Project Dissertation

Time Series Analysis of Paddy(Dhan) on the basis of Arrival & Prices & Building a Diagnostic Tool

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CERTIFICATE

This is to certify that the dissertation report titled **"Time Series Analysis of Paddy(Dhan) on the basis of Arrival & Prices & Building a Diagnostic Tool"** is a bonafide work carried out by **Mr. Vivek Sheel** of **MBA 2015-17** and submitted to Delhi School of Management, Delhi Technological University, Bawana Road, Delhi-42 in partial fulfillment of the requirement for the award of the Degree of Masters of Business Administration.

Signature of Guide **Signature of Head (DSM)**

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DECLARATION

I, **Vivek Sheel**, student of **MBA 2015-17** of Delhi School of Management, Delhi Technological University, Bawana Road, Delhi – 42, hereby declare that the dissertation report **"Time Series Analysis of Paddy(Dhan) on the basis of Arrival & Prices & Building a Diagnostic Tool"** submitted in partial fulfillment of Degree of Masters of Business Administration is the original work conducted by me.

The information and data given in the report is authentic to the best of my knowledge.

This report is not being submitted to any other University, for award of any other Degree, Diploma or Fellowship.

Vivek Sheel

Place:

Date:

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ABSTRACT

The AGMARKNET website (http://www.agmarknet.nic.in) is an initiative taken by the Directorate of Marketing and Inspection, Ministry of Agriculture and Farmer Welfare, Government of India, with the aim of collecting and disseminating marketing related information of agricultural commodities throughout the country. It is an online G2C e-governance portal which caters to the needs of various stakeholders such as farmers, policy makers, industry, & academic institutions by providing agricultural marketing related information from a single Platform. The portal has helped to reach farmers who do not have sufficient resources to get adequate market information. It facilitates web- based information flow, of the daily arrivals and prices of commodities in the agricultural produce markets spread across the country. Such information will enable the farmers to obtain fair returns on their produce. For consumers, it means that they will be able to obtain agricultural produce at fair and affordable prices.

To achieve these objectives, it is necessary that the information being recorded and disseminated by the AGMARKNET portal be of accurate and reliable nature. The fact that this information is also intended to be used for national level agricultural policy decisions makes it even more crucial for the information to be highly accurate and complete in all aspects.

This study aims to forecast the modal prices of Paddy(Dhan) for a particular variety (Paddy fine) using time series modeling, data cleansing, filtering, soring, are the essential tasks conducted as a part of this process. The time series modeling has been attempted to forecast Paddy prices in 2017. Microsoft Excel 2013 & E views 9.5 Lite have been used for time for time series analysis.

The second objective of the study is to develop a diagnostic tool for major markets where paddy(dhan) arrivals are high. The diagnostic tool will help the data quality by monitoring the data reporting process continuously. Microsoft Excel was used for developing the diagnostic tool

Table of Contents

Chapter 1

Introduction

1.1 Introduction to the project

1.1.1 Background

Agricultural marketing in India has come a long way since independence, but still many challenges are present. Market information could be considered as crucial factors for farmers in order to plan production and marketing of the produce. Other market participants also require market information in order to make decisions related to trading. Thus it was highly essential that the marketing information is accurate and complete in all aspects, and is efficiently disseminated to the stakeholders. With the advent of Information and Communication Technology (ICT), it became easier to communicate large volumes of data to far and remote locations. Thus in order to strengthen the farming communities and to provide them with opportunities of trade, there was a need to implement a solution providing "Agricultural Marketing Information Network" in the country.

As a result, the Central Sector Scheme project of Agricultural Marketing Information Network (AGMARKNET) was launched by the Ministry of Agriculture, Government of India in the month of March, 2000. It aimed to connect together all the agricultural produce wholesale markets throughout the country and the State Agricultural Marketing Boards and Directorates. The project received technical support from National Informatics Centre (NIC).

The key objective is to gather, break down & disseminate market information to the stakeholders. Around 3245 nodes have been affiliated with the scheme. These nodes comprise of agricultural produce markets, field offices of Directorate of Marketing and Inspection and State Agricultural Marketing Boards/Directorates and their attached offices, etc. These nodes have been provided with necessary computer hardware components along with internet connectivity. 'AGMARK,' a user friendly software package has been developed to facilitate compilation and transmission of data at market level. The reporting system is now web enabled. The Agmarknet portal (http://agmarknet.dac.gov.in/) strengthens interface with farmers

and other beneficiaries The AGMARKNET portal also provides access to various websites of organizations involved with agricultural marketing. It provides weekly trend analysis, futures prices and international price trendsfor important commodities.

1.1.2 Directorate of Marketing and Inspection

The Directorate of Marketing and Inspection (DMI) is under the Governance of the Ministry of Agriculture. The Government of India had setup the DMI in the year 1935 to facilitate the implementation of agricultural marketing policies and programmes. Since then the Directorate has been working tirelessly to bring about advancement of agricultural marketing as well as safeguarding the interests of produces, suppliers as well as consumers. It also facilitates interaction between the Central and State Governments regarding agricultural marketing policies. The Directorate is headed by the Agricultural Marketing Adviser to the Govt. of India (AMA).

1.1.3 National Informatics Centre (NIC)

The National Informatics Centre (NIC) was established in 1976 to provide ICT Solutions for effective e-Governance initiatives. National Informatics Centre has spearheaded the "Informatics-led-development" programme of the Government of India and has generated competitive advantage by implementing ICT applications in social & public administration. The following major activities are being undertaken:

- Setting up of ICT Infrastructure
- Implementation of National and State Level e-Governance Projects
- Products and Services
- Consultancy to the government departments
- Research and Development
- Capacity Building

Since its inception, NIC has undertaken many software application implementations based on state-of-the-art technology. NIC is also responsible for managing the information systems and websites of Central Ministries/Departments, Disaster Recovery Centres, Network Operations facility to manage heterogeneous networks spread across Bhawans, States and Districts, Certifying Authority, Video-Conferencing and capacity building across the country. NIC also has under its belt

various initiatives such as Government eProcurement System(GePNIC), Office Management Software (eOffice), Hospital Management System (eHospital), Government Financial Accounting Information System (eLekha), etc.

For the Agricultural Marketing Network Scheme, NIC had provided computer hardware, developed the software, provided training to market personnel towards the operation of the hardware and software systems and provided internet connectivity. It has also developed the integration between the software packages developed by the various states with AGMARKNET to bring about seamless uniformity in the database.

1.1.4 State Agricultural Marketing Boards

Ever since the country attained independence, the Planning Commission of India has been striving hard to maximize agricultural production. In pursuit of this goal, the Zamidari system had to be abolished and surplus land had to be distributed among farmers and laborers. The programmes like Intensive Agricultural Development Programme (IADP) were launched. And rural development became of prime importance. So, on one hand, on the national level, efforts were being made to maximize production, while on the state level, the focus was laid on sale, storage and processing of agricultural produce. There was also the issue of distribution of the produce so that the produce was sold off at prices which were to be fair to both farmers, traders and consumers. It was with this objective in view thatmany states chose to establish State Agricultural Marketing Boards in order to facilitate marketing activities regarding agricultural produce.

For AGMARKNET, the State Government/ Marketing Boardsprovided the list of markets to be covered under theAgricultural Marketing Scheme. The selected markets were to provide site for installation comprisingfacilities for computer installation, telephone connectivity and computer operator.

Market Committees/ Controlling authorities of AGMARKNET nodeat market level were assigned to collect relevant data and information,feed it and transmit it to the State level and AGMARKNET portal. NIC had alsotrained suitable persons from each node in operating computer and handlingsoftware package.

At each market node, there is a person assigned to collect data and transmit it. An incentive scheme has been introduced to reward data entry operators for maintaining performance standards regularly.

