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Exploring Regression Techniques for Predictions of Wheat and Rice Prices in India

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Abstract - Agriculture products play an important role in the economy of the country. In India, Wheat and Rice are the two major agriculture products and lots of economical decisions are taken by considering the prices of these agriculture products. Regression techniques are the most commonly and popularly used techniques in prediction. In this paper three regression techniques namely, Linear, Logistic and Isotonic regression are used for carrying experimental study on predicting Wheat and Rice prices for Indian markets. Performance parameters Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), Relative Absolute Error (RAE), and Root Relative Squared Error (RRSE) are calculated for comparing the regression techniques for prediction of Rice and Wheat prices.
Keywords – Wheat Price Prediction, Rice Price Prediction, Linear Regression, Logistic Regression, Isotonic Regression.

I. INTRODUCTION

The prices of agriculture products play a critical role in the economy of any country. Using IT (Information Technology) and MIS (Management Information System) in this area can help in forecasting and building effective financial models for the country. The work presented in this paper is exploring the basic regression techniques for forecasting the Wheat and Rice prices for Indian markets. Three regression techniques namely, Linear, Logistic and Isotonic regression are used and compared to forecast the Wheat and Rice prices.

Other countries are also working in the same directions for their economic and financial planning's and scientist and researchers have also shown their interest in this area in the recent years. Some of the major contributions are mentioned is discussed here in brief. Angus (1989) [1] presented a non-parametric analysis of Rice prices and income distribution in Thailand. Gandhi et al. (2008) [2] have presented a decision-oriented market information system for Wheat and Rice in India. Sandika (2009) [3] studied the price behavior of Rice in Sri Lanka after liberalization of economy in Sri Lanka. Sharma and Kumar (2001) [4] presented an analysis of the price behavior of selected commodities in India. Shim (1971) [5] studied the economical analysis of Rice prices in the Republic of Korea.

Tuong (2011) [6] presented an analysis marketing and technique for forecasting Rice price in the Mekong Delta of Vietna. A price distribution visualization tool is presented by Nagwani et al. [7], the purpose of the presented tool is to analyze and compare the prices of Wheat and Rice varieties available in India. The analysis can be performed at state, district, city and market level over the time dimension. Time can be selected in days, weeks, months, quarters and years. Regression techniques are explored for prediction problems in earlier studies the similar regression techniques are earlier used for predicting the concrete compressive strength in civil engineering by Nagwani and Deo [9].

Commodities price prediction task using Quantum Neural Network (QNN) is presented by Mahajan [10]. The commodity price prediction initiates the use of QNN in financial engineering applications. The system supports android and IOS system mobile phones , the Widgets technology and http communication is technology is be used by Chen et al. [11] to develop a real-time agricultural information collection system, which is based on cross-platform mobile GIS. Agricultural MIS is a kind of information system focusing on the agricultural production, management, scientific research information collecting, collating, sorting, retrieval and output. An integration model using SOA is proposed by Duan [12] to design agricultural MIS.

By using classified agricultural software products registered during last 15 years from 1994 to 2009, Sun [13] analyzed data and statistics in order to look at growth in number of the agro-software packages, their application areas, and research and development organizations, as well as their contribution to the agricultural IT industry in China. A study is presented by Das et al. [14] to explore the potential of this mobile- based voice messaging services provided by IFFCO Kishan Sanchar Limited (IKSL) Green Card, to know the frequency of its messaging. This study was carried to analyze the proper usage of IKSL system in agriculture. A technique is proposed by Ursani et al. [15] for agricultural land-use mapping that addresses a known weakness of classical per-pixel methods in situations involving mixed tree crops.

An ontology-based agricultural knowledge management system framework is proposed by Ye-lu and Qi-yun [16], which includes modules of ontology-based knowledge acquisition, knowledge representation, knowledge organization, and knowledge mining, etc. The key technologies, building tools and applications of the framework are explored. Another ontology framework of agricultural product is developed by Liu et al. [17] for agricultural product information. A review on applications of expert systems for pest management and crop protection is presented by Dubey et al [18]. A dynamic feedback crop simulation system is presented by Jiayu et al. [19], which is used to simulate and forecast the growth of crops. The real-time monitoring data applied for this simulation system was derived from Agriculture monitoring and early-warning research space (AMERS) which was established by Agriculture Information Institute of Chinese Academy of Agricultural Sciences.

