

Report on
DEVELOPING A DIAGNOSTIC TOOL AND
TIME SERIES ANALYSIS IN RESPECT OF
WHEAT PRICES

Submitted By

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CERTIFICATE

This is to certify that the dissertation report titled “**Developing a Diagnostic Tool and Time Series Analysis in Respect of Wheat Prices**” is a bonafide work carried out by **Mr. Nawab Hasim Jahan Dowla** of **MBA 2016-18** 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.

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DECLARATION

I, **Nawab Hasim Jahan Dowla**, student of **MBA 2016-18** of Delhi School of Management, Delhi Technological University, Bawana Road, Delhi – 42, hereby declare that the dissertation report “**Developing a Diagnostic Tool and Time Series Analysis in Respect of Wheat Prices**” 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.

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ABSTRACT

Appropriate circulation of data related to agricultural commodities all through the nation is basic requirement in the present situation. AGMARKNET portal is one such proposal to gather, integrate and disseminate price information of agrarian products. The data that this gateway gives is basic to every one of the partners related with agribusiness. AGMARKNET expects to convey right and finish data to the farmers keeping in mind the end goal to reinforce their financial position. Agriculturists can know before heading off to the business sectors the cost at which the yield can be sold which acquires them a superior dealing position. Customers can profit as well as this will get straightforwardness landings, checking storing.

This investigation means to build up a tool for real markets where wheat arrivals are high. This diagnostic tool will help the data entry administrators to have different checks on the whole procedure of information section, thereby enhancing the information quality by observing the information detailing process persistently. Statistical Process Control (SPC) can help the right detailing of information. Microsoft Excel 2016 was utilized for diagnostic tool development.

The second target of the examination is to estimate the modal prices of wheat for a specific variety utilizing time series modeling. Data filtering, sorting and cleaning are the fundamental undertakings directed as a feature of this procedure. The time series modeling has been endeavored to forecast wheat prices in 2018. Microsoft Excel 2016 and Eviews 9 have been used for time series analysis.

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Chapter 1

Introduction

1.0 Introduction to the Project

This chapter explains the significance of agriculture and related data for country like India. The section will likewise put an attention on the organizations specifically connected with the agricultural promoting system. The centrality and the different destinations to be shrouded in the study are likewise to be featured in this chapter.

1.1 Background

Nourishment has been the most imperative need to humanity and subsequently different nations are pushing ahead to market agrarian creations. India has 33% of its populace specifically or in a roundabout way subject to agribusiness and contributing 25 for every penny to the GDP. Buying and selling of agrarian items is the essential meaning of agricultural marketing. Marketing information has turned into an imperative perspective so as to plan their crop agricultural produce and marketing of the product. Different partners engaged with the farming markets additionally require marketing data to settle on and take very well informed choices. In this way, over the years it had turned out to be imperative that the marketing data passed on is complete and error free, and is additionally imparted to all the key partners. IT and IT empowered administrations have empowered to oversee and spread data even in the remote corners of the nation. It was the need of the hour to setup a marketing information gateway for agrarian items developed all through the nation.

Therefore, the Central Sector Scheme Project of Agricultural Marketing Information Network (AGMARKNET) was propelled in March of the year 2000 by the Ministry of Agriculture under Government of India. It expected to associate

together all the agricultural produce wholesale markets all through the nation and the State Agricultural Marketing Boards and Directorates. The task is technically supported by the National Informatics Center (NIC).

The key target is to accumulate, separate and disseminate market data to the partners. In excess of 3200 markets are arranged under the plan and in excess of 2700 markets are itemizing data to AGMARKNET entry. In excess of 350 commodities and 2000 varieties are secured under the arrangement. Each unit is outfitted with vital PC hardware, closed by web arrange. "AGMARK," a straightforward entrance has been delivered to energize collection and transmission of data at market level.

1.1.1 Directorate of Marketing and Inspection

The Directorate of Marketing and Inspection (DMI), under Ministry of Agriculture and Farmers Welfare, was set up in the year 1935. The Agricultural Marketing Adviser to the Government of India (AMA) heads the Directorate.

Its prime motive is to actualize agrarian arrangements and plans with the goal that a coordinated advancement of marketing data relating to agribusiness can occur. By keeping up a nearby contact with Central Government and State Government DMI likewise flourishes to defend the enthusiasm of both farmers and consumers.

1.1.2 National Informatics Centre (NIC)

Since its foundation in the year 1976, National Informatics Center (NIC) has been the real builder applications relating to the space of e-governance having a reach up to the grassroots levels. "NICNET", interfaces every one of the Ministries and Departments of the Central Government, links 36 of the State Governments or Union Territories, and traverses around 688 local organizations crosswise over India. NIC plans to actualize Information Communication Technology based applications to determine upper hand in social and public administration.

NIC additionally has added to its repertoire different activities, for example, Government eProcurement System (GePNIC), Office Management Software (eOffice), Hospital Management System (eHospital), Government Financial Accounting Information System (eLekha).

For the Agricultural Marketing Network Scheme, NIC had given PC equipment, built up the product, training staff towards the activity of the equipment and programming frameworks and gave web availability. It has likewise built up the combination between the product bundles created by the different states with AGMARKNET to achieve consistency in the database.

1.1.3 State Agricultural Marketing Boards

As far back as the country achieved autonomy, the Planning Commission of India has been attempting hard to increase agrarian creation. In mission for this goal, the Zamindari system was revoked and surplus land must be passed on among agriculturists and laborers. The ventures like Intensive Agricultural Development Program (IADP) were impelled. Additionally, rural change was the destiny of prime importance. Thus, on one hand, on the national level, efforts were being made to expand creation, while on the state level, the accentuation was laid at a deal, amassing and planning of rural deliver. There was in like

manner the issue of assignment of the deliver so that the commodity was sold off at costs which were to be sensible for agriculturists, dealers and customers. It was with this objective in see that numerous states developed State Agricultural Marketing Boards remembering the true objective to empower displaying practices concerning agricultural commodity.

For AGMARKNET, the State Government/Marketing Boards gave the rundown of business sectors to be secured under the AGMARKNET venture. The picked markets were to offer site to foundation including workplaces for computer installation, telephone organize and computer operating faculty.

Showcase Committees/Controlling authorities of AGMARKNET center at market level were doled out to accumulate relevant data and information, empower it and transmit it to the State level and AGMARKNET passage. NIC had furthermore arranged appropriate individuals from each center in taking a shot at a PC and managing programming group.

At each market center point, there is a man assigned to accumulate data and transmit it. An inspiration plot has been familiar with reward information area administrators for keeping up execution rules reliable.

1.2 Significance of Study

The Agricultural Marketing Information System Network (AGMARKNET) which depends on the "NICNET" goes for connecting all the vital Agricultural Produce Market Committees (APMC), State Marketing Boards and Directorate of Marketing and Inspection regional workplaces. Along these lines, that there can be consistent trade of information.

