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A STUDY ON FORECASTING MODELLING ON FUTURES AND SPOT PRICES WITH SPECIAL REFERENCE TO SELECTED NSE INDICES

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Abstract

The model used Autoregressive Integrated Moving Average (ARIMA) modelling made to refine the model by using moving averages to smoothen the raw data. In addition, an effective way to account for the general market impact by incorporating the Nifty indices with further testing through the serial correlation. The data for the study consist of far month's contract futures prices and spot prices. To forecast the prices, we applied ARIMA model. This research attempts, to forecast the equity index market through the frame general equation. The ARIMA model fit the lags (p, d, q) 2 1 3 model for Futures and ARIMA (p, d, q) 2 1 2 model. The stock equity index futures were alone taken in to account, the indices which were used for analysis namely, CNX Nifty, Bank Nifty, and CNX IT. The index futures prices were obtained on the basis of the near month (1st month). The both the model result is shown the CNX Nifty Futures and Spot gets the low difference with the standard limits, the high difference registered in CNX IT Futures and Spot market. Bank Nifty Futures and Spot have registered quite low difference compared to the CNX IT Futures and Spot prices.

Key words : ARIMA, Forecasting, NSE, Indices, Futures, Spot

Introduction

Equity price forecasting is a popular and important are in financial and academic studies. Time series method is the popular and fundamental method used to perform this task. In an efficient financial market, the prices of financial assets will adjust rapidly to new information. If futures and spot markets are perfectly efficient, all available

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information should be instantaneously and completely utilized to determine the price of related securities. That is, futures prices should move concurrently with the prices of its underlying assets, and the two markets should reflect the same information simultaneously. The Forecasting of the futures and spot prices is to essential investors can confidently to take up the risk. There might be past information moves the same in present or future. In this chapter we are forecasting the futures and spot market of the indices and frame the best suitable model for the future.

Over the years, researchers have focussed on different issues in commodities market with particular emphasis on modelling in pricing, forecasting, price discovery, risk management etc. Reviewing the empirical work on commodity price, ***Hathway et al*** (1974) has found that there is a strong relationship between food prices and inflation. Hathway argued that stability in agricultural prices is desirable on production grounds and historical data show that instability is a major inhibitor to the expansion of agricultural output. Later ***Paul et al*** (1976) and ***Helmuth*** (1977) describe how storers and processors who contract forward with farmers typically hedge their commitments, by either futures trading or a forward contract with a buyer at the next level. Then risk transfer and price discovery are two of the major contribution of futures market to the organisation of economic activity that was studied by ***Evans*** (1978) and ***Silber*** (1981). Risk transfer refers to hedgers using futures contract to shift price risk to others.

Wiese&Lake (1978) studied that Price Discovery refers to the use of futures price for pricing cash market transactions. The significance of their contributions depends upon a close relationship between the prices of futures contract and cash commodities. However, futures and forward contract are not perfect substitutes, among their differences is the daily resettlement ("marking to market") features of future contracts. ***Cox, Ingersoll*** and ***Ross*** (1981) and ***Jarrow*** and ***Oldfield*** (1981) have shown that if daily interest rates are non-stochastic, then futures and forward price must be identical. More generally, futures and forward prices should be very close since their differences are due to shifts in the timing of cash flows over period of only a few months. ***Cornell*** and ***Reinganum*** (1981) and ***French*** (1983) found empirically that the differences between futures and forward prices for metals and foreign exchange were small and were not explained by models of the daily vs. terminal settlement features.

Murat and Tokat (2009) examined the relationship between crude oil and crack spread prices, where the crack spread is the difference between crude oil prices and crude oil product (heating oil and gasoline) prices. The authors use weekly WTI spot prices and weekly prices of NYMEX future contracts from January 2000 to February 2009. They apply a Johansen cointegration test and VECM approach to analyze the Granger causality relationship between the two variables and to forecast WTI oil prices. Furthermore, they apply a time-series random walk model as a benchmark and conclude that the random walk model displays the poorest forecasting accuracy, while the VECM approach works well with crack spread futures and the ECM is effective with crude oil futures.

Nomikos et al. (2011) consider the volatility forecasting ability and VaR performance of various volatility regime switching models including the MIX (distribution) GARCH and two regime MRS-GARCH models based on the mixed conditional heteroscedasticity models.

