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Comparative Predictive Modeling on CNX Nifty with Artificial Neural Network

Bikramaditya Ghosh*

Research Scholar, Christ University, Bangalore, India

Abstract

CNX Nifty being an important barometer to indicate country's growth has always been followed with lots of interest from both academia and industry. Now, CNX Nifty could be predicted or not on a random basis gives rise to many a questions. This sounds redolent with any predictive modeling, though with a certain degree of accuracy inbuilt into the system. The major point of consideration is that predictive modeling could be done by various measures and mechanisms. In predictive modeling Multiple Adaptive Regression (MARS), Classification and Regression Trees (CART), Logistic OLS or Non Linear OLS could be used. Here in this study, the researcher has utilized Neural Network as a "Predictive Modeler" to predict CNX Nifty closing on certain definite time zones under consideration, because it is closer to the functioning of the human brain in comparison to the other models. As Indian markets are a clear case of the weak form of efficiency, so, Neural Network will be an ideal tool for detection or prediction in this market.

Keywords: *Neural Network, CNX Nifty, Predictive Modeling*

1. Literature Review

Quite a few in depth articles were found in the said domain. However India specific studies were missing. The author took the baton from his own research, where he did detect the presence of sentiment in CNX Nifty deploying Probabilistic Neural Network. Wu, Y. Z. (2009) has done similar approach on S&P 500, however, instead of two time zones their approach relied on two methods in the said domain. Hirotaka Mizuno, Michitaka Kosaka, Hiroshi Yajima (1998) has done detailed work on Application of Neural Network to Technical Analysis of Stock Market Prediction. K Kim, I Han (2000), have done extensive work on the Genetic algorithm approach to feature discretization in artificial neural networks for the prediction of stock price index.

2. Methodology

Two definite time zones have been considered in post LPG India. They were based on the volatility component. In fact Log Likelihood function through the GARCH Model has been used to find those two zones in time. Based on that 2002 to 2003 along with 2005 to 2006 calendar year dates have been chosen to calculate and formulate this study. Artificial Neural Network with Neuron Layers [3, 10, 34, and 1] has been applied to achieve the two distinct sets of results. This Network works on Back-propagation theory. These layers resemble human brain neuron layers both as a function specific way also as an orientation specific way. Three neurons represent the three input variables. The hidden layers are dynamic in most cases. Output layer is one neuron representing the single dependent variable; in this case it is closing of CNX Nifty. A total 251 observation points in each case has been differentiated into two halves. 201 first observations are taken into neural network for running a neural networking algorithm on them, and the last 50, data set where the predicted values are supposed to be matched with the actual values (as all these events have already happened in the past). The neural network multilayered structure gives possibility to optimize the

*Email: bikram77777@gmail.com

set of input variables at each layer, while the accuracy increases. The accuracy of forecasting, an approximation or pattern recognition can be increased beyond the limits with this kind of usage. These multilayer neural networks are quite complex and tries close and hard to replicate the brain functioning of human. In this body of work, P/E, PB and Dividend Yield have become the predictors and the Adjusted Close of Nifty at the end of the trading day becomes the dependent variable. The use of neural network is more useful if the market efficiency is on the lower side, as the propensity of investors, are to follow sentiments or confidence related parameters rather than a technical or a fundamental approach.

3. Results

The second half of the Figure 1 (in red) depicts the predicted, and the shadow line at the back indicate the actual closing. If noticed carefully, we can observe that they are quite similar and merged at different points too. The interesting thing to notice here is the trend has been the same while comparing the actual and the predicted closing of Nifty, (Table 1 & 2).

Autocorrelations are not significant for more lags; in fact they seem to die down quite fast. Residuals are quite random as well. Residual distribution is skewed to the left. These indicate that efficiency of prediction of residuals may not be that high.

