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Onion price forecasting in Hubli market of Northern Karnataka using ARIMA technique

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Abstract: The present study is an attempt to forecast the prices of onion at Hubli market of Northern Karnataka, as the arrivals of Onion were found to be maximum in this market. The time series data on monthly price of onion required for the study was collected from the registers maintained in the Hubli APMC from year 1996-97 to 2010-11. The ARIMA model forecasted prices revealed an increase in the prices of onion in the future years and also demand for onion. Hence, farmers need to plan the production process in such a way that good price for the produce could be expected. ARIMA model is an extrapolation method that requires only historical time series data on the variable under study. The Box-Jenkins model provides a verified approach for identifying and filtering most appropriate variations for the series being analyzed, for diagnosing the accuracy and the reliability of the models that have been estimated and lastly, for forecasting the price.

Keywords: Akike Information Coefficient, Auto-Correlation Function, Swarz Information Coefficient

Introduction

Auto Regressive Integrated Moving Average (ARIMA) models are extensively used to study market fluctuations particularly of agricultural commodities. The main advantage of this class of models lies in its ability to quantify random variations present in any economic time series. Hence the data on prices of onion in the selected markets were subjected to ARIMA analysis to quantify the variation and also to predict the future prices of onion.

Since ARIMA model used only stationary series, there was also a need to change the non-stationary series into stationary series by applying appropriate order of differencing to the series. Thereafter, the autocorrelation and partial autocorrelation coefficients of the working series were computed and confirmed the absence of trend component in the series. An examination of such tables revealed that this is justified by the autocorrelation function of the series dropping to zero after second or third lag. The present study is an attempt to study the forecasting of prices of onion at Hubli taluk of Dharwad district.

Material and methods

The Hubli regulated market is one of the most important and terminal markets in North Karnataka. The Hubli market was chosen for the present study as it is one of the largest markets for arrivals of onion in North Karnataka. The time series data on monthly price of onion required for the study was collected from the registers maintained in the Hubli APMC from the year 1996-97 to 2010-11. This market maintains data on daily, monthly and yearly prices of agricultural commodities. The data on prices refers to modal prices in a month. Modal price was considered superior to the monthly average price as it represented the major proportion of the commodity marketed during the month in a particular market.

A mixed Auto Regressive Integrated Moving Average model developed by Box and Jenkins (1976) was employed for analysis of the data, which involved selection of appropriate model, estimation of parameters, diagnostic checking and finally forecasting the prices.

Results and discussion

Identification of the model was concerned with deciding the appropriate values of (p,d,q) (P,D,Q). It was done by observing Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) values. The Auto Correlation Function helps in choosing the appropriate values for ordering of moving average terms (MA) and Partial Auto-Correlation Function for those autoregressive terms (AR). The number of non-zero coefficients in ACF determines order of MA terms and the number of non-zero coefficients in PACF plots determines order of AR terms. Based on the Akike Information Coefficient and Swarz Baysian Criteria, the model (1,1,1) (2,1,1) was found to fit the series suitably. The results of these coefficients are given in Table 1.

ARIMA model was estimated after transforming the variables under study into stationary series through computation of either seasonal or non-seasonal or both, order of differencing. The attainment of stationary series could be through computation of auto-correlation and partial auto-correlation functions which are provided in the Table 2. A careful examination of ACF and PACF upto 36 lags revealed the presence of seasonality in the data. However, the series was found to be stationary, since the coefficient dropped to zero after the second lag. Each individual coefficient of ACF and PACF were tested for their significance using 't' test. Further, the absence of peak at first values clearly indicated suitability of the choice of non-seasonal difference d=1 to

Table1. Residual analysis of monthly prices of onion in Hubli market

Model	Akike Information Coefficient	Swarz Baysian Criteria Criteria
(1,1,1) (2,1,1)	2183.901	2196.373

Table 2. Auto correlation function and partial auto correlation function of onion prices in Hubli market