Ju-Jie Wang et.al (2012) have been examined theStock index forecasting based on a hybrid model They have made an attempt on a hybrid approach combining ESM, ARIMA, and BPNN is proposed to be the most advantageous of all three models. The weight of the proposed hybrid model (PHM) is determined by genetic algorithm (GA). The closing of the Shenzhen Integrated Index (SZII) and opening of the Dow Jones Industrial Average Index (DJIAI) are used as illustrative examples to evaluate the performances of the PHM. Numerical results show that the proposed model outperforms all traditional models, including ESM, ARIMA, BPNN, the equal weight hybrid model (EWH), and the random walk model (RWM).

Mishra, A. Singh (2013) have been studied on Forecasting Prices of Groundnut Oil in Delhi by Arima. Forecasting of prices of commodities specially those of agricultural commodities is very difficult because they are not only governed by demand and supply but by so many other factors which are beyond control like weather vagaries, storage capacity, transportation etc. In this paper times series namely ARIMA (Autoregressive Integrated Moving Average) methodology given by Box and Jenkins has been used for forecasting prices of edible oils and this approach has been compared with ANN (Artificial Neural Network).

Maarta Szymanowska et.al(2014) have examined An Anatomy of Commodity Futures Risk Premia. They identified two types of risk premia in commodity futures returns: spot premia related to the risk in the underlying commodity, and term premia related to changes in the basis. Sorting on forecasting variables such as the futures basis, return momentum, volatility, inflation, hedging pressure, and liquidity results in sizable spot premia between 5% and 14% per annum and term premia between 1% and 3% per annum. We show that a single factor, the high-minus-low portfolio from basis sorts, explains the cross-section of spot

The study is based on both primary and secondary data. Predominantly is used secondary data. The secondary data were drawn from the official website of NSE, India (www.nseindia.com). The stock equity index futures alone were taken in to account, and the indices which were used for analysis namely, CNX Nifty, Bank Nifty, and CNX IT. The index futures prices were obtained on the basis of the near month (1st month). The data used for this exercise, spanned over the period April 1, 2001 to March 31, 2015. During the sample period, all the required information for the stock futures contracts trade on the National Stock Exchange (NSE) and contract specifications and trading details were retrieved from their website. Usually three types of contracts are traded simultaneously in the futures markets (i.e.) near month, middle month and far month futures contracts. Near month futures contracts are considered for the analysis, because most trading activities take place in the near month contracts than on the other two types of contracts.

Period of Study

The index futures prices were obtained on the basis of the near month (1st month). The study period is from April1, 2001- March 31, 2015. Historical data on CNX Nifty was available from 2001, whereas Nifty IT and Bank Nifty data was available only for 2003 and 2005 respectively.

A non-seasonal ARIMA model is classified as an "ARIMA(p,d,q)" model, where:

- **p** is the number of autoregressive terms,
- **d** is the number of non-seasonal differences, and
- **q** is the number of lagged forecast errors in the prediction equation.

ARIMA(0,2,1) or (0,2,2) without constant = linear exponential smoothing:
Linear exponential smoothing models are ARIMA models which use two non-seasonal differences in conjunction with MA terms. The second difference of a series Y is not simply the difference between Y and itself lagged by two periods, but rather it is the *first difference of the first difference*--i.e., the change-in-the-change of Y at period t. Thus, **the second difference of Y at period t is equal to (Y(t)-Y(t-1)) - (Y(t-1)-Y(t-2)) = Y(t) - 2Y(t-1) + Y(t-2)**. A second difference of a discrete function is analogous to a second derivative of a continuous function: it measures the "acceleration" or "curvature" in the function at a given point in time.

The ARIMA(0,2,2) model without constant predicts that the second difference of the series equals a linear function of the last two forecast errors:

$$\hat{Y}(t) - 2Y(t-1) + Y(t-2) = -\theta_1 e(t-1) - \theta_2 e(t-2)$$

which can be rearranged as: where theta-1 and theta-2 are the MA(1) and MA(2) coefficients. This is essentially the same as Brown's linear exponential smoothing model, with the MA(1) coefficient corresponding to the quantity 2*(1-alpha) in the LES model. To see this connection, recall that forecasting equation for the LES model is:
Upon comparing terms, we see that the MA(1) coefficient corresponds to the quantity 2*(1-alpha) and the MA(2) coefficient corresponds to the quantity -(1-alpha)^2 (i.e., "minus (1-alpha) squared"). If alpha is larger than 0.7, the corresponding MA(2) term would be less than 0.09, which might not be significantly different from zero, in which case an ARIMA(0,2,1) model probably would be identified.
ARIMA models which include MA terms are similar to regression models, but can't be fitted by ordinary least squares:
Forecasts are a linear function of past data, but they are *nonlinear* functions of coefficients--e.g., an ARIMA(0,1,1) model without constant is an exponentially weighted moving average:
in which the forecasts are a non-linear function of the MA(1) parameter ("theta").