The purpose of presented work is to develop a forecasting system for predicting the Wheat and Rice prices for Indian markets. The presented system is implemented using three popular regression techniques and various performance parameters are evaluated. The overview of the regression techniques is presented in the next section.

II. REGRESSION TECHNIQUES

Regression techniques are used to discover the relationship between a set of variable. These techniques helps in identifying the patterns of independent and dependent variables, the independent variables are technically termed as response variables and dependent variable is termed as predictors. Regression techniques typically try to relate some statistical measures like mean or average between the set of variables to identify the relationship between them. There are a number of regression techniques exists some of them are used in this paper namely, Isotonic Regression [9], Linear Regression, Logistic Regression and LMS Regression technique [8].

A. Linear Regression

Linear regression Technique used for prediction of the relative quality statistical model for the given set of data and is able to deal with set of data. This technique shows the relationship given in the Eq. (1).

$$Y = \alpha X + \beta \qquad (1)$$

where X is the explanatory variable and Y is the dependent variable. It is the most simple and commonly used regression model used in general prediction tasks.

B. Logistic Regression

Logistic Regression technique is the another regression technique, which is used to determines the impact of multiple independent variables presented simultaneously to predict membership of one or other of the two dependent variable categories. If the dependent variable, Y, is one of the binary response or dichotomous variables, logistic regression can be used to describe its relationship with several predictor variables, $(X_1, X_2, \ldots, X_N)$ and an odds ratio can be estimated. There are two main uses of logistic regression, the first is the prediction of group membership and second is, it provides knowledge of the relationships and strengths among the variables. Logistic Regression is used for prediction of the probability of occurrence of an event by fitting data to a logistic curve. The logistic model can be expression as given in Eq. (2).

$$logit(p) = \ln\frac{p}{1-p} = \alpha + b_1 x_1 + b_2 x_2 + \cdots + b_i x_i \qquad (2)$$

where p is the probability of a classification match, and $x_1, x_2, \ldots, x_i$ are the explanatory, independent variables.

C. Isotonic Regression

Isotonic Regression technique is a useful non-parametric regression technique, this technique used to fiend the lowest squared error attribute in the result this technique not allow the missing value and work only in numeric attribute. The advantage of isotonic regression technique is that it does not accept any structure from the object function, Y = Y1,Y2,Y3, …., YN represent the observed response and X = X1,X2,X3, ….,XN is unknown response then value be fiend in Eq. (3).

Minimize $\sum_{i=0}^{n} \boldsymbol{\omega i}\,(xi - yi)$ (3)

Subject $X_i \leq \ldots.. \geq X_n$

Where $\boldsymbol{\omega i}$ is positive value.

D. Least Median of Squares (LMS) Regression

Rousseeuw (1984) [8] introduced Least Median of Squares (LMS) as a robust regression procedure. In this regression technique instead of minimizing the sum of squared residuals, coefficients are chosen so as to minimize the median of the squared residuals. In contrast to conventional least squares (LS), there is no closed-form solution with which to easily calculate the LMS line since the median is an order or rank statistic. A general nonlinear optimization algorithm performs poorly because the median of squared residuals surface is so rutted that merely local minima are often incorrectly reported as the solution.

III. Performance Measurements

The performance of regression based prediction techniques is carried in terms of errors in regression. Some such common errors in regression based prediction are Correlation Coefficient (r), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), Relative Absolute Error (RAE), Root Relative Squared Error (RRSE).

