CROSS-EVALUATION OF STOCK MARKET INDICES AND THEIR PREDICTIVE EFFICIENCY ON THE S&P 500

Anna Skarpalezou

Information plays a central role in modern finance. Investors are exposed to an ever-increasing amount of new facts, data and statistics every minute of the day. Stock market performance has historically worked as out strongest indicator of the economic conditions of a country. Indices such as the S&P 500 which tracks the stocks of 500 large-cap U.S. companies, are meant to represent the stock market's performance by reporting the risks and returns of the biggest companies. Investors use it as the benchmark of the overall market, to which all other investments are compared. Predicting stock performance through their returns, given their dynamic nature of the market can be incredibly worthwhile. However, the predictability of stock returns, requires forecasts on the basis of large sets of conditioning information and is still an .

This paper tries to establish an efficient model in predicting the S&P 500 returns, using information from 3 major stock exchanges- London, Tokyo and Frankfurt – through indices FTSE 100, Nikkei 225 and GDAXI respectively. I will try to do so by fitting the value to a multiple regression model as expressed by the equation:

$$y_i = \beta_0 + \beta_1 x_{1i} + \cdots + \beta_p x_{pi} + \varepsilon_i.$$

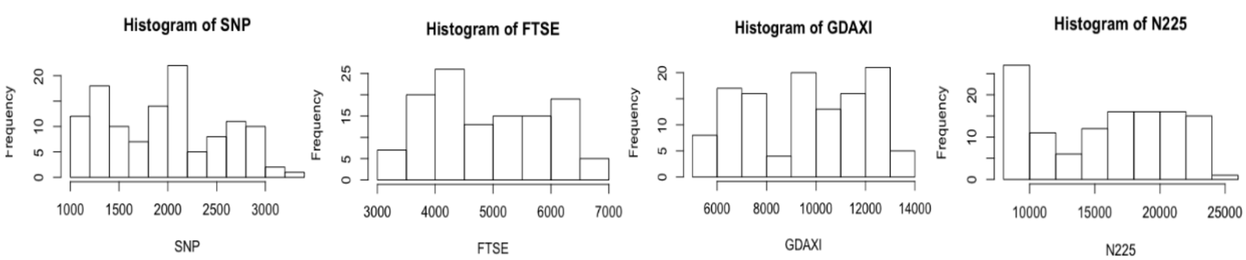
return.SNP = β_0 + β_1 * return.FTSE + β_2 * return.GDAXI + β_3 * return.N225 + ε

Data Collection

Historical data for stock exchange were fetched from the publicly available stock exchange database of Yahoo finance[1]. The collected data consists of monthly stock market prices of the S&P 500, the FTSE 100, the Nikkei 225 and the GDAXI index over a time of 10 years from 1st January 2010 to 1 January 2020.

Data Analysis

Histograms of the prices of each Index can be found below:



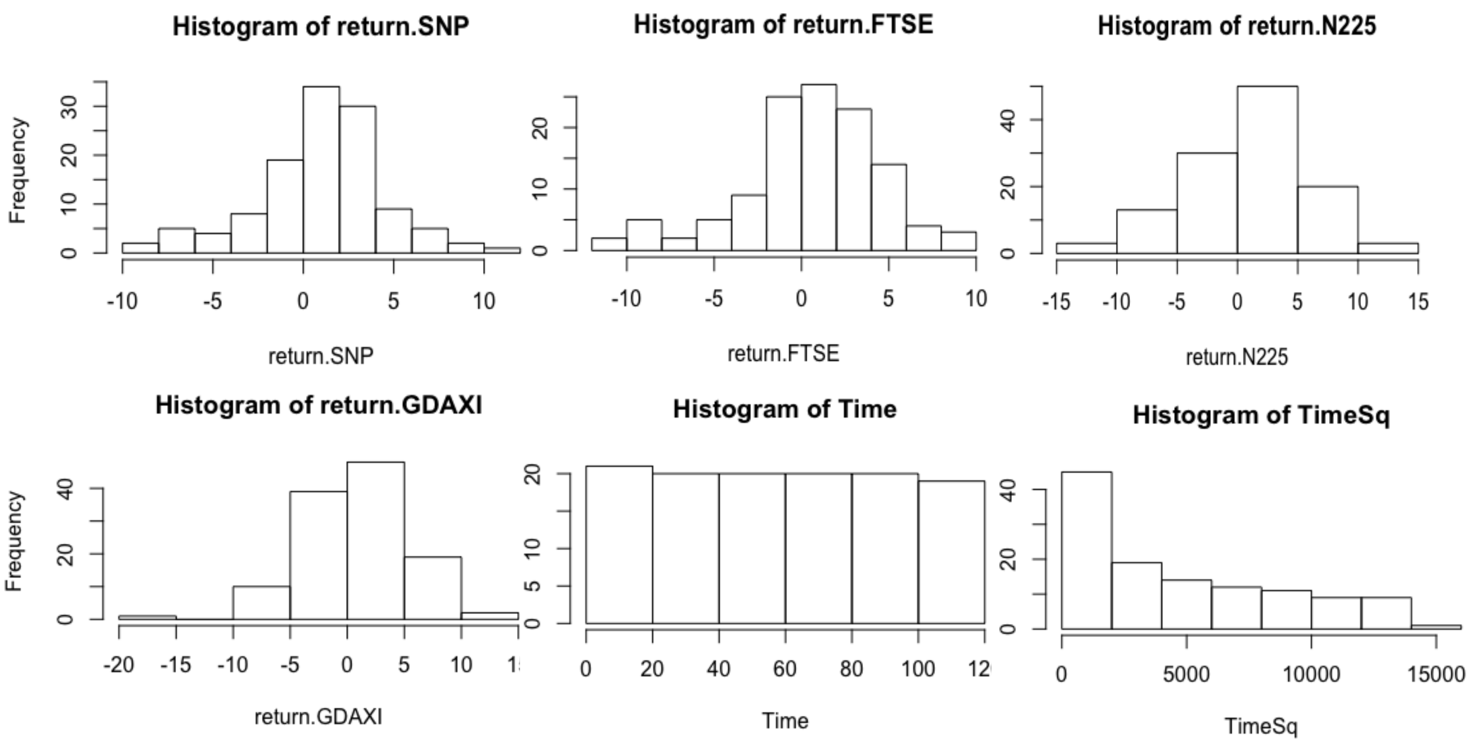
[1] https://finance.yahoo.com/quote/%5EGSPC/history?period1=1262304000&period2=1577836800&interval=1mo&filter=history&frequency=1mo

However, the prices themselves are not of interest to an investor. Instead I decided to explore the returns to each index

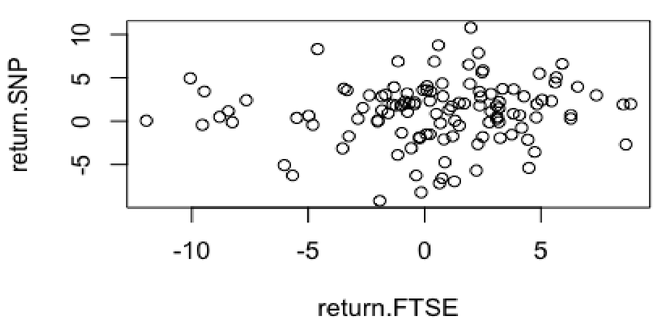
I calculated those using the formula

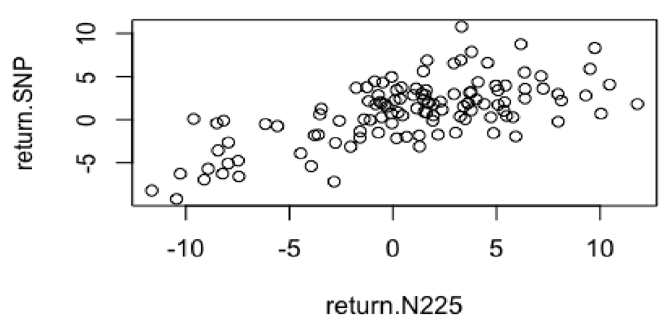
$$\boxed{return = \left(\text{price} - \text{lag(price)}\right)/\text{lag(price)} * 100}$$

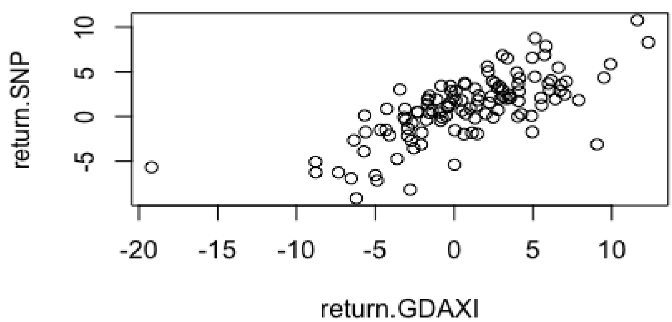
The histogram of the returns of each stock index can be found below



To explore the relationship of the predictors to the target variable on an preliminary level, I used scatter plot of the response variable versus each predictor. These describe the independent relationships however and not how the predictors will work together in our model.







Interestingly, it seems that the SNP 500 is more closely related to Japan's Nikkei and Germany's GDAXI, than the UK's FTSE 100 .