The reason for the investigation is to help AGMARKNET to enhance the information nature of the reporting prices. As data nature of an agricultural commodity is of prime significance to the partners especially with regards to issue, for example, price rise, consequently with the examination it was intended to enhance the nature of prices announced. The information relating to the both arrivals and prices is effortlessly accessible on the AGMARKNET portal, in spite of the fact that the announced information has some deficiencies with regards to the quality. Further, daily price reporting data likewise experienced a few inconsistencies as a result of lack of daily updated data. Likewise, the daily reporting makes the data inclined to errors which may be inadvertent in nature. The study plans to discover any errors in the data reporting, and after that to connect those gaps keeping in mind the end goal to enhance the data quality. Also the future costs of a farming commodity can help the partners to be better arranged for value rise or fall. Through convenient awareness, anticipated qualities can give the genuinely necessary use of time to adjust and perform appropriately. Data filtering, sorting and data gap filling can help us to draw significant summaries from the agrarian information and perform exercises, for example, estimating and diagnostic tool improvement utilizing that information for particular markets.

1.3 Objectives of the Study

The study will fundamentally spin around the agricultural item wheat and center around the study of modal costs. After the examination of data, the study plans to satisfy two noteworthy targets:

- To build up a diagnostic tool which can report abnormalities in price for significant wheat markets

- Forecast the future prices of Wheat for major markets

1.4 Concluding Remarks

In this chapter, it was seen that how AGMARKNET is underscoring the need to gather data and is encouraging it. Different organizations associated with the AGMARKNET venture were likewise featured. The significance of the venture and the key targets of the study were featured in this part. Presently, in the following section the audit of the available literature with respect to the study of the project shall be discussed.

Chapter-2

Review of Literature

2.0 Introduction to Review of Literature

Extensive literature relating to agrarian marketing and marketing information framework is accessible on the web. Through the review of literature in this chapters, it was meant to feature a portion of the key definitions and highlights of agribusiness related market information. It turns out to be of prime significance to perceive how that data can be checked and controlled. In this way, statistical process controls especially in non-producing areas needs to be explored. Through proper data checking, data quality can be enhanced which can give exact information to the partners related with agribusiness.

2.1 What Is Agricultural Marketing?

As demonstrated by Thomsen (1951), the examination of agrarian marketing contains each one of the tasks, and the associations driving them, required in the improvement of farm produced food, unrefined materials and their subordinates, for instance, materials, farms to the final customers, and the effects of such activities on famers, middlemen and purchasers. Agricultural marketing is the investigation of the significant number of exercises, workplaces and courses of action required in the procurement of farms by the farmers and the necessities required to deliver it to the end customers. The agricultural marketing structure is an association between the farm supply and the non-cultivate fragments. It fuses the evaluation of rural crude materials supply to dealing with organizations, the examination of enthusiasm for residence information sources and rough materials, and the approach relating to the showcasing of farm items and information sources. As demonstrated by the

National Commission on Agriculture (XII Report, 1976), agricultural marketing is a strategy which starts with a decision to make a saleable homestead item, and it incorporates each one of the parts of market structure or system, both handy and institutional, in perspective of particular and fiscal examinations, and consolidates pre-and post-assemble tasks, hoarding, assessing, limit, transportation and dissemination. Agrarian marketing structure joins the appraisal of enthusiasm for cultivate inputs and their supply, post-assemble treatment of farms produce, execution of various activities required in trading rural things from farms, assessment of enthusiasm for farm items and open methodologies and ventures relating to the valuing, dealing with, and purchase and offer of farm data sources and farming things.

2.2 Agricultural Marketing Information System

Jobber (2007) defines it as a "system in which marketing data is formally gathered, stored, analyzed and distributed to managers in accordance with their informational needs on a regular basis." In countries like India, the diverse activities, particularly that of marketing information is set up by government as a bit of agricultural marketing and agribusiness system progression. Profitable market information arrangement can be seen to have positive favorable circumstances for agriculturists, merchants and the administration. Current marketing information fortifies the farmer's situation to counsel with buyers from a position of a superior relative preferred standpoint. It additionally supports spatial scattering of things from nation regions to urban zones and between urban markets by sending the portrayal of information in its actual shape from urban customers to rural producers with respect to amounts and assortments required.

Current exchanges advancements open up the possible results market information organizations to improve information transport through SMS on cell

phones and the quick advancement of FM radio stations in numerous developing countries offers the conceivable outcomes of more localized information administrations. Radio ventures like Kisanvani on All India Radio and Kisan Suvidha give farmers the truly fundamental information with respect to farm and farm produce delivery.

Additionally, there has been an expansion in entrance of web in the course of the most recent 16 years. This is clear from the reality in the year 2000, India had around 0.53% of its populace utilizing the web though in 2016 29.55% of the aggregate populace of India utilizes web, be it on work area, PC or cell phones. Accordingly, there is quick stream of data. AGMARKNET is one such gateway giving agrarian related data of different assortments of product to its partners. The data should be complete and correct.

2.3 Data Reporting on AGMARKNET portal

Information on the AGMARKNET portal is basically detailed as commodity Arrivals and Prices. The arrival data demonstrates the measure of agricultural produce acquired in tons. Arrival data is reported on yearly, month to month, week by week and even regular routine which is utilized to accumulate reports. One can without much of a stretch see which state, area or market gets most extreme entries of a specific farming product.

Then again, the price data is detailing in the unit of Rs/Quintal. There are three kinds of prices reported on the portal, they are:

- Maximum Price

The most extreme price paid for an agrarian commodity amid a few exchanges held in a day in a market is named at maximum price.

- **Minimum Price**

The base cost paid for an agrarian item amid a few exchanges held in a day in a market is named at minimum price.

- **Modal Price**

The modal price is the cost at which the vast majority of the commodity was sold in a market amid the day.

Alongside these three prices one can likewise get the subtle elements of state name, district name, group to which the product belongs, variety and grade.

In this way, the data being dispersed through the AGMARKNET portal is very thorough and essential to every stakeholders of agriculture.

2.4 Overview of Wheat Production

As per Agricultural Market Information System (AMIS) and FAO, wheat is a Rabi product and it is sown in mid-October-mid-November and harvested in March. It grows well in cool, damp climate and ages in a warm, dry environment. The cool winters and the sweltering summers are useful for a decent item. A cloudless sky having splendid light in the midst of mature and gathering periods will enhance quality wheat. Winter precipitation is great.

The climatic conditions appropriate for developing wheat are given beneath:

- Temperature: The month to month ordinary temperature should go in the region of 10°C and 15°C in the midst of the season of sowing. The same should be in the region of 21°C and 26°C in the midst of developing period. Wheat grain does not grow totally if the temperature falls underneath 21°C.
- Rainfall: Wheat grows better in those extents where precipitation occurs in winter. Areas having 50 to 100 cm yearly typical precipitation develop wheat. Water system serves the best if precipitation falls underneath 50 cm.

2.4.1 Wheat Statistics

Directorate of Economics and Statistics reports that in the past 10 years India's wheat age has extended at a Compound Annual Growth Rate (CAGR) of 2.46 per cent. In a like manner, over the most recent years there has been an extension in the region under wheat generation at CAGR of 0.77 per cent. As demonstrated by United States Department of Agriculture Database from 2014-17, China was the pioneer to the extent that wheat creation was concerned and was trailed by India and United States of America. In the year 2016-17, India's share in overall wheat was recorded at 11.78 percent. In 2016-17, India's major export countries were Bangladesh, Nepal, UAE and Taiwan. Commission at Agricultural Costs and Costs (CACCP) announces the Minimum Support Price (MSP) for wheat and this figure has expanded by 20.4 percent in the course of recent years.