The second half of the Figure 3 (in red) depicts the predicted, and the shadow line at the back indicate the actual closing. If noticed carefully, we can observe that they are quite similar and merged at different points too. The interesting thing to notice here is the trend has been the same while comparing the actual and the predicted closing of Nifty. In Figure 1 (200–2003) the red line and

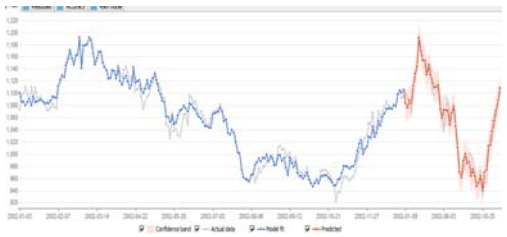


Figure 1. 2002 to 2003 Prediction model.

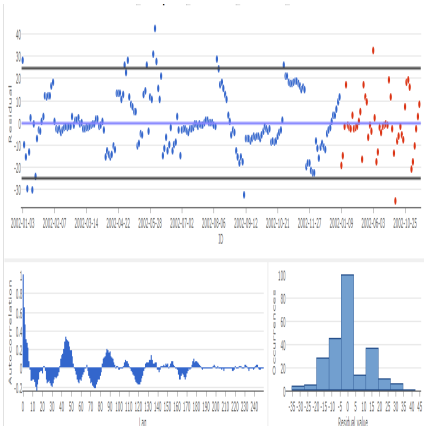


Figure 2. 2002 to 2003 Residual plot.

Table 1. 2002 to 2003 Accuracy of the model

rror measure	Absolute	Target: Close of CNX NIFTYall02-01-2002-TO-01-01-2003
ostprocessed results	Model fit	Predictions
umber of observations	200	50
lax. negative error	-32.5717	-35.2484
lax. positive error	42.1203	32.1874
lean absolute error (MAE)	9.38518	9.05753
oot mean square error (RMSE)	12.3933	12.2075
esidual sum	2.58296E-10	-55.6399
tandard deviation of residuals	12.3933	12.1567
oefficient of determination (R^2)	0.966544	0.967942
orrelation	0.98313	0.984035

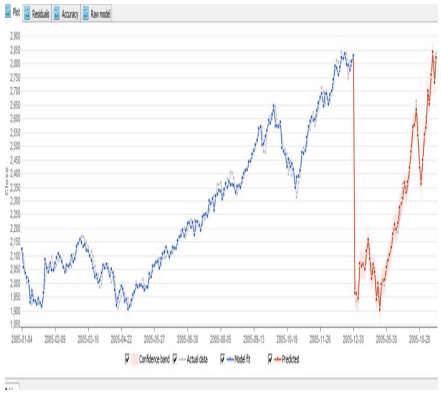


Figure 3. 2005 to 2006 Prediction model.

the shadow line merges and diverge on many occasions; however Figure 3 (2005-2006) depicts visibly more overlaps. In fact the first half of Figure 1 (2002-2003) has been slightly more random, compared to the first half

of Figure 3 (2005-2006). Overall random come down in the second base, so naturally the predictability improves a lot. Also, it has been noted that dates when the actual closing and predicted closing went exactly down by half, from zone 1 to zone 2. In 2002-2003 phase (Zone 1) 4 dates were found out of 50 predictions where the difference is more than 2%. In 2005-2006 phases (Zone 2) only 2dates were found out of 50 predictions where the difference is more than 2%. Most of these dates are surprisingly falling within the first three days of the week. Which means that predicting at the beginning of the week seems harder compared to the mid of the week.

In Figure 4 (2005-2006), Autocorrelations are not significant for more lags; in fact they seem to die down quite fast. Residuals are not quite random here. Residual distribution seems even. These indicate that efficiency of prediction of residuals could be higher than Figure 2 (2002-2003).

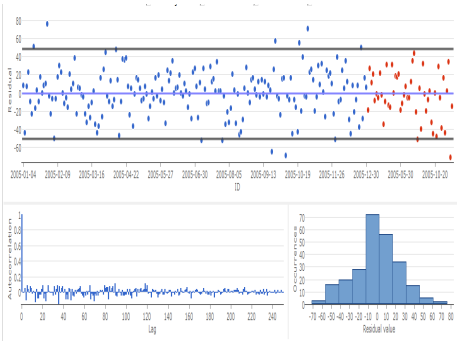


Figure 4. 2005 to 2006 Residual plot.