Lags	Prices		
	ACF	Standard error	PACF
1	-0.069	0.077	0.069
2	-0.050	0.076	-0.056
3	-0.201	0.076	-0.195
4	0.070	0.076	0.099
5	0.091	0.076	0.064
6	0.027	0.076	-0.019
7	0.022	0.075	0.063
8	0.032	0.075	-0.014
9	0.086	0.075	0.085
10	0.057	0.075	0.057
11	0.021	0.074	0.001
12	-0.049	0.074	-0.016
13	-0.024	0.074	-0.008
14	-0.016	0.074	-0.037
15	-0.043	0.073	-0.067
16	-0.035	0.073	-0.043
17	-0.002	0.073	-0.005
18	-0.028	0.073	-0.056
19	-0.014	0.072	0.018
20	-0.055	0.072	-0.049
21	-0.034	0.072	-0.034
22	-0.040	0.072	-0.028
23	-0.033	0.071	-0.038
24	-0.030	0.071	-0.021
25	-0.014	0.071	0.002
26	0.025	0.071	0.028
27	-0.014	0.07	-0.010
28	-0.030	0.07	-0.017
29	-0.016	0.07	0.015
30	-0.004	0.07	-0.007
31	0.001	0.069	-0.004
32	-0.003	0.069	0.005
33	0.002	0.069	0.000
34	0.000	0.069	-0.002
35	0.094	0.068	0.091
36	-0.022	0.068	-0.052

ACF- Auto Correlation Function, PACF- Partial Auto Correlation Function, The standard error at each lag for PACF - 0.077

accomplish stationary series. Hence based on ACF and PACF many models were tested. Finally model (1,1,1) (2,1,1) was identified as the best model for forecasting of prices of onion in Hubli market.

Having tentatively identified the model, next the parameters which minimize the sum of squares of error were estimated through iteration process. The parameters of the tentatively identified model were estimated and are presented in the Table 3. The standard error values of MA1.1 was significant and the other values were non-significant. Here the standard error of seasonal and non-seasonal autoregressive both at first lag and second lag were non-significant, whereas the standard error of moving average were

Table 3. Conditional least square estimate of onion prices in Hubli market

Parameter	Prices			
	Estimate	Standard Error	t value	P value
MA1.1	0.665	0.098	6.811	0.000
AR1.1	0.223	0.128	1.748	0.082
MA2.1	0.996	1.548	0.643	0.521
AR2.1	0.015	0.090	0.171	0.864
AR2.2	0.073	0.086	0.846	0.399

MA – Moving average, AR – Auto-regressive

statistically significant. The estimated models were then subjected to diagnostic checking to validate the adequacy of the estimated model prior to carrying out forecasting.

The residual of estimated models were examined for testing the randomness of series and analyzed to determine the adequacy. Model verification is concerned with checking of the residuals of the model to see if they contain any systematic pattern, which can still be removed to improve the chosen ARIMA model. Seasonality was found and the forecast consideration was best.

The residual of the estimated models was random in all cases since none of the coefficients were significantly different from zero which also supported by the non-significance of Box-Pierce 'Q' statistics. These entire joint statistics approved that, all the tentatively identified and estimated models were appropriate for forecasting the onion prices of the selected market. Manasa (2010) arrived at similar conclusions regarding validation of ARIMA modeling in her study on the pigeon pea price. The values of these statistics are shown in Table 1. The model (1,1,1) (2,1,1) was found to be the best model for prices in Hubli market, since the statistic of AIC and Q statistics was found to be non-significant.

The principal objective of ARIMA model for a variable is to generate post sample period forecast for the variable price. Both Ex-ante and Ex-post forecasting were done and it was compared with actual values of observations. The forecasting was done upto 2013. The results of ex- ante and ex-post forecast of prices of onion in the market are shown in the Table 4. The forecasts depicted in Fig. 1 indicate that there are narrow