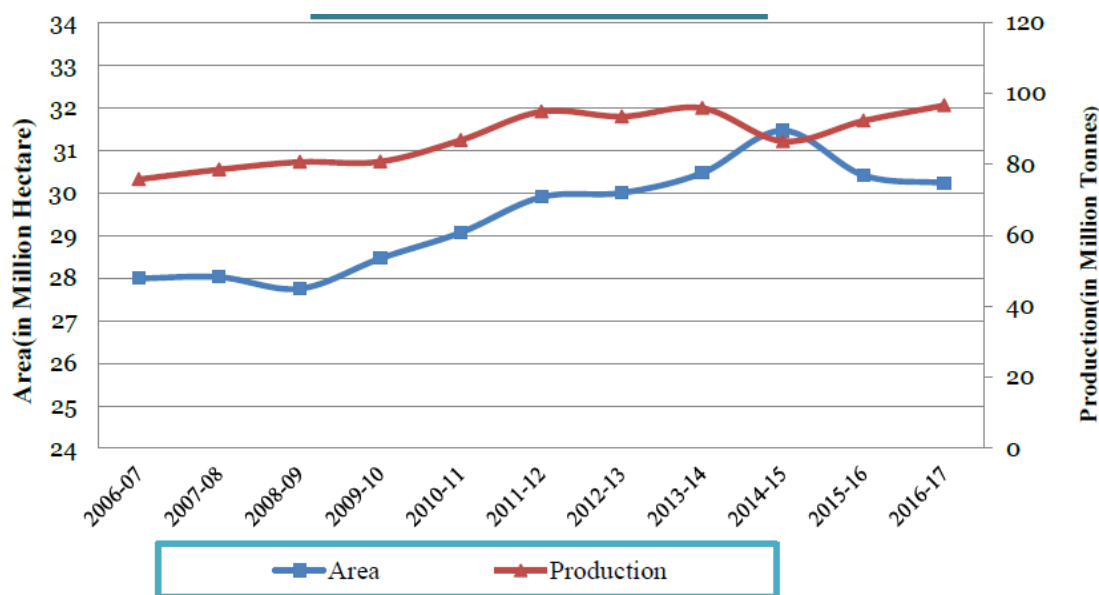
Figure 2.1: Wheat estimates for India (crop year 2015-16 and marketing year 2016- 2017)

Sources: Department of Food & Public Distribution (DoFPD); Department of Commerce (DoC); Directorate of Economics & Statistics (DES); Department of Agriculture and Cooperation (DoAC).

2015-16	2016-17 (Estimated)	Particulars/Year	January, 2017	Source
17.22	14.54#	Opening Stock in Central Pool	13.74	DoFPD
92.29**	96.64	Production	96.64	DES
0.51	0.18	Total Imports	3.03*	DoC
110.02	111.36	Availability	113.41	
0.61	3.03	Total Export	0.23*	DoC
15.47	13.06##	Ending Stock in Central Pool	11.52	DoFPD
93.94	95.27	Total Availability for Domestic Consumption	101.65	

Figure 2.2: India's Wheat Area and Production during 2005-06 to 2015-16

Source: Directorate of Economics & Statistics



2.4.2 Trade Policy

- Export Policy: Under the arrangement of the Government of India, the fare of wheat is free.
- Import Policy: Import of wheat for human use is permitted through State Trading Enterprises yet import of seeds is limited.

Figure 2.3: India's Top 10 Export Destinations

Source: Directorate General of Commercial Intelligence and Statistics (DGCI&S)

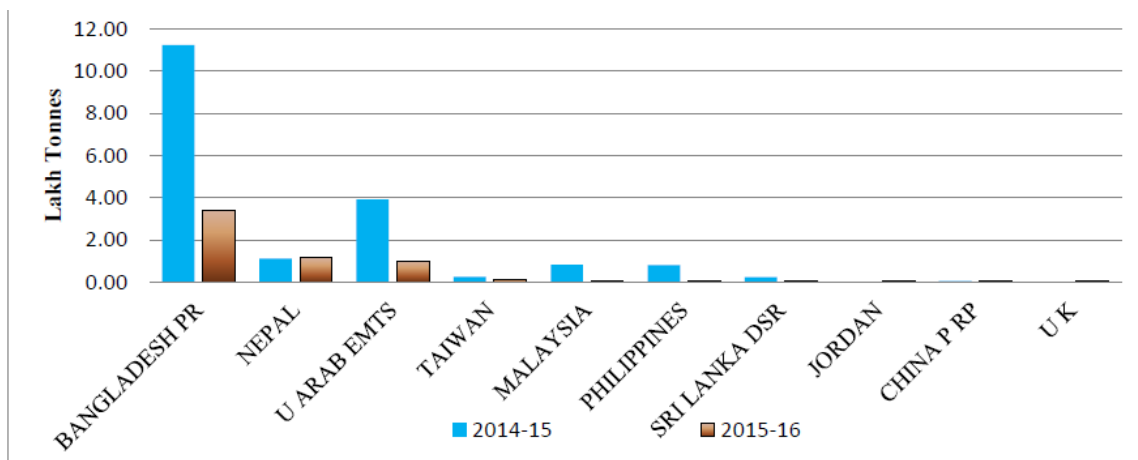


Figure 2.4: Trade flow for Wheat

Source: Deptt. Of Commerce

Year	Export	Import
2012-13	6.51	0.0
2013-14	5.56	0.01
2014-15	2.92	0.03
2015-16	0.61	0.51
2016-17(April-Jan)	0.23	3.03

2.4.3 Wheat Arrivals in Major Domestic Mandis

The wheat arrivals in major domestic Mandis according to AGMARKNET and Agriwatch are:

Figure 2.5: Wheat arrivals in Major Domestic Mandis

	Arrivals Feb,2017 (Cumulative)	Arrivals Jan, 2017 (Cumulative)	Arrivals Feb, 2016 (Cumulative)	% Change Over Previous Month)	% Change(Over Previous Year)
Kanpur	19.78	18.40	6.98	7.52	183.52
Mathura	33.38	33.33	13.78	0.13	142.30
Bhopal	5.45	5.07	6.09	7.63	-10.38
Indore	10.49	9.85	13.74	6.42	-23.71
Khanna	11.07	11.05	6.38	0.14	73.50
Nagpur	0.91	0.87	0.31	4.44	194.34
Jalana	0.10	0.07	0.14	38.10	-29.68

In this manner, it is seen that with regards to agriculture then the nature of information announced is the fate of prime significance. Information detailing of arrivals and prices every day turns into an unwieldy errand frequently including blunders. In this manner, the whole information announcing process continues to take place with no checks and controls.

2.5 Statistical Process Control

In 1920, Dr. Walter A. Shewhart built up the idea of control chart and condition of statistical control while working at Bell Laboratories, in this manner spearheading the Statistical Process Control (SPC) which was conveyed forward by W Edwards Deming. There are fundamentally seven key devices of statistical process control, they are:

- **Check Sheets**

The check sheet might be a sort (record) used to gather information logically at the range of the place from where the information is prepared. Most of the information it gets might make quantitative and then again subjective. In that viewpoint, the moment that some data is quantitative, at that point a check sheet is sometimes called a count sheet.