Below are the results of a regression of S&P returns on the predictors:

```
lm(formula = return.SNP ~ return.FTSE + return.GDAXI + return.N225)

Residuals:
    Min      1Q  Median      3Q     Max 
-7.375 -1.448 -0.096  1.494  5.082 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept)   0.48480    0.22415   2.163 0.032626 *  
return.FTSE  -0.01634    0.05533  -0.295 0.768323    
return.GDAXI  0.38310    0.06381   6.004  2.3e-08 ***
return.N225   0.23733    0.05995   3.959 0.000131 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.391 on 115 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5677,	Adjusted R-squared:  0.5564 
F-statistic: 50.33 on 3 and 115 DF,  p-value: < 2.2e-16
```

Regression Equation

return.SNP = .4848 - .01634*return.FTSE + .38310*return.GDAXI + .23733 * return.N225

The regression is quite strong with an adjusted R-squared of .5564. Somewhat shockingly, it seems that given the other information, a FTSE's returns adds relatively little predictive power to the model, with its value actually being negative. This suggests when exploring the health of the US economy via the returns on the S&P 500, the performance of a trading partner such as the UK is not good point of comparison. Similarly, given the other values, the returns of the GDAXI and the Nikkei 225 seem to contribute insignificantly to the predictive power of the model. The coefficient for return.GDAXI shows that given the other 2 predictors are held constant, a one percentage increase in the index's return is associated with an estimated expected increase in the

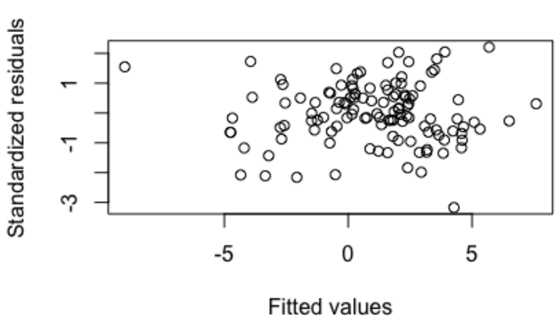
S&P 500 index by .38310 percent. The coefficient for return.N225 says that given the other 2 predictors are held constant, a one-percentage increase is associated with an expected increase in the S&P score of .23733 percentage points. The value for the residual standard error implies that a rough 95% prediction interval for a the S&P 500 returns using this model is ± 4.782.

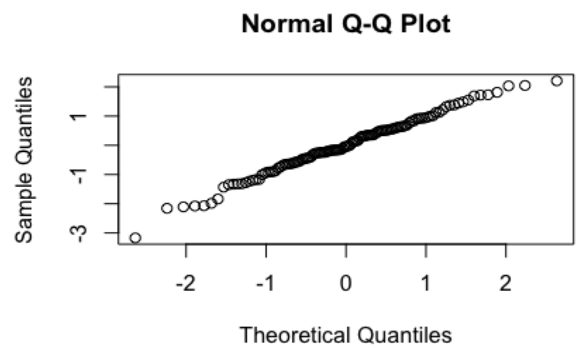
To measure multicollinearity, I used the variance inflation factor (VIF), which assesses how much the variance of an estimated regression coefficient increases if the predictors are correlated. Each of these VIF values corresponds to an estimate of how much we think the variance of its predictor's β hat, the variance of its slope coefficient, has been inflated relative to what the variance would have been if our data had perfectly uncorrelated predictors. My VIF numbers are relatively close to 1, so collinearity doesn't seem to be a concern at this point.

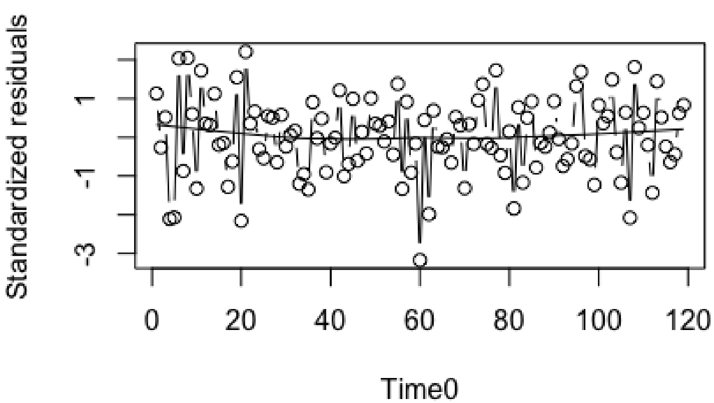
VIF VALUES

return.FTSE	return.GDAXI	return.N225
1.027497	1.806864	1.840016

Looking now at the relevant residual plots, the standardized residual versus fitted values plot, the normal plot of the residuals and the standardized residuals versus index. The normal plot shows the some heavy-tailedness, with the right upper end of the normality plot going above the hypothetical straight and the left lower end going below it. The residuals versus fitted values plot also shows some non-constant variance, hinting at traces of a time trend.







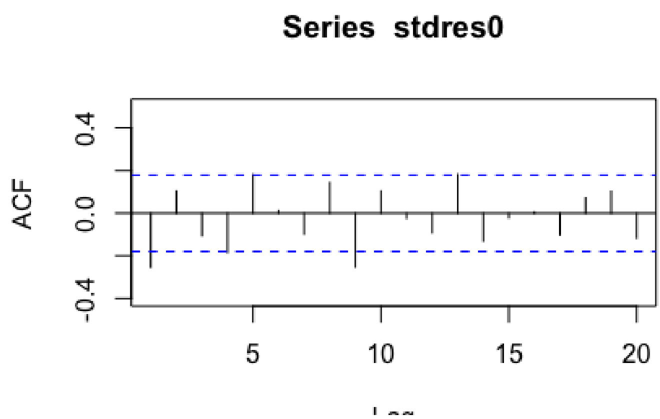
This suggest we might benefit from including time as a predictor, however as the line is slightly curved the pattern might also be parabolic instead of linear. Autocorrelation however doesn't seem to be a big issue, as the residuals are pretty normally distributed

Looking at the standardized residuals graph, we can see the value at time zero seems to be an outlier. That value corresponds to January 2015. We will explore this later on.

The Durbin-Watson test verifies that preliminary evaluation with a value relatively close to 2, at 2.4887. As indicated by the high p value of 0.9963, we should not reject the no autocorrelation hypothesis.

```
        Durbin-Watson test

data:  return.SNP ~ return.FTSE + return.GDAXI + return.N225
DW = 2.4887, p-value = 0.9963
alternative hypothesis: true autocorrelation is greater than 0
```

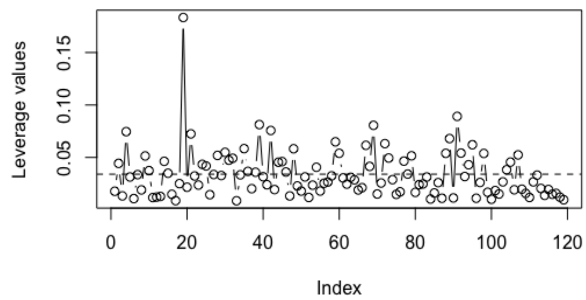
The test is contingent upon our assumptions of normality and constant variance, which do not seem to pose a big problem here. I decided however to explore the other test on the data. An ACF plot was created for the data

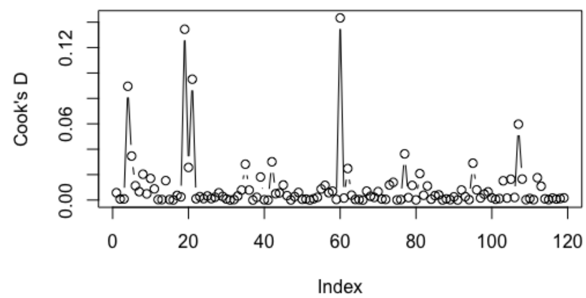


The ACF graph shows residuals that do not go down geometrically, therefore the DW test might not be effective. The values that are not all within the blue lines indicating to some autocorrelation, which seems to be negative. The Runs tests gives a p-value of .1125, according which the data is deemed to be random and we should not reject the no autocorrelation hypothesis.

```
        Runs Test

data:  stdres0
statistic = 1.5872, runs = 69, n1 = 57, n2 = 62, n = 119, p-value = 0.1125
alternative hypothesis: nonrandomness
```

To explore the potential existence of leverage points or influential points, I looked at Leverage values and Cook's distances; We can recognize here that a few points seem to have high leverage values and Cook’s distance, especially the observation at index 20 and that at 60, therefore it is important to explore the implications of removing them on our model.