A. Correlation Coefficient

Coefficient of correlation is a quantity that gives the quality of a least squares fitting to the original data. It is a measure of the strength of a relationship between two variables. For predictions it is the measure of strength between the actual values and forecasted values. The coefficient of correlation is calculated as shown in the Eq. (4).

$$r = \frac{\sum_{i=1}^{N}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{N}(x_i-\bar{x})^2}\sqrt{\sum_{i=1}^{N}(y_i-\bar{y})^2}} \quad (4)$$

Where x_i and y_i are the ith values of the datasets X and Y and $\bar{x}$ and $\bar{y}$ are the mean values of the datasets X and Y.

B. Mean Absolute Error

The Mean Absolute Error (MAE) is the average of the absolute value of the residuals (error). The MAE is very similar to the RMSE but is less sensitive to large errors. The MAE is calculated using Eq. (5).

$$MAE = \frac{1}{n}\left(\sum |y_i - \hat{y}_i|\right) \quad (5)$$

Where y_i, $\hat{y}_i$ and n are the ith value, mean value and total number of points in dataset Y.

C. Root Mean Squared Error

The Root Mean Squared Error (RMSE) is the square root of the average squared distance of a data point from the fitted line. The RMSE is calculated using Eq. (6).

$$RMSE = \sqrt{\frac{\sum (y_i - \hat{y}_i)^2}{n}} \quad (6)$$

Where y_i, $\hat{y}_i$ and n are the ith value, mean value and total number of points in dataset Y.

D. Relative Absolute Error

The absolute error is the difference between the measured value and the actual value. Relative error is given in Eq. (7) and is the ratio of the absolute error of the measurement to the accepted measurement.

$$RAE = \frac{\sum_{i=1}^{N}|\boldsymbol{p_i - a_i}|}{\sum_{i=1}^{N}|\boldsymbol{\bar{a} - a_i}|} \quad (7)$$

Where p_i, a_i and N are the predicted ith value, actual ith value and total number of data points.

E. Root Relative Squared Error

The Root Relative Squared Error (RRSE) is given in the Eq. (8) and is the square root of the square of the difference between the measured value and the actual value.

$$\boldsymbol{RRSE} = \sqrt{\frac{\sum_{i=1}^{N}(\boldsymbol{p_i - a_i})^2}{\sum_{i=1}^{N}(\boldsymbol{\bar{a} - a_i})^2}} \quad (8)$$

Where p_i, a_i and N are the predicted ith value, actual ith value and total number of data points.

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IV. METHODOLOGY

The methodology of the presented work is shown in the Fig. 1. The price information is selected from the price database for the Rice and Wheat varieties. The task relevant data is filtered for which forecasting has to be performed. After selecting the task relevant data, regression techniques are applied on it and forecasting is performed. The output of the regression technique is the forecasted prices and finally the performance of the process is evaluated using the various prediction errors.

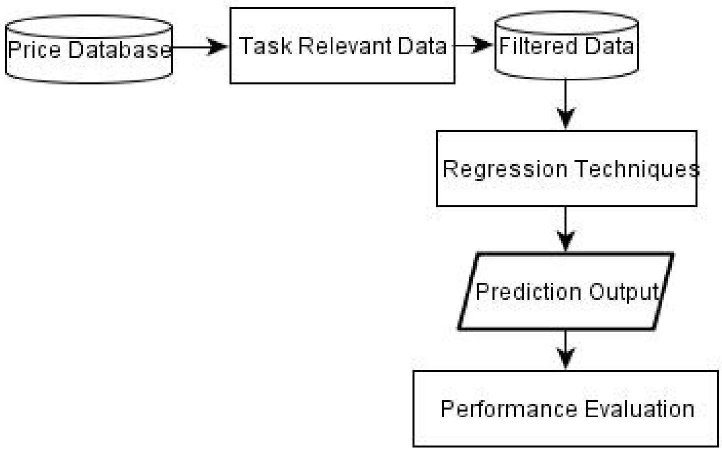

Fig. 1. Methodology of Price Prediction using Regression Techniques.

V. EXPERIMENTS

Experiments are performed on two popular Rice varieties namely “Broken Rice” and “Fine Rice” for Karnataka state using the three regression techniques namely, Isotonic, Linear and LeastMedSq regression techniques and performance parameters are tabulated in the tables.