Then the p-order auto regressive equation can be written in terms of deviations from the mean as:

$$\hat{Y}(t) = (1-\theta)[Y(t-1) + \theta Y(t-2) + \theta^2 Y(t-3) + \ldots]$$

$$\hat{Y}(t) - \mathrm{m} = \phi_1(y(t-1)-m) + \phi_2(y(t-2)-m) + \ldots + \phi_p(y(t-p)-m)$$

$$\mu = m(-\phi_1 - \phi_{2-\ldots}\phi_p$$

By collecting all the constant terms in this equation, we see it is equivalent to the "mu" form of the equation if:

Auto Correlation Function (ACF)and Partial Auto Correlation Function (PACF) – hypothesis is as follows:
Null hypothesis: Data not follows the periodicity
Alternate hypothesis: Data follows the periodicity
Q-Statistics (LJung Box Test) hypothesis is as follows:
Null hypothesis: Data are random
Alternate hypothesis: Data are not random

Results and Discussions

Test Results of Auto Correlation (ACF), Partial Auto Correlation Function (PACF) and Q-Statistics

Auto Correlation function exhibits the periodicity, in other words the past information leads the present or future. Since the majority of the data does not have impact of the past, LJung Box (Q-Statistics) test to check the randomness of data. It was tested through the joint hypothesis. Auto Correlation coefficient was tested through the 36 lags; more than 70 per cent lags were insignificant in both Futures and Spot prices of the indices. So it could be concluded that the data does not follow periodicity. Q- Statistics results of the indices were also show the joint hypothesis value restricted within the table value. Here we can conclude that data were random. This result has shown the data in majority has been not affected by the past information; it satisfies that the data could be used to examine forecasting model.

ARIMA – (p,d,q – Model) Results on Futures and Spot Prices

The various p,d,q model lags have been tested and to frame the first difference of all the data series are incorporated into alternate ARIMA models. The maximum likelihood estimation method was used for calculating parameters estimates. Two alternate criteria –Akaike Information Criterion (AIC) and SBC (Schwartz Bayesian Criterion) are used to select best model. The ACFs in corellogram indicates the tentative lag size for ARIMA model. The lowest AIC and BIC has been used to frame the ARIMA model. CNX Nifty Futures and Spot has got low AIC and BIC in the lags 2 1 3, the Nifty IT Futures and Spot has the low AIC and BIC in the lags 2 1 2. The Bank Nifty Futures has low AIC and BIC in lags 2 1 3 and Bank Spot has the low AIC and BIC in 2 1 1 p d q lags.

Conclusion

We decided to test our models by choosing three indices futures and spot prices based on our variables.The model forecasting has been through the ARIMA, after confirms the serial correlation and randomness of the data. The entire framed model is lies within the error limits. We can conclude that framed is suitable for future forecasting.Our forecasting models will be useful for individual investors and professional looking for a suitable future returns who have no access to detailed information about the performance of the companies behind performance of indices.Further researches can be done with possible improvements such as more refined search data and more accurate algorithm to compute news values.

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Figure -1

CNX Nifty Futures Closing Values

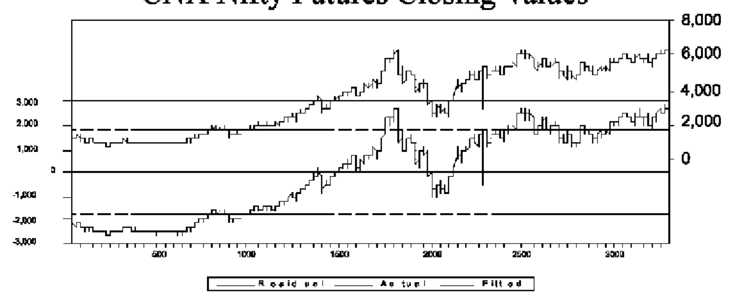

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Figure -2
CNX Nifty Spot Closing Values