1.2 Significance of study

- “The Agricultural Marketing Information System Network (AGMARKNET)" which is NICNET based aims at linking all the important Agricultural produce Market Committees (APMC), State marketing boards & directorate of marketing & inspectional Regional offices. So that there can be seamless exchange of information.
- The purpose of study is to understand and investigate into the data quality & to help AGMARKNET to improve upon the data quality of reporting prices.
- There are many approaches in the literature that can be applied to studying data quality. With the study it was aimed to improve upon the quality of price reported.
- Moreover forecasting the future prices of an agricultural commodity can help the stakeholders to be better prepared for price rise or fall. Through timely awareness, Forecasted values can provide the much-needed leverage of time to adapt & perform accordingly.
- Data filtering, sorting & data gap filling can help us to draw a meaningful inferences from the agricultural data & perform activities such as forecasting & diagnostic tool development using that data for distinct market.

1.3 Objectives of the Study

The data pertaining to marketing information about the various agricultural produce is easily available on the AGMARKNET portal. Although the reported data has some shortcomings when it comes to the reporting quality. Further daily price reporting data also suffered from irregularities due to lack of discipline in daily data reporting & human errors which may be either deliberate or unintentional in nature. This study aims to find out whether such errors exist and the gaps in the data reporting & then to bridge those gaps order to improve the quality of the data being provided by the AGMARKNET portal. Since it would be impractical to evaluate the data of all the commodities being listed on the portal, we shall only evaluate the data for one of the

non-perishable commodities i.e. Paddy(Dhan). The objectives of this study are as follows:

1. To develop a diagnostic tool which can report irregularities in price for major Paddy(dhan) market
2. To forecast the future prices of Paddy(Dhan) for major markets.

Chapter-2

LITERATURE REVIEW

Numerous literature related to the context of agricultural marketing and its management is available online. By the review of relevant literature related to the agricultural markets, it was aimed to highlight the key definitions & features of the agricultural related market information. Therefore, it becomes necessary to see how that information can be monitored & controlled. So appilacbility statistical process controls particularly in non manufacturing sectors needs to explored. Through proper data monitoring, data quality can be improved which can provide accurate information to the stakeholders associated with the agricultural market.

2.1 WHAT IS AGRICULTURAL MARKETING?

Agricultural marketing can best be defined as series of services involved in moving a product from the point of production to the point of consumption. Thus agricultural marketing is a series of interconnected activities involving: planning production, growing and harvesting,, grading, packing, transport, storage, agro- and food processing, distribution, and sale (Tracey, 2003). Such activities cannot take place without the exchange of information and are often heavily dependent on the availability of suitable finance. Marketing systems are dynamic. They are competitive and involve continuous 21 change and improvement. Those who have high costs, do not adapt to changes in market demand and provide poor quality are often forced out of business. Marketing has to be customer-oriented and has to provide the farmer, transporter, trader, processor, etc. with a profit. This requires those involved in marketing chains to understand buyer requirements, both in terms of product and business conditions.

2.2 MARKET INFORMATION

Efficient market information can be shown to have positive benefits for farmers and traders. Up-to-date information on prices and other market factors enables farmers to negotiate with traders and also facilitates spatial distribution of products from rural areas to towns and between markets. Most governments in developing countries have tried to provide market information services to farmers, but these have tended

to experience problems of sustainability. Moreover, even when they function, the service provided is often insufficient to allow commercial decisions to be made because of time lags between data collection and dissemination (Barrett., 1997). Modern communications technologies open up the possibilities for market information services to improve information delivery through SMS on cell phones and the rapid growth of FM radio stations in many developing countries offers the possibilities of more localised information services. In the longer run, the internet may become an effective way of delivering information to farmers in developing countries like India. However, problems associated with the cost and accuracy of data collection still remain to be addressed. Even when they have access to market information, farmers often require assistance in interpreting that information. For example, the market price quoted on the radio may refer to a wholesale selling price and farmers may have difficulty in translating this into a realistic price at their local assembly market (Barrett, and Carter, 1999). Various attempts have been made in developing countries to introduce commercial market information services but these have largely been targeted at traders, commercial farmers or exporters. It is not easy to see how small, poor farmers can generate sufficient income for a commercial service to be profitable, although, in India a new service introduced by Thompson Reuters was reportedly used by over 100,000 farmers in its first year of operation (Fafchamps, and Minten , 2001).

2.3 MARKETING TRAINING

Farmers frequently consider marketing as being their major problem. However, while they are able to identify such problems as poor prices, lack of transport and high post-harvest losses, they are often poorly equipped to identify potential solutions. Successful marketing requires learning new skills, new techniques and new ways of obtaining information. Extension officers working with ministries of agriculture or NGOs are often well-trained in horticultural production techniques but usually lack knowledge of marketing or post-harvest handling (Fickler, Goodwin, 2001). Ways of helping them develop their knowledge of these areas, in order to be better advise the farmers about market-oriented horticulture, need to be explored. While there is a range of generic guides and other training materials available from FAO and others, these should ideally be tailored to national circumstances to have maximum effect.

2.4 ROLE OF AGRICULTURAL MARKETING SYSTEM IN ECONOMIC DEVELOPMENT

Rao (2000) in his study, "Experience in Agricultural Marketing in India" states that it is only now that the developing countries have increasingly recognized that the agricultural marketing system plays a crucial role in economic development, not only by physically distributing increased production through incentives but also distributing the benefits of growth. As a result, many governments have now tried many approaches to develop the marketing system, with varying degrees of success. Jaganathan (1997) in his paper "Utilisation of Regulated Markets by Farmers in Periyar District, Tamil Nadu", outlines that the establishment of regulated markets to solve marketing problems could be reflected in their proper utilization by farmers for deriving economic benefits. A high degree of utilization of regulated markets by farmers would lead the farming community to higher standard of living.

2.5 IMPORTANCE OF FAIR PRICE TO BOTH FARMERS AND CONSUMERS

Organized market can alone ensure fair price to producers as well as consumers. Farmers' markets operate in the same line. If marketing of agricultural produce is properly organized, it can fetch a good price to the farmer and he will be inspired to produce more. The interest of the consumer will also be taken care of side by side. An efficient and properly organized marketing should get along with price strategies. Therefore, insure fair price to the producer as well as to the consumer.

2.6 GREEN REVOLUTION

M.S. Swaminathan, the eminent agricultural scientist, analyzing the success of green revolution in Punjab state "The green revolution in Punjab is not a miracle". It happened only because the following prerequisites for its success existed in mid-sixties.

1. Land consolidation and levelling.

2. Owner cultivation resulting in a long term stake in land.

3. Rural communication.

4. Rural electrification and

5. A dynamic agricultural university.

According to Acharya (2004) India's age old farming practice has taken a turn in the recent years. There had been a technological breakthrough after the advent of Green Revolution, the evolution of high-yielding variety seeds, increased use of fertilizers, insecticides and pesticides, installation of pump sets and tractorisation and mechanization. This technological breakthrough has led to a substantial increase in production on the farms and to a large marketable and marketed surplus.

2.7 AGMARKNET –GLOBALISATION OF INDIAN AGRICULTURE & GREEN REVOLUTION

A step towards globalisation of Indian agriculture, and a step in bringing another green revolution the e-governance portal AGMARKNET facilitates generation and transmission of prices, commodity arrival information from agricultural produce markets, and Web-based dissemination to producers, consumers, traders, and policy makers transparently and quickly.

It aims at improving the decision-making capability of the farmers and strengthening their bargaining power.

2.7.1 Situation

Agricultural marketing is an initiative to bring the second generation of green revolution problems. Indian marketing is undergoing a significant metamorphosis because of economic liberalization and globalization.

Market information is an important aspect of agricultural marketing. The importance of sound agricultural marketing policies for ensuring fair returns to the farmers cannot be overemphasized.

Therefore, it has become necessary on the part of the regulatory agencies to ensure remunerative prices to farmers for the sale of their produce, to boost up their efforts for increasing and sustaining the agricultural production. Almost all states and union territories are providing market information in one form or the other for the benefits of market users like producers, traders, and consumers. However, the information is

collected and disseminated by use of conventional methods causing inordinate delay in communicating to different groups and this, in turn, adversely affects their economic interest.

Therefore, the availability and dissemination of complete and accurate marketing information is the key to achieve both operational and pricing efficiency in the marketing system.

