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Forecasting Of Onion Prices in Maharashtra: An Approach to Support Vector Regression and ARIMA Model

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Abstract: **The study on the Forecasting of Monthly Prices of Onion in Major Markets of Maharashtra is selected with an objective estimate the better forecast for the monthly onion prices and test validity of model. For this Support Vector Regression is used to classify the data and fitting better non-linear line. With this the length of support vector can be obtained and it can be use to forecaste the price. For the study, around 14 market price data for are taken from Maharashtra. The data is collected in the form of model price per day from 2002 to 2012 from the website of agmarknet and further converted to monthly price.**

The prices forecasted by Polynomial and Sigmoid model of Support Vector Non-Linear Regression are very much closer with actual prices than ARIMA forecasted prices. Deviation declined much more between actual value and forecasted value. As the price of onion per quintal in actual market was Rs.298 in Lasalgaon market and forecasted price is Rs.313 and Rs.314. If the methodology by putting volatility and better optimisation can be tried, there are chances of better results. The result shows that if the data is classified by Support Vector Regression, the forecasted prices are better over other models. The validity of forecasting model is estimated by AIC, R Square and DW test.

From the results of the model fitting, it can be concluded from above results that the model fitting is good in all market except two markets. The best fitted model is observed in Mumbai, Solapur, Nagpur and Pune sequentially.

Keywords: **ARIMA forecasted prices, Markets of Maharashtra, monthly onion prices, Support Vector Regression.**

1. INTRODUCTION

India is facing strong inflation in food price. Especially we can observe it in Fruits and Vegetables. Onion is one of the cash crops in Indian Agriculture. It is basic ingredient in Indian dishes. It is perishable and it is bulky stock to store. Onion production is around 14.56 million tons annually and second largest producer in the world after china. Kharif production is 40-50 percent and Rabi production is 50-60 percent. Area of onion in the country is 10 lakh hectares and productivity is 15.00 ton per hectare (Directorate of Onion and Garlic, 2011). Major onion producing State in the country is Maharashtra, Andhra Pradesh, Karnataka and Gujrat. Maharashtra produces shares 34 percent in Indian production. India exports onion 1.16 million tons to Gulf and Europe countries, Malaysia, Japan, Bangladesh and Shri-Lanka. India has pushed production through onion and garlic research centres and export through NAFED and different cooperatives. India started exports of onions since 1952 with 5000 tonnes per annum. Presently, it exports 12.86 percent of its production. It fetches foreign exchange for country.

Onion Prices has been always an issue of discussions. Shortage of onion supply in spot market leads to higher variation in prices. The higher prices of onion has major influenced the food inflation rate. The Competition Commission of India (CCI) had made enquiry in sudden raise in onion prices. Lasalgaon and its few peripheral markets in Nasik and Ahmednagar have largest turnover of onions. It is hub of onions and specially make effect on the national prices. It is said that the decision of the Lasalgaon market traders are more responsible for raising onion prices. The government has made

efforts to control the price and provide optimum supply. The government imported onions from neighbour countries viz; Pakistan and reduced import duties. A private trading company i.e. Hindustan trading imported Chinese onion. As the onion is basic ingredient in Indian dishes, its demand is less elastic. This year the onion prices has been down due to high 'Minimum Export Price' as compared to international prices.

Therefore the prices generally observed in boom in the month of Nov, Dec and Jan, are at lower side. The Railway administration also responsible for stagnating the prices due to not making available the sufficient rakes at Nasik stations. The value of annual onion production is ranges around Rs. 200-1 lakh crores in Indian market.

It is very surprising that the prices of onion ranges from Rs.100(Min) to Rs. 8000 per quintal(Max). Looking to the price variation in onion prices and its annual volume of trade, the present study is selected with following objectives.

Objectives of study:

1. To classify the monthly price data of onion by kernel function.
2. To forecast the monthly onion prices.
3. To test the validity of the forecasting models' fitting.

Hypotheses:

It is hypothesed that the onion monthly prices are forecasted better by Support Vector Regression/ Classification. Test will come true for most of the forecasted prices.

It will guide the researcher in price study and different study related to onion. It will be also helpful to avoid risk as well as making future contract.

2. METHODOLOGY

i) Data and Market:

To accomplish the objectives, the daily recorded data on prices and arrivals are collected from the period Jan 2002 to Dec 2012 from the government published website i.e. www.agmarknet.com. The data are collected on model price. For the study, around 14 market price data for onions is taken from Maharashtra. The onion data is collected for all markets in Maharashtra state, but the major markets which are showing time-series data are only selected for study. Those are as follows.