Table 2. 2005 to 2006 Accuracy of the model

Plot | Residuals | Accuracy | Raw model

rror measure: Absolute — Target: Close of CNX NIFTYall04-01-2005-TO-02-01-2006

ostprocessed results	Model fit	Predictions
umber of observations	201	50
lax. negative error	-69.1368	-71.0389
lax. positive error	75.6503	43.7291
lean absolute error (MAE)	18.9176	20.2489
oot mean square error (RMSE)	24.6286	25.8661
esidual sum	-2.58001E-9	-180.721
tandard deviation of residuals	24.6286	25.6123
oefficient of determination (R^2)	0.991055	0.99097
orrelation	0.995518	0.995894

Table 3. Final prediction

	2002-2003	2005-2006
Standard Deviation in differentiated Predicted Close	1.18%	1.09%
Accuracy in Prediction of differentiated Close	98.8%	98.9%

In Table 3 "Differentiated Predictive Close" has been used as a concept. Differentiated close is the % difference between actual close & the predicted close. So, that depicts the variation in prediction. Standard Deviation will mean the deviation of the variation during predicting. That plausibly indicates to the fact that if that Standard deviation is coming down, will surely a result of the increasing convergence between the actual close and the predicted close.

4. Conclusion

It has been observed in two completely random time zones that…

1. MAE becomes double from 9 to 18 (2003 to 2006). So, the error amount increased in the second leg of the work.
2. RMSE becomes double from 12 to 24 (2003 to 2006). So, the error amount increased in the second leg of the work.
3. Coeff. Of Correlation has improved from 2003 to 2006 from 0.98 to 0.99. So, prediction has become even more accurate despite the error multiplication.
4. Standard Deviation in the differentiated close has decreased too from 2003 to 2006 from 1.18% to 1.09%. Data has become stable and stationary, so the prediction efficiency has improved. It means CNX Nifty has become more predictable and tending towards being an efficient stock basket. As Indian bourses have become globalized only from 1991, so, even a 3-4 year span in its infancy created a significant difference, as far as efficiency is concerned.
5. ACF of residuals indicates stationary and autoregressive series as the lags are diminishing quite quickly hinting that the predictions could be quite accurate.
6. Prediction accuracy becomes even better with time, i.e. 98.82% to 98.91%.

4.1 Equation 1.0

Final Model for 2002-2003

Y1 = -168.847 + N394*0.20274 -
N394*N5*0.000130613 + N5*1.09544

Descriptions are in Annexure A

4.2 Equation 1.1

Final Model for 2005-2006

Y1 = 81.3602 - N472*N11*0.00640087 +
N472^2*0.0031779 + N11*0.923142 +
N11^2*0.00324016

Descriptions are in Annexure B

5. Limitations

- Neural Network with [9, 10, 34, 1] neuron structure has been used.
- Geographic selection of stocks from CNX Nifty 50.
- Stocks have changed inside CNX Nifty 50 in those two time zones (marginally though).

6. Further Scope of Research

- A similar study could be carried out with different time zones.
- A similar study could be carried out for a continuous time period.
- A similar study could be carried for different Index or Indices.

7. References

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About the Author

Dr. Bikramaditya Ghosh is an ex investment banker turned financial modelling/ financial engineering researcher having noted publications in International Journals of repute. He is a science graduate, management post graduate (Finance) and Management Doctorate as well. In a decade long investment banking experience across various economies, the author has identified many a gap areas in applied financial analytics. He found similar gap areas during his doctoral research process as well. The continuous effort is for bridging those gaps with efficient models for Prediction of various asset prices, bubble zones and impact points. The researcher firmly believes in the use of statistical measurements as well as combination of econometrics, neural tools and machine learning tools as a potent predictive modeller. The current research interest relies more upon Neural Network and its application in various and diverse financial asset classes for the sole purpose of prediction in a market, where sentiment plays a major role in decision making. The other areas of research involves behavioural finance, bond convexity, sharia based investments, index construction, economic bubble identification,

sentiment quantification and impact calculation. The author has attended many a seminars and conferences nationally and internationally. Dr. Ghosh can be reached at bikram77777@gmail.com.