Below are the standard residuals, hat values and cook's distance for each of the data points

```
> cbind(stdres0, hatvalues(IndecesR0), cooks.distance(IndecesR0))
       stdres0
2    1.12869938 0.017740753 5.752313e-03
3   -0.26603235 0.044340585 8.209320e-04
4    0.51540669 0.013300133 8.951814e-04
5   -2.10816626 0.074575506 8.953750e-02
6   -2.06936718 0.031324167 3.461913e-02
7    2.03404366 0.010742001 1.123146e-02
8   -0.87328442 0.033578949 6.624486e-03
9    2.04777212 0.019008798 2.031388e-02
10   0.59953121 0.051387946 4.867839e-03
11  -1.32273427 0.037409632 1.699915e-02
12   1.71925855 0.011730452 8.771255e-03
13   0.35363577 0.012162324 3.849314e-04
14   0.31519573 0.012757850 3.209626e-04
15   1.12246062 0.046269377 1.528094e-02
16  -0.20003104 0.034933926 3.620972e-04
17  -0.14727770 0.014841453 8.169289e-05
18  -1.28012049 0.008767917 3.623788e-03
19  -0.62318007 0.025010344 2.490501e-03
20   1.54762042 0.183364106 1.344481e-01
21  -2.15732232 0.021585019 2.566844e-02
22   2.20721755 0.072430350 9.510522e-02
23   0.35008650 0.032298837 1.022672e-03
24   0.66501113 0.023623702 2.675029e-03
25  -0.31192059 0.043408421 1.103762e-03
26  -0.53938205 0.041860585 3.177676e-03
27   0.55128964 0.014473209 1.115825e-03
28   0.50283377 0.033700216 2.204498e-03
29  -0.64538993 0.051894270 5.699635e-03
30   0.57837980 0.032724963 2.829407e-03
31  -0.24054052 0.054851513 8.394698e-04
32   0.05047848 0.047359183 3.166851e-05
33   0.16468851 0.049180778 3.507228e-04
34  -1.20100212 0.008670063 3.153781e-03
35  -0.95210816 0.033393673 7.829376e-03
36  -1.34924129 0.058373364 2.821339e-02
37   0.90743587 0.036696959 7.842220e-03
38  -0.02500207 0.020177527 3.218195e-06
39   0.47962917 0.035858985 2.138989e-03
40  -0.90524477 0.081294356 1.812826e-02
41  -0.16056839 0.031565697 2.100900e-04
42  -0.01190305 0.023956946 8.693993e-07
43   1.21287730 0.075690474 3.011602e-02
44  -1.00814298 0.019319547 5.005572e-03
45  -0.68623593 0.045430669 5.603102e-03
46   0.99229469 0.045977743 1.186344e-02
47  -0.60701450 0.036099888 3.449943e-03
48   0.13608204 0.013255108 6.218992e-05
49  -0.42011580 0.058234619 2.728454e-03
50   1.01050383 0.022807975 5.958305e-03
51   0.35220357 0.017895359 5.650803e-04
52   0.29856652 0.031406245 7.225977e-04
53  -0.10886249 0.011827469 3.546138e-05
54   0.40805528 0.023541413 1.003591e-03
55  -0.44785862 0.040615438 2.122855e-03
56   1.37880899 0.017936199 8.680384e-03
57  -1.33203734 0.025396431 1.155893e-02
58   0.91912216 0.026530563 5.755865e-03
59  -0.91323553 0.032387398 6.978790e-03
60  -0.16194913 0.064854624 4.547357e-04
61  -3.17128100 0.053936485 1.433415e-01
62   0.44281808 0.030429101 1.538510e-03
63  -1.98649397 0.024542218 2.482103e-02
64   0.69143441 0.031013571 3.825393e-03
65  -0.24626152 0.028664544 4.474133e-04
66  -0.26214306 0.018977512 3.323357e-04
67  -0.04894825 0.021151305 1.294303e-05
68  -0.65475383 0.061526716 7.026482e-03
69   0.52503478 0.041438932 2.979236e-03
70   0.30837521 0.080580421 2.083602e-03
71  -1.31409336 0.015138544 6.635924e-03
72   0.33523416 0.025599565 7.381280e-04
73  -0.17184803 0.063148577 4.976477e-04
74   0.95586837 0.049424231 1.187652e-02
75   1.37103128 0.028792300 1.393154e-02
76  -0.17397267 0.014774143 1.134667e-04
77  -0.27836062 0.017194239 3.388994e-04
78   1.72745664 0.046462612 3.635132e-02
79  -0.46540354 0.034119838 1.912860e-03
80  -0.92039907 0.051536201 1.150758e-02
81   0.14656187 0.016683767 9.111354e-05
82  -1.83851897 0.024066821 2.083890e-02
83   0.77185171 0.024686477 3.769837e-03
84  -1.16992053 0.031297366 1.105529e-02
85   0.50161920 0.010305829 6.550437e-04
86   0.92749885 0.016117579 3.523087e-03
87  -0.78196867 0.025957501 4.073837e-03
88  -0.14775904 0.011057051 6.102618e-05
89  -0.24566317 0.053888089 8.593506e-04
90   0.11731119 0.067978416 2.509366e-04
91   0.93134881 0.011338714 2.487030e-03
92  -0.04205592 0.089140726 4.327321e-05
93  -0.74363791 0.054120545 7.910236e-03
94  -0.56961733 0.031769825 2.661599e-03
95  -0.16089302 0.043017023 2.909046e-04
96   1.32409350 0.062095321 2.901867e-02
97   1.69068057 0.011081257 8.007400e-03
98  -0.48785741 0.026088183 1.593859e-03
99  -0.57055337 0.053796345 4.627013e-03
100 -1.22979627 0.016755313 6.443136e-03
101  0.82907744 0.010100135 1.753340e-03
102  0.35844412 0.018385368 6.016089e-04
103  0.54737921 0.015114948 1.149576e-03
104  1.48682422 0.026672155 1.514461e-02
105 -0.39064847 0.038245445 1.517147e-03
106 -1.17294825 0.045529498 1.640696e-02
107  0.64286381 0.019147157 2.016872e-03
108 -2.07822866 0.052393688 5.970046e-02
109  1.81371895 0.019669128 1.650032e-02
110  0.24285098 0.015701183 2.351934e-04
111  0.63567418 0.011816210 1.207952e-03
112 -0.20023944 0.026651057 2.744638e-04
113 -1.43232928 0.033123954 1.757103e-02
114  1.44402038 0.020417147 1.086527e-02
115  0.51353385 0.013829925 9.245835e-04
116 -0.23948550 0.019417253 2.839239e-04
117 -0.64107965 0.014846147 1.548366e-03
118 -0.44000228 0.015697778 7.718974e-04
119  0.62208692 0.012113386 1.186317e-03
120  0.83256861 0.009603242 1.680307e-03
```

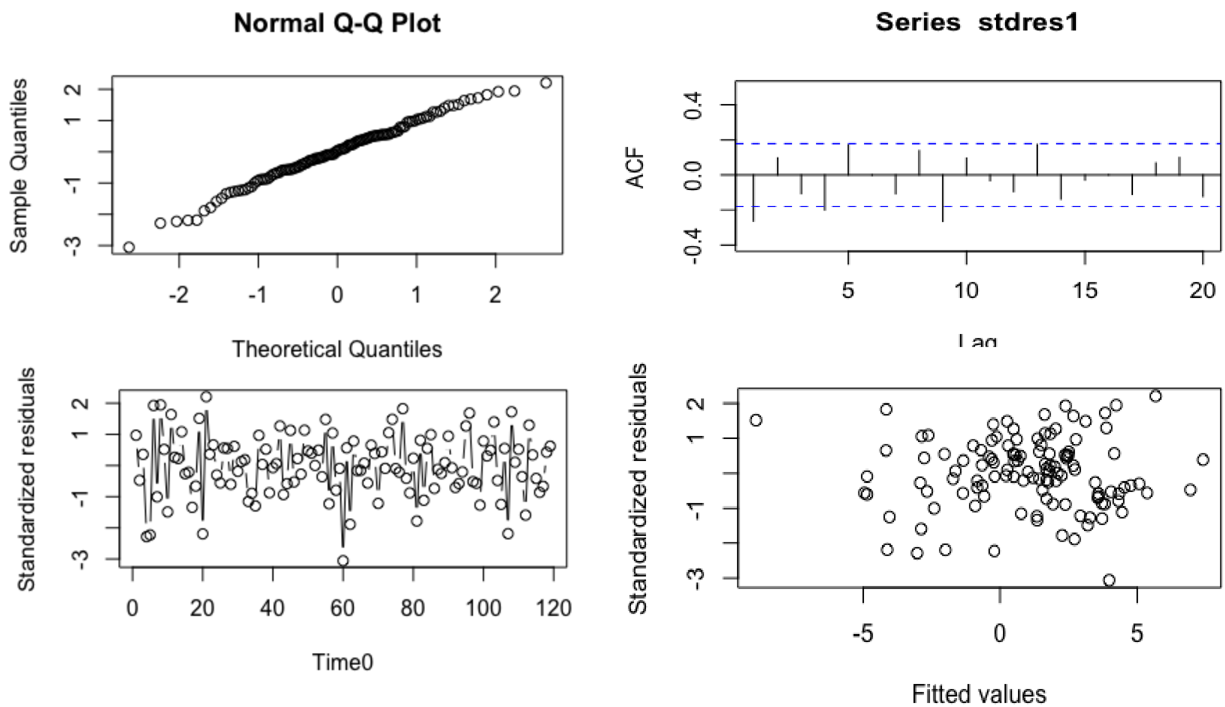
I decide to add a variable for time, to account for the potential growth in the economy we would expect to see. Below are the results of a regression of S&P returns on the predictors, having added a variable for time:

```
lm(formula = return.SNP ~ return.FTSE + return.GDAXI + return.N225 +
    Time + TimeSq)

Residuals:
    Min      1Q  Median      3Q     Max
-7.0807 -1.3633  0.0853  1.3823  5.0841

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)   0.9851818  0.7026867   1.402 0.163650
return.FTSE  -0.0255221  0.0572844  -0.446 0.656787
return.GDAXI  0.3772745  0.0646347   5.837 5.18e-08 ***
return.N225   0.2463002  0.0611684   4.027 0.000103 ***
Time         -0.0258506  0.0266985  -0.968 0.334990
TimeSq        0.0002202  0.0002136   1.031 0.304780
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.4 on 113 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5718,    Adjusted R-squared:  0.5528
F-statistic: 30.17 on 5 and 113 DF,  p-value: < 2.2e-16
```

Regression Equation

return.SNP = .9852 - .0255*return.FTSE + .3773*return.GDAXI + .2463* return.N225 -.02585 * Time + .0002 *TimeSq

The regression is actually less strong, with an adjusted R-squared of .5528. Somewhat shockingly, it seems that given the other information, Time and Time squared add virtually no predictive power to the model. The multicollinearity of Time and TimeSq is expected and not worrying



VIF VALUES

return.FTSE	return.GDAXI	return.N225	Time	TimeSq
1.092600	1.839111	1.900168	17.370039	17.056195

```
        Runs Test

data:  stdres1
statistic = 1.2045, runs = 67, n1 = 61, n2 = 58, n = 119, p-value = 0.2284
alternative hypothesis: nonrandomness
```

```
        Durbin-Watson test

data:  return.SNP ~ return.FTSE + return.GDAXI + return.N225 + Time +     TimeSq
DW = 2.5137, p-value = 0.9958
alternative hypothesis: true autocorrelation is greater than 0
```

The Durbin-Watson test verifies that preliminary evaluation with a value relatively close to 2, at 2.5137. As indicated by the high p value of 0.9958, we should not reject the no autocorrelation hypothesis. The Runs tests gives a p-value of .2284, the data is deemed to be random and we should not reject the no autocorrelation hypothesis. The values at the ACF plot though are still not within the blue lines, hinting at the exitance of autocorrelation.