To strengthen interface with farmers and other beneficiaries, AGMARKNET portal has been evolved. Over 600 markets regularly report price-related data being disseminated through the portal. The portal also serves as a single window for accessing Web sites of various organizations.

It also provides weekly trend analysis, linkage to online commodity exchange of India, Food and Agriculture Organization (FAO), Indian Farmers Fertilizer Cooperative Limited (IFFCO) Web site, and so forth.

The development of the AGMARKNET portal and the state-level portal, and undertaking market-led extension activities are important components of this scheme. AGMARKNET ensures dissemination of data through the network to any distance for the benefit of citizens, farmers, traders, and consumers.

The improved communication system has enabled producers to learn about probable markets in which their produce can be disposed more profitably. Also the modernization of the market information system has led to efficiency in markets and increased participation of the farmers.

2.7.2 Knowledge Portal

The AGMARKNET portal is constantly enriched with agricultural marketing–related information. Efforts are on to reach out to the farmers in their regional languages. As of now, the portal is disseminating daily prices and arrivals information in eleven regional languages. The portal also caters to the diversified needs of these stakeholders by providing the following agricultural marketing–related information as a single window Web service over the Internet.

2.7.3 Price and Arrivals

The portal provides access to commodity-wise, variety-wise daily prices and arrivals information of various wholesale markets. Future prices from the three national multi-commodity exchanges are reflected on the portal. The price data is reported in the unit of Rs/Quintal. There are three types of prices reported on the portal, they are:

- **Maximum Price**

  The maximum prices paid for an agricultural commodity during several transactions held in a day in a market is termed at maximum price.

- **Minimum Price**

  The minimum prices paid for an agricultural commodity during several transactions held in a day in a market is termed at minimum price.

- **Modal Price**
  The modal price is the price at which most of the commodity was sold in the market during the day.

Along with these three prices one can also get the details of the state name, district name, group to which agricultural commodity belongs, variety & grade.

Thus the information being disseminated through the AGMARKNET portal is quite comprehensive and vital to all the stakeholders of agriculture.

2.8 Overview of Paddy(Dhan) Production

According to Agricultural Market Information System (AMIS) and FAO, Paddy(Dhan) is sown in March and reaped in mid-October-mid-November. It develops well in cool, damp atmosphere and ages in a warm, dry atmosphere. The cool winters and the hot summers are helpful for a decent product. A cloudless sky having brilliant daylight amid maturing and gathering periods will improve quality Paddy(Dhan). Winter precipitation is perfect. The climatic conditions suitable for growing Paddy(Dhan) are given below:

• **Temperature:** The month to month normal temperature ought to go in the vicinity of 10°C and 15°C amid the time of sowing. The same ought to be in the vicinity of

21°C and 26°C amid maturing period. Paddy(Dhan) grain does not develop completely if the temperature falls underneath 21°C.

• **Rainfall:** Paddy(Dhan) develops better in those ranges where precipitation happens in winter. Regions having 50 to 100 cm yearly normal rainfall develop Paddy(Dhan). Irrigation serves the best if rainfall falls underneath 50 cm.

2.8.1 Trade Policy

• Export Policy: Under the policy of the Government of India, the export of Paddy(Dhan) is free.

• Import Policy: Import of Paddy(Dhan) for human utilization is allowed through State Trading Enterprises but import of seeds is confined.

2.8.2 Major Paddy(Dhan) Producing States (2016)

The Major Paddy(Dhan) producing states for the year 2014-15 according to Directorate of Economics and Statistics, Ministry of Agriculture are:

Table 2.1: Control Charts

S.No	State Name	Paddy (Tonnes)
1	Punjab	11566774.99
2	Chattisgarh	6183534.44
3	Haryana	3758286.51
4	Uttar Pradesh	3716519.61
5	Chattisgarh	1986428.31
6	Uttrakhand	1809145.82
7	Karnataka	1558452
8	West Bengal	1363543.35
9	Orissa	1282701.86
10	Tamil Nadu	764221.54

Thus, it is seen that when it comes to agriculture then the quality of data reported becomes of prime importance. Data reporting of arrivals and prices on a daily basis becomes a cumbersome task often involving errors. Thus, the entire data reporting process keeps on running without any checks and controls.

2.9 Statistical Process Control

In 1920, Dr. Walter A. Shewhart developed the concept of control chart and state of statistical control while working at Bell Laboratories, thereby pioneering the Statistical Process Control (SPC) which was carried forward by W Edwards Deming. There are primarily seven key tools of statistical process control, they are:

• **Check Sheets**

The check sheet may be a type (document) used to assemble data progressively at the range the place the data is processed. The majority of the data it catches might make quantitative and alternately subjective. In that perspective, the point when some information is quantitative, then a check sheet is sometimes called a count sheet.

• **Pareto Chart**

A Pareto chart, also called a Pareto distribution diagram, is a vertical bar graph where values are plotted in decreasing order of relative frequency from left to right.

• **Histograms**

Introduced by Karl Pearson, a histogram graphically represents the distribution of data in which is in numerical form.

• **Scatter Diagrams**

Values of two variables are plotted along two axes on a single graph, the pattern of the resulting points revealing any correlation present.

• **Defect Concentration Diagrams**

The defect concentration diagram (also problem concentration diagram) is graphical apparatus that is helpful in breaking down the reasons for the item or part defects.

• **Control Charts**

The control chart is a chart used to study how a procedure changes after some time. Information are plotted in time arrange. A control graph dependably has a central for

the average, an upper line for the upper control limit and a lower line for the lower control limit. These lines are developed from past information.

2.9.1 SPC and Non-Manufacturing Sector

Since its being statistical process control was thought to be applicable to only manufacturing processes with the objective of reducing waste or scrap and it was thought impractical to apply statistical process control to non- manufacturing processes. But in the year 1988, Software Engineering Institute suggested that statistical process control could be applied to non-manufacturing processes, such as software engineering processes. The Level 4 and Level 5 practices of the Capability Maturity Model Integration (CMMI) use this concept. Also in his book titled “Statistical Process Control”, Leonard A. Doty has said that any of the control charts can be applied in the non-manufacturing sector (like education, health care, politics, family life and self-improvement) in the similar way as they are applied in the manufacturing process. Thus, there is enough evidence that statistical process control can be applied to non-manufacturing processes as well. Due to the above evidence, it was clear that information relating to statistical process control tools particularly that of control charts needs to be gathered and comprehended. Control charts are basically graphs to show how a process changes over time. With three lines namely, Upper Control Limit (UCL), Lower Control Limit (LCL) and a Control Line (CL) determined by the previous data available. These charts can help in drawing conclusions about process variations.

Table 2.2: Control Charts
(**Source:** Internet)

Attribute Data Chart	**Variable Data Chart**
p Chart (Fraction Defective)	$\bar{X}$ and R (Average and Range Chart)
np Chart (Number Defective)	X and R_m (Individuals and Moving Range Chart)
c Chart (Number of Defects)	
u Chart (Number of Defects per Unit)	

Attribute data chart is used when the data is counted as discrete events, whereas, in variable data chart data is measured on a continuous scale. The type of chart used is determined by the type of data collected as well as the subgroup size of the data. Since the aim is to collect price data over a period of year, variable data chart will be most suitable for the process. When it comes to control charts it is important to understand the subgroups i.e. a group of measured units under the same conditions. The subgroup restrictions for Individuals and Moving Range Chart are that the data must have a subgroup size equals 1 (i.e. data cannot be grouped and each measurement is unique), whereas subgroup size for Average and Range Chart is greater than 1 (i.e. data can be grouped and each measurement is not unique).

2.9.2 Individuals and Moving Range Chart

An I-MR chart is a plot of individual observations (I chart) and moving ranges (MR chart) over time for variables data. The moving range is defined as MRi=|Xi− Xi−1|, which is also the absolute value of the first difference.

Table 2.3: Control Charts

Lower Control Limit	Control Limit	Upper Control Limit
$\bar{X} - \frac{3\overline{MR}}{d_2}$	$\bar{X}$	$\bar{X} + \frac{3\overline{MR}}{d_2}$

The value of d2 is 1.128(Shewhart constants) for moving range value that equals 2 (since we are taking the absolute first level difference). So, substituting this value in the control limits equations, the equation becomes $\bar{X} \pm 2.66\overline{MR}$, where $\bar{X}$ is the average of the series and $\overline{MR}$ is the moving range.