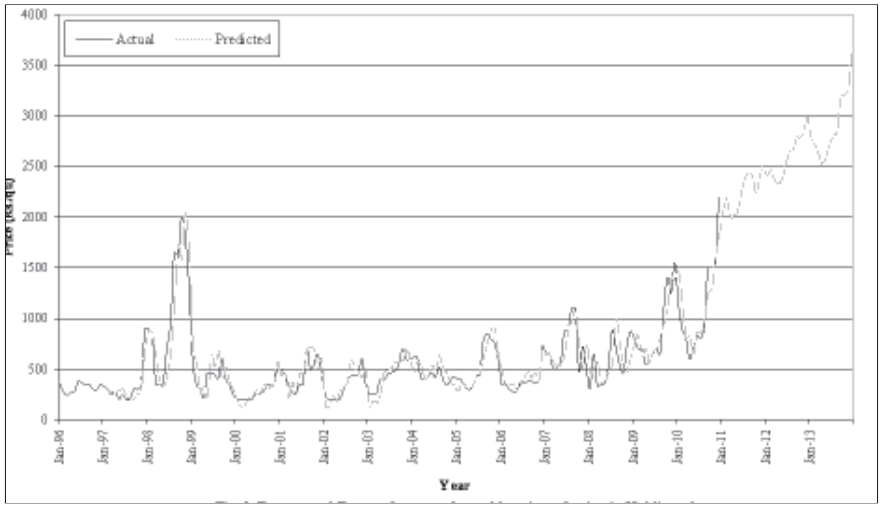

Fig. 1. Ex-ante and Ex-post forecast of monthly prices of onion in Hubli market

Table 4. Ex-ante and Ex-post forecast of monthly prices of onion in Hubli market

Year	Price (₹/q)		Year	Price (₹/q)		Year	Price (₹/q)	
	Actual	Predicted		Actual	Predicted		Actual	Predicted
Jan-1996	350	.	Jan-2001	500	430	Jan-2006	350	469
Feb-1996	270	.	Feb-2001	450	466	Feb-2006	360	324
Mar-1996	240	.	Mar-2001	350	211	Mar-2006	300	344
Apr-1996	270	.	Apr-2001	280	372	Apr-2006	280	353
May-1996	280	.	May-2001	250	278	May-2006	280	296
Jun-1996	380	.	Jun-2001	350	452	Jun-2006	350	377
Jul-1996	360	.	Jul-2001	350	459	Jul-2006	360	399
Aug-1996	350	.	Aug-2001	700	681	Aug-2006	380	481
Sep-1996	350	.	Sep-2001	500	720	Sep-2006	380	416
Oct-1996	300	.	Oct-2001	550	688	Oct-2006	360	467
Nov-1996	300	.	Nov-2001	650	505	Nov-2006	370	372
Dec-1996	350	.	Dec-2001	480	601	Dec-2006	720	692
Jan-1997	325	.	Jan-2002	250	141	Jan-2007	650	638
Feb-1997	300	248	Feb-2002	200	128	Feb-2007	650	642
Mar-1997	250	273	Mar-2002	200	237	Mar-2007	500	563
Apr-1997	275	283	Apr-2002	200	179	Apr-2007	520	531
May-1997	200	288	May-2002	200	300	May-2007	580	545
Jun-1997	250	303	Jun-2002	300	324	Jun-2007	875	655
Jul-1997	200	233	Jul-2002	380	369	Jul-2007	890	889
Aug-1997	200	193	Aug-2002	430	590	Aug-2007	1100	985
Sep-1997	300	203	Sep-2002	430	506	Sep-2007	1100	1072
Oct-1997	300	253	Oct-2002	450	465	Oct-2007	479	737
Nov-1997	350	303	Nov-2002	600	416	Nov-2007	725	510
Dec-1997	900	703	Dec-2002	360	511	Dec-2007	510	741
Jan-1998	900	878	Jan-2003	260	127	Jan-2008	310	469
Feb-1998	850	855	Feb-2003	250	193	Feb-2008	650	510
Mar-1998	350	613	Mar-2003	260	166	Mar-2008	330	569
Apr-1998	350	382	Apr-2003	400	258	Apr-2008	350	345
May-1998	360	317	May-2003	388	467	May-2008	360	383
Jun-1998	700	436	Jun-2003	450	487	Jun-2008	530	466
Jul-1998	950	668	Jul-2003	465	506	Jul-2008	880	556
Aug-1998	1650	1150	Aug-2003	480	576	Aug-2008	720	990
Sep-1998	1600	1710	Sep-2003	550	566	Sep-2008	550	737
Oct-1998	2000	1582	Oct-2003	700	586	Oct-2008	465	515
Nov-98	1850	2032	Nov-2003	600	688	Nov-2008	720	488
Dec-1998	1350	1685	Dec-2003	600	610	Dec-2008	870	627
Jan-1999	600	743	Jan-2004	615	478	Jan-2009	805	739
Feb-1999	350	543	Feb-2004	620	563	Feb-2009	700	838
Mar-1999	301	278	Mar-2004	415	535	Mar-2009	700	621
Apr-1999	220	328	Apr-2004	400	400	Apr-2009	550	706
May-1999	460	226	May-2004	430	432	May-2009	580	571
Jun-1999	450	636	Jun-2004	465	532	Jun-2009	650	666
Jul-1999	450	517	Jul-2004	420	498	Jul-2009	700	698
Aug-1999	410	670	Aug-2004	520	632	Aug-2009	650	812
Sep-1999	600	413	Sep-2004	400	499	Sep-2009	1100	954
Oct-1999	400	503	Oct-2004	345	456	Oct-2009	1400	1118
Nov-1999	350	366	Nov-2004	380	366	Nov-2009	1250	1422
Dec-1999	250	296	Dec-2004	430	340	Dec-2009	1550	1371
Jan-2000	200	189	Jan-2005	400	277	Jan-2010	1150	1459
Feb-2000	200	133	Feb-2005	400	355	Feb-2010	900	1141
Mar-2000	200	126	Mar-2005	330	339	Mar-2010	810	821
Apr-2000	200	218	Apr-2005	300	315	Apr-2010	600	815
May-2000	200	212	May-2005	320	327	May-2010	700	644
Jun-2000	250	290	Jun-2005	420	425	Jun-2010	830	870
Jul-2000	260	251	Jul-2005	450	474	Jul-2010	800	847
Aug-2000	270	320	Aug-2005	780	608	Aug-2010	900	967
Sep-2000	320	349	Sep-2005	850	759	Sep-2010	1500	1252
Oct-2000	350	319	Oct-2005	800	882	Oct-2010	1500	1288
Nov-2000	350	362	Nov-2005	760	889	Nov-2010	1530	1589
Dec-2000	500	577	Dec-2005	600	646	Dec-2010	2200	1828