Here is a best subset regression including the Time and Time squared as potential predictors.

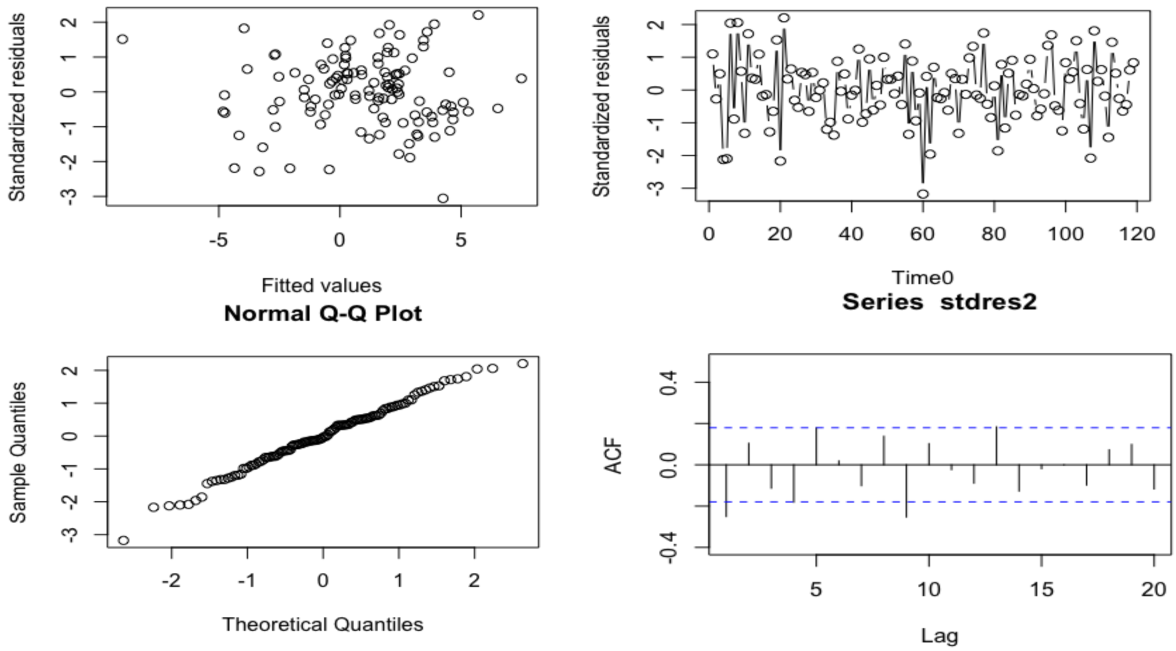
```
> leaps(cbind(return.FTSE,return.GDAXI,Time, TimeSq,return.N225)[2:n,],return.SNP[2:n],nbest=2)
$which
      1     2     3     4     5
1 FALSE  TRUE FALSE FALSE FALSE
1 FALSE FALSE FALSE FALSE  TRUE
2 FALSE  TRUE FALSE FALSE  TRUE
2 FALSE  TRUE FALSE  TRUE FALSE
3 FALSE  TRUE FALSE  TRUE  TRUE
3  TRUE  TRUE FALSE FALSE  TRUE
4 FALSE  TRUE  TRUE  TRUE  TRUE
4  TRUE  TRUE FALSE  TRUE  TRUE
5  TRUE  TRUE  TRUE  TRUE  TRUE

$label
[1] "(Intercept)" "1"           "2"           "3"           "4"           "5"

$size
[1] 2 2 3 3 4 4 5 5 6

$Cp
[1] 14.685202 35.022734  1.165791 16.392359  3.000614  3.079307  4.198499  4.940293  6.000000
$adjr2
[1] 0.5043202 0.4265865 0.5598764 0.5011760 0.5566915 0.5563855 0.5559494 0.5530395 0.5528053
$r2
[1] 0.5085209 0.4314460 0.5673361 0.5096307 0.5679621 0.5676639 0.5710019 0.5681907 0.5717542
```

The simplest model that seems viable (achieving the maximal adjusted and predicted Rsquared values respectively) is the two predictor model, using the returns of the GDAXI and the N225. The regression follows

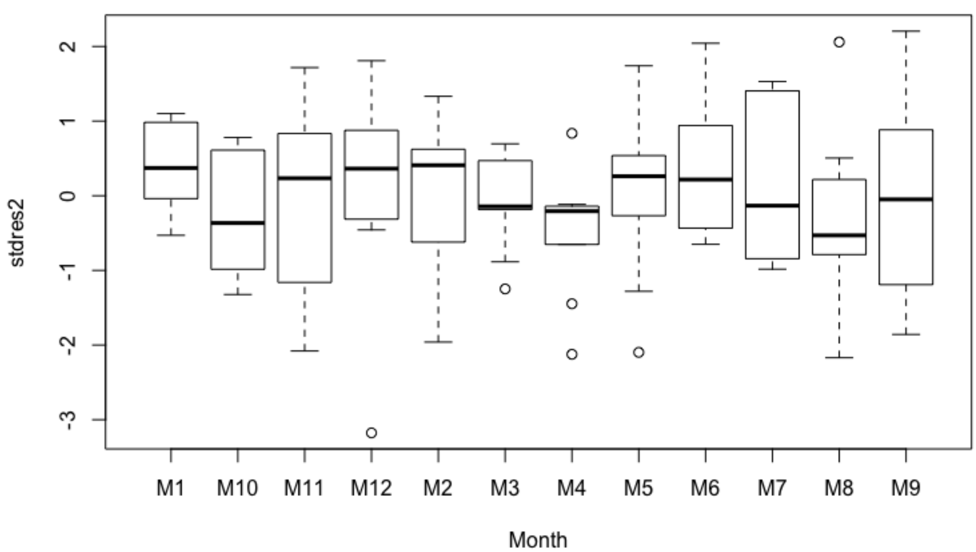
```
lm(formula = return.SNP ~ return.GDAXI + return.N225)

Residuals:
    Min      1Q  Median      3Q     Max 
-7.3600 -1.4525 -0.0903  1.4624  5.0593 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept)   0.47854    0.22227   2.153 0.033390 *  
return.GDAXI  0.38353    0.06354   6.036 1.94e-08 ***
return.N225   0.23492    0.05916   3.971 0.000125 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.381 on 116 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5673,    Adjusted R-squared:  0.5599 
F-statistic: 76.05 on 2 and 116 DF,  p-value: < 2.2e-16
```

Regression Equation

return.SNP = .47854 + .38353*return.GDAXI + .23492* return.N225



The autocorrelation evident in the ACF plot demonstrates negative autocorrelation at multiples of lags of four, which indicates potential seasonality in the data. This is something that would not show up on the Durbin-Watson test, as this is non-AR(1) autocorrelation. I decided to try and take the seasonality into account by creating a variable for each month