A. Dataset

Dataset from Open Government Data (OGD) Platform India is selected for Rice and Wheat price distribution information. The platform provides authentic data of last 12 years for Rice and Wheat prices of different markets at district and state level across India.

B. Isotonic Regression

The experiments are first performed using Isotonic regression technique. Results for daily and monthly prediction of “Broken Rice” for Karnataka state using Isotonic regression is presented in the Table I and Table II. Similarly the results of daily and monthly prediction of “Fine Rice” for Karnataka state using Isotonic regression is presented in the Table III and Table IV.

Experiments are performed by selecting the last 11 years data for the prices. Parameters coefficient of correlation (r), MAE, RMSE, RAE, RRSE and total number of instances (records) for predictions are tabulated in the Tables. Correlation coefficient increases with increase in volume of historical data. The error parameters gives lower values (best predictions) if the most recent historical data (last one year data) are considered for the prediction of prices. The similar pattern is observed for daily and monthly price predictions for both of the Rice varieties “Broken Rice” and “Fine Rice” using Isotonic regression technique.

TABLE I - DAILY PREDICTION OF “BROKEN RICE” PRICE USING ISOTONIC REGRESSION.

Year	R	MAE	RMSE	RAE	RRSE	N
1	0.7936	75.4147	**112.9337**	50.7585	60.8394	**363**
2	0.8024	**74.4428**	115.9365	49.0654	59.6746	720
3	0.7475	80.7707	118.7174	59.7952	66.4267	1061
4	0.7	86.3789	129.452	65.1119	71.4176	1367
5	0.7625	86.8419	127.3277	60.5681	64.7004	1695
6	0.8343	85.3554	123.8146	50.73	55.129	2003

7	0.8682	84.0507	121.7163	43.5829	49.6295	2332
8	0.8838	82.5467	119.0872	39.8025	46.7799	2609
9	0.8849	83.1101	118.0969	39.7253	46.5703	2805
10	0.9016	80.8876	115.1235	36.1583	43.2641	3124
11	0.9105	79.7659	114.1173	**34.1867**	**41.3489**	3369

TABLE II - MONTHLY PREDICTION OF "BROKEN RICE" PRICE USING ISOTONIC REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.9995	**3.0637**	**4.4767**	**2.3082**	**3.093**	13
2	0.9908	12.5954	21.2999	10.1624	13.5051	25
3	0.9587	24.0278	39.43	23.4484	28.4507	37
4	0.9437	28.3537	44.7876	29.1532	33.0671	49
5	0.9534	30.4801	46.3454	28.5936	30.1822	61
6	0.9745	27.5776	42.8051	19.4357	22.4186	73
7	0.9822	25.3046	40.1298	14.5497	18.8088	85
8	0.9848	25.3141	38.8993	13.1307	17.3577	97
9	0.9833	28.2694	40.7485	14.3926	18.1842	109
10	0.9865	25.8744	38.7034	12.3904	16.3836	121
11	0.9881	24.627	37.5408	11.4022	15.3508	129

TABLE III - DAILY PREDICTION OF "FINE RICE" PRICE USING ISOTONIC REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.8891	**81.1763**	**119.8483**	36.6826	45.7802	**294**
2	0.8869	95.5344	133.4499	40.8451	46.1912	584
3	0.8171	118.5385	157.9559	55.4851	57.648	869
4	0.6804	150.7594	214.859	68.7985	73.2826	1147
5	0.8739	134.423	198.8968	42.7584	48.6098	1417
6	0.931	123.9515	187.9341	28.7151	36.5092	1695
7	0.947	117.1034	178.3865	23.6068	32.1146	1993
8	0.9547	113.517	172.4678	21.465	29.7411	2267
9	0.9554	114.3719	172.498	21.4034	29.5471	2374
10	0.9575	113.0183	168.6499	**21.0813**	28.8422	2661
11	0.9559	116.4969	172.3526	21.831	**29.3665**	2928
12	0.9555	117.2034	172.8028	22.0141	29.4885	2942