Annexure

A. Explanation for Equation 1.0

N5 = 798.314 - N143*1.16452 + N143*N20*0.00068896 + N20*0.678331

N20 = -18.4617 + N38*0.547989 + N55*0.469492

N55 = 580.16 - N246*1.30144 + N246*N62*0.000468212 + N62*1.25588

N62 = 213.374+N109*0.367637+N109*N139*0.000220163 + N139*0.197009

N139 = 7003.4 - N218*3.00772 + N218*N338*0.00620626 - N338*9.20004

N338 = -2263.83+N350*2.96918-N350*N390*0.00197943 + N390*2.27046

N390 = 3851.49 - “”P/B”, cubert“*2698.94 + “”P/B”, cubert” *N393*2.71687 - N393*2.87551

N350 = -2628.68+N367*2.74242-N367*N368*0.00229574 + N368*3.17891

N218 = -3219.04+N361*3.68983-N361*N389*0.00277792 + N389*3.29893

N361 = -4249.25 + “”P/E”, cubert”*1523.23 - “”P/E”, cubert” *N371*1.67029 + N371*5.60636

N109 = -5307.5 + N215*11.2362 - N215*N297*0.00483257 - N297*0.089523

N297 = -7214.81+N354*7.94217-N354*N384*0.00643077 + N384*6.70011

N354 = -2654.42+N368*3.30972-N368*N388*0.00229661 + N388*2.63595

N215 = -2506.27+N333*2.99972-N333*N377*0.00216468 + N377*2.66592

N333 = 5005.13 - “”Div Yield”, cubert”*4569.66 + “”Div Yield”, cubert”*N368*4.57038 - N368*4.00976

N246 = -1953.68+N320*3.28493-N320*N396*0.00183463 + N396*1.50759

N320 = -4891.95 + N368*5.4562 - N368*N393*0.00428572 + N393*4.71346

N38 = 2367.92 - N240*3.42863 + N240*N76*0.00206307

N76 = -563.316+N126*1.08248-N126*N138*0.000482154 + N138*0.96187

N138 = 3606.29+N206*1.05241+N206*N300*0.00317216 - N300*6.82868

N300 = -5335.46+N360*5.92589-N360*N391*0.00469676 + N391*5.09902

N391 = -2615.55 + N393*3.3773 - N393*N397*0.00232178 + N397*2.55719

N360 = -2071.18 + “”P/B”, cubert”*1415.15 - “”P/B”, cubert” *N368*1.4899 + N368*3.17279

N368 = -411875 + “date, cubert”*12289.6 - “date, cubert” *””P/E”, cubert”*4838.19 + “”P/E”, cubert”*162564

N206 = -4805.77 + N366*5.25618 - N366*N389*0.0041875 + N389*4.72721

N366 = -49.4422 - “”P/B”, cubert”*N371*0.0872974 + N371*1.1687

N126 = 20276.4 - “”P/E”, cubert”*9083.99 + “”P/E”, cubert” *N261*6.81787 - N261*13.7342

N261 = -2777.44 + N363*3.2805 - N363*N384*0.0024047 + N384*2.89555

N384 = 570991 - “date, cubert”*17075.6 + “date, cubert” *N393*16.2794 - N393*543.345

N363 = 1773.61 - “”Div Yield”, cubert”*1576.19 + “”Div Yield”, cubert”*N371*1.55283 - N371*0.744588

N371 = -1444.95 + “”P/E”, cubert”*903.733 + “”Div Yield”, cubert”*184.41

N240 = -1049.18+N275*1.59674-N275*N325*0.000922571 + N325*1.37422

N325 = -509.43 + N359*2.07463 - N359*N396* 0.000559328

N396 = -3048.26 + “”P/B”, cubert”*2147.55 - “”P/B”, cubert” *N397*2.07316 + N397*3.94496

N359 = -4876.54 + “”P/E”, cubert”*2228.34 - “”P/E”, cubert”*N393*1.58587 + N393*4.30171

N275 = -4242.23+N364*4.78937-N364*N389*0.00371545 + N389*4.16119

N389 = 5480.68 - “”Div Yield”, cubert”*4780.65 + “”Div Yield”, cubert”*N393*4.63672 - N393*4.29969

N364 = -26269 + “date, cubert”*783.998 - “date, cubert”*N367*0.643381 + N367*22.5618