- **Pareto Chart**

A Pareto chart, additionally 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**

Presented by Karl Pearson, a histogram graphically speaks to the distribution of data in which is in numerical form.

- Scatter Diagrams
Estimations 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 is graphical device that is useful in separating the reasons behind the item or part defects.
- Control Charts
The control graph is a chart used to consider how a strategy changes after some time. Data are plotted in time arrange. A control graph constantly 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 created from past data.

2.5.1 SPC and Non-Manufacturing Sector

Since its being, statistical process control was believed to be pertinent to just manufacturing forms with the target of decreasing waste or scrap and it was thought unrealistic to apply statistical process control to non-fabricating forms. Yet, in the year 1988, Software Engineering Institute proposed that statistical process control could be connected to non-fabricating forms, for example, software engineering processes. The Level 4 and Level 5 practices of the Capability Maturity Model Integration (CMMI) utilize this idea. Likewise in his book titled "Statistical Process Control", Leonard A. Doty has said that any of the control charts can be connected in the non-producing part (like training, social insurance, governmental issues, family life and self-change) in the comparative path as they are connected in the assembling procedure. In this manner, there is

sufficient confirmation that statistical process control can be connected to non-fabricating forms too.

Because of the above proof, unmistakably data identifying with statistical process control apparatuses especially that of control charts should be accumulated and understood. Control charts are essentially charts to indicate how a procedure changes after some time. With three lines to be specific, Upper Control Limit(UCL), Lower Control Limit(LCL) and a Control Line(CL) controlled by the past information accessible. These graphs can help in reaching determinations about process varieties.

Attribute data chart is utilized when the information is considered discrete occasions, though, in variable data chart, information is estimated on a continuous scale. The kind of chart utilized is controlled by the sort of information gathered and the subgroup size of the information. Since the point is to gather value information over a time of year, variable information outline will be most reasonable for the procedure. With regards to control outlines it is essential to comprehend the subgroups i.e. a gathering of estimated units under similar conditions. The subgroup limitations for Individuals and Moving Range Chart are that the information must have a subgroup measure squares with 1 (i.e. information can't be assembled and every estimation is interesting), while subgroup measure for Average and Range Chart is more noteworthy than 1 (i.e. information can be gathered and every estimation isn't one of a kind).

2.5.2 Individuals and Moving Range Chart

An I-MR outline is a plot of individual perceptions (I graph) and moving reaches (MR diagram) after some time for factors information. The moving extent is characterized as $MR_i = |X_i - X_{i-1}|$, which is likewise the supreme estimation of the principal distinction.

Table 2.6: Control Limits

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 estimation of d_2 is 1.128 (Shewhart constants) for moving range estimate that equivalents 2 (since we are taking unquestionably the primary level distinction). In this way, substituting this in possible conditions, the condition progresses toward becoming $\bar{X} \pm 2.66(\overline{MR})$, where \bar{X} is the normal of the arrangement and (\overline{MR}) is the moving extent.

As indicated by Nancy R. Tague's 'The Quality Toolbox', the control diagram fundamental system is to right off the bat pick the fitting control graph for the information. Besides, decide the proper day and age for gathering and plotting information. Furthermore, third, gather information, build the outline and examine the information. Once the outline is plotted one should search for "wild flags" on the control diagram. Keep on plotting information as they are created. As each new information point is plotted, look at for new of-control signals.

2.6 Time Series Forecasting

A period arrangement is a progression of data centers documented (or recorded or charted) in time mastermind. Most regularly, a period arrangement is a plan

taken at dynamic likewise isolated concentrations in time. Estimating is a method that is used generally in time arrangement examination to predict a response variable, for instance, month to month benefits, stock execution, or joblessness figures, for a foreordained time span. Guesses rely upon cases in existing data. One can use a collection of time arrangement systems, for example, slant examination, decay, or single exponential smoothing, to display cases in the data and extrapolate those cases to what's to come.

Ramasubramanian V. of Indian Agricultural Statistics Research Institute(IASR) with skill in Agricultural Economics, Aquaculture, Artificial Neural Network has examined different time arrangement models for farming anticipating in "Estimating Techniques in Agriculture" to be specific:

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

Thus, from the above references it is seen that there is confirm that forecasting of time arrangement has been done in agricultural division to foresee the future harvest yields.

2.6.1 Exponential Smoothing Models

Exponential smoothing weights past perceptions with exponentially diminishing weights to gauge future qualities. For whenever period t , the smoothed esteem S_t is found by computing where S_i remains for smoothed perception and Y remains for the first esteem.

$$S_t = \alpha Y_t + (1 - \alpha) S_{t-1} \quad , \quad 0 < \alpha \leq 1, \quad t \geq 3.$$

Alpha (α) is known as the smoothing consistent. The streamlined estimation of alpha can be picked utilizing the estimation of Mean Absolute Percentage Error (MAPE) i.e. pick the estimation of alpha for which the estimation of MAPE is slightest.

Another type of Exponential Smoothing strategy is ETS(Error-Trend-Seasonality) exponential smoothing technique. The ETS demonstrating structure was produced in 2002 IJF paper (with Hyndman, Koehler, Snyder and Grose), and in 2008 Springer book (with Koehler, Ord and Snyder). Exponential smoothing techniques were initially characterized by 'Pegels' (1969). This was later reached out by Gardner (1985), altered by Hyndman et al. (2002), and broadened again by Taylor (2003), giving a sum of fifteen techniques found in the accompanying table.

Table 2.7: The fifteen exponential smoothing methods
(**Source:** Automatic Time Series Forecasting: The forecast Package for R)

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

As indicated by Rob J. Hyndman and Yeasmin Khandakar, "the cells (N, N) depicts the straightforward exponential smoothing (or SES) technique, cell (A, N) portrays Holt's direct strategy, and cell (Ad, N) portrays the damped drift technique. The added substance Holt-Winters' strategy is given by cell (An, An) and the multiplicative Holt-Winters' technique is given by cell (A,M). Conditions for technique (A,A), the Holt-Winters' added substance strategy."

Figure 2.8: Equations in ETS Models

(Source: Automatic Time Series Forecasting: The forecast Package for R)

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

Additionally, as indicated by Rob J. Hyndman and Yeasmin Khandakar, in the above condition "where m is the length of regularity, t speaks to the level of the arrangement, b_t means the development, s_t is the occasional segment, $\hat{y}_{t+h|t}$ is the figure for h periods ahead. Some fascinating unique cases can be gotten by setting the smoothing parameters to outrageous qualities. For instance, if $\alpha = 0$, the level is consistent after some time; if $\beta^* = 0$, the slant is steady over the long haul; and if $\gamma = 0$, the regular example is steady over the long haul."

2.6.2 Making Time Series Stationary

To check a whether a period arrangement is stationary or not a test known as Breakpoint Unit Root Test is utilized. This test has an invalid theory that H_0 : Series has a unit root.