Contd……

Table 4. Contd……..

Year	Price (₹/q)		Year	Price (₹ /q)		Year	Price (₹/q)	
	Actual	Predicted		Actual	Predicted		Actual	Predicted
Jan-2011	.	2046	Jan-2012	.	2402	Jan-2013	.	2774
Feb-2011	.	2177	Feb-2012	.	2470	Feb-2013	.	2712
Mar-2011	.	1997	Mar-2012	.	2363	Mar-2013	.	2623
Apr-2011	.	2011	Apr-2012	.	2331	Apr-2013	.	2520
May-2011	.	2051	May-2012	.	2368	May-2013	.	2587
Jun-2011	.	2231	Jun-2012	.	2512	Jun-2013	.	2728
Jul-2011	.	2384	Jul-2012	.	2642	Jul-2013	.	2796
Aug-2011	.	2434	Aug-2012	.	2652	Aug-2013	.	2845
Sep-2011	.	2407	Sep-2012	.	2778	Sep-2013	.	3183
Oct-2011	.	2228	Oct-2012	.	2788	Oct-2013	.	3208
Nov-2011	.	2405	Nov-2012	.	2847	Nov-2013	.	3252
Dec-2011	.	2495	Dec-2012	.	2983	Dec-2013	.	3616

variations in between the actual and forecasted values of prices of onion in the Hubli market and the forecasted values of prices showed an increasing trend in the future months. The prices of onion in the market during 2011 will be high (₹ 2495/q) and less (₹ 1997/q) during the months of December and March, respectively. In 2012 the prices will be high in the month of December (₹ 2983/q) and less during the month of April (₹ 2331/q). Similarly, in 2013 the prices will be high in the month of December (₹ 3616/q) and less during the month of April (₹ 2520/q). Similar model was used by Almemaychu Amera (2002) and Punitha (2007) to forecast the prices and arrivals of agricultural commodities and drawn conclusions.

ARIMA model is an extrapolation method that requires only the historical time series data on the variable under study. The ARIMA model forecasted prices revealed an increase in the prices of onion in the future years and also demand for the crop. Hence, increase in the area of production of onion and their sale in the suitable markets can be planned suitably.

References

Almemaychu Amera, 2002, Production and price behaviour of potato in Karnataka state, India-An economic analysis, *Ph.D. Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Box, G. E. P. and Jenkin, G. M., 1976, Time Series of Analysis, Forecasting and Control, Sam Franscico, Holden-Day, California. USA.

Manasa, P. B., 2010, Market dynamics and price forecasting of pigeon pea in south Karnataka. *M. Sc. Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Punitha, S. B., 2007, A Comparative analysis of market performance of agricultural commodities – An economic approach. *M. Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).