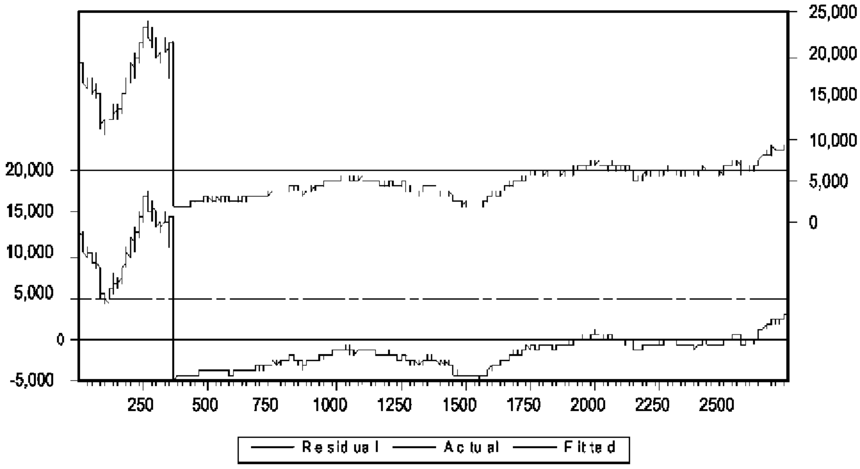

Figure -3
CNX IT Futures Closing Values

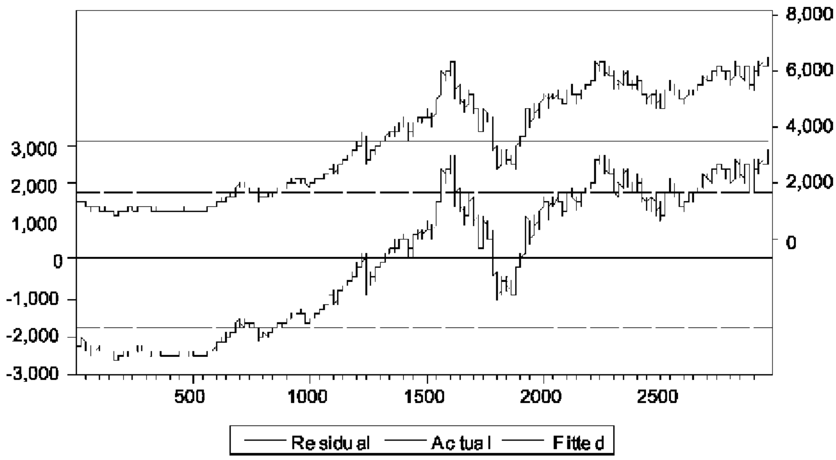

Figure – 4
CNX IT Futures Spot Values

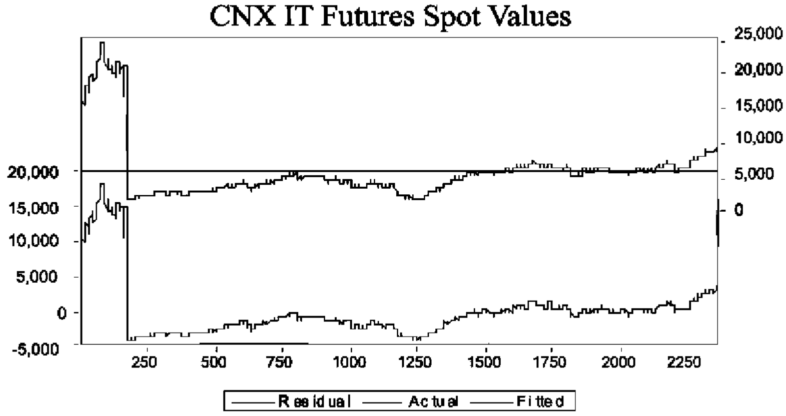

Figure - 5
Bank Nifty Futures Spot Values

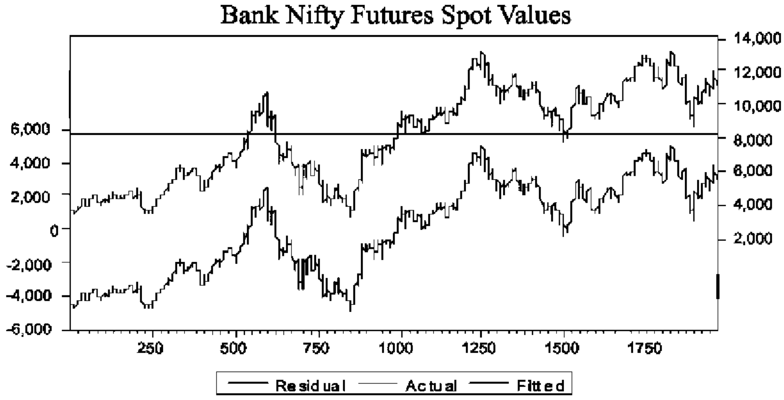

Figure – 6
Bank Nifty Spot Prices

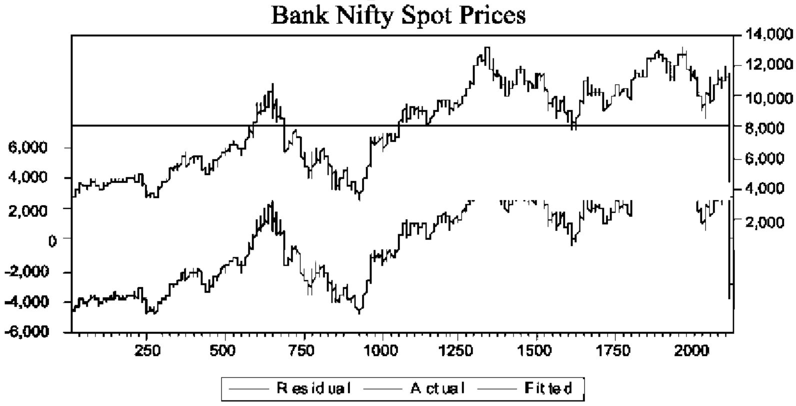

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Table – 1
ARIMA – (p,d,q – Model) Results on Futures and Spot Prices

ARIMA (p, d, q)	AIC (Akaike Information Criterion)	SBC (Schwartz Bayesian Criterion)
CNX Nifty – Futures		
2, 1, 0	24522.51	24539.59
2, 1, 1	24524.17	24546.95
2 , 1, 2	24510.13	24538.59
2 , 1, 3	**24483.12**	**24517.28**
CNX Nifty – Spot		
2, 1, 0	24031.21	24048.29
2, 1, 1	24030.85	24053.63
2 , 1, 2	24011.59	24040.05
2 , 1, 3	**24000.95**	**24037.11**
CNX IT – Futures		
2, 1, 0	32996.30	33013.38
2, 1, 1	32986.23	33009.01
2 , 1, 2	**32972.27**	**33002.73**
2 , 1, 3	32973.58	33007.73
CNX IT – Spot		
2, 1, 0	32964.44	32981.52
2, 1, 1	32956.46	32979.23
2 , 1, 2	**32946.93**	**32975.40**
2 , 1, 3	32947.17	32980.33
Bank Nifty – Futures		
2, 1, 0	28898.44	28915.22
2, 1, 1	28898.52	28921.29
2 , 1, 2	28896.91	28925.38
2 , 1, 3	**28893.98**	**28913.14**
Bank Nifty – Spot		
2, 1, 0	28788.65	28809.92
2, 1, 1	**28787.00**	**28809.77**
2 , 1, 2	28788.95	28817.41
2 , 1, 3	28791.07	28825.23

Table - 2
Test Results of Auto Correlation (ACF), Partial Auto Correlation Function (PACF) and Q-Statistics on CNX Nifty Futures and CNX Nifty SpotNote: ***