According to Nancy R. Tague's 'The Quality Toolbox', the control chart basic procedure is to firstly choose the appropriate control chart for the data. Secondly, determine the appropriate time period for collecting and plotting data. And third, collect data, construct the chart and analyze the data. Once the chart is plotted one should look for "out-of-control signals" on the control chart. Continue to plot data as

they are generated. As each new data point is plotted, check for new out-of- control signals.

2.10 Time Series Forecasting

A time series is a series of information focuses filed (or recorded or diagramed) in time arrange. Most normally, a time series is an arrangement taken at progressive similarly separated focuses in time. Forecasting is a technique that is utilized widely in time series examination to foresee a reaction variable, for example, month to month benefits, stock execution, or unemployment figures, for a predetermined timeframe. Conjectures depend on examples in existing information. One can utilize an assortment of time series techniques, such as trend analysis, decomposition, or single exponential smoothing, to model examples in the information and extrapolate those examples to what's to come. Ramasubramanian V. of Indian Agricultural Statistics Research Institute(IASR) with expertise in Agricultural Economics, Aquaculture, Artificial Neural Network has discussed various time series models for agricultural forecasting in “Forecasting Techniques in Agriculture” namely:

- **Exponential Smoothing Models**
- **Auto Regressive Integrated Moving Average (ARIMA) Models**

So, from the above references it is seen that there is evidence that forecasting of time series has been done in agriculture sector to predict the future crop yields.

2.10.1 Exponential Smoothing Models

Exponential smoothing weights past observations with exponentially decreasing weights to forecast future values. For any time period t, the smoothed value St is found by computing where Si stands for smoothed observation and Y stands for the original value.

$$St=\alpha Yt-1+(1-\alpha)*S\ t-1\ ,\ 0<\alpha\leq 1,\ t\geq 3.$$

Alpha (α) is known as the smoothing constant. The optimized value of alpha can be chosen using the value of Mean Absolute Percentage Error (MAPE) i.e. choose the value of alpha for which the value of MAPE is least. Another form of Exponential Smoothing method is ETS (Error-Trend- Seasonality) exponential smoothing

method. The ETS modeling framework was developed in 2002 IJF paper (with Hyndman, Koehler, Snyder and Grose), and in 2008 Springer book (with Koehler, Ord and Snyder). Exponential smoothing methods were originally classified by 'Pegels' (1969). This was later extended by Gardner (1985), modified by Hyndman et al. (2002), and extended again by Taylor (2003), giving a total of fifteen methods seen in the following table.

Trend Component		Seasonal Component N (None)	A (Additive)	M (Multiplicative)
N	(None)	N,N	N,A	N,M
A	(Additive)	A,N	A,A	A,M
A_d	(Additive damped)	A_d,N	A_d,A	A_d,M
M	(Multiplicative)	M,N	M,A	M,M
M_d	(Multiplicative damped)	M_d,N	M_d,A	M_d,M

Figure 2.4: The Fifteen Exponential Smoothing Methods
(**Source:** Forecasting Package of R Language)

According to Rob J. Hyndman and Yeasmin Khandakar, "the cells (N, N) describes the simple exponential smoothing (or SES) method, cell (A, N) describes Holt's linear method, and cell (Ad, N) describes the damped trend method. The additive Holt-Winters' method is given by cell (A, A) and the multiplicative Holt-Winters' method is given by cell (A, M). Equations for method (A, A), the Holt-Winters' additive method."

$$
\begin{aligned}
\text{Level:} \quad & \ell_t = \alpha(y_t - s_{t-m}) + (1-\alpha)(\ell_{t-1} + b_{t-1}) \\
\text{Growth:} \quad & b_t = \beta^*(\ell_t - \ell_{t-1}) + (1-\beta^*)b_{t-1} \\
\text{Seasonal:} \quad & s_t = \gamma(y_t - \ell_{t-1} - b_{t-1}) + (1-\gamma)s_{t-m} \\
\text{Forecast:} \quad & \hat{y}_{t+h|t} = \ell_t + b_t h + s_{t-m+h_m^+}.
\end{aligned}
$$

Figure 2.5: Equations in ETS Models
(**Source:** Forecasting Package of R Language)

Also, according to Rob J. Hyndman and Yeasmin Khandakar, in the above equation "where m is the length of seasonality, t represents the level of the series, bt denotes the growth, st is the seasonal component, ˆyt+h|t is the forecast for h periods ahead. Some interesting special cases can be obtained by setting the smoothing parameters to extreme values. For example, if α = 0, the level is constant over time;

if $\beta * = 0$, the slope is constant over time; and if $\gamma = 0$, the seasonal pattern is constant over time."

2.10.2 Making Time Series Stationary

To check a whether a time series is stationary or not a test known as Breakpoint Unit Root Test is used. This test has a null hypothesis that Ho: Series has a unit root. If a series has unit root then it a non-stationary series. To check the hypothesis, p-value is seen i.e. if p-value is less than 0.05 then hypothesis is rejected and time series is stationary, where as if p- value is greater than 0.05 then hypothesis is accepted and the time series is non-stationary. One approach to make a time series stationary is to find the differences between the data recorded. This is known as differencing. Changes, for example, logarithms can balance out the variations of a time series. Differencing can help balance out the mean of a time series.

• **Random walk model**

The differenced series is formed by subtracting the next observation from the previous one, and can be written as

$$y't = yt - yt-1$$

The differenced series will have only t−1 values since it is not possible to calculate a difference for the first observation. Once the series is stationary one can run time series analysis to perform forecasting.

2.10.3 Commodities and Varieties

A commodity base, comprising of more than 300 commodities and about 2,000 varieties has been evolved. The commodities are being categorized into various groups: cereals, pulses, oil seeds, fruits, vegetables, spices, fiber crops, beverages, forest products, drugs and narcotics, dry fruits, flowers, forest products, livestock/poultry, and so forth to facilitate easy retrieval of market information.

2.10.4 Grading and Standardization

To promote the importance of quality among the farming community, the portal emphasizes on standardization and grading aspects of the agricultural products. The information is provided in the form of documents/specifications prescribed by the

act/rules of DMI and other agencies. It also links to the Codex International food standards, guidelines, and related texts such as the codes of practice under the joint FAO/World Health Organization (WHO) Food Standards Programme.

2.10.5 Benefits

The AGMARKNET project has strengthened the interfaces among government organizations, farmers, industry, policy makers, and other beneficiaries.The project also aims at empowering the farming community with market information. For maximizing the benefits it needs to be integrated with other ICT initiatives targeting the upliftment of rural India. The project is part of National eGovernance action plan of Government of India.

2.10.6 Efficient and timely utilization of market data

AGMARKNET has helped establish a nationwide information network for speedy collection and dissemination of market data for efficient and timely utilization.

2.10.7 Farmer empowerment

The AGMARKNET has already emerged as the sun-shine website to bargain better prices for their produce, and marching ahead towards becoming an e-Commerce and e-Business Portal in India.

2.10.8 Improvement in agricultural marketing

Progressive sensitization and orientation of farmers helps them respond to new challenges in agricultural marketing by using Information, Communication and Technology (ICT) as a vehicle of extension.

2.11 Conclusion of the Literature

Through the review, it has been brought to light that extensive literature is available online regarding marketing information. Also, how AGMARK reports prices and arrivals to deliver timely information was also noted. There are evidences regarding the applicability of statistical process control in non- manufacturing sector and how time series forecasting has been done on the agricultural sector as well. Now, the methodology involved in the study shall be discussed.

Chapter-3

METHODOLOGY

3.0 Introduction to Methodology

Analytical research was embraced keeping in mind the end goal to study this venture. Analytical research is a particular sort of research that includes basic deduction abilities & the assessment of truths & data in respect to the research being directed. Inside analytical research articles, information & other essential truth that relate to a venture is gathered; after the data is gathered & assessed, the sources are utilized to demonstrate a speculation or bolster a thought. A person can bring out small details to form greater assumptions about the material by using critical thinking skills effectively.