N143 = 9837.2 - N301*2.56414 + N301*N347*0.00863609 - N347*14.9012

N347 = -658.64+N362*1.36721-N362*N386*0.000548692 + N386*0.837536

N386 = 281956 - “date, cubert”*8435.34 + “date, cubert” *N388*8.26624 - N388*275.3

N362 = -2278.34+N367*3.22762-N367*N397*0.00203878 + N397*2.08808

N301 = -1211.4 + N352*1.76384 - N352*N377*0.001026 + N377*1.46983

N377 = -7538.19+N388*7.97672-N388*N393*0.00659564 + N393*7.14443

N393 = 460675 - “date, cubert”*13721.7 + “date, cubert” *””Div Yield”, cubert”*11354.9 - “”Div Yield”, cubert”*380370

N388 = -1.28795e+06 + "date, cubert"*38516 - "date, cubert"*""P/B", cubert"*28849.1 + ""P/B", cubert" *965453

N352 = 2668.29 - ""Div Yield", cubert"*2461.4 + ""Div Yield", cubert"*N367*2.48327 - N367*1.69793

N367 = 6028.65 - ""P/E", cubert"*1911.6 + ""P/E", cubert" *""P/B", cubert"*1902.74 - ""P/B", cubert"*4911.07

N394 = -663112 + "date, cubert"*19828.9 - "date, cubert"*N397*19.1817 + N397*642.451

N397 = -4825.71 + ""P/B", cubert"*4696.49 - ""P/B", cubert" *""Div Yield", cubert"*4001.36 + ""Div Yield", cubert"*5012.63

B. Explanation for Equation 1.1

N11 = -10.8521 + N18*1.01206 + N18*N24*0.0278767 - N18^2*0.014086 - N24^2*0.0137936

N24 = 154.257 - N516*0.402203 - N516*N36*0.00431105 + N516^2*0.0022172 + N36*1.2705 + N36^2 *0.00212071

N36 = -228.94 + N550*0.885005 - N550^2*0.000200045 + N62*0.310926 + N62^2*0.00015847

N62 = 3.782+N125*N134*0.0123691-N125^2*0.00602881 + N134*1.00236 - N134^2*0.00634166

N134 = -495.918 - N461*1.54371 - N461*N253*0.0199256 + N461^2*0.0103314 + N253*2.94625 + N253^2 *0.00951234

N253 = -249.708 + N344*1.1918 - N344*N536*0.00263511 + N344^2*0.00122595 + N536^2*0.00137236

N536 = -662.085-N556*2.37014+N556*N561*0.00705685 - N556^2*0.00277461 + N561*3.94243 - N561^2 *0.00439743

N344 = -286.366-N470*1.57305-N470*N514*0.00108685 + N470^2*0.00103894 + N514*2.80853

N125 = 597.59 - N407*5.34314 + N407*N300*0.0695153 - N407^2*0.0337281 + N300*5.86285 - N300^2 *0.0356912

N300 = -303.27 + N381*10.4826 + N381*N442*0.0596114 - N381^2*0.0318852 - N442*9.1763 - N442^2 *0.0277983

N442 = -3846.04+N550*4.07094+N550*N564*0.000177984 - N550^2*0.000822437 + N564*0.105114

N381 = -4790.38 + ""P/E", cubert"*N550*1.08064 + N550*2.84498 - N550^2*0.0010416

N516 = 2227.7 - N527*0.886294 - N527*N566*0.00306296 + N527^2*0.00198183 + N566^2*0.00147042

N566 = -2.67294e+07 - "P/B"*1.73138e+07 + "P/B"*"" P/B", cubert"*1.0065e+07 - "P/B"^2*597642 + ""P/B", cubert"*4.6466e+07 - ""P/B", cubert"^2 *1.27468e+07

N527 = -179109+"DivYield"*60058.4-"DivYield"*""P/E", cubert"*18769.8 - "Div Yield"^2*4163.98 + ""P/E", cubert"*103241 - ""P/E", cubert"^2*13882.1