	CNX Nifty Futures				CNX Nifty Spot			
Lag	ACF	PACF	Q-Statistics	Prob.	ACF	PACF	Q-Statistics	Prob.
1	0.008	0.008	0.1693	0.681	0.042**	0.042**	5.694	0.017
2	-0.011	-0.012	0.5607	0.756	-0.247***	-0.249***	23.515	0.718
3	-0.009	-0.009	0.7853	0.853	-0.008	0.016	23.726	0.683
4	-0.008	-0.008	0.9995	0.910	0.001	-0.065***	23.747	0.922
5	0.003	0.003	1.0235	0.961	-0.018	-0.014	24.852	0.222
6	-0.052***	-0.052***	9.0361	0.172	-0.027	-0.044**	27.138	0.055
7	0.047**	0.048***	15.557	0.029	0.027	0.023	29.427	0.187
8	0.027	0.025	17.803	0.023	0.035**	0.016	23.413	0.054
9	0.032*	0.032*	20.820	0.013	0.008	0.018	23.625	0.187
10	0.003	0.003	20.848	0.022	0.008	0.019	23.878	0.045
11	-0.006	-0.004	20.949	0.034	-0.008	-0.002	24.088	0.281
12	0.009	0.007	21.177	0.048	-0.004	0.006	24.172	0.188
13	0.037**	0.043**	25.329	0.021	0.007	0.008	24.268	0.487
14	0.002	0.001	25.336	0.031	0.021	0.025	25.750	0.351
15	-0.009	-0.007	25.566	0.043	0.008	0.009	25.941	0.214
16	-0.002	-0.004	25.576	0.060	-0.014	-0.004	26.521	0.322
17	0.006	0.004	25.692	0.080	0.022	0.028	28.015	0.225
18	-0.019	-0.020	26.795	0.083	0.017	0.012	29.051	0.115
19	-0.016	-0.012	27.539	0.093	-0.007	0.006	29.175	0.122
20	-0.034*	-0.038**	30.965	0.056	-0.039**	-0.035**	34.273*	0.032
21	0.030*	0.027	33.725	0.039	-0.001	0.003	34.273	0.067
22	0.003	-0.001	33.751	0.052	0.002	-0.019	34.285	0.479
23	0.008	0.009	33.937	0.066	-0.024	-0.023	36.077	0.048
24	0.021	0.019	35.230	0.065	0.044**	0.041**	37.299**	0.011
25	-0.001	-0.001	35.236	0.084	0.017	-0.003	37.284	0.222
26	0.003	0.000	35.581	0.100	-0.007	0.012	37.577	0.114
27	-0.042**	-0.033**	40.779	0.043	0.013	0.016	38.141	0.414
28	-0.004	-0.002	40.821	0.056	-0.007	-0.004	38.238	0.042
29	0.018	0.018	41.743	0.059	-0.009	0.001	38.525	0.046
30	0.001	-0.000	41.747	0.075	-0.010	-0.009	39.819	0.058
31	-0.012	-0.014	42.195	0.087	-0.004	-0.006	42.915	0.089
32	-0.014	-0.013	42.799	0.096	-0.008	-0.017	45.146	0.010
33	-0.008	-0.011	42.983	0.114	-0.018	-0.020	46.250	0.105
34	-0.003	-0.003	43.003	0.138	0.014	0.007	47.822	0.121
35	-0.001	0.001	43.009	0.166	-0.002	-0.015	48.844	0.175
36	0.056***	0.057***	52.557	0.037	-0.007	-0.002	54.010	0.023

Note: *** indicates the value significant at 1% level, ** indicates the value significant at 5% level, * indicates the 10% level.

Table-3
Test Results of Auto Correlation (ACF), Partial Auto Correlation Function (PACF) and Q-Statistics on CNX IT Futures and CNX IT Spot

	CNX IT Futures				CNX ITSpot			
Lag	ACF	PACF	Q-Statistics	Prob.	ACF	PACF	Q-Statistics	Prob.
1	-0.008	-0.008	0.1483	0.700	-0.002	-0.002	0.0147	0.904
2	0.007	0.007	0.2598	0.878	0.006	0.006	0.1216	0.941
3	-0.011	-0.011	0.5539	0.907	-0.009	-0.009	0.3234	0.956
4	-0.026	-0.026	2.3317	0.675	-0.029	-0.029	2.5008	0.644
5	0.002	0.001	2.3384	0.801	0.006	0.006	2.5802	0.764
6	0.006	0.007	2.4432	0.875	0.002	0.003	2.5926	0.858
7	-0.006	-0.006	2.5225	0.925	-0.004	-0.005	2.6449	0.916
8	-0.044**	-0.04**	7.5600	0.478	-0.035*	-0.036*	5.8103	0.668
9	0.072***	0.07***	21.200	0.012	0.063***	0.063***	15.956	0.068
10	0.001	0.002	21.201	0.020	0.001	0.002	15.960	0.101
11	-0.009	-0.011	21.391	0.030	-0.008	-0.010	16.139	0.136
12	-0.004	-0.005	21.428	0.044	-0.003	-0.004	16.163	0.184
13	0.010	0.014	21.678	0.061	0.009	0.013	16.362	0.230
14	0.001	0.001	21.681	0.085	-0.000	-0.001	16.362	0.292
15	0.009	0.006	21.879	0.111	0.010	0.008	16.603	0.343
16	0.004	0.003	21.923	0.146	0.005	0.004	16.663	0.408
17	-0.007	-0.000	22.063	0.182	-0.006	-0.001	16.762	0.471
18	-0.015	-0.020	22.659	0.204	-0.016	-0.020	17.391	0.496
19	0.007	0.006	22.776	0.247	0.002	0.002	17.401	0.563
20	-0.002	0.000	22.782	0.300	-0.002	-0.000	17.410	0.626
21	0.003	0.004	22.802	0.355	0.002	0.002	17.418	0.685
22	0.020	0.018	23.855	0.355	0.021	0.018	18.535	0.674
23	0.013	0.014	24.309	0.387	0.013	0.014	18.965	0.703
24	-0.001	-0.001	24.310	0.444	0.001	-0.000	18.966	0.754
25	-0.003	-0.004	24.333	0.500	-0.001	-0.002	18.971	0.798
26	-0.009	-0.009	24.542	0.545	-0.008	-0.008	19.147	0.830
27	0.002	0.006	24.552	0.600	0.000	0.003	19.147	0.865
28	-0.004	-0.005	24.593	0.650	-0.002	-0.003	19.159	0.893
29	-0.006	-0.007	24.689	0.694	-0.007	-0.007	19.293	0.914
30	0.001	0.002	24.689	0.740	0.003	0.003	19.309	0.933
31	-0.019	-0.020	25.652	0.738	-0.021	-0.022	20.479	0.925
32	0.004	0.001	25.686	0.777	0.004	0.002	20.514	0.942
33	-0.005	-0.004	25.740	0.812	-0.004	-0.004	20.563	0.955
34	-0.004	-0.004	25.781	0.843	-0.005	-0.005	20.628	0.965
35	-0.004	-0.004	25.828	0.870	-0.003	-0.003	20.648	0.974
36	-0.005	-0.007	25.896	0.893	-0.006	-0.006	20.729	0.980