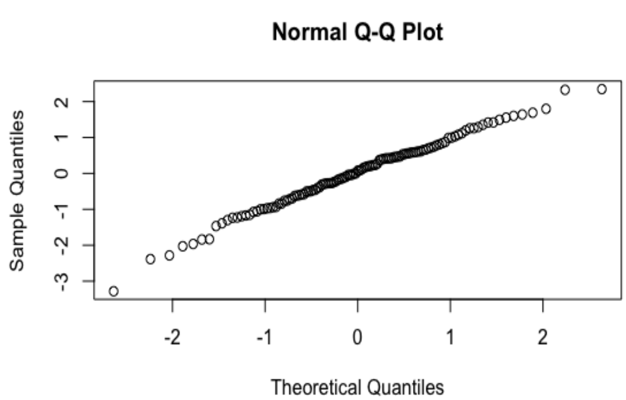


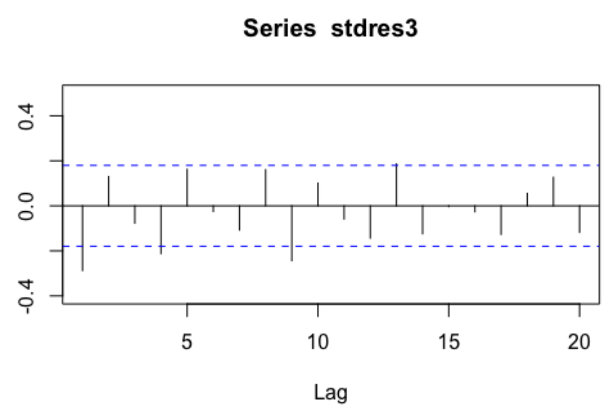
```
lm(formula = return.SNP ~ return.FTSE + return.GDAXI + return.N225 +
    Time + TimeSq + Indices$M1 + Indices$M2 + Indices$M3 + Indices$M4 +
    Indices$M5 + Indices$M6 + Indices$M7 + Indices$M8 + Indices$M9 +
    Indices$M10 + Indices$M11)

Residuals:
    Min      1Q  Median      3Q     Max
-7.3982 -1.4235  0.1727  1.4108  5.2703

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.0346605  1.0444896   0.991 0.324230
return.FTSE -0.0216735  0.0623860  -0.347 0.728999
return.GDAXI 0.3657709  0.0703670   5.198 1.04e-06 ***
return.N225  0.2543097  0.0651199   3.905 0.000169 ***
Time        -0.0267019  0.0278563  -0.959 0.340048
TimeSq       0.0002276  0.0002192   1.039 0.301485
Indices$M1   0.3877216  1.1537007   0.336 0.737510
Indices$M2   0.9087749  1.1061742   0.822 0.413250
Indices$M3   0.1979577  1.1212645   0.177 0.860213
Indices$M4  -0.2359442  1.1003751  -0.214 0.830646
Indices$M5  -1.0752333  1.1085126  -0.970 0.334352
Indices$M6   0.1769577  1.0983019   0.161 0.872318
Indices$M7   0.7749680  1.1019649   0.703 0.483496
Indices$M8   0.0864445  1.1146853   0.078 0.938338
Indices$M9  -0.7619477  1.1154013  -0.683 0.496083
Indices$M10 -0.0745523  1.1334141  -0.066 0.947684
Indices$M11 -0.7477434  1.1137526  -0.671 0.503501
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.449 on 102 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5978,    Adjusted R-squared:  0.5347
F-statistic: 9.474 on 16 and 102 DF,  p-value: 6.057e-14
```

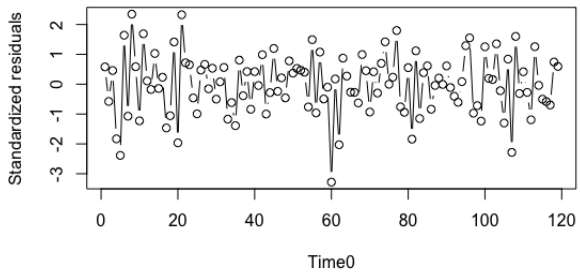
Regression Equation

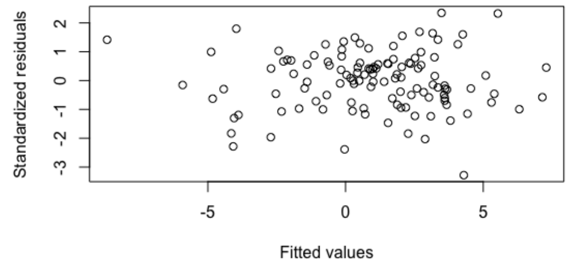
```
[1] "Y = 1.03 + -0.02 * return.FTSE + 0.37 * return.GDAXI + 0.25 * return.N225 + -0.03 * Time + 0 * TimeSq + 0.39 *
 Indices$M1 + 0.91 * Indices$M2 + 0.2 * Indices$M3 + -0.24 * Indices$M4 + -1.08 * Indices$M5 + 0.18 * Indices$M6 +
 0.77 * Indices$M7 + 0.09 * Indices$M8 + -0.76 * Indices$M9 + -0.07 * Indices$M10 + -0.75 * Indices$M11 + e"
```

The R squared remains strong with an adjusted R squared of 53.47



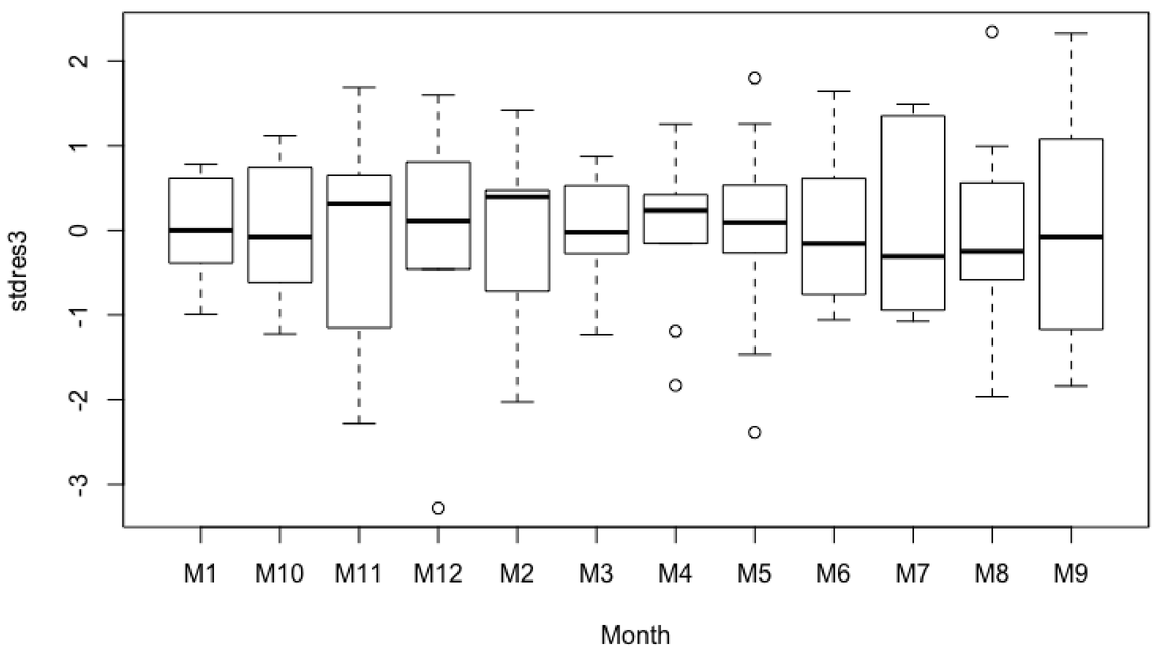







```
        Durbin-Watson test

data:  return.SNP ~ return.FTSE + return.GDAXI + return.N225 + Time +     TimeSq + Indices$M1 + Indices$M2 +
 Indices$M3 + Indices$M4 +     Indices$M5 + Indices$M6 + Indices$M7 + Indices$M8 + Indices$M9 +     Indices
$M10 + Indices$M11
DW = 2.5691, p-value = 0.9979
alternative hypothesis: true autocorrelation is greater than 0
```

```
        Runs Test

data:  stdres3
statistic = 3.039, runs = 77, n1 = 60, n2 = 59, n = 119, p-value = 0.002374
alternative hypothesis: nonrandomness
```



With a A p-**value** ≤ 0.05, at .002374, there is strong evidence against the null hypothesis of randomness in the data, so the Runs tests is signaling to some autocorrelation too. However, when comparing the boxplots of the residuals before and after there seems to be a marginal improvement.

I run a best subsets test on all the potential predictors:

```
> leaps(cbind( return.FTSE,return.GDAXI,return.N225,Time ,TimeSq ,Indices$M1,Indices$M2,Indices$M3,Indices$M4,Indices$M5,
Indices$M6,Indices$M7,Indices$M8,Indices$M9,Indices$M10,Indices$M11)[2:n,],return.SNP[2:n],nbest=2,method="r2")
       1     2     3     4     5     6     7     8     9     A     B     C     D     E     F     G
1  FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
1  FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
2  FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
2  FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
3  FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
3  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
4  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
4  FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE
5  FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE
5  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE  TRUE FALSE  TRUE FALSE FALSE FALSE FALSE
6  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE
6  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE FALSE
7  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
7  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE
8  FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE
8  FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE FALSE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
9  FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
9  FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE
10 FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
10 FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
11  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
11 FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE  TRUE
12  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
12  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE  TRUE
13  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE  TRUE
13  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
14  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE
14  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE  TRUE
15  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
15  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE
16  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE

$label
 [1] "(Intercept)" "1"           "2"           "3"           "4"           "5"           "6"
 [8] "7"           "8"           "9"           "A"           "B"           "C"           "D"
[15] "E"           "F"           "G"

$size
 [1]  2  2  3  3  4  4  5  5  6  6  7  7  8  8  9  9 10 10 11 11 12 12 13 13 14 14 15 15 16 16 17

$Cp
 [1]  9.6345281 29.1800017 -3.2804690  7.7998671 -3.2810377 -2.8716389 -2.5813052 -2.5617903
 [9] -1.9456941 -1.8139031 -0.7577090 -0.6299872  0.4769914  0.9703373  2.2488004  2.2632737
[17]  3.4915675  3.9697886  5.3285372  5.3369093  7.2092845  7.2131347  9.0877413  9.1220524
[25] 11.0396892 11.0547472 13.0185059 13.0259666 15.0043266 15.0060141 17.0000000
$r2
 [1] 0.5085209 0.4314460 0.5673361 0.5236423 0.5752251 0.5736107 0.5803525 0.5802755 0.5857328
[10] 0.5852131 0.5889348 0.5884312 0.5919527 0.5900073 0.5928525 0.5927955 0.5958386 0.5939528
[19] 0.5964815 0.5964485 0.5969517 0.5969365 0.5974310 0.5972957 0.5976205 0.5975611 0.5977040
[28] 0.5976746 0.5977600 0.5977533 0.5977770
$adjr2
 [1] 0.5043202 0.4265865 0.5598764 0.5154293 0.5641440 0.5624875 0.5656280 0.5655484 0.5674024
[10] 0.5668597 0.5669135 0.5663829 0.5662200 0.5641519 0.5632418 0.5631806 0.5624675 0.5604260
[19] 0.5591186 0.5590826 0.5555169 0.5555001 0.5518572 0.5517066 0.5478021 0.5477354 0.5435488
[28] 0.5435154 0.5391813 0.5391737 0.5346832
```

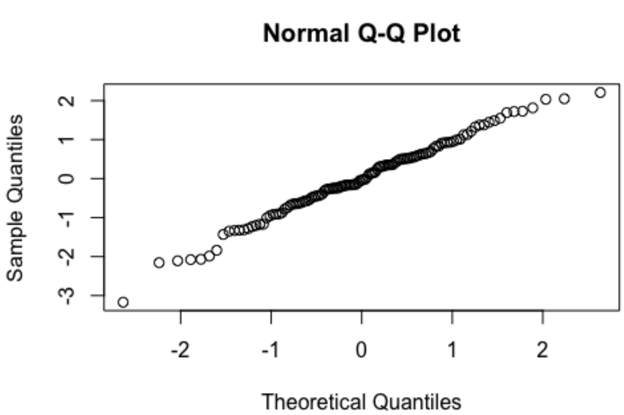
Best subsets seem to suggest the best model to be one with 3 predictors, the return of the GDAXI, the return of the Nikkei 225 and the Variable for month 5.