N18 = 76.2105 + N31*N42*0.074655 - N31^2*0.0371643 + N42*0.941768 - N42^2*0.0374794

N42 = -23.027 + N68*N85*0.0358378 - N68^2*0.0178255 + N85*1.02289 - N85^2*0.0180174

N85 = -23.1811 + N132*4.57406 - N132*N138*0.0396183 + N132^2*0.0188412 - N138*3.56132 + N138^2 *0.0207753

N138 = -171.819+N290*1.60748-N290*N363*0.00209319 + N290^2*0.00083138 - N363*0.463516 + N363^2 *0.00123191

N363 = -230.653 - N425*N459*0.0179778 + N425^2 *0.00915836 + N459*1.17408 + N459^2 *0.00878644

N459 = 3.29447e+06-date*168.003+date*N526*0.0017953 + date^2*0.00213987 - N526*66.1331 - N526^2 *0.000535905

N526 = -212536 + "P/E"*7079.23 - "P/E"*""Div Yield", cubert"*4619.32 - "P/E"^2*47.0795 + ""Div Yield", cubert"*271141 - ""Div Yield", cubert"^2*85309.9

N425 = -1200.23+N511*2.44154+N511*N564*0.000321079 - N511^2*0.000518896 - N564* 0.455908

N511 = -315473 - date*"Div Yield"*7.94501 + date^2* 0.00020796 + "Div Yield"*316489 - "Div Yield"^2 *2985.57

N132 = -494.746 - N461*1.56444 - N461*N255*0.0200733 + N461^2*0.0104094 + N255*2.96607 + N255^2 *0.00958216

N255 = -239.65 + N346*1.18321 - N346*N531*0.00265429 + N346^2*0.00123751 + N531^2*0.00138179

N531 = -724.678-N556*2.41584+N556*N562*0.00698074 - N556^2*0.00272634 + N562*4.04101 - N562^2 *0.0043807

N556 = -1.10928e+06 + ""P/B", cubert"*773389 - ""P/B", cubert"*""Div Yield", cubert"*291020 - ""P/B", cubert"^2*132684 + ""Div Yield", cubert"*830275 - ""Div Yield", cubert"^2*155211

N346 = -281.592-N470*1.56949-N470*N513*0.00108334 + N470^2*0.00103627 + N513*2.80091

N68 = -76.7861 + N124*1.07204 + N124*N189*0.0165095 - N124^2*0.00836656 - N189^2*0.008159

N189 = 103.707+N544*0.885784-N544*N315*0.00400864 + N544^2*0.00183477 + N315^2*0.00220182

N315 = -266.106+N388*1.22226-N388*N443*0.000310819 + N443^2*0.000265092

N443 = -3855.29 + N550*4.06552 + N550*N563* 0.000172005 - N550^2*0.000818218 + N563*0.118606

N388 = 25195.2 - “”P/E”, cubert”*20694.6 + “”P/E”, cubert”*N513*1.73477+“”P/E”,cubert”^2*3672.75 - N513^2*0.000757196

N513 = -905513 - date*””Div Yield”, cubert”*33.8305 + date^2*0.000555773 + “”Div Yield”, cubert” *1.44132e+06 - “”Div Yield”, cubert”^2*57436.3

N544 = 21.0036 - N558*3.50467 + N558*N563*0.00745734 - N558^2*0.00271269 + N563*4.48035 - N563^2* 0.00473099

N563 = -68227.9 - “P/E”*1459.96 + “P/E”*””P/B”, cubert” *1066.14 + “”P/B”, cubert”*100572 - “”P/B”, cubert”^2 *36738.7

N31 = 213.65 - N463*0.451484 + N463^2*3.78817e-05 + N69*1.27026

N69 = -104.545 + N124*1.09342 + N124*N174*0.0104543 - N124^2*0.00534866 - N174^2*0.00512582

N174 = -7.66885 + N290*0.607634 + N342*0.395748

N342 = -245.08 + N416*2.40575 - N416*N461*0.0154323 + N416^2*0.00735578 - N461*1.22486 + N461^2*0.00804305

N461 = -964.698 + N525*0.265625 + N525* N550*0.000152002 + N550*1.50911 - N550^2 *0.000304078

N525 = -453446 + “”P/E”, cubert”*172414 - “”P/E”, cubert”*””Div Yield”, cubert”*82418.3 - “”P/E”, cubert”^2*14445.5 + “”Div Yield”, cubert”*403725 - “”Div Yield”, cubert”^2*84738.8