If a series has unit root then it a non-stationary series. To check the speculation, p-value is seen i.e. in the event that p-value is under 0.05 then speculation is rejected and time arrangement is stationary, where as though p-value is more noteworthy than 0.05 then theory is acknowledged and the time series is non-stationary.

One way to deal with make a time series stationary is to discover the contrasts between the information recorded. This is known as differencing. Changes, for instance, logarithms can offset the varieties of a period arrangement. Differencing can help offset the mean of a period arrangement.

- Random walk model

The differenced arrangement is framed by subtracting the following perception from the past one, and can be composed as

$$y'_t = y_t - y_{t-1}$$

The differenced arrangement will have just $t-1$ values since it isn't conceivable to compute a distinction for the principal observation. Once the arrangement is stationary one can run time arrangement examination to perform estimating.

2.7 Conclusion of the Literature

Through the survey, it has been seen that extensive literature is accessible online with respect to showcasing data. Likewise, how AGMARK reports prices and arrivals to convey auspicious information was additionally noted. There are confirmations in regards to the materialness of statistical process control in non-producing part and how time series forecasting has been done on the farming sector too. Presently, the procedure engaged with the investigation should be examined.

Chapter 3

Methodology

3.0 Introduction to Methodology

Investigative research was embraced keeping in mind the true objective to think about this venture. Analytical research is a specific kind of research that incorporates essential conclusion capacities and the evaluation of realities and information in regard to the examination being coordinated. Inside analytical research articles, data and other fundamental realities that identify with a venture is assembled; after the information is accumulated and surveyed, the sources are used to show a theory or support an idea. A person can convey out little points of interest to frame more prominent suspicions about the material by utilizing basic reasoning abilities viably.

The research in this task focuses on optional information obtained from the AGMARKNET.GOV.IN gateway. Through this investigation, the examination plans to present to the data gaps so as to build up a statistical process control and a forecasting model.

In this part, the different stages associated with the examination shall be discussed.

3.1 Project Phases

3.1.1 Understanding Phase

Step 1: To grasp the more extensive purpose(s) of the venture.

The undertaking expects to build up a diagnostic tool for a specific commodity keeping in mind the end goal to enhance the nature of the information detailed in future. Building up an analytic instrument will help farmers and citizens of the nation to have correct data regarding the crop commodity as it will help address the issues, for example, modal costs announced as zeros, modal costs revealed as midpoints of most extreme and least cost and modal costs with outrageous qualities.

The second goal of the task is to forecast the prices of the chosen commodity. This movement will help farmers and government to comprehend the costs in the coming future of 2018.

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

The AGMARKNET entryway reports Arrivals (in tons) and Prices (in Rs/Quintal) alongside crop commodities' state, district, variety, grade and date of reporting.

3.1.2Defining Phase

Step 1: To pick a commodity for examination.

The product decided for the undertaking was Wheat.

Step 2: To characterize a time allotment of the data reporting period for that product.

The time period for the information so that the diagnostic tool can be created was 01 January, 2017 to 31 December, 2017. Though, for forecasting data for the year 2018, the time period was chosen to be 01 January, 2014 - 31 December, 2017.

Step 3: To recognize the key information term(s) to be worked upon for investigation from among maximum price, modal price and least price.

The information given on the AGMARKNET portal comprises of maximum price, minimum price and modal price. Out of them modal price were decided for the investigation part as this is the cost at which the greater part of the commodity is executed in a market.

3.1.3 Data Preparation and Analysis Phase

Step 1: Tools decided for Analysis

The product decided for development of diagnostic tool was Microsoft Excel 2016, where the virtual products decided for time series forecasting were Microsoft Excel 2016 and Eviews 9.

Step 2: To discover the state, district and market with maximum arrivals within the reported time frame.

The state with greatest arrivals for wheat was discovered. Then within the state the district and market with maximum arrivals for wheat were found.

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

The plot of prices reported every month was done for the whole reporting period to check the consistency in the information.

Step 4: Clean the data for better examination.

The data gaps were recognized and they were filled using the average method in order to have a reliably announced past information which can be worked upon effectively to create diagnostic tool and forecast model.

Step 5: Analyze the data to develop diagnostic tool and forecast model in the following stage.

The information was dissected for data gaps and zeros.

3.1.4 Developing Phase

Step 1: To build up a diagnostic tool fusing statistical process control charts. To build up a diagnostic tool, it was important to keep the process statistically controlled. For this control charts was used. Different literature to control graphs was studied and the right outline was picked by the best information fit. The graph helped us to get the upper and lower control limits.

Step2: Develop a time series forecast model for the modal price of the picked product.

To gauge the time series data into 2018, exponential smoothing technique was utilized.

3.1.5 Testing Phase

Step 1: Test the diagnostic tool on different markets reporting the similar item.

The diagnostic tool in this manner created for one market was connected on different markets too by utilizing their individual control cutoff points to check the relevance of the device crosswise over business sectors for a similar commodity.

Step 2: Check the accuracy of the forecast model.

To check the exactness of the estimate different parameters like Mean Absolute Error (MAE) and Mean Absolute Percentage Error(MAPE) were utilized.

3.1.6 Findings and Recommendations Phase

After broad examination, one will have the capacity to draw out a few discoveries and proposals through which the AGMARKNET portal can profit. The constraints of the diagnostic tool and forecasting model are likewise to be featured.

3.2 Concluding Remarks

The approach towards the investigation of the undertaking and the project procedure was discussed about in this section. Presently in the following part the data analysis, findings, limitations and recommendations with respect to the investigation shall be discussed

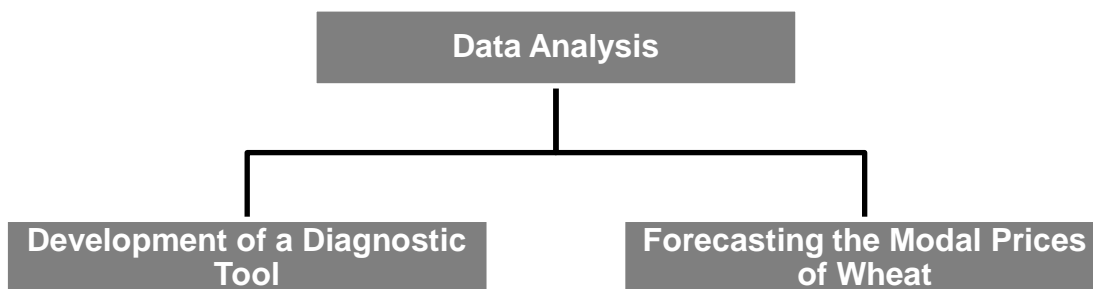
Chapter-4

Data Analysis

4.0 Introduction to Data Analysis

The commodity chosen for investigation in the understanding stage was Wheat. The item data for wheat obtained from the AGMARKNET portal was generally in .xls design and different tasks, for example, data filtering, data sorting and data cleaning was done with a specific end goal to draw and bode well out of the accumulated information. Since, the project had two noteworthy destinations the whole examination process was arranged into two noteworthy headings as appeared in Figure 4.1

Figure 4.1: Components of Data Analysis



4.1 Development of a Diagnostic Tool

The development of diagnostic tool was a multi staged process. The stages were as per the following:

4.1.1 Choosing a Tool to Analyze Data

Since, the information obtained from AGMARKNET was in excel format, so, Microsoft Excel 2016 was used to dissect the data and build up a diagnostic tool also.