The research in this project focuses on secondary data obtained from the AGMARKNET.GOV.IN portal. Through this analysis, the study aims to bring to forward the data gaps in order to develop an effective diagnostic tool & a forecasting model.

In this chapter, the various phases involved in the study shall be discussed.

3.1 Process of analysis

Phase I – Preliminary activities

Step 1: To write a mission statement, decides the purpose of project and what are we looking for. As the project aims to develop a diagnostic tool for a particular commodity in order to improve the quality of the data reported in future. Developing a diagnostic tool will help farmers & citizens of the country to have correct information regarding the crop commodity as it will help address the issues such as modal prices reported zeros, modal prices reported as averages of maximum & minimum price & modal prices with extreme values. Thereby reducing the error in reporting.

The second objective of the project is to forecast the prices of the chosen commodity. This activity will help farmers & government to understand the prices in the coming months of 2017.

Step 2: To understand the data reporting fields of AGMARKNET portal.

The AGMARKNET portal reports Arrivals (in tones) & Prices (in Rs/Quintal) along with crop commodities state, district, variety, grade & date of reporting

Phase II – Compile and analyze the data

Step 1: Tools chosen for Analysis:- The software chosen for the development of diagnostic tool was Microsoft Excel 2013, where the softwares chosen for time series forecasting were Microsoft Excel 2013 & Eviews 9.5 SV Lite. .

Step 2: To find the the state, district & market with maximum arrivals within the reporting period.

The state with maximum arrivals for paddy(dhan) was found out. Then within that state the district & market with maximum arrivals for paddy(dhan) were found.

Step 3: Check for the reporting frequency of the data fields (Modal price & date).

The plot of prices reported per month was done for the whole reporting period to check the consistency of the data.

Step 4: Clean the data for better analysis.

The data gaps were identified & they were filled using the average method in order to have a consistently reported past data which can be worked upon easily to develop diagnostic tool & forecast model

Step 5: Analyze the data to develop diagnostic tool & forecast model in the next phases. The data was analyzed for data gaps, zeros & reporting of averages of maximum prices & minimum prices in place of modal prices.

3.1.1 Developing Phase

Step 1: To develop a diagnostic tool incorporating statistical process control charts. To develop a diagnostic tool, it was necessary to keep the process statistically controlled. For this control chart was used. Various literature pertaining to control

charts was studied and the correct chart was chosen according to the best data fit. The chart helped us to get the upper and lower control limits.

Step 2: Develop a time series forecast model for the modal price of the chosen commodity. To forecast the time series data into 2017, exponential smoothing method was used.

3.1.2 Testing Phase

Step 1: Test the diagnostic tool on other markets reporting the same commodity.

The diagnostic tool thus developed for one market was applied on other markets as well by using their respective control limits to check the applicability of the tool across markets for the same commodity.

Step 2: Check the accuracy of the forecast model.

To check the accuracy of the forecast various parameters like Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE) were used.

3.1.3 Findings and Recommendations Phase

After extensive analysis, one will be able to bring out some findings and recommendations through which the AGMARKNET portal can benefit. The limitations of the diagnostic tool and forecasting model are also be highlighted.

3.2 Concluding Remarks

The approach towards the study of the project and the project methodology was discussed in this chapter. Now in the next chapter the data analysis, findings, limitations and recommendations regarding the study shall be discussed.

Chapter-4

Data Analysis

4.0 Introduction to Data Analysis

The commodity chosen for analysis in the understanding phase was Paddy(Dhan). The commodity data for Paddy(Dhan) obtained from the AGMARKNET portal was usually in .xls format and various operations such as data filtering, data sorting and data cleaning was done in order to draw and make sense out of the compiled data. Since, the project had two major objectives the entire analytics process was classified into two major headings as:

DATA-ANALYSIS

- **Development of a Diagnostic Tool**
- **Forecasting the modal prices of Paddy(Dhan)**

4.1 Development of a Diagnostic Tool

The development of diagnostic tool was a multi phased process. The phases were as follows:

4.1.1 Choosing a Tool to Analyze Data

Since, the data obtained from AGMARKNET was in excel format, so, Microsoft Excel 2016 was chosen to analyze the data and develop a diagnostic tool also.

4.1.2 Selection of Market for Analysis

The arrival data for Paddy(Dhan) for the past one year i.e. from 01 January,2016 to 31 December,2016 was obtained for all the states from the AGMARKNET portal. The arrivals were for each state and the percentage share of total arrivals for each state was found. It was clear to see that Punjab was the leader in Paddy(Dhan) arrivals with 31.28% share of the total Paddy(Dhan) arrivals. Hence, the data of the state Punjab was analyzed to find the district and market showcasing maximum arrivals in tonnes. The district that gave maximum arrivals was Sangrur with a share of 9.67% and in that district Bhawanigarh market showed the highest percentage of arrivals of about 51.96%. So, it was decided to develop the diagnostic tool for

Bhawanigarh market of Sangrur district in Punjab. However, it was found that the Bhawnigarh market showed all its arrival in the month of April 2016 and the data reporting of prices during the same period was also not upto the mark. So, it was decided to do analysis for the next major state in terms of Paddy(Dhan) arrivals viz. Chattisgarh. Hence the state of analysis was shifted from Punjab to Chattisgarh, which had 16.72% of the total Paddy(Dhan) arrivals during the year 2016. The Surguja district (20.84% of Paddy(Dhan) arrivals for Chattisgarh) ranked one in terms of Paddy(Dhan) arrival and within Surguja district, Surajpur market was seen to have 82.29% of the total district arrivals. The arrivals were seen throughout the year making the market appropriate for further analysis.

Table 4.1 Arrival data for Paddy(Dhan)(State, District & Market Wise)
(**Source:**Own Analysis on AGMARKNET data)

District	Arrival	%Arrival
Bastar	228299.1	3.69%
Bijapur	2854.4	0.05%
Bilaspur	544573.3	8.81%
Dantewada	16225	0.26%
Dhamtari	377135.3	6.10%
Durg	76757.6	1.24%
Janjgir	770384.8	12.46%
Jashpur	64788.1	1.05%
Kanker	23391.7	0.38%
Kawardha	2858.71	0.05%
Korba	107256	1.73%
Koria	1746.5	0.03%
Mahasamund	350895.4	5.67%
Narayanpur	363.7	0.01%
North Bastar	76602.46	1.24%
Raigarh	485092.1	7.84%
Raipur	1282475	20.74%
Rajnandgaon	483309.3	7.82%
Surguja	1288526	20.84%
Grand Total	6183534	

Surajpur	Arrival(in tonnes)
jan	342191
feb	72009
mar	810
apr	1020
may	4270
june	4965
july	4853
Aug	680
sept	2300
oct	2010
nov	172617
dec	452607

4.1.3 Checking for Modal Price Reporting Frequency

Along with arrivals it became necessary to see the frequency with which prices were reported for Surajpur market in Chattisgarh. We found the price reporting to be good throughout the year as it reported for 307 days out of 366 days.

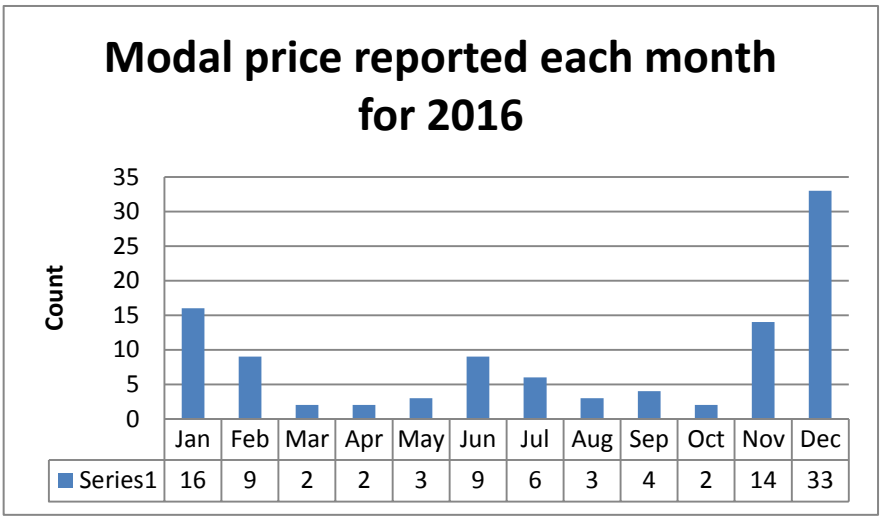

Figure 4.2: Modal Price Reported
(Source: Own Analysis on AGMARKNET Data**)**

4.1.4 Data Cleaning of Modal Prices

The price reporting sheet for Surajpur market was analyzed on the following points

• Modal Price is Average

In the entries, it was checked that how many entries had modal price equal to average of maximum and minimum price by using the "IF" statement in MS Excel. It was found that there were some entries where modal price was actually average.