Note: *** indicates the value significant at 1% level, ** indicates the value significant at 5% level, * indicates the 10% level.

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Table - 4

Test Results of Auto Correlation (ACF), Partial Auto Correlation Function (PACF) and Q-Statistics on Bank Nifty Futures and Bank Nifty Spot

	Bank Nifty Futures				Bank NiftySpot			
Lag	ACF	PACF	Q-Statistics	Prob.	ACF	PACF	Q-Statistics	Prob.
1	0.104***	0.104***	23.841	0.000	0.127***	0.127***	35.531	0.000
2	0.003	-0.008	23.854	0.000	-0.006	-0.022	35.602	0.000
3	-0.009	-0.008	24.029	0.000	-0.004	-0.000	35.637	0.000
4	-0.036*	-0.035	26.926	0.000	-0.040*	-0.040*	39.141	0.000
5	-0.053**	-0.046**	33.025	0.000	-0.055**	-0.046**	45.781	0.000
6	-0.052**	-0.043**	38.962	0.000	-0.054**	-0.044**	52.300	0.000
7	0.022	0.031	39.987	0.000	0.025	0.037*	53.705	0.000
8	0.053**	0.047**	46.246	0.000	0.051**	0.041*	59.343	0.000
9	0.008	-0.005	46.399	0.000	0.019	0.005	60.125	0.000
10	0.028	0.024	48.158	0.000	0.023	0.015	61.252	0.000
11	-0.009	-0.017	48.341	0.000	-0.007	-0.014	61.360	0.000
12	0.034	0.041*	50.891	0.000	0.030	0.038*	63.353	0.000
13	0.008	0.008	51.024	0.000	0.016	0.016	63.943	0.000
14	0.020	0.025	51.888	0.000	0.020	0.024	64.842	0.000
15	0.028	0.023	53.609	0.000	0.027	0.021	66.410	0.000
16	-0.018	-0.022	54.293	0.000	-0.014	-0.020	66.842	0.000
17	-0.007	-0.001	54.392	0.000	-0.007	-0.001	66.936	0.000
18	-0.026	-0.022	55.851	0.000	-0.030	-0.025	68.868	0.000
19	-0.043**	-0.035	59.974	0.000	-0.046**	-0.036*	73.549	0.000
20	0.005	0.012	60.036	0.000	0.005	0.014	73.596	0.000
21	0.011	0.009	60.314	0.000	0.009	0.004	73.773	0.000
22	-0.002	-0.013	60.319	0.000	-0.009	-0.020	73.970	0.000
23	0.008	0.003	60.449	0.000	0.015	0.013	74.500	0.000
24	0.025	0.020	61.888	0.000	0.022	0.012	75.572	0.000
25	-0.019	-0.026	62.667	0.000	-0.015	-0.021	76.057	0.000
26	0.032	0.044**	64.936	0.000	0.029	0.041*	77.965	0.000
27	0.010	0.004	65.158	0.000	0.011	0.003	78.219	0.000
28	0.000	0.000	65.158	0.000	0.005	0.006	78.270	0.000
29	0.035	0.038*	67.873	0.000	0.034	0.037*	80.860	0.000
30	0.008	0.004	68.021	0.000	0.006	-0.000	80.928	0.000
31	-0.019	-0.017	68.836	0.000	-0.013	-0.009	81.307	0.000
32	-0.034	-0.027	71.455	0.000	-0.038*	-0.031	84.526	0.000
33	-0.006	0.005	71.523	0.000	-0.005	0.008	84.573	0.000
34	0.008	0.008	71.677	0.000	0.009	0.010	84.749	0.000
35	-0.027	-0.028	73.272	0.000	-0.020	-0.023	85.643	0.000
36	0.050	0.048**	78.946	0.000	0.041*	0.038*	89.315	0.000