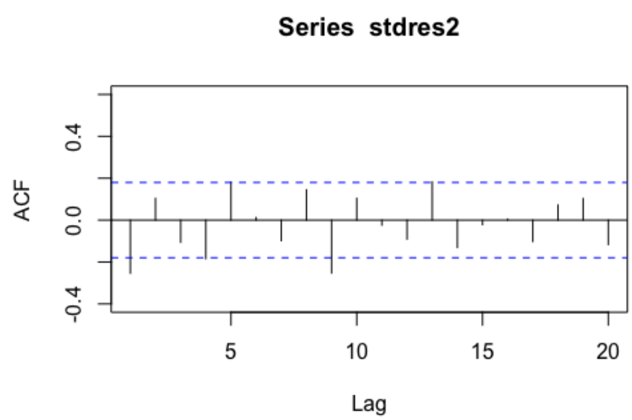
The regression follows

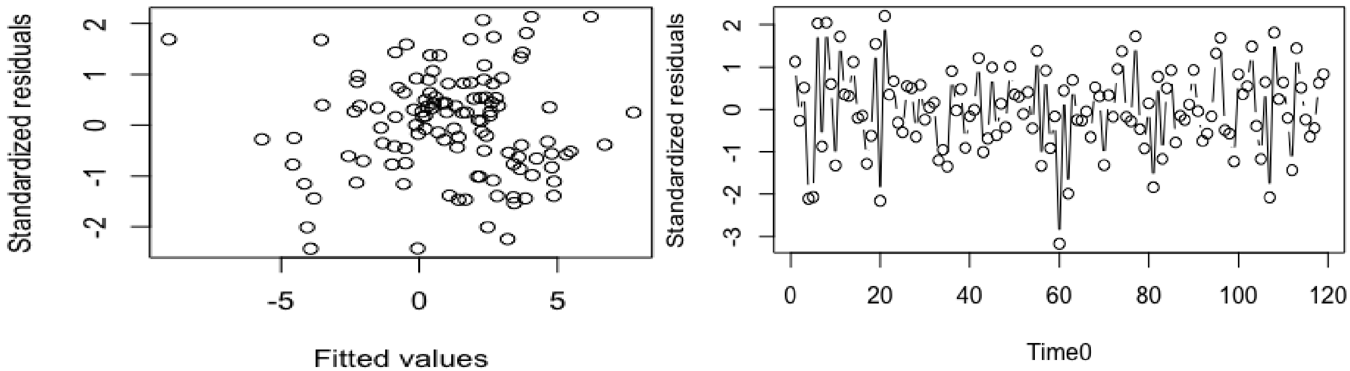
```
lm(formula = return.SNP ~ +return.GDAXI + return.N225 + Indices$M5)

Residuals:
   Min     1Q Median     3Q    Max 
-7.473 -1.506  0.351  1.357  4.965 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept)   0.58451    0.23277   2.511 0.013424 *  
return.GDAXI  0.38609    0.06326   6.104 1.44e-08 ***
return.N225   0.22234    0.05950   3.737 0.000292 ***
Indices$M5   -1.16153    0.79479  -1.461 0.146623    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.37 on 115 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5752,    Adjusted R-squared:  0.5641 
F-statistic: 51.91 on 3 and 115 DF,  p-value: < 2.2e-16
```

Adjusted R squared is marginally better at 56.41%. The run test gives us a p value close enough to the .05 limit that signals there is still autocorrelation remaining in the data. Similarly, autocorrelation is evident in the ACF plot.

```
        Runs Test

data:  stdres4
statistic = 1.9561, runs = 71, n1 = 62, n2 = 57, n = 119, p-value = 0.05045
alternative hypothesis: nonrandomness
```







In order to account for the outlier and influential points as identified by the cook's distance and leverage values, also evident in the standardized residuals plot above, I created two new indicator variables to identify each of those points. The regression follows:

```
lm(formula = return.SNP ~ return.FTSE + return.GDAXI + return.N225 +
    Time + TimeSq + Indices$M1 + Indices$M2 + Indices$M3 + Indices$M4 +
    Indices$M5 + Indices$M6 + Indices$M7 + Indices$M8 + Indices$M9 +
    Indices$M10 + Indices$M11 + Indices$J15 + Indices$S11)

Residuals:
    Min      1Q  Median      3Q     Max
-5.4946 -1.4644  0.0289  1.2957  4.9364

Coefficients: (1 not defined because of singularities)
               Estimate Std. Error t value Pr(>|t|)
(Intercept)   1.4485839  0.8357342   1.733 0.086093 .
return.FTSE  -0.0268986  0.0583030  -0.461 0.645533
return.GDAXI  0.4006405  0.0672347   5.959 3.74e-08 ***
return.N225   0.2278868  0.0612152   3.723 0.000325 ***
Time         -0.0212712  0.0262960  -0.809 0.420468
TimeSq        0.0001698  0.0002064   0.823 0.412507
Indices$M1    0.8010402  0.9676168   0.828 0.409708
Indices$M2           NA         NA      NA       NA
Indices$M3   -0.2839335  0.9007912  -0.315 0.753257
Indices$M4   -0.7127455  0.8880696  -0.803 0.424103
Indices$M5   -1.5770551  0.9006557  -1.751 0.082981 .
Indices$M6   -0.2469442  0.8916401  -0.277 0.782381
Indices$M7    0.2842691  0.8893378   0.320 0.749900
Indices$M8   -0.3411114  0.9193255  -0.371 0.711381
Indices$M9   -0.7046853  0.9365117  -0.752 0.453526
Indices$M10  -0.5835146  0.9117372  -0.640 0.523620
Indices$M11  -1.1531007  0.9010104  -1.280 0.203552
Indices$J15  -8.6269503  2.4872173  -3.469 0.000771 ***
Indices$S11  -4.9235488  2.4684427  -1.995 0.048782 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.29 on 101 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.6517,	Adjusted R-squared:  0.593
F-statistic: 11.11 on 17 and 101 DF,  p-value: 2.507e-16
```

Regression Equation

```
[1] "Y = 1.45 + -0.03 * return.FTSE + 0.4 * return.GDAXI + 0.23 * return.N225 + -0.02 * Time +
 Indices$M1 + NA * Indices$M2 + -0.28 * Indices$M3 + -0.71 * Indices$M4 + -1.58 * Indices$M5 +
 + 0.28 * Indices$M7 + -0.34 * Indices$M8 + -0.7 * Indices$M9 + -0.58 * Indices$M10 + -1.15 * ]
 * Indices$J15 + -4.92 * Indices$S11 + e"
```

I run a best subset test on the potential predictors:

```
> leaps(cbind(return.FTSE,return.GDAXI,return.N225,Time,TimeSq,Indices$M1,Indices$M5,Indices$M6,Indices$M7,Indices$M10,Indices$M11,Indices$J15
+Indices$S11)[2:n,],return.SNP[2:n],nbest=2)
$which
      1     2     3     4     5     6     7     8     9     A     B     C
1  FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
1  FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
2  FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE
2  FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
3  FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE
3  FALSE  TRUE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE  TRUE
4  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE  TRUE
4  FALSE  TRUE  TRUE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE  TRUE
5  FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE  TRUE  TRUE
5  FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE  TRUE
6  FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE  TRUE
6  FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE  TRUE FALSE FALSE  TRUE
7  FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE
7  FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE
8   TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE
8  FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
9  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE
9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE FALSE  TRUE  TRUE
10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE
10 FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
11  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
11  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE
12  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE

$label
 [1] "(Intercept)" "1"           "2"           "3"           "4"           "5"           "6"           "7"           "8"           "9"

[11] "A"           "B"           "C"

$size
 [1]  2  2  3  3  4  4  5  5  6  6  7  7  8  8  9  9 10 10 11 11 12 12 13

$Cp
 [1] 31.882308 54.916730 15.226185 16.304922  2.614992 12.005147  1.600672  3.009580  2.058125  2.365992  3.006778  3.387711  4.253111  4.7530
99
[15]  6.083314  6.105428  7.455504  7.774944  9.088790  9.320162 11.002732 11.081300 13.000000

$adjr2
 [1] 0.5043202 0.4265865 0.5635481 0.5598764 0.6099184 0.5776786 0.6169367 0.6120570 0.6189366 0.6178609 0.6192406 0.6178977 0.6184912
[14] 0.6167127 0.6156324 0.6155531 0.6143803 0.6132232 0.6121504 0.6113045 0.6088432 0.6085533 0.6051632


$r2
 [1] 0.5085209 0.4314460 0.5709456 0.5673361 0.6198358 0.5884156 0.6299219 0.6252076 0.6350834 0.6340532 0.6386013 0.6373266 0.6411231
[14] 0.6394501 0.6416913 0.6416173 0.6437920 0.6427231 0.6450190 0.6442448 0.6453070 0.6450441 0.6453161
```

Best subsets seem to suggest the best model to be one with 5 predictors, the return of the GDAXI, the return of the Nikkei 225, the Variable for month 5 and the variables accounting for the outliers.