N416 = -1387.55 + N514*2.66095 + N514*N561 *0.000353483 - N514^2*0.000584192 - N561* 0.516979

N561 = -3593.52 - “P/E”*413.145 + “P/E”*”P/B”*162.262 + “P/B”*3661.09 - “P/B”^2*766.177

N514 = 5.59419e+06 - “date, cubert”*479362 - “date, cubert” *””Div Yield”, cubert”*113203 + “date, cubert”^2*9219.61 + “”Div Yield”, cubert” *3.95887e+06 - “”Div Yield”, cubert”^2*56438.8

N290 = -769.176+N382*1.63509-N382*N539*0.00255869 + N382^2*0.00108418 + N539^2*0.00134436

N539 = -126.632-N558*3.58822+N558*N562*0.00731832 - N558^2*0.00262434 + N562*4.68922 - N562^2 *0.00470672

N558 = -544966+“DivYield”*131523-“DivYield”*””P/B”, cubert”*66256.3 - “Div Yield”^2*7871.28 + “”P/B”, cubert”*544293 - “”P/B”, cubert”^2*134354

N124 = 544.043 + N407*N263*0.0419284 - N407^2 *0.0211651 + N263*0.555444 - N263^2*0.0206731

N263 = -252.3 + N382*10.9639 + N382*N444*0.0724617 - N382^2*0.0383721 - N444*9.69632 - N444^2 *0.0341543

N444 = -3770.69 + N550*4.11236 + N550*N562* 0.000223079 - N550^2*0.000854118

N562 = 12864.1 - “P/B”*2194.39 + “P/B”*””P/E”, cubert”*3395.18 - “P/B”^2*774.924 - “”P/E”, cubert” *9264.12

N382 = -4966.06+“P/E”*N550*0.0593554+N550*4.77524 - N550^2*0.00107612

N550 = 1.19782e+07 - date*233.624 - date*”date, cubert” *4.23803 + date^2*0.00730918 - “date, cubert” *24568.5 - “date, cubert”^2*6557.32

N407 = 303.201 + “P/B”*N470*1.16038 - “P/B”^2*345.084 + N470*0.73356 - N470^2*0.000912023

N470 = 1.43663e+07 + “P/E”*”date, cubert”*18.7107 - “P/E”^2*16.5963 - “date, cubert”*855927 + “date, cubert”^2*12745.2

N463 = 1.71926e+06 - date*90.8405 + date*””P/E”, cubert” *0.804783 + date^2*0.00117338 - “”P/E”, cubert”^2 *5807.13

N472 = 52.9291 - N495*0.218807 - N495 *N522 *0.000385406 + N495^2*0.000399717 + N522 *1.16216

N522 = 534.459 - N528*2.43209 + N528*N564*0.00158596 + N564*2.98721 - N564^2*0.00149491

N564 = -13245.8 - “”P/E”, cubert”*31890.4 + “”P/E”, cubert” *””P/B”, cubert”*22771.5 + “”P/B”, cubert”* 62545.1 - “”P/B”, cubert”^2*37384.6

N528 = -48426.3 + “P/E”*3307.78 - “P/E”*”Div Yield” *1052.72 - “P/E”^2*45.3674 + “Div Yield”*29659.2 - “Div Yield”^2*4191.87

N495 = -3650.89 + N538*2.72768 - N538^2*0.000413356 + N565*1.3051 - N565^2*0.000206942

N565 = -1.41756e+07 - “P/E”*2.5197e+06 + “P/E” *””P/E”, cubert”*896131 - “P/E”^2*21067.7 + “”P/E”, cubert” *1.53634e+07 - “”P/E”, cubert”^2 *2.35548e+06

N538 = 8.2866e+07 - “date, cubert”*4.87086e+06 + “date, cubert”*””P/B”, cubert”*28439 + “date, cubert”^2*71533.5 - “”P/B”, cubert”*902172 - “”P/B”, cubert”^2*17913.]