4.1.2 Selection of Market for Analysis

The arrival data for wheat for the past one year i.e. from 01 January, 2017 to 31 December, 2017 was obtained for the major nodal markets of wheat in India as provided by our mentor. The major nodal markets analyzed are as follows: Fatehabad, Narwana, Pillukhera, Kaithal and Ellanabad (Haryana), Nainpur (Madhya Pradesh), Bundi (Rajasthan), Bahraich (Uttar Pradesh). The arrivals were for each market and the percentage share of total arrivals for each market was found. It was clear to see that Haryana was the leader in wheat arrivals with 1,62,582.10 tonnes of arrivals. Hence, the data of the state Haryana was analyzed to find the district and market showcasing maximum arrivals in tonnes. The district that gave maximum arrivals was Jind and in that district Pillukhera market showed the highest arrivals of 837001.00 tonnes of arrivals. So, it was decided to develop the diagnostic tool for Pillukhera market of Jind district in Haryana.

Figure 4.2: Arrival Data for Wheat (State) for the year 2017

(Source: Own Analysis on AGMARKNET Data)

1		State	Arrivals (Tonnes)
2		Haryana	5232638.1
3		Uttar Pradesh	5115501.19
4		Rajasthan	2020139.43
5		Gujarat	758693.32
6		Uttrakhand	399198.94
7		Maharashtra	397371
8		NCT of Delhi	198630.5
9		West Bengal	115291.06
10		Karnataka	47831
11		Chattisgarh	42671.55
12		Assam	2945.8
13		Jharkhand	2821.49
14		Kerala	592.6
15		Andhra Pradesh	437.7
16		Orissa	357.6
17		Telangana	228.19

Figure 4.3: Arrival Data for Wheat (District) for the year 2017

(Source: Own Analysis on AGMARKNET Data)

1	District	Arrival
2	Jind	1294744.4
3	Sirsa	561664.5
4	Yamuna Nagar	518302.9
5	Fatehabad	402616.5
6	Ambala	330592.9
7	Karnal	178605.5
8	Hissar	98206.7
9	Kurukshetra	95926
10	Panipat	58145.2
11	Palwal	48706.3
12	Bhiwani	37126.6
13	Sonipat	28510
14	Rewari	20217
15	Gurgaon	3560.8
16	Mewat	1678
17	Panchkula	159
18	Mahendragarh-Narnaul	80

Figure 4.4: Arrival Data for Wheat (Market) for the year 2017

(Source: Own Analysis on AGMARKNET Data)

1	Market	Arrivals
2	Pillukhera	837001
3	Narwana	185571.7
4	Uchana	84317.7
5	Safidon	83730.3
	New Grain	
6	Market , Jind	81655.5
7	Jullana	22468.2

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 Pillukhera market in Haryana. We found the price reporting to be inconsistent throughout as it reported for 28 days out of 61 days.

4.1.4 Data Cleaning of Modal Prices

The data cleaning of price reporting sheet for Pillukhera market was done on the following points:

- 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.

4.1.5 Developing a Control Limits and Control Charts

Once the data was legitimately cleaned it was important to create control limits. For this statistical control charts were used. Since, the modal prices were of variable nature, estimated on a constant size of day by day dates and the data collection had a subgroup size of one (as every day's value information cannot be combined with the following day's information), along these lines, the Individual Moving Range Chart was

chosen to get the upper control limit and lower control limit. The condition for control limits for I-MR outline is:

$$\bar{X} \pm \frac{3\overline{MR}}{d_2}, \text{ where } E_2 = \frac{3}{d_2} \text{ and } d_2 = 1.128.$$

Therefore, the equation becomes,

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

To reduce the effect of seasonality, factors were developed for each month of the entire year 2017. To include some marginally rejected prices and to widen the limits the LCL was multiplied with 0.88 (lowest value) and UCL was multiplied with 1.09 (highest value).

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 prices to check whether the prices were inside the range or not. The excel sheet also comprised of dynamic Control Charts, reflecting new data value entered dynamically.

Two checks were developed. These checks would keep the error messages on record if the data entry operator still proceeded with the price reporting. Check 1 took care of the error if the modal price thus reported was out of bounds and gave a red flag "Check Modal" or if the price is within limits then a green flag "Go". Similarly, Check 2 took care if the modal price was the average of maximum and minimum prices by giving a red flag "Modal is Average" or giving a green flag "Go" if modal is not average, dynamically.

The tool also showed the percentage of modal price data reported being within limits and the number of entries where modal price is the average of maximum and minimum prices.

Figure 4.5: Look of the diagnostic tool
(Source: Own Analysis on AGMARKNET Data)

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Min Price (Rs./Quintal)	Max Price (Rs./Quintal)	Modal Price (Rs./Quintal)	Price Date	Check 1	Check 2							
1													
2	1735	1735	1735	01-Apr-18	Go	Modal is Average							
3	1735	1735	1735	02-Apr-18	Go	Modal is Average							
4	1735	1735	1735	03-Apr-18	Go	Modal is Average							
5	1740	1745	1740	05-Apr-18	Go	Go							
6	1735	1740	1735	09-Apr-18	Go	Go							
7	1735	1735	1735	10-Apr-18	Go	Modal is Average							
8	1735	1735	1735	11-Apr-18	Go	Modal is Average							
9	1735	1735	1735	12-Apr-18	Go	Modal is Average							
10	1735	1735	1735	13-Apr-18	Go	Modal is Average							
11	1735	1735	1735	15-Apr-18	Go	Modal is Average							
12	1735	1735	1735	16-Apr-18	Go	Modal is Average							
13	1735	1735	1735	17-Apr-18	Go	Modal is Average							
14	1735	1735	1735	18-Apr-18	Go	Modal is Average							
15	1735	1735	1735	19-Apr-18	Go	Modal is Average							
16	1735	1735	1735	20-Apr-18	Go	Modal is Average							
17	1735	1735	1735	23-Apr-18	Go	Modal is Average							
18	1735	1735	1735	24-Apr-18	Go	Modal is Average							
19	1735	1735	1735	25-Apr-18	Go	Modal is Average							
20	1735	1735	1735	26-Apr-18	Go	Modal is Average							
21	1735	1735	1735	27-Apr-18	Go	Modal is Average							
22	1735	1735	1735	30-Apr-18	Go	Modal is Average							
23													

LCL	UCL	Within Limits	Modal is Average
1430	1771.25	1	19

4.2 Forecasting the Modal Prices of Wheat

With a specific end goal to forecast the wheat modal prices for the year 2018 in view of the modal prices of the earlier years following advances were taken after:

4.2.1 Choosing the Tools of Analyses

To build up a better forecast model two apparatuses were utilized

- 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 expected to create forecast model for one of the best Wheat producing markets of Haryana, and for that it became important to investigate the arrivals data of Haryana's markets.

