6.10%	-12.20%	-6.10%	-28.05%	-3.66%	-28.05%	-1.22%	0.00%	-98.78%	-4.73%

Portfolio Information Technology was the most unbalanced on 2/27/2007 with a total exposure of -14.63%, long exposure of 13.41% and short exposure of -28.05%. The portfolio return for the day was -4.41%

d) After restricting the data to the GICS Financial Sector, we ran a regression of the data for the Financial sector on the market data. Details of the regression data are provided below –

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.039373653
R Square	0.001550285
Adjusted R Square	0.000755973
Standard Error	0.074456128
Observations	1259

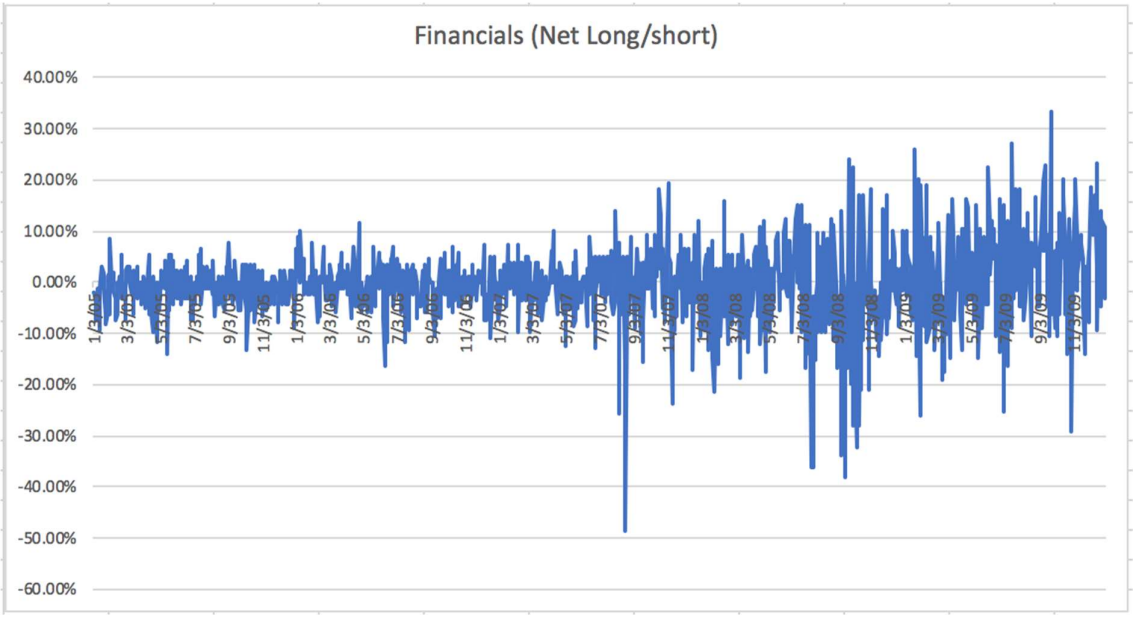
ANOVA

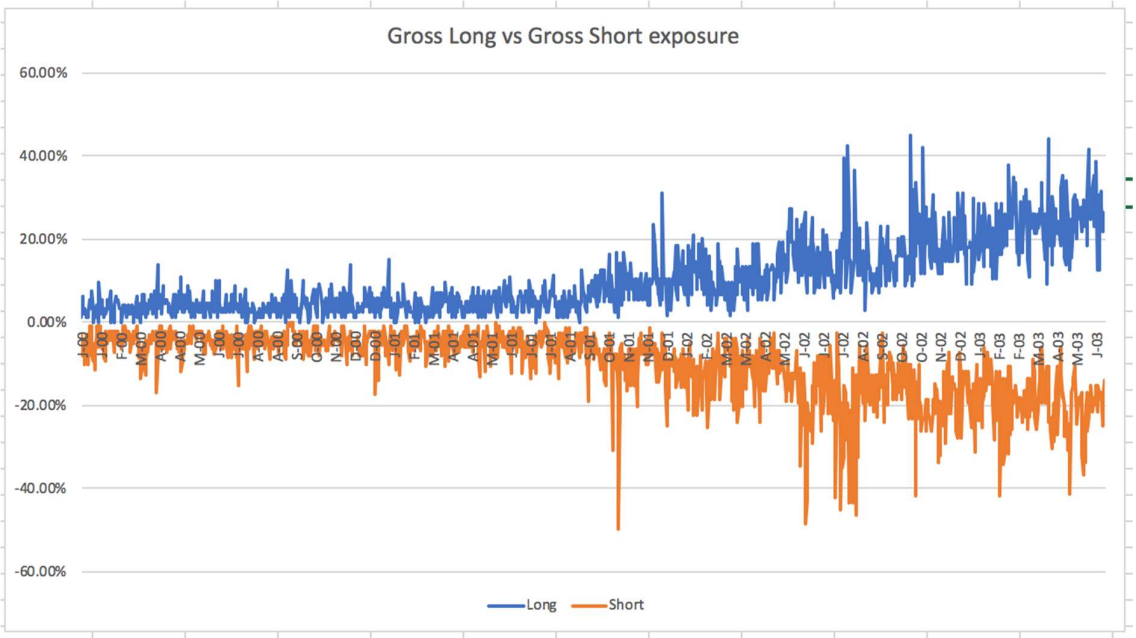
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.010819854	0.010819854	1.951733458	0.162646744
Residual	1257	6.968449839	0.005543715		
Total	1258	6.979269693			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.003328864	0.002098427	-1.586361874	0.112908753	-0.00744567	0.000787941	-0.00744567	0.000787941
X Variable 1	0.193068908	0.138198104	1.397044544	0.162646744	-0.078055461	0.464193276	-0.078055461	0.464193276

As we can see, the X intercept coefficient is 0.19 and the data is significant away from 0 as it lies outside the 95% confidence interval implying that the sub strategy is not market neutral.

We then plotted the net long/short exposure as well as the gross long vs. gross short exposures for this sub strategy. The results are provided below –