• Modal Price is Zero

The reported entries were checked for where the modal price is reported to be zero. No entry was found to be reporting modal price zero. The entries having modal price as average of maximum and minimum prices were deleted. Some entries were now reported after deletion and by using VLOOKUP command PIVOT TABLE the daily data gaps were filled by the average modal price of that month. Thereby, having a continuous series.

4.1.5 Developing a Control Limits and Control Charts

Once the data was properly cleaned it was necessary to develop control limits. For this statistical process control charts were referred. Since, the modal prices were of variable nature, measured on a continuous scale of daily dates and the data set had a subgroup size of one (as each day's price data cannot be combined with the next day's data), so, the Individual Moving Range Chart was chosen to get the upper control limit and lower control limit. The equation for control limits for I-MR chart is:

$$\bar{X} \pm 3\bar{MR}/d2, \text{ Where } E2=3/d2 \text{ and } d2=1.128.$$

Therefore, the equation becomes,

$$\bar{X} \pm 2.66\bar{MR}$$

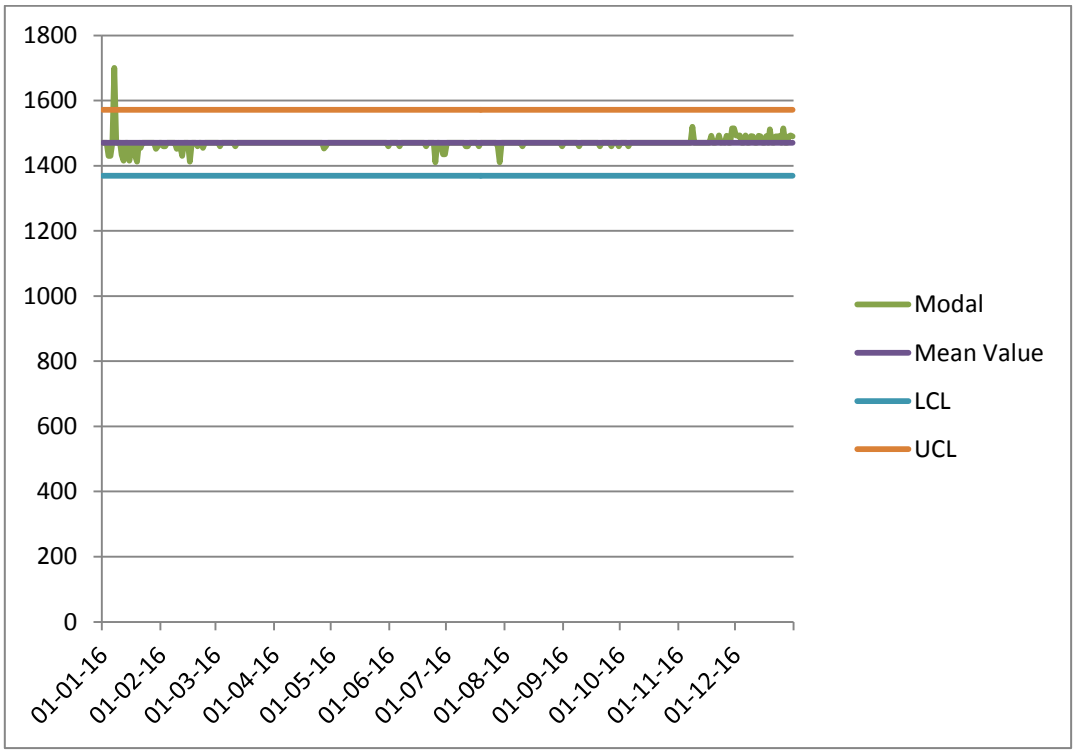

Figure 4.3: Control Chart for Surajpur Market
(Source: Own Analysis on AGMARKNET data**)**

4.1.6 Developing the Interface of the diagnostic tool

The diagnostic tool was a standalone excel sheet where users can enter the data for modal price to check whether the price values where within the range or not. The excel sheet also consisted of dynamic Control Charts, reflecting new data value entered dynamically. The tool prompted for a warning message"Outlier" if the date did not belong to 2016 or if the modal price was out of the UCL and LCL or if the maximum and minimum prices were negative.

		Market	Surajpur	Surguja	(Chattisgarh)	
Date	Modal	Mean Value	LCL	UCL		Outlier error
01-01-16	1470.081	1470.081081	1368.814	1571.348		
02-01-16	1470.081	1470.081081	1368.814	1571.348		
03-01-16	1470.081	1470.081081	1368.814	1571.348		
04-01-16	1430	1470.081081	1368.814	1571.348		
05-01-16	1430	1470.081081	1368.814	1571.348		
06-01-16	1470.081	1470.081081	1368.814	1571.348		
07-01-16	1700	1470.081081	1368.814	1571.348		Outliar
08-01-16	1470.081	1470.081081	1368.814	1571.348		
09-01-16	1470.081	1470.081081	1368.814	1571.348		
10-01-16	1470.081	1470.081081	1368.814	1571.348		
11-01-16	1433.5	1470.081081	1368.814	1571.348		
12-01-16	1415	1470.081081	1368.814	1571.348		
13-01-16	1470.081	1470.081081	1368.814	1571.348		
14-01-16	1470.081	1470.081081	1368.814	1571.348		
15-01-16	1415	1470.081081	1368.814	1571.348		
16-01-16	1455	1470.081081	1368.814	1571.348		
17-01-16	1470.081	1470.081081	1368.814	1571.348		
18-01-16	1430	1470.081081	1368.814	1571.348		
19-01-16	1412	1470.081081	1368.814	1571.348		
20-01-16	1470.081	1470.081081	1368.814	1571.348		
21-01-16	1455	1470.081081	1368.814	1571.348		
22-01-16	1470.081	1470.081081	1368.814	1571.348		
23-01-16	1470.081	1470.081081	1368.814	1571.348		
24-01-16	1470.081	1470.081081	1368.814	1571.348		

Figure 4.4: Look of the Diagnostic Tool
(**Source**: Own Analysis on AGMARKNET data)

The activities performed for one year data of 2016 of Surajpur Market to check the applicability of the developed diagnostic tool is performed in following steps as:

- Drawing Inferences from the Arrivals data
- Checking for modal price Reporting frequency
- Cleaning of data for Modal Prices
- Developing a control limit & Control chart
- Developing the logic & Interface

4.2 Forecasting the Modal Prices of Paddy(Dhan)

In order to forecast the Paddy(Dhan) modal prices for the year 2017 based on the modal prices of the previous years following steps were followed:

4.2.1 Choosing the Tools of Analyses

To develop a better forecast model two tools were used

- Microsoft Excel 2016: For sorting, filtering and cleaning data
- Eviews 9: To help choose a forecast model

4.2.2 Drawing Inferences from the Arrivals Data

It was aimed to develop forecast model for one of the top Paddy(Dhan) producing markets of Chattisgarh, and for that it became necessary to look into the arrivals data of Chattisgarh markets.