TABLE IV - MONTHLY PREDICTION OF "FINE RICE" PRICE USING ISOTONIC REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.9999	**1.5804**	**3.1737**	**0.7274**	**1.3158**	13
2	0.9902	22.0505	36.1629	10.1933	13.9502	25
3	0.8894	65.5672	107.9257	35.0804	45.7176	37
4	0.8335	85.1135	135.8484	47.9616	55.2545	49
5	0.9497	69.8846	121.9641	23.6364	31.3155	61
6	0.9743	60.3475	111.8061	14.2148	22.5074	73

7	0.9807	57.0718	104.714	11.7355	19.5422	85
8	0.9832	57.6187	102.5555	11.1018	18.2465	97
9	0.9836	61.3201	102.7736	11.5873	18.0543	109
10	0.9836	62.143	102.0004	11.8505	18.0398	121
11	0.9816	67.4952	107.6761	13.0555	19.1027	133

C. Linear Regression

Next the experiments are performed using Linear regression technique. Results for daily and monthly prediction of "Broken Rice" for Karnataka state using Linear regression is presented in the Table V and Table VI. Similarly the results of daily and monthly prediction of "Fine Rice" for Karnataka state using Linear regression is presented in the Table VII and Table VIII. Experiments are performed by selecting the last 11 years data for the prices. Parameters coefficient of correlation (r), MAE, RMSE, RAE, RRSE and total number of instances (records) for predictions are tabulated in the tables. Similar kind of patterns in the parameters is observed using Linear regression as found in Isotonic regression technique, correlation coefficient increases with increase in volume of historical data. The error parameters gives lower values (best predictions) if the most recent historical data (last one year data) are considered for the prediction of prices. The similar pattern is observed for daily and monthly price predictions for both of the Rice varieties "Broken Rice" and "Fine Rice" using Linear regression technique. In terms about selected parameters, Isotonic regression performs better than Linear regression.

TABLE V - DAILY PREDICTION OF "BROKEN RICE" PRICE USING LINEAR REGRESSION.

Year	R	MAE	RMSE	RAE	RRSE	N
1	0.7499	**83.6817**	**122.8046**	56.3227	66.157	363
2	0.7091	95.2723	136.9928	62.7942	70.5126	720
3	0.5209	114.4209	152.555	84.7067	85.3601	1061
4	**0.4842**	115.949	158.5932	87.4017	87.4946	1367
5	0.6194	113.664	154.498	79.2753	78.5068	1695
6	0.7407	112.1865	150.8839	66.6768	67.1817	2003
7	0.8045	107.4156	145.6746	55.6982	59.3984	2332
8	0.8287	105.2246	142.4692	50.7374	55.9649	2609
9	0.8185	109.5108	145.7005	52.3444	57.4555	2805
10	0.8457	105.8752	142.0002	47.3282	53.3645	3124
11	0.8611	103.5019	140.3034	**44.3597**	**50.837**	3369

TABLE VI - MONTHLY PREDICTION OF "BROKEN RICE" PRICE USING LINEAR REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.9417	**38.5407**	**48.7028**	**29.0363**	**33.6489**	13
2	0.8783	66.8806	75.4168	53.9616	47.8176	25
3	**0.6578**	83.7991	104.3856	81.7781	75.3195	37
4	0.6741	81.2186	100.0457	83.509	73.8647	49
5	0.7801	77.9218	96.0722	73.0988	62.5665	61
6	0.872	78.8631	93.4486	55.5798	48.9424	73
7	0.9132	70.3861	86.9497	40.4706	40.7531	85
8	0.9252	69.0425	85.0339	35.8131	37.9439	97
9	0.9099	75.045	92.9691	38.207	41.4879	109
10	0.9259	70.7574	89.2429	33.8834	37.7776	121
11	0.9342	67.9653	87.2592	31.4676	35.681	129