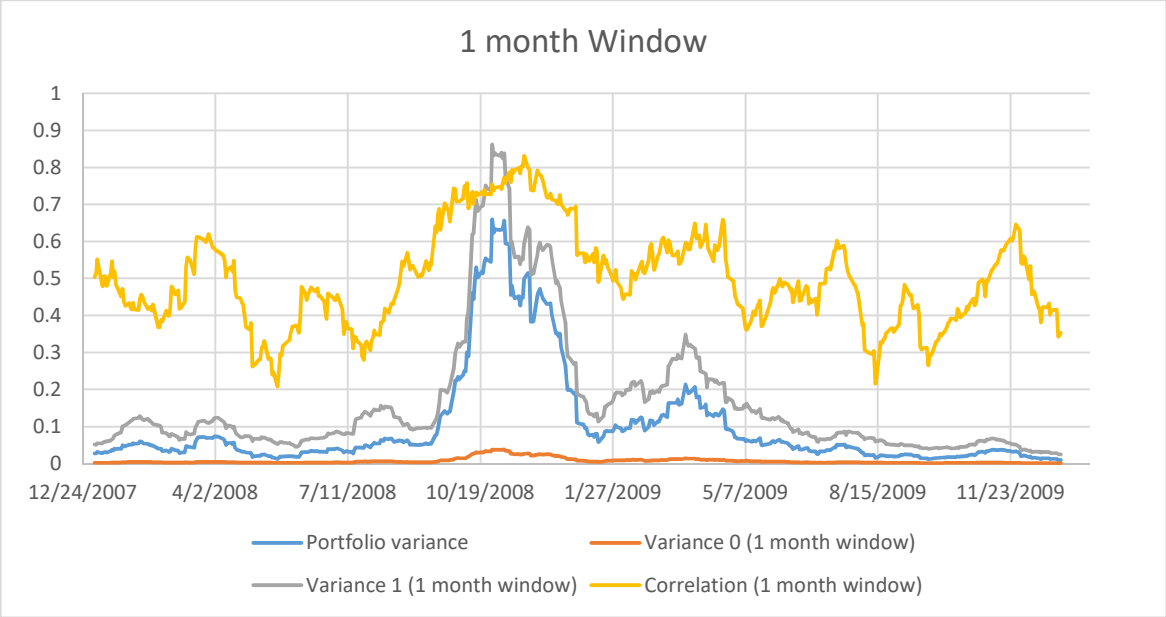




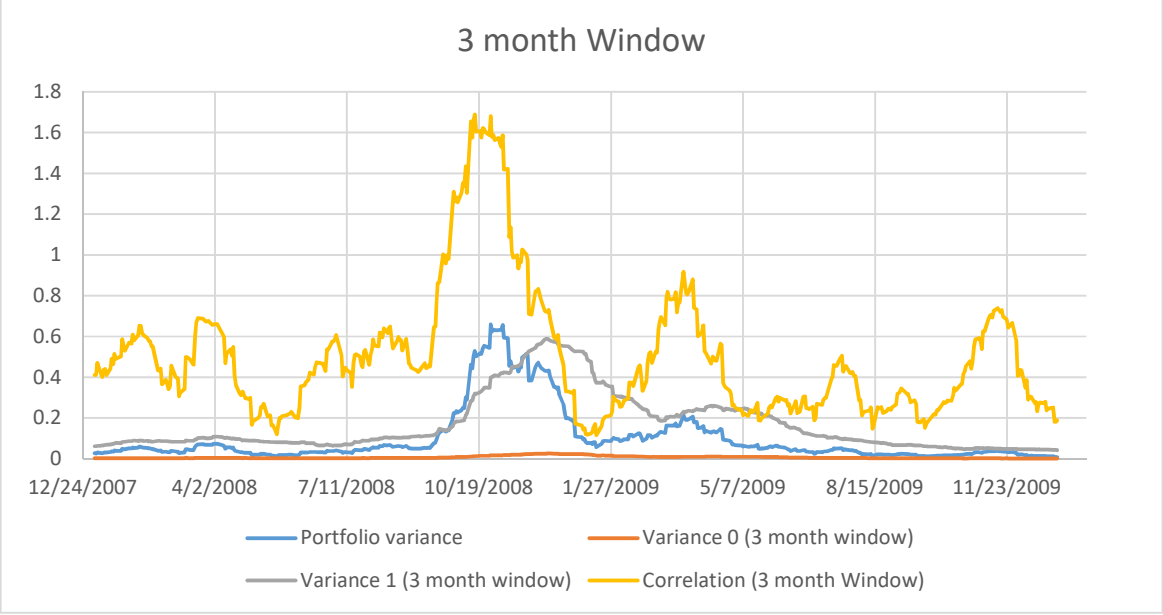
The individual exposures as well as the gross long and gross short exposures tell us how the exposures evolve over time in the absence of constraints. As we can see, over time these exposures diverge and become larger in magnitude.

5.a – d

We retrieved the variances and correlations for both windows (21 and 62 days) from the scripy04 database.



Time series of index realized variance, index variance$_0$, index variance$_1$, and correlation in a 1 month (21 day) time window



Time series of index realized variance, index variance¬0, index variance1, and correlation in a 1 month (63 day) time window

e. For a one month variance window, the maximum value of the average correlation is 0.83 and it occurs on November 21st, 2008. For a 3 month variance window the maximum average correlation is 1.69 and it occurs on October 16th, 2008

d. By definition, all values need to be greater than zero, and the correlation needs to be smaller than one. This also implies that for all times, the index variance when member correlations are 100% need to be greater than the index realized variance, which in turn is greater than the index variance when member correlations are 0%. These constraints hold for most of our values except for between September 29th, 2008 and November 24th, 2008 when the correlations were greater than 1 in the three month window, implying that the index realized variance is greater than index variance$_1$.

e. The violation of constraints might occur because of the way average variance is calculated. The weight of each stock in the index varies through time, so calculating the average variance across different time frame might lead to inconsistent results. Within one month the individual weights vary only slightly, which is why all parameters are still within constraints, but within the three-month window the weights can vary dramatically. Stocks are added and removed from the index every month, so in some cases it would not make sense to calculate the weighted standard deviation of a particular stock in a 3-month window. The absence of some stocks in the previous 3-month window might explain why index variance$_1$ is smaller than expected, which would lead to correlations greater than one.