The regression follows:

```
lm(formula = return.SNP ~ return.GDAXI + return.N225 + Indices$M5 +
    Indices$J15 + Indices$S11)

Residuals:
    Min      1Q  Median      3Q     Max
-5.3266 -1.4095  0.2141  1.2017  4.6999

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)   0.70329    0.22071   3.187 0.001862 **
return.GDAXI  0.41794    0.06106   6.845 4.18e-10 ***
return.N225   0.19565    0.05644   3.467 0.000746 ***
Indices$M5   -1.31348    0.74724  -1.758 0.081495 .
Indices$J15  -7.84628    2.28874  -3.428 0.000849 ***
Indices$S11  -5.27919    2.25126  -2.345 0.020773 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.225 on 113 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.632,	Adjusted R-squared:  0.6157
F-statistic: 38.81 on 5 and 113 DF,  p-value: < 2.2e-16
```

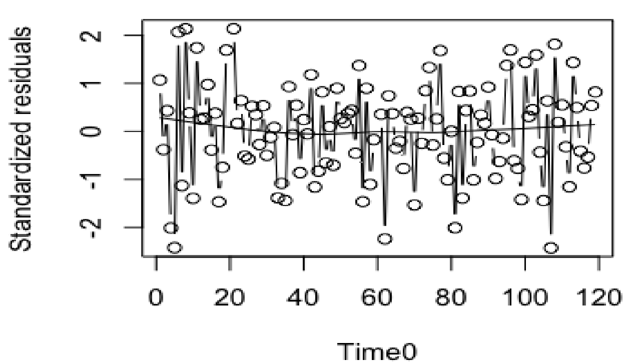
Regression Equation

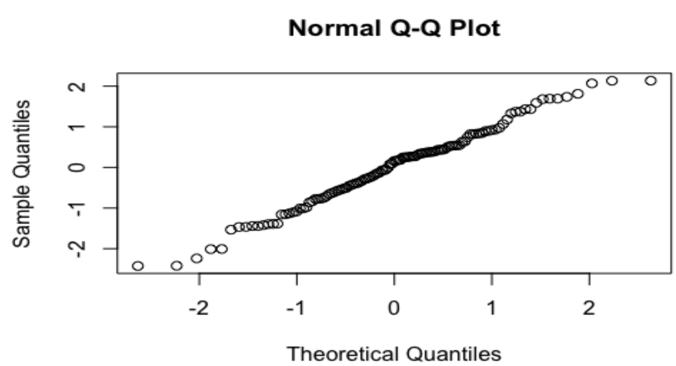
return.SNP = .70329 + .41794*return.GDAXI + .19565* return.N225 - 1.31348 * Month5 - 7.84628 * January2015 - 5.27919 *September2011

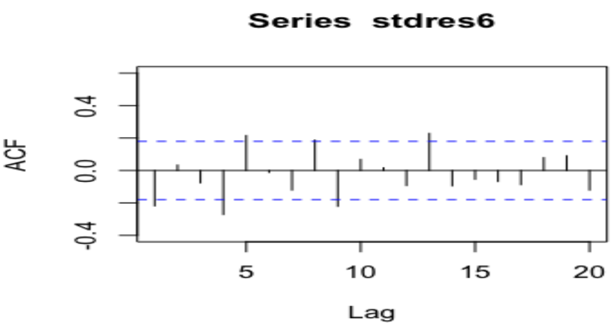
VIF VALUES

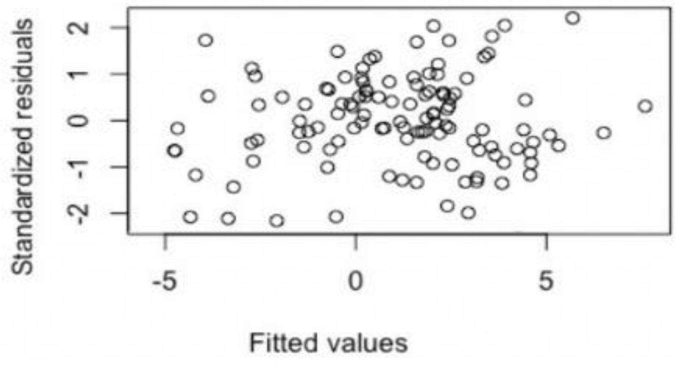
return.GDAXI	return.N225	Indices$M5	Indices$J15	Indices$S11
1.910009	1.882253	1.032826	1.048942	1.014867

As shown by the VIF values, multicollinearity does not seem to be an issue here.

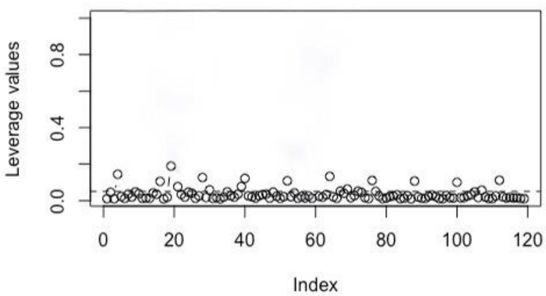


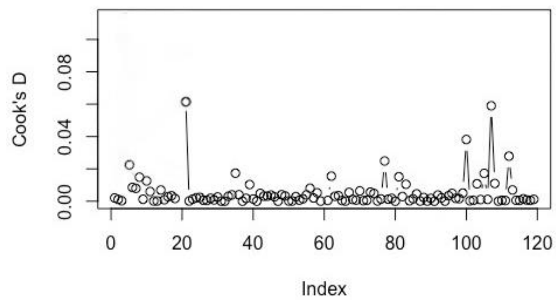







```
        Runs Test

data:  stdres6
statistic = 1.8096, runs = 69, n1 = 62, n2 = 55, n = 117, p-value = 0.07036
alternative hypothesis: nonrandomness
        Durbin-Watson test

data:  return.SNP ~ return.FTSE + return.GDAXI + return.N225
DW = 2.4887, p-value = 0.9963
alternative hypothesis: true autocorrelation is greater than 0
```





The adjusted R squared with this model is the highest at 61.57%. Autocorrelation unfortunately remain an issue, as evident by the ACF plot, however the increased p-value from the Runs test shows a decreased level of autocorrelation. The Durbin-Watson is insisting on no autocorrelation, but this can be attributed to non AR(1) autocorrelation being here. It seems like the methods that we have explored so far for correcting autocorrelation have not been sufficient for this data.

The equation tells us that given the return for the GDAXI and the index variables for the 5th Month and the outliers are held fixed, a one percentage increase in the return of the N225 index is associated with a .19565% increase in the return of the S&P. Similarly, a one percentage point increase is associated with a .41794% increase in the return of the S&P, holding all else constant. The regression is somewhat significant with 61.57% of the variability in the return of the S&P is being accounted for by the predictors. A prediction interval for the return of the S&P is ±2ˆσ ≈ 4.45; that is 95% of the time the logged inbound tourism is known within ±4.45. The normal plot shows the some heavy-tailedness, with the right upper end of the normality plot going above the hypothetical straight and the left lower end going below it. The residuals versus fitted values plot also shows some non-constant variance.