TABLE VII - DAILY PREDICTION OF "FINE RICE" PRICE USING LINEAR REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.8593	**95.9971**	**133.888**	43.38	51.1432	294
2	0.7999	135.9328	173.4022	58.1173	60.02	584
3	0.6158	170.9397	215.8836	80.0129	78.7894	869
4	**0.4427**	203.106	262.9023	92.6867	89.6689	1147
5	0.7222	222.8656	283.0127	70.8909	69.1675	1417
6	0.8398	217.5501	279.4336	50.3986	54.2845	1695
7	0.8794	205.1787	264.4907	41.3618	47.6157	1993
8	0.8953	200.489	258.3316	**37.9106**	**44.5479**	2267
9	0.8922	206.5973	263.6549	38.6624	45.1614	2374
10	0.8741	231.116	284.0897	43.1046	48.579	2654
11	0.8616	242.6835	297.9367	45.4777	50.7643	2928
12	0.8587	244.2716	300.3041	45.881	51.2465	2942

TABLE VIII - MONTHLY PREDICTION OF "FINE RICE" PRICE USING LINEAR REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.9801	**34.9057**	**47.8619**	**16.0667**	**19.8427**	13
2	0.9075	94.2131	108.8945	43.5519	42.007	25
3	0.6155	149.8709	186.0521	80.1854	78.8122	37
4	**0.5681**	168.0234	202.3257	94.6813	82.2933	49
5	0.7947	194.1425	236.4169	65.6628	60.7024	61
6	0.8837	188.9412	232.5247	44.505	46.809	73
7	0.9122	178.2546	219.519	36.6539	40.9675	85
8	0.9237	173.6017	215.3716	33.449	38.3186	97
9	0.9177	183.4625	226.2125	34.6677	39.7388	109
10	0.9016	204.3721	244.5554	38.9733	43.252	121
11	0.8861	215.4604	261.2373	41.6762	46.3459	133
12	0.8679	225.9027	277.2159	44.3893	49.6665	136

D. LeastMedSq Regression

Finally, experiments are performed using LeastMedSq regression technique. Results for daily and monthly prediction of "Broken Rice" for Karnataka state using LeastMedSq regression is presented in the Table IX and Table X. Similarly the results of daily and monthly prediction of "Fine Rice" for Karnataka state using LeastMedSq regression is presented in the Table XI and Table XII. Experiments are performed by selecting the last 11 years data for the prices and Parameters coefficient of correlation (r), MAE, RMSE, RAE, RRSE and total number of instances (records) for predictions are tabulated in the Tables. In line with previous results, correlation coefficient increases with increase in volume of historical data, and the error parameters gives lower values (best predictions) if the most recent historical data (last one year data) are considered for the prediction of prices. Performance parameters wise, Isotonic regression technique performs better than the Linear and LeastMedSq regression techniques. Whereas, Linear regression technique performs marginally better than LeastMedSq regression technique.

TABLE IX - DAILY PREDICTION OF "BROKEN RICE" PRICE USING LEASTMEDSQ REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.7499	83.5133	122.9101	56.2093	66.2139	363
2	0.7091	94.767	137.791	62.4611	70.9234	720

3	0.5209	113.8269	155.1503	84.267	86.8122	1061
4	0.4842	114.8065	161.4802	86.5405	89.0873	1367
5	0.6194	112.9092	156.5374	78.7489	79.5431	1695
6	0.7407	111.7382	152.0468	66.4103	67.6995	2003
7	0.8045	107.0037	146.5938	55.4847	59.7732	2332
8	0.8287	104.7803	143.4643	50.5231	56.3557	2609
9	0.8185	109.1169	146.7301	52.1561	57.8616	2805
10	0.8457	105.3317	142.9786	47.0853	53.7322	3124
11	0.8611	102.9653	140.9298	44.1297	51.064	3369
12	0.8611	102.9653	140.9298	44.1297	51.064	3369