Table 4.5: District leading in Paddy (Dhan) Arrivals
(Source: Own Analysis on AGMARKNET Data**)**

District	%Arrival
Surguja	20.84
Raipur	20.74
Janjgir	12.46
Bilaspur	8.81
Raigarh	7.84
Mahasamund	5.67

But after analyzing the data of Surajpur and Ambikapur (leading markets in terms of arrivals) belonging to the leading district Surguja in terms of Paddy (Dhan) arrivals it was found that there were large numbers of data gaps prominently because of price reporting gaps. As a consequence, the analysis had to move to Paddy (Dhan) arrival district of Chattisgarh i.e. Mahasamund. In Mahasamund, it was found that Mahasamund was leading in terms of Paddy (Dhan) arrivals (66.15% of total arrivals of Mahasamund). So, Mahasamund was chosen as the market to develop a forecast model. During the period of 01 January 2011 to 31 December 2015, Mahasamund reported three varieties of Paddy (Dhan), which were as follows:

• I.R 36

• Paddy (Fine)

• Others

Paddy (Fine) was reported the maximum times, quite ahead of the other varieties (I.R. 36 & Others). Also, Paddy (Fine) variety of Paddy(Dhan) reported in Mahasamund had fewer data gaps to be replaced.

Table 4.6: Arrivals-Mahasamund(Paddy(Dhan))
(Source: Own Analysis on AGMARKNET Data**)**

Market Name	% of total Paddy Arrival
Bagbahra	15.58%
Basana	3.15%
Bhavarpur	1.06%
Bheemkhoj	0.01%
Bhoring	3.36%
Bhurkoni	0.01%
Jhalap	1.54%
Komakhan	0.58%
Mahasamund	66.15%
Pirda	0.22%
Pithoura	3.62%

Sakra	0.84%
Sarayapali	3.88%
Tendukona	0.00%

4.2.3 Data Cleaning of Modal Prices

To forecast the data, it was necessary to fill the data gaps and improve the quality of data. For this it was seen that how many number of times (count) the Paddy (Dhan) variety-Paddy (fine) was reported is month i.e. in days. To bridge the data gaps, the months which had more than 15 days of reporting of modal prices had their remaining non-reported days filled with the averages of that month. Whereas, the months having data reported days' count greater than 10 but less than or equal to 15 were replaced by the average of the modal price values present of that month and the average of annual modal price. Lastly, if the count of the modal price reported days was less than 10, then, the missing values were replaced by annual average.

Now, EViews has a special command titled "Exponential Smoothing" which helps users to find the best fit model out of the given models. The ETS (Error-Trend-Seasonality) Exponential Smoothing of EViews gives the best fit model according to the select criteria and justifies the chosen model statistically.

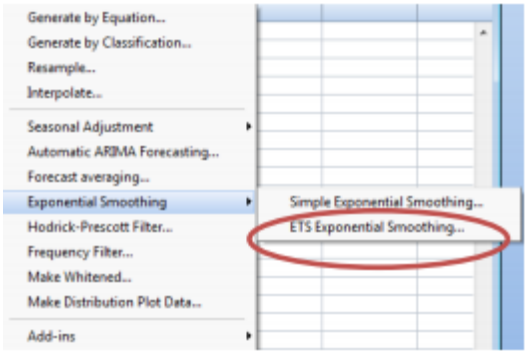

Figure 4.7: ETS Exponential Smoothing-Eviews
(**Source:** Eviews)

The ETS exponential smoothing method was first employed on the period 01 January 2011 to 31 December 2015 to forecast the modal prices for the month January to December 2016. Since the data for 2016 was already present it was easy to check the model's accuracy by finding out various errors.

In order to find the appropriate model, the value of Error, Trend and Seasonality was set to "AUTO". The Estimation sample was 2012M01 (Jan-2012) 2015M12 (Dec-2015) with a forecast endpoint 2016M12 (Dec-2016). The model selection criteria were set to Average MSE option. To further optimize the model the objective was set to Average MSE the cyclicity for the forecast was set as 12, since it focuses on 12 months a year. After running the operation, it was found that Eviews by using ETS Exponential Smoothing Technique gave the model A, M, D, A. It gave the value of alpha as 0.844850, beta as 0.0. The MSE

comparison made it evident (as visible in the screenshots below) that the A, M, D, A model has the least MSE as compared to other ETS exponential smoothing models. Thus, the model was applied on the modal price data from 01 January, 2011-31 December 2015, to get the forecast for 2016.

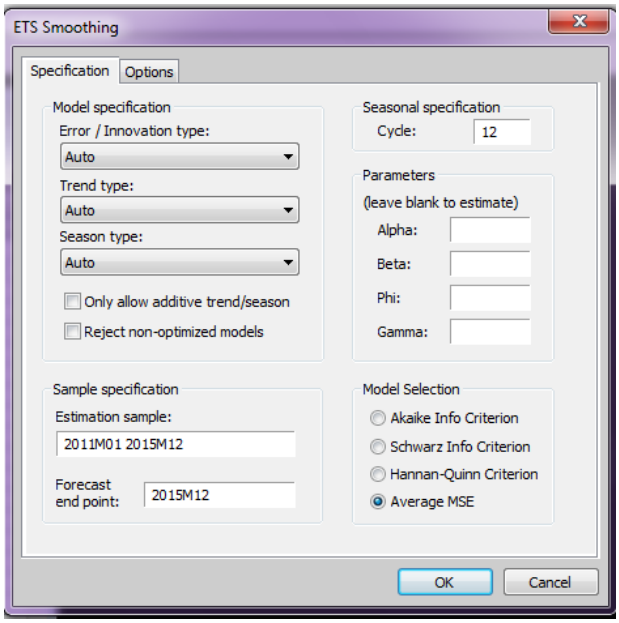

Figure 4.8: ETS Model Options
(**Source:** Eviews)

Parameters	
Alpha:	0.844850
Beta:	0.000000
Gamma:	0.000000
Phi:	0.959205

Figure 4.9: ETS Model Parameters & Comparisons
(**Source:** EViews)

4.2.4 Forecast Errors for the Months of the 2016

Once the model was applied and the forecast of the model prices were obtained month wise, then, the mean absolute percentage error and mean absolute error were calculated.

Table 4.10: Forecast Errors
(**Source:** Own Analysis on AGMARKNET data)

ERROR	Value
Mean Absolute Percentage Error(MAPE)	6.88%
Mean Absolute Error(MAE)	91.07

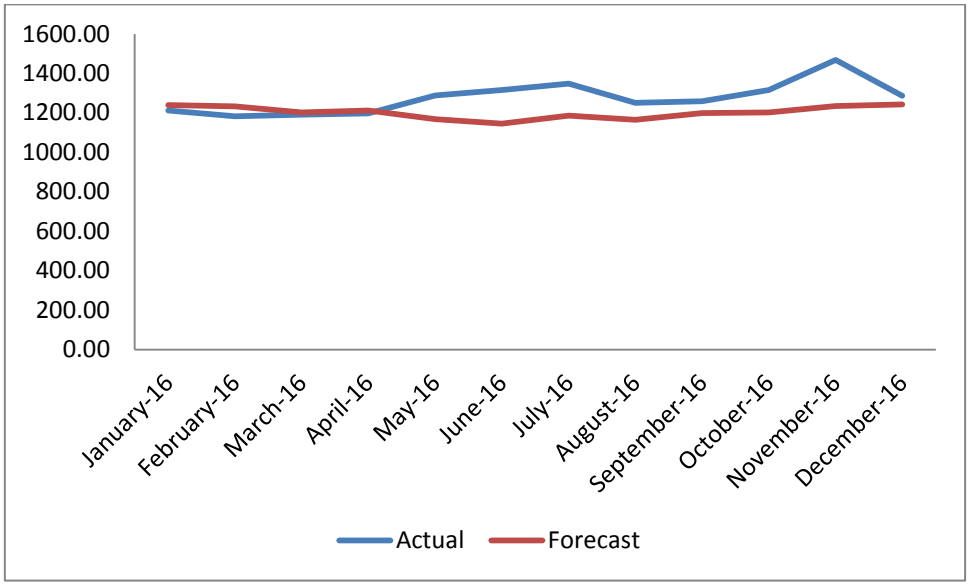

Figure 4.11: Forecast-Actual Comparison for 2016
(**Source:** Own Analysis on AGMARKNET data)

The forecasted values were close to the actual values of model price, and hence the data from 01 January 2012 to 31 December 2016 was used to forecast the values of various months of 2017 using the same model constraints obtained earlier.