4.2.3 Data Cleaning of Modal Prices

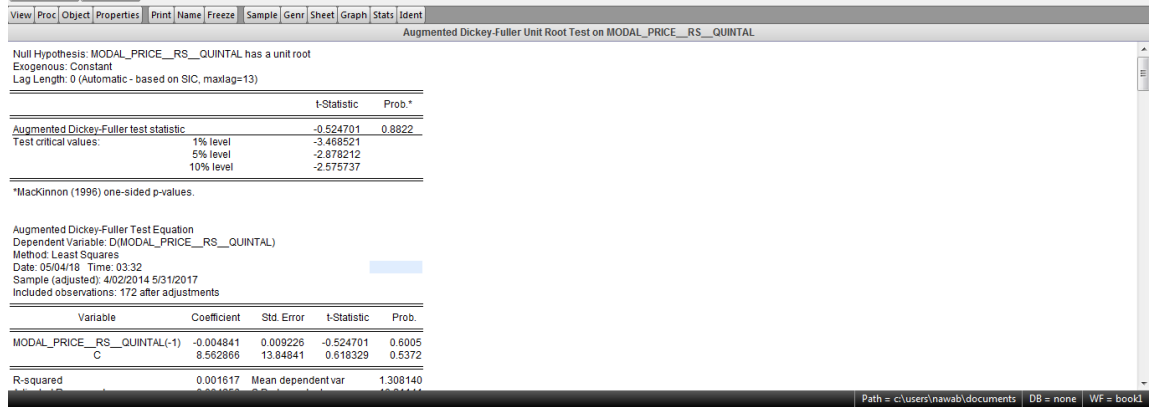
To forecast the data, it was necessary to fill the data gaps and improve the quality of data. For this it was seen that how many number of times (count) the wheat variety was reported in a month i.e. in days. To bridge the data gaps, the months which had more than 15 days of reporting of modal prices had their remaining non-reported days filled with the averages of that month.

4.2.4 Choosing a Forecast Model and Technique

Since, the series is a time series, a mainstream technique of estimating was used viz. Exponential Smoothing Method has been utilized for forecasting. To pick the correct fit model the software EViews rendition 9 has been utilized.

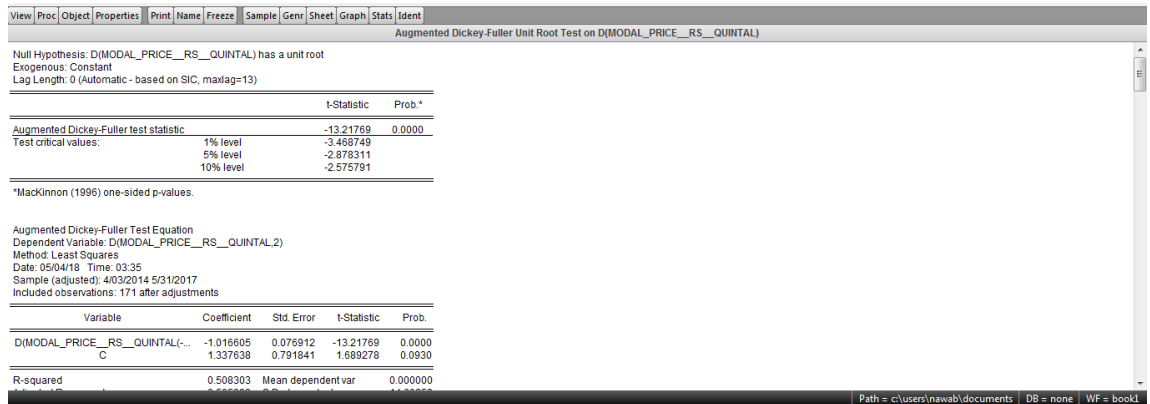
In the first place, it was checked that was the time series was stationary or not. Utilizing the Breakpoint Unit Root Test which depends on the Dickey-Fuller test, the p-value turned out to be 0.8822 which implies that the invalid theory "Arrangement has a unit root" is accepted, this acknowledgment implies that the time arrangement is non-stationary in nature.

Figure 4.6: Test for Stationarity
(Source: Own Analysis on AGMARKNET Data Using EViews)



So, in order to make the time series stationary first level difference was taken i.e. $\text{Difference}_{n+1} = \text{Price}_{n+1} - \text{Price}_n$. We again ran the unit root test on it based on Dickey-Fuller test to get the p-value. The p-value this time was found to be less than 0.01, hence the null hypothesis was rejected, meaning that it does not have a unit root and thus is stationary in nature.

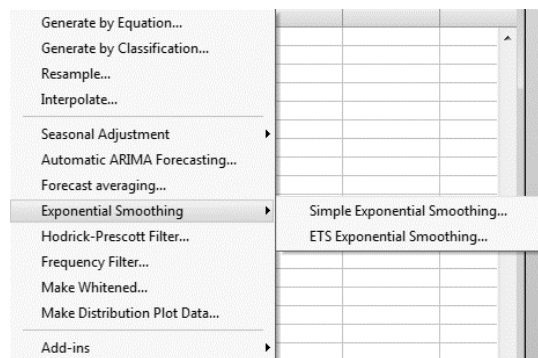
Figure 4.7: Test for Stationarity after difference
(Source: Own Analysis on AGMARKNET Data Using EViews)



Thus, a stationary series at first level of difference was found.

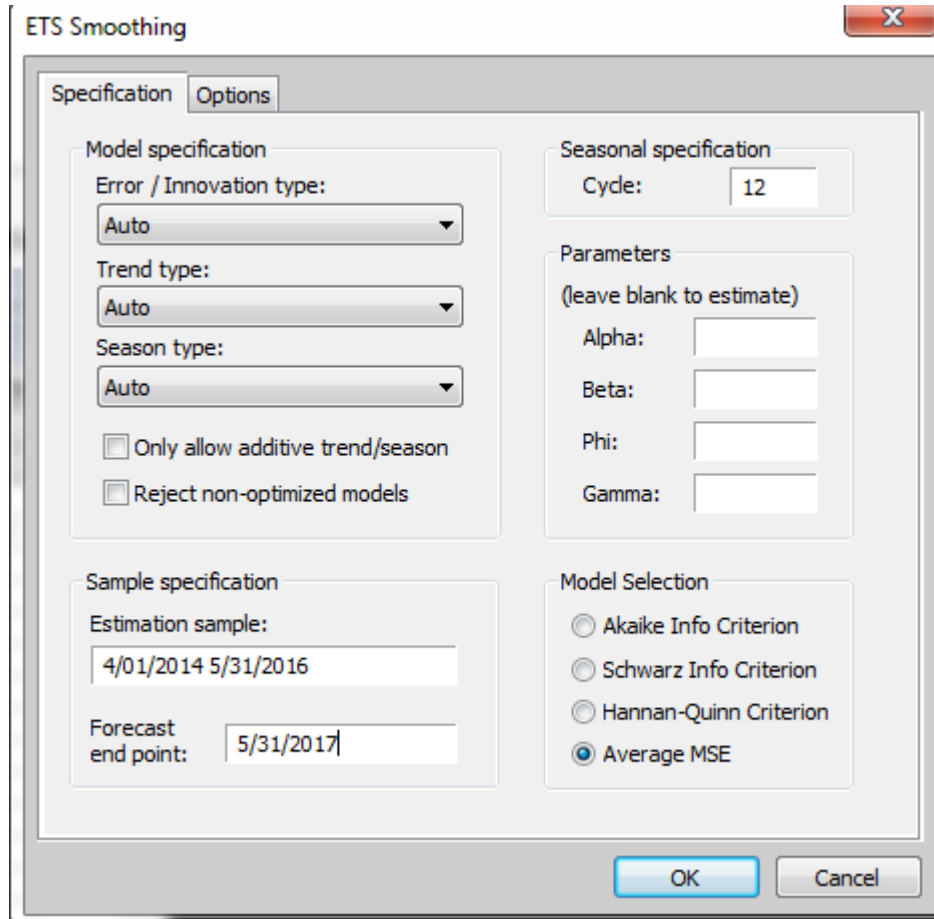
Now, EViews has a special command titled “Exponential Smoothing” which helps users to find the best fit model out of the given models. The ETS (Error-Trend-Seasonality) Exponential Smoothing of EViews gives the best fit model according to the select criteria and justifies the chosen model statistically.