Table no.1: Major Markets in Maharashtra selected for study

S.No.	Market	Number of additional sub-market
1	Ahmednagar	
2	Chandvad (Nasik)	
3	Junnar (Ahmednagar)	Junnar(Otur) and Junnar(alphata)
4	Lasalgaon(Nasik)	Lasalgaon (Niphad)
5	Malegaon(Nasik)	
6	Malegaon(Nasik)	Malegaon(Umarane)
7	Mumbai	
8	Nagpur	
9	Newasa (Ahmednagar)	Newasa(Ghodegaon)
10	Pimpalgaon(Nasik)	Pimpalgaon Baswant(Saykheda) (Nasik)
11	Pune	
12	Rahuri(Ahmednagar)	Rahuri(vambhori)
13	Solapur	
14	Yeola(Nasik)	

Major Markets are selected on the basis of arrivals in the market. It is observed that most of the onion markets are located in Ahmednagar and Nasik districts of Maharashtra State.

For the monthly price component, the daily price data is averaged on monthly basis by weighted average method.

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ii) Analytical Methods:

The objective-wise methods used for analysis are given as below

1) To classify the data by non linear Kernel Function.

The data of monthly price are converted to binary digit i.e. +1 or -1 on the basis of increment or decrement in price. The time is transformed to log for getting optimised function.

The Support Vector regression classifies the data in two or more classes by maximising the margin of the linearly or non-linearly fitted line by minimising the Loss function.

Support Vector Regression:

Min $Z = 1/2w^{T}.w + \lambda \sum s_i$

Subjected to

$yi(wx+b) + s_i \geq 1, s \geq 0$

Where w = weight, s = slack variable, λ = penalty to error and it greater than 0, t = number of hyperplanes of classes, y = class of the data /sign of margin score.

There are three Kernel Function which classify data by nonlinear way Kernel function is mapping function which converts the 2D data in to high dimension space without knowing the mapping function Those are as fallows.

1) Polynomial = $(au^{T}v+b)^{d}$

2) Sigmoid= $\tanh (au^{T}v+b)$

3) Radial Basis Function (RBF)= $\exp (-a\|u-v\|^{2})$

The u and v are two different vectors of different class or line, a,b,d are constants

After these estimated classified data, the different forecasting models can be applied. But as our result for the daily data are best by ARIMA than other models, the ARIMA model is applied for forecasting the classes of the data and length of the support vector.

ARIMA model:

The Auto-regressive Integrated Moving Average model(ARIMA model) is fitted considering the significant lags from Auto-correlations(ACF) and Partial Autocorrelations(PACF).

ARIMA Model

$P_t = a + b_1P_{t-1} + b_2P_{t-2}\ldots\ldots b_nP_{t-n} + u_t + c_1u_{t-1} + c_2u_{t-2}\ldots..c_nu_{t-n}$

_____AR_____ _____MA_____

$P_{t,}$ = Class of Price at current traded month

P_{t-1} = Class of Price at previous traded month (lag term)/season

a, $b_{1,}$ b_2: Coefficients of lag price class term

u_t = Error term on current traded monthly price class

u_{t-1} = Error term of previous monthly(lag term) price class

Coefficients: $c_{1,}$ c_n of lag price term

The function is fitted on the basis of knowing stationary of the series. If the series is non-stationery, then it is integrated by differencing and made it stationery.

. Once you know the forecasted length of the support vector, you are able to know deviation from the fitted line and forecasted price can be estimated

2) **Testing of validity of forecasting models' fitting**:;

The model fitting is tested with three test i.e.

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a) Akaike's Information Criterion (AIC) : AIC= (Dev +2P)/N Dev=deviance, P=parameters, N is sample size. Smaller the value of AIC, better fitting of model.

b) R Square: To test the variance of the result.

c) Durbin–Watson statistic: It is a test statistic used to detect the presence of autocorrelation in the residuals.

$$d = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2},$$

Du value for more than 100 sample is 1.56, 1.63, 1.69

3. RESULT AND DISCUSSION

The results regarding classification and forecasted monthly prices onion obtained from analysis are presented and discussed in this section subsequently.

First the data of all considered market is converted to binary codes on the basis of increased or decreased like +1 and -1.

The classified data is predicted/estimated for fitting new non-linear lines by Kernel Functions.

On another side the ACF and PACF Patterns are estimated for fitting the ARIMA model on estimated data as fallows.

Table no. 2: Fitting of Auto-regression, differencing and Moving averages(ARIMA) for Monthly prices of Onions

S.No	Market	Model
1	Ahmednagar	2.1.1
2	Chandvad	1.1.0
3	Junner	2.1.3
4	Junner Otur	3.1.2
5	Lasalgaon	4.1.3
6	Lasalgaon Niphad	1.1.0
7	Malegaon	1.1.0
8	Malegaon Umrane	1.1.1
9	Mumbai	5.1.4
10	Nagpur	5.1.4
11	Newasa Ghodegaon	0.1.0
12	Pimpalgaon	5.1.4
13	Pune	5.1.5
14	Rahuri	2.1.2
15	Rahuri Vambori	1.1.0
16	Solapur	2.1.1
17	Vashi	2.1.1
18	Yeola	2.1.0

The estimated binary code data are then forecasted on the basis of ARIMA model fitted. The example of forecasted binary data of Lasalgaon market is as fallows

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Table no.3: Forecasted Value of Support Vector

Month	Forecast Support Vector
1	0.899511
2	0.899512
3	0.899512
4	0.899513
5	0.899515
6	0.899517
7	0.899519
8	0.899523
9	0.899526
10	0.899530

Suppose the current month forecasted price is Rs. 348 per quintal. The predicted price for next month is height of the support vector i.e. 0.899511 multiplied by current month price (348).