Appendices

Appendix A.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Date	Month	SNP	FTSE	GDAXI	N225	Time	TimeSq	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
2	01/01/2010	M1	1073.87	3009.3	5608.79	10198.04	0	0	1	0	0	0	0	0	0	0	0	0	0
3	01/02/2010	M2	1104.49	3137.9	5598.46	10126.03	1	1	0	1	0	0	0	0	0	0	0	0	0
4	01/03/2010	M3	1169.43	3216.7	6153.55	11089.94	2	4	0	0	1	0	0	0	0	0	0	0	0
5	01/04/2010	M4	1186.69	3319.4	6135.7	11057.4	3	9	0	0	0	1	0	0	0	0	0	0	0
6	01/05/2010	M5	1089.41	3314.6	5964.33	9768.7	4	16	0	0	0	0	1	0	0	0	0	0	0
7	01/06/2010	M6	1030.71	3463.3	5965.52	9382.64	5	25	0	0	0	0	0	1	0	0	0	0	0
8	01/07/2010	M7	1101.6	3477.8	6147.97	9537.3	6	36	0	0	0	0	0	0	1	0	0	0	0
9	01/08/2010	M8	1049.33	3508.2	5925.22	8824.06	7	49	0	0	0	0	0	0	0	1	0	0	0
10	01/09/2010	M9	1141.2	3529.1	6229.02	9369.35	8	64	0	0	0	0	0	0	0	0	1	0	0
11	01/10/2010	M10	1183.26	3664.3	6601.37	9202.45	9	81	0	0	0	0	0	0	0	0	0	1	0
12	01/11/2010	M11	1180.55	3689.3	6688.49	9937.04	10	100	0	0	0	0	0	0	0	0	0	0	1
13	01/12/2010	M12	1257.64	3759.3	6914.19	10228.92	11	121	0	0	0	0	0	0	0	0	0	0	0
14	01/01/2011	M1	1286.12	3727.6	7077.48	10237.92	12	144	1	0	0	0	0	0	0	0	0	0	0
15	01/02/2011	M2	1327.22	3699.7	7272.32	10624.09	13	169	0	1	0	0	0	0	0	0	0	0	0
16	01/03/2011	M3	1325.83	3817.9	7041.31	9755.1	14	196	0	0	1	0	0	0	0	0	0	0	0
17	01/04/2011	M4	1363.61	3747.8	7514.46	9849.74	15	225	0	0	0	1	0	0	0	0	0	0	0
18	01/05/2011	M5	1345.2	3711	7293.69	9693.73	16	256	0	0	0	0	1	0	0	0	0	0	0
19	01/06/2011	M6	1320.64	3703.2	7376.24	9816.09	17	289	0	0	0	0	0	1	0	0	0	0	0
20	01/07/2011	M7	1292.28	3867.6	7158.77	9833.03	18	324	0	0	0	0	0	0	1	0	0	0	0
21	01/08/2011	M8	1218.89	3953.7	5784.85	8955.2	19	361	0	0	0	0	0	0	0	1	0	0	0
22	01/09/2011	M9	1131.42	3979.1	5502.02	8700.29	20	400	0	0	0	0	0	0	0	0	1	0	0
23	01/10/2011	M10	1253.3	4058	6141.34	8988.39	21	441	0	0	0	0	0	0	0	0	0	1	0
24	01/11/2011	M11	1246.96	4118.5	6088.84	8434.61	22	484	0	0	0	0	0	0	0	0	0	0	1
25	01/12/2011	M12	1257.6	4275.8	5898.35	8455.35	23	529	0	0	0	0	0	0	0	0	0	0	0
26	01/01/2012	M1	1312.41	4308.3	6458.91	8802.51	24	576	1	0	0	0	0	0	0	0	0	0	0
27	01/02/2012	M2	1365.68	4312.9	6856.08	9723.24	25	625	0	1	0	0	0	0	0	0	0	0	0
28	01/03/2012	M3	1408.47	4436	6946.83	10083.56	26	676	0	0	1	0	0	0	0	0	0	0	0
29	01/04/2012	M4	1397.91	4621.3	6761.19	9520.89	27	729	0	0	0	1	0	0	0	0	0	0	0
30	01/05/2012	M5	1310.33	4604.6	6264.38	8542.73	28	784	0	0	0	0	1	0	0	0	0	0	0
31	01/06/2012	M6	1362.16	4907.5	6416.28	9006.78	29	841	0	0	0	0	0	1	0	0	0	0	0
32	01/07/2012	M7	1379.32	4817.5	6772.26	8695.06	30	900	0	0	0	0	0	0	1	0	0	0	0
33	01/08/2012	M8	1406.58	5244.2	6970.79	8839.91	31	961	0	0	0	0	0	0	0	1	0	0	0
34	01/09/2012	M9	1440.67	4842.3	7216.15	8870.16	32	1024	0	0	0	0	0	0	0	0	1	0	0
35	01/10/2012	M10	1412.16	4831.8	7260.63	8928.29	33	1089	0	0	0	0	0	0	0	0	0	1	0
36	01/11/2012	M11	1416.18	5135.5	7405.5	9446.01	34	1156	0	0	0	0	0	0	0	0	0	0	1
37	01/12/2012	M12	1426.19	5458.5	7612.39	10395.18	35	1225	0	0	0	0	0	0	0	0	0	0	0
38	01/01/2013	M1	1498.11	5767.3	7776.05	11138.66	36	1296	1	0	0	0	0	0	0	0	0	0	0
39	01/02/2013	M2	1514.68	5932.2	7741.7	11559.36	37	1369	0	1	0	0	0	0	0	0	0	0	0
40	01/03/2013	M3	1569.19	5928.4	7795.31	12397.91	38	1444	0	0	1	0	0	0	0	0	0	0	0
41	01/04/2013	M4	1597.57	5870.7	7913.71	13860.86	39	1521	0	0	0	1	0	0	0	0	0	0	0
42	01/05/2013	M5	1630.74	5832.6	8348.84	13774.54	40	1600	0	0	0	0	1	0	0	0	0	0	0
43	01/06/2013	M6	1606.28	5837.1	7959.22	13677.32	41	1681	0	0	0	0	0	1	0	0	0	0	0
44	01/07/2013	M7	1685.73	5249.4	8275.97	13668.32	42	1764	0	0	0	0	0	0	1	0	0	0	0
45	01/08/2013	M8	1632.97	5064.4	8103.15	13388.86	43	1849	0	0	0	0	0	0	0	1	0	0	0
46	01/09/2013	M9	1681.55	5438.4	8594.4	14455.8	44	1936	0	0	0	0	0	0	0	0	1	0	0
47	01/10/2013	M10	1756.54	5743.9	9033.92	14327.94	45	2025	0	0	0	0	0	0	0	0	0	1	0
48	01/11/2013	M11	1805.81	5882.6	9405.3	15661.87	46	2116	0	0	0	0	0	0	0	0	0	0	1
49	01/12/2013	M12	1848.36	5896	9552.16	16291.31	47	2209	0	0	0	0	0	0	0	0	0	0	0
50	01/01/2014	M1	1782.59	6175.1	9306.48	14914.53	48	2304	1	0	0	0	0	0	0	0	0	0	0
51	01/02/2014	M2	1859.45	6295.3	9692.08	14841.07	49	2401	0	1	0	0	0	0	0	0	0	0	0
52	01/03/2014	M3	1872.34	6552.2	9555.91	14827.83	50	2500	0	0	1	0	0	0	0	0	0	0	0
53	01/04/2014	M4	1883.95	6226.2	9603.23	14304.11	51	2601	0	0	0	1	0	0	0	0	0	0	0
54	01/05/2014	M5	1923.57	6318.5	9943.27	14632.38	52	2704	0	0	0	0	1	0	0	0	0	0	0
55	01/06/2014	M6	1960.23	6231.9	9833.07	15162.1	53	2809	0	0	0	0	0	1	0	0	0	0	0
56	01/07/2014	M7	1930.67	6246.4	9407.48	15620.77	54	2916	0	0	0	0	0	0	1	0	0	0	0
57	01/08/2014	M8	2003.37	6029.8	9470.17	15424.59	55	3025	0	0	0	0	0	0	0	1	0	0	0
58	01/09/2014	M9	1972.29	6255.7	9474.3	16173.52	56	3136	0	0	0	0	0	0	0	0	1	0	0
59	01/10/2014	M10	2018.05	6597.2	9326.87	16413.76	57	3249	0	0	0	0	0	0	0	0	0	1	0
60	01/11/2014	M11	2067.56	6930.2	9980.85	17459.85	58	3364	0	0	0	0	0	0	0	0	0	0	1
61	01/12/2014	M12	2058.9	6268.5	9805.55	17450.77	59	3481	0	0	0	0	0	0	0	0	0	0	0
62	01/01/2015	M1	1994.99	6232.6	10694.32	17674.39	60	3600	1	0	0	0	0	0	0	0	0	0	0
63	01/02/2015	M2	2104.5	6540.2	11401.66	18797.94	61	3721	0	1	0	0	0	0	0	0	0	0	0
64	01/03/2015	M3	2067.89	6327.4	11966.17	19206.99	62	3844	0	0	1	0	0	0	0	0	0	0	0
65	01/04/2015	M4	2085.51	6359.4	11454.38	19520.01	63	3969	0	0	0	1	0	0	0	0	0	0	0
66	01/05/2015	M5	2107.39	6312.7	11413.82	20563.15	64	4096	0	0	0	0	1	0	0	0	0	0	0
67	01/06/2015	M6	2063.11	6365.3	10944.97	20235.73	65	4225	0	0	0	0	0	1	0	0	0	0	0
68	01/07/2015	M7	2103.84	6672.7	11308.99	20585.24	66	4356	0	0	0	0	0	0	1	0	0	0	0
69	01/08/2015	M8	1972.18	6294.2	10315.62	18890.48	67	4489	0	0	0	0	0	0	0	1	0	0	0
70	01/09/2015	M9	1920.03	6438.4	9660.44	17388.15	68	4624	0	0	0	0	0	0	0	0	1	0	0
71	01/10/2015	M10	2079.36	6142.2	10850.14	19083.1	69	4761	0	0	0	0	0	0	0	0	0	1	0
72	01/11/2015	M11	2080.41	6222.5	11382.23	19747.47	70	4900	0	0	0	0	0	0	0	0	0	0	1
73	01/12/2015	M12	2043.94	6297.5	10743.01	19033.71	71	5041	0	0	0	0	0	0	0	0	0	0	0
74	01/01/2016	M1	1940.24	5917.9	9798.11	17518.3	72	5184	1	0	0	0	0	0	0	0	0	0	0
75	01/02/2016	M2	1932.23	5633.7	9495.4	16026.76	73	5329	0	1	0	0	0	0	0	0	0	0	0
76	01/03/2016	M3	2059.74	5967	9965.51	16758.67	74	5476	0	0	1	0	0	0	0	0	0	0	0
77	01/04/2016	M4	2065.3	5796.2	10038.97	16666.05	75	5625	0	0	0	1	0	0	0	0	0	0	0
78	01/05/2016	M5	2096.95	5642.5	10262.74	17234.98	76	5776	0	0	0	0	1	0	0	0	0	0	0
79	01/06/2016	M6	2098.86	5529.1	9680.09	15575.92	77	5929	0	0	0	0	0	1	0	0	0	0	0
80	01/07/2016	M7	2173.6	5345	10337.5	16569.27	78	6084	0	0	0	0	0	0	1	0	0	0	0