Chapter 4

Forecasting of Agriculture Price Data

We now apply Auto-regressive Moving Average (ARMA) and Artificial Neural Network (ANN) to forecast agriculture data. The data for Sugar, Castorseed, Chana, Coriander, Cotton, Guarseed, Rmseed, Turmeric, Jeera, Soyabean is collected from 14 May 2013 to 14 March 2014.
The next 10 days price are forecasted by using ARMA model. The order of each ARMA (p,q) model is decided from the values of ACF and PACF.

4.1 Autoregressive Moving average model(ARMA)

Autoregressive moving average (ARMA) model provide a parsimonious description of a stationary stochastic process in terms of two polynomials, one for the auto-regression and the second for the moving average. For a given time series$r_1, r_2, \ldots$ an ARMA(p,q) model is defined as [Tsay(2009)]

$$r_t = \phi_0 + \phi_1 r_{t-1} + \phi_2 r_{t-2} + \cdots + \phi_p r_{t-p} + \theta_1 a_{t-1} + \theta_2 a_{t-2} + \cdots + \theta_q a_{t-q} + e_t,$$

where, ϕ_0 is constant, $\phi_1, \phi_2, \phi_3, ...$ are AR parameters and $\theta_1, \theta_2, \theta_3...$ are MA parameters. Random noise, represented by a_{t-j} (j= 1, 2,. . ., q) are assumed to be white noise process with constant variance and zero mean, e_t is random error.

Identification of Model After stationarizing time series by differencing, next step is to determine whether AR or MA are needed to correct any autocorelation that remains in series.
It can be judged with the help of ACF and PACF. By looking at ACF and PACF of time series we can find numbers of AR and MA terms that are needed.

Auto-correlation function (ACF) Auto Corelation is amount of corelation between variable and lags itself that is not explained by corelation at all lower order lags. ACF plot is bar chart of coefficient of correlation between time series and lags of itself.

Partial Auto-correlation function (PACF) PACF plot is bar chart of partial autocorrelation coefficient between series and lags of itself.

Identifying AR Process

If PACF displays a sharp cut off while ACF decays more slowly. Number at which PACF cuts off is indicated number of AR terms.

Identifying MA Process

If ACF of differenced series displays a sharp cut off and/or the lag-l auto corelation is negative then MA should be added. Lag at which ACF cuts off is indicated number of MA terms.

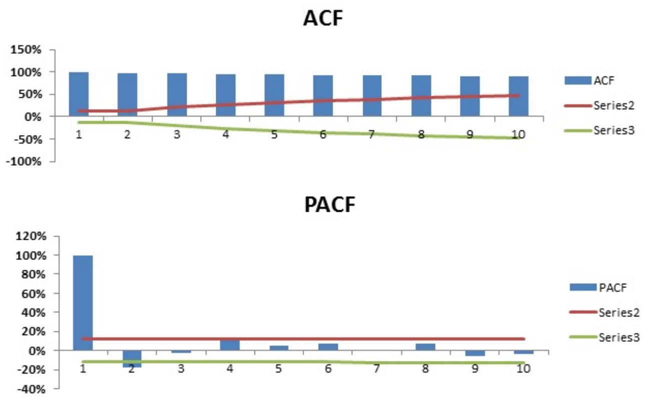


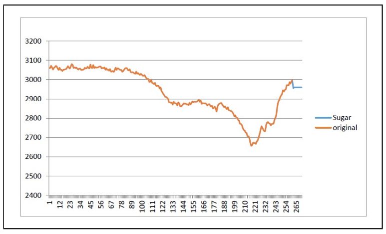
Figure 4.1: ACF and PACF plot for coriander data

As we have seen in Figure 4.1, ARMA (1,1) should be applied for coriander data. AR order, decided by PACF plot, has first and maximum cut off at lag 1 so it's order is one and MA order, decided by ACF plot, has first cut off at lag 1 so MA order should also be one. In the same way we will find out ARMA (p,q) order for different grains.

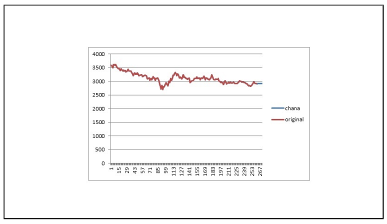
4.2 Forecasting by Using ARMA

We have considered agriculture grain data for forecasting. The data for Sugar, Castorseed, Chana, Coriander, Cotton, Guarseed, Rmseed, Turmeric,Jeera, Soyabean is collected from 14 may 2013 to 14 March 2014. We apply ARMA model to find out next 10 forecasted values of grains.