Forecasted Price = 0.899511 X 348 = 313. This is much closed to actual price.

The all the forecasted prices are compared with actual value price and forecasted price by ARIMA.

Table No.4: Forecasted Price of Mixed Onions for next trading months

Market	Actual Price for the next month	Forecasted Price by ARIMA	Forecasted Price by Polynomial SVM	Forecasted Price by Sigmoid SVM
Ahmednagar	**NA**	**322.86**	**419**	**419**
Chandvad	**361.37**	**486.24**	**485**	**485**
Junner	**481.25**	**1252.91**	**991**	**991**
Junner Otur	**NA**	**1020.9**	**987**	**994**
Lasalgaon	**298.45**	**560.23**	**314**	**313**
Lasalgaon Niphad	**NA**	**318.16**	**312**	**251**
Malegaon	**NA**	**443.81**	**441**	**441**
Malegaon Umrane	**NA**	**940.42**	**312**	**312**
Mumbai	**NA**	**1093.1**	**969**	**975**
Nagpur	**714.47**	**858.88**	**700**	**810**
Pimpalgaon	**322.53**	**747.51**	**518**	**532**
Pune	**423.96**	**658.51**	**597**	**596**
Rahuri	**315.4**	**331.59**	**348**	**369**
Rahuri Vambori	**362.5**	**437.55**	**429**	**431**
Solapur	**NA**	**361.86**	**405**	**406**
Vashi	**542.86**	**448.15**	**514**	**768**
Yeola	**NA**	**563.36**	**571**	**571**

It is observed that the Radial Basis Function type of Kernel Function is not suitable for prediction of onion data. While the prices forecasted by Polynomial and Sigmoid model are very much closer with actual prices than ARIMA prices. Deviation declined much more between actual value and forecasted value. As the price of onion per quintal in actual market was Rs.298 in Lasalgaon Market and forecasted price is Rs.313 and Rs.314. If we could modify more the methodology by putting volatility and better optimisation, we can give better results.

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Validity of the model fitted ARIMA:

The validity of the model is estimated by Akaike's Information Criterion (AIC) test, R Square and Durbin Watson Stat. The results are presented in table 4.

Table No.5: Validity testing of the Model fitting

Market	Actual Price for the next month	Forecasted Price by ARIMA	AIC	R Sqr	DW Stat
Ahmednagar	NA	322.86	14.29	0.59	2.01
Chandvad	361.37	486.24	14.47	0.31	2.17
Junner	481.25	1252.91	14.34	0.68	2.01
Junner Otur	NA	1020.9	15.49	0.53	1.99
Lasalgaon	298.45	560.23	14.39	0.62	1.88
Lasalgaon Niphad	NA	318.16	14.67	0.12	2.00
Malegaon	NA	443.81	14.12	0.30	2.05
Malegaon Umrane	NA	940.42	15.00	-0.02	1.41
Mumbai	NA	1093.1	13.50	0.84	1.94
Nagpur	714.47	858.88	13.51	0.80	2.08
Pimpalgaon	322.53	747.51	13.78	0.75	1.90
Pune	423.96	658.51	13.67	0.78	1.97
Rahuri	315.4	331.59	13.72	0.50	1.99
Rahuri Vambori	362.5	437.55	14.18	0.36	1.52
Solapur	NA	361.86	13.50	0.37	2.17
Vashi	542.86	448.15	14.52	0.72	1.91
Yeola	NA	563.36	14.74	0.14	2.02

As per the result obtained of the AIC Test, the lower value as compared to other markets is observed in Mumbai(13.50), Solapur (13.50), Nagpur, (13.51) and Pune(13.67). It indicates the better fitting of model in these markets.

The R square indicates that the prices are highly varying values are observed in Mumbai(0.84) , Nagpur (0.80) and Pune(0.78) markets. While Malegaon Urmane (-0.02) and Lasalgaon Niphad(0.12) has shown lowest value of R Square.

The results of the Durbin Watson Stat indicates that the actual DW estimates of the all markets except Malegaon Urmane and Rahuri Vambori are more than the Table Critical Values It reveals the we don't need to reject hypothesis. Model is fitted properly.

It can be concluded from above results that the model fitting is good in all market except two markets. The best fitted model is observed in Mumbai, Solapur, Nagpur and Pune sequentially.

5. CONCLUSION

The result shows that if the data is classified by Support Vector Regression, the forecasted prices are better over ther models.

From results of validity testing , it can said that the model fitting is good in all market except two markets. The best fitted model is observed in Mumbai, Solapur, Nagpur and Pune sequentially.

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