TABLE X - MONTHLY PREDICTION OF “BROKEN RICE” PRICE USING LEASTMEDSQ REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.9417	98.7339	145.7627	74.3854	100.707	13
2	0.8783	69.0828	108.6508	55.7383	68.8894	25
3	**0.6578**	80.3064	123.1293	78.3697	88.844	37
4	0.6741	73.6757	115.6303	75.7534	85.3709	49
5	0.7801	70.8312	106.3493	66.4471	69.2594	61
6	0.872	78.288	105.4585	55.1745	55.2324	73
7	0.9132	68.3807	92.1998	39.3175	43.2138	85
8	0.9252	**66.1001**	**88.7953**	34.2869	39.6223	97
9	0.9099	73.9029	96.408	37.6256	43.0225	109
10	0.9259	69.221	92.7192	33.1477	39.2492	121
11	0.9342	67.0865	91.0591	**31.0607**	**37.2349**	129

TABLE XI - DAILY PREDICTION OF “FINE RICE” PRICE USING LEASTMEDSQ REGRESSION.

Year	R	MAE	RMSE	RAE	RRSE	N
1	0.8593	**95.8727**	**137.3654**	43.3237	52.4715	294
2	0.7999	135.7746	173.5077	58.0496	60.0565	584
3	0.6158	171.673	217.4788	80.3561	79.3716	869
4	**0.4427**	202.6128	263.3423	92.4616	89.819	1147
5	0.7222	221.6545	285.7997	70.5057	69.8486	1417
6	0.8398	211.8429	286.0942	49.0765	55.5784	1695
7	0.8794	203.706	266.4152	41.0649	47.9622	1993
8	0.8953	200.0778	260.3425	**37.8329**	**44.8946**	2267
9	0.8922	206.0649	264.7592	38.5627	45.3505	2374
10	0.8741	230.2393	284.7883	42.9411	48.6984	2654
11	0.8616	277.3532	347.4264	51.9746	59.1967	2928
12	0.8587	290.2407	366.3272	54.5153	62.5132	2942

TABLE XII - MONTHLY PREDICTION OF "FINE RICE" PRICE USING LEASTMEDSQ REGRESSION.

Year	r	MAE	RMSE	RAE	RRSE	N
1	0.9801	**34.3472**	**48.1834**	**15.8096**	**19.976**	13
2	0.9075	89.2172	120.8455	41.2424	46.6172	25
3	0.6155	160.4227	218.9812	85.831	92.761	37
4	**0.5681**	169.6438	234.8471	95.5944	95.5209	49
5	0.7947	196.9634	249.8817	66.6169	64.1596	61
6	0.8837	178.4804	246.7415	42.041	49.6709	73
7	0.9122	176.0824	227.5149	36.2072	42.4598	85
8	0.9237	172.1352	218.7364	33.1664	38.9172	97
9	0.9177	181.7884	227.6877	34.3514	39.9979	109
10	0.9016	419.1632	596.8616	79.9335	105.5608	121
11	0.8861	403.8918	590.3851	78.1242	104.7397	133
12	0.8679	410.1239	596.445	80.5883	106.8602	136

VI. CONCLUSIONS

Regression techniques are explored in this work to forecast the Wheat and Rice prices for Indian markets. Three regression techniques namely, Linear, Logistic and Isotonic regression are covered in the experimental study. Performance parameters Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), Relative Absolute Error (RAE), and Root Relative Squared Error (RRSE) are calculated for comparing the regression techniques for prediction of Rice and Wheat prices. Daily and monthly forecasting of Broken and Fine Rice for Karnataka state of India. It is shown from the experiments that for daily and monthly price predictions of Wheat and Rice for the three regression techniques give minimum errors when the recent historical data for prices is considered for predictions (rather than considering long historical values). Out of the three regression techniques Linear, Logistic and Isotonic regression MAE, RMS, RAE and RRSE are minimum for Isotonic regression as compared to the other two regression techniques. Linear regression performs better than the LeastMedSq regression. The coefficient of correlation r is maximum when large volume of historical data is considered. Prediction error is minimum when most recent values for the predictions are considered i.e. last one or two years for all the regression techniques.

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