4.3 Findings

Once the diagnostic tool was prepared it was seen that what percentage of values of the months January, February and March for the year 2017 actually fell within limits. It was also seen whether the seasonal correction improved the tool or not. It was evident that the control limits were increased marginally to include nominally larger or smaller modal prices. Thus, the diagnostic tool was improved.

The forecast model (A, M, D, A) obtained after ETS exponential smoothing was applied to the previous data to get forecasts for the months of January, February and March 2017. The MAPE for first three months of 2017 was 6.07% whereas the MAE was Rs 78.701/Quintal. The Market was Mahasamund and Paddy (Dhan) variety Paddy (Fine).

Table 4.11: Actual & Forecast Values
(**Source:** Own Analysis on AGMARKNET data)

Month	Actual	Forecast	MAE	MAPE
January-17	1308.90	1227.829	81.07119	6.19%
February-17	1272.27	1220.194	52.07593	4.09%
March-17	1297.7	1194.744	102.9559	7.93%
			78.701	6.07%

4.4 Limitations

• The analysis was done only on modal price and not on maximum and minimum prices.

• The data used for the development of the diagnostic tool was only of one year i.e. of 2016. To develop a better tool the data horizon can be widened to include previous year data.

• The diagnostic tool was checked for accuracy on five markets viz. Ambikapur, Surajpur, Ramanujganj, Pratappur and Rajpur.

• The diagnostic tool needs to be developed for each market separately which can make the task cumbersome.

• The data used for forecasting the modal prices of 2017 was taken from 01 January 2011 to 31 December 2015, giving a forecast horizon of only five years which can be made large.

• The forecast was done only for one market and one specific variety of Paddy (Dhan). Thus, it can only be applied to that market and that variety of Paddy (Dhan) (market-Badnagar, Paddy (Dhan) variety Paddy (fine))

4.5 Concluding Remarks and Recommendations

After the data analysis, the diagnostic tool was developed for five major Paddy (Dhan) markets (in terms of arrivals) of Chattisgarh. Also, the time series forecasting for Paddy (fine) variety of Paddy (Dhan) for a chosen market (Surajpur-Chattisgarh) was done. To conclude the data analysis of the project, here are some recommendations.

• The diagnostic tool developed as part of the project work can be accommodated alongside the data entry reporting portal of Paddy (Dhan) prices i.e. http://agmarknet.nic.in/market_online/. Integration with the portal will give the checks and raise alerts then and there itself, making the data entry process effective and thereby improving the data quality of reporting.

• The price data reporting frequency should be monitored daily as it can help provide the actual data. This actual data can in turn help in developing robust diagnostic tools and accurate forecast models. For example, Punjab-the leading Paddy (Dhan) producer for 2016 had a poor reporting frequency for the market Bhawingarh and the state of analysis was shifted.

• The time series forecast in the case of this study was done for a specific variety of Paddy (Dhan) and for a specific market but instead the forecast model needs to be developed for all varieties of Paddy (Dhan) across various markets.

• The variety terms of Paddy (Dhan) on AGMARKNET portal like “Others” need to classified as well to maintain effective tracking on the Paddy (Dhan) arrivals.

• In the findings of the study it was seen that the data reported historically pertaining to an agricultural commodity can be edited and changed. The editing of already reported data can disturb and hamper the entire data analysis of the project and thus, the changing of the data should be done in a restrictive manner to ensure integrity of reported data.

Chapter 5

Conclusion of the Study

The project began by understanding the agencies associated with AGMARKNET. Also, the importance of the study and objectives of the study were highlighted which gave a direction to develop a well-planned methodological approach to the project study.

Further on in the project, the review of literature had highlighted the importance of the information particularly when it comes to the aspect of agricultural marketing information. The review of literature had also brought to light the need manage and improve the quality of data being reported. Various definitions of marketing information were obtained. The working of AGMARKNET, an agricultural commodity data reporting portal which can help in bringing insightful information to the farmers, government and consumers was understood. It was also seen how the data is being reported on this portal. The agricultural commodity's data worked on in this project was that of Paddy (Dhan). Whereas, time series forecasting was done for the Paddy (fine) variety of Paddy (Dhan). It was also necessary to understand some facts related to Paddy (Dhan) like major Paddy (Dhan) producing states, temperature and rainfall conditions and trade policies, and the same was done in this study.

The study had also highlighted how statistical process control can be used in non-manufacturing sector to continuously monitor the data being reported. In this project, it was also emphasized that which statistical process control charts can be used to have mechanism of check on the prices being reported on the AGMARKNET portal for a particular commodity such as Paddy (Dhan). The equations of upper control limit, lower control limit and control limit were highlighted for variable process control chart i.e. individual moving range chart. It was also discussed that how the control limits can be improved by developing seasonal factors for each month so that marginally neglected prices can be accommodated. The diagnostic tool developed on the platform of Microsoft Excel was on the basis of statistical process control charts for one major Paddy (Dhan) arrival market of Chattisgarh. To check whether the approach adopted for developing the diagnostic tool was scalable to other markets or not, the same approach was applied to other four markets of Chattisgarh. It was seen that more than 90% of the modal prices reported for all the five markets was within the limits developed by using statistical process control chart. The diagnostic tool also took care of the modal prices that were being reported as average of maximum and minimum prices and reported a warning whenever modal prices was average.

Also, the study of this project emphasized the importance of time series forecasting particularly when it comes to the prices of agricultural commodities. Through the review of the available literature it was seen that what were the different models and techniques to analyze the time series. With a well-defined mechanism for data gap

filling and after applying data filtering and data sorting in Microsoft Excel 2016, EViews 9 was used to develop a suitable model to forecast the modal prices for Paddy (Dhan) for the year 2017. Using the ETS exponential smoothing, EViews gave a particular model, this model was applied to a subset of the dataset and was checked for errors. The error percentage came out to be less than 4%. Then the ETS exponential model was applied on the entire data set to get the forecasted values for the year 2017. Till March 2017, the mean absolute error percentage was 7.92%. The forecasting of time series was done for one particular market of Chattisgarh and for one specific variety of Paddy (Dhan) (Paddy (fine)).

During the study, it was also seen that AGMARKNET had some data reporting inconsistencies i.e. the data reported was changed after a time period. Screenshot comparison of the data taken on a previous date with that of the reported data values in the future showed enough evidence of data inconsistencies. Along with the findings, the study also highlighted the findings and recommendations of the study.

Thus, we see that by developing a diagnostic tool for various markets can help in improving the quality of data being reported as it will create a mechanism of checks and balances. The need for developing these kinds of diagnostic tools across all markets and for all varieties of agricultural commodities was emphasized in the study. Whereas, the forecasted modal prices will assure the farmers, government agencies and consumers to get a prior information regarding the agricultural commodities. It was also highlighted that with a wider range of data set the forecasted model thus developed can be more accurate.

Bibliography

- Agrawal, R., & Mehta, S. C. (2007). Weather based forecasting of crop yields, pests and diseases-IASRI models. J. Ind. Soc. Agril. Statist, 61(2), 255-263.
- Amrutlal, P. A. (2011). An In Depth Comparative Study Of Supply Chain Management Practices At Selected Agriculture Produce Marketing Committees Of North Gujarat.
- Arora, R. (2017). Marketing of Agricultural Commodities in India. In Strategic Marketing Management and Tactics in the Service Industry (pp. 185-212). IGI Global.
- Hyndman, R. J., Ahmed, R. A., Athanasopoulos, G., & Shang, H. L. (2011), "Optimal combination forecasts for hierarchical time series", *Computational Statistics & Data Analysis*, 55(9), 2579-2589.
- Spinks, G. R. (1956). Uses and methods of Crop Forecasting. Review of Marketing and Agricultural Economics, 24(01), 18-32.
- Thomsen, F. L. (1951). Agricultural marketing. McGraw-Hill Book Company, Inc.; New York.

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