Note: *** indicates the value significant at 1% level, ** indicates the value significant at 5% level, * indicates the 10% level.

Table - 5
Estimated Model Variables in the Model for CNX Nifty Futures Price (2 1 3)

	Co-efficient	Std.Errors	T-Ratio	Approx.Prob
AR1	1.28230	0.00354	361.506	0.00000
AR2	-0.99421	0.00354	-280.728	0.00000
MA1	1.27844	0.01871	68.327	0.00000
MA2	-0.99769	0.02358	-42.300	0.00000
MA3	0.00735	0.01847	0.3978	0.69075

Using these values the model estimated is

$$Y_t = 1.28230Y_{t-1} - 0.99421\ Y_{t-1} + 1.27844\varepsilon_{t-1} - 0.99769\varepsilon_{t-2} + 0.00735\ \varepsilon_{t-3}$$

Table 6
Estimated Model Variables in the Model for CNX Nifty Spot Prices (2 1 3)

	Co-efficient	Std.Errors	T-Ratio	Approx.Prob
AR1	0.22511	1.31494	0.17120	0.86408
AR2	0.03651	0.17120	0.21330	0.83111
MA1	0.18946	1.31499	0.14408	0.88545
MA2	0.31144	0.12652	2.46156	0.01389
MA3	-0.03184	0.36202	-0.08797	0.92991

Using these values the model estimated is

$$Y_t = 0.22511Y_{t-1} + 0.03651\ Y_{t-2} + 0.18946\varepsilon_{t-1} + 0.31144\varepsilon_{t-2} - 0.03184\ \varepsilon_{t-3}$$

Table 7
Estimated Model Variables in the Model for CNX IT Futures Prices (2 1 2)

	Co-efficient	Std.Errors	T-Ratio	Approx.Prob
AR1	-0.44530	0.03931	11.32800	0.00000
AR2	-0.88331	0.03694	23.90588	0.00000
MA1	-0.40865	0.03508	11.64845	0.00000
MA2	-0.90938	0.03232	28.13550	0.00000

Using these values the model estimated is

$$Y_t = -0.44530Y_{t-1} - 0.88331\ Y_{t-2} - 0.40865\varepsilon_{t-1} - 0.90938\varepsilon_{t-2}$$

Table - 8
Estimated Model Variables in the Model for CNX IT Spot Prices (2 1 2)

	Co-efficient	Std.Errors	T-Ratio	Approx.Prob
AR1	-0.42570	0.04823	8.82489	0.00000
AR2	-0.86969	0.04541	19.15139	0.00000
MA1	-0.39455	0.04316	9.13999	0.00000
MA2	-0.89849	0.03986	22.54128	0.00000

Using these values the model estimated is

$$Y_t = -0.42570Y_{t-1} - 0.86969\, Y_{t-2} - 0.39455\varepsilon_{t-1} - 0.89849\varepsilon_{t-2}$$

Table - 9
Estimated Model Variables in the Model for Bank Nifty Future Prices (2 1 3)

	Co-efficient	Std.Errors	T-Ratio	Approx.Prob
AR1	1.06923	0.07366	14.51447	0.00000
AR2	-0.88071	0.07004	-12.57330	0.00000
MA1	0.96436	0.07714	12.50036	0.00000
MA2	-0.80036	0.06385	-12.53387	0.00000
MA3	-0.06060	0.02651	-2.28538	0.02239

Table - 10
Estimated Model Variables in the Model for Bank Nifty Spot Prices (2 1)

	Co-efficient	Std.Errors	T-Ratio	Approx.Prob
AR1	0.77266	0.27083	2.85286	0.00437
AR2	-0.11547	0.03155	-3.65931	0.00026
MA1	0.64485	0.27188	2.37174	0.01779

Using these values the model estimated is

$$Y_t = 0.77266Y_{t-1} - 0.11547\, Y_{t-2} + 0.64485\varepsilon_{t-1}$$