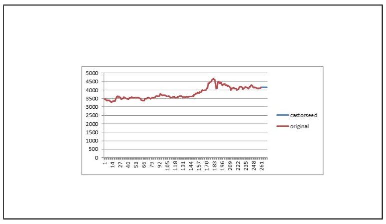
Order (p,q) is decided by ACF and PACF plot. After that by applying appropriate ARMA (p,q) model we find out different parameters to predict next value. Plots for forecasted grain data are given below. Original data is shown by red line and next 10 forecasted value is shown by blue line in the plots.



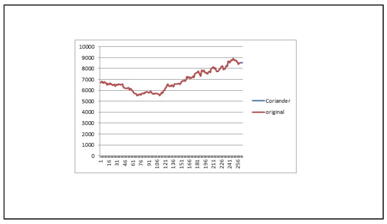
(a) Forecasted value of sugar data



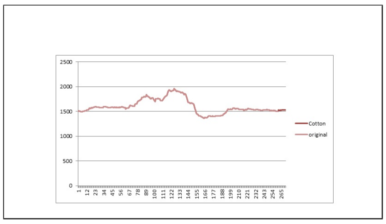
(b) Forecasted value of chana data



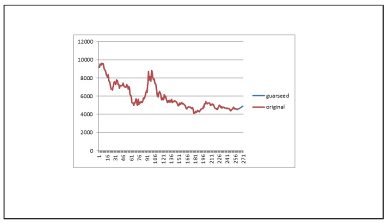
(c) Forecasted value of castorseed data



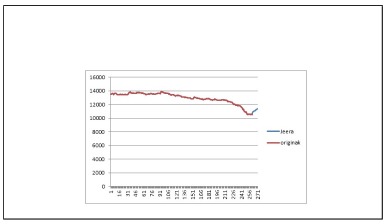
(d) Forecasted value of coriander data



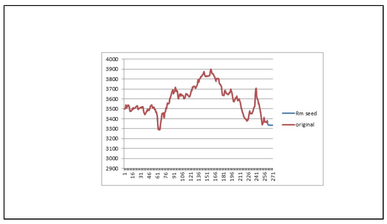
(e) Forecasted value of cotton data



(f) Forecasted value of guarseed data

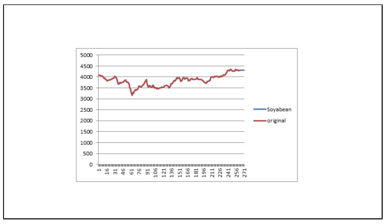


(g) Forecasted value of jeera data

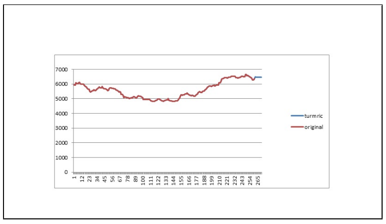


(h) Forecasted value of rmseed data

Mean Squre Error and percentage fit by ARMA are given in table 4.1.



(i) Forecasted value of soyabean data



(j) Forecasted value of turmric data

Grain	MSE	% Fit data
Cotton	230.2	89.42
Jeera	3156	92.96
Rm seed	437.9	85.4
Soyabean	1256	85.6
Coriander	7138	91.08
Sugar	91.09	91.96
Castorseed	2314	86.5
Chana	1608	78.8
Guarseed	4980	92.75
Turmeric	1756	92.42

Table 4.1: MSE and percentage fit by using ARMA

4.3 Forecasting by using ANN

We now apply neural network back propagation algorithm to forecast future values for all ten data sets. The details of the algorithm are given in Chapter 3. We calculate the corresponding Mean Square Errors and coefficient of determination. The values are given in table 4.2,

Grain	MSE	% R value
Cotton	201	0.9960
Jeera	2769.2	0.9976
Rm seed	436.99	0.9879
Soyabean	1129.3	0.9898
Coriander	6003	0.9967
Sugar	80.74	0.9970
Castorseed	1843.8	0.9924
Chana	1655.3	0.9785
Guarseed	5766	0.9862
Turmeric	1653	0.9972

Table 4.2: MSE and coefficient of determination by using ANN