Figure 4.8: ETS Exponential Smoothing-EViews
(Source:EViews)



The ETS exponential smoothing method was first employed on the period 01 January 2014 to 31 December 2016 to forecast the modal prices for the month January to December 2017. Since the data for 2017 was already present it was easy to check the model's accuracy by finding out various errors.

Figure 4.9: ETS Model Options
 (Source:EViews)



In order to find the appropriate model, the value of Error, Trend and Seasonality was set to “AUTO”. The Estimation sample was 2014M04(April-2014) 2016M05(May-2016) with a forecast endpoint 2017M05(May-2017). The model selection criteria were set to Average MSE option. To further optimize the model the objective was set to Average MSE the cycle 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, A, A. It gave the value of alpha as 0.9800, beta as 0.0000. The MSE comparison made it evident (as visible in the screenshots below) that the

A, A, 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, 2014-31 December 2016, to get the forecast for 2017.

Figure 4.10: ETS Model Parameters and Comparisons
(Source: EViews)

View	Proc	Object	Properties	Print	Name	Freeze	Sample	Genr	Sheet	Graph	Stats	Ident	
Date: 05/04/18 Time: 03:37													
Sample: 4/01/2014 5/31/2016													
Included observations: 130													
Method: Holt-Winters No Seasonal													
Original Series: MODAL_PRICE__RS__QUINTAL													
Forecast Series: MODAL_SM													
<hr/>													
Parameters:							Alpha						0.9800
							Beta						0.0000
							Sum of Squared Residuals						8007.468
							Root Mean Squared Error						7.848306
<hr/>													
End of Period Levels:							Mean						1525.016
							Trend						0.769231
<hr/>													

4.2.5 Forecast Errors for the Months of the 2017

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 4.11: Forecast Errors

(Source: Own Analysis on AGMARKNET Data)

Errors	Value
Mean Absolute Percentage Error(MAPE)	0
Mean Absolute Error(MAE)	0

So, it was seen that the forecast accuracy for the months of 2016 was 100%.

4.3 Findings

Once the diagnostic tool was prepared it was seen that what percentage of values for the year 2018 actually fell within limits.

Table 4.12: Control Limits and Percentage Values within Limit

(Source: Own Analysis on AGMARKNET Data)

LCL	UCL	Within Limits	Modal is Average
1430	1771.25	1	19

The forecast model (A, A, A) obtained after ETS exponential smoothing was applied to the previous data to get forecasts for the year 2018.

Figure 4.13: Forecasted Values of Modal Prices for the year 2017
(Source: Own Analysis on AGMARKNET Data)

Sl no.	District Name	Market Name	Commodity	Variety	Grade	Price Date	Forecasted Values
1	Jind	Pillukhera	Wheat	Other	FAQ	03-04-2017	1525
2	Jind	Pillukhera	Wheat	Other	FAQ	04-04-2017	1623
3	Jind	Pillukhera	Wheat	Other	FAQ	05-04-2017	1624.96
4	Jind	Pillukhera	Wheat	Other	FAQ	06-04-2017	1624.9992
5	Jind	Pillukhera	Wheat	Other	FAQ	07-04-2017	1624.999984
6	Jind	Pillukhera	Wheat	Other	FAQ	10-04-2017	1625
7	Jind	Pillukhera	Wheat	Other	FAQ	11-04-2017	1625
8	Jind	Pillukhera	Wheat	Other	FAQ	12-04-2017	1625
9	Jind	Pillukhera	Wheat	Other	FAQ	13-04-2017	1625
10	Jind	Pillukhera	Wheat	Other	FAQ	14-04-2017	1625
11	Jind	Pillukhera	Wheat	Other	FAQ	17-04-2017	1625
12	Jind	Pillukhera	Wheat	Other	FAQ	18-04-2017	1625
13	Jind	Pillukhera	Wheat	Other	FAQ	19-04-2017	1625
14	Jind	Pillukhera	Wheat	Other	FAQ	20-04-2017	1625
15	Jind	Pillukhera	Wheat	Other	FAQ	21-04-2017	1625
16	Jind	Pillukhera	Wheat	Other	FAQ	24-04-2017	1625
17	Jind	Pillukhera	Wheat	Other	FAQ	25-04-2017	1625
18	Jind	Pillukhera	Wheat	Other	FAQ	26-04-2017	1625
19	Jind	Pillukhera	Wheat	Other	FAQ	27-04-2017	1625
20	Jind	Pillukhera	Wheat	Other	FAQ	28-04-2017	1625
21	Jind	Pillukhera	Wheat	Other	FAQ	01-05-2017	1625
22	Jind	Pillukhera	Wheat	Other	FAQ	02-05-2017	1625
23	Jind	Pillukhera	Wheat	Other	FAQ	03-05-2017	1625
24	Jind	Pillukhera	Wheat	Other	FAQ	04-05-2017	1625
25	Jind	Pillukhera	Wheat	Other	FAQ	05-05-2017	1625
26	Jind	Pillukhera	Wheat	Other	FAQ	08-05-2017	1625
27	Jind	Pillukhera	Wheat	Other	FAQ	09-05-2017	1625
28	Jind	Pillukhera	Wheat	Other	FAQ	10-05-2017	1625
29	Jind	Pillukhera	Wheat	Other	FAQ	11-05-2017	1625
30	Jind	Pillukhera	Wheat	Other	FAQ	12-05-2017	1625
31	Jind	Pillukhera	Wheat	Other	FAQ	15-05-2017	1625
32	Jind	Pillukhera	Wheat	Other	FAQ	16-05-2017	1625
33	Jind	Pillukhera	Wheat	Other	FAQ	17-05-2017	1625
34	Jind	Pillukhera	Wheat	Other	FAQ	18-05-2017	1625
35	Jind	Pillukhera	Wheat	Other	FAQ	19-05-2017	1625
36	Jind	Pillukhera	Wheat	Other	FAQ	22-05-2017	1625
37	Jind	Pillukhera	Wheat	Other	FAQ	23-05-2017	1625
38	Jind	Pillukhera	Wheat	Other	FAQ	24-05-2017	1625
39	Jind	Pillukhera	Wheat	Other	FAQ	25-05-2017	1625
40	Jind	Pillukhera	Wheat	Other	FAQ	26-05-2017	1625
41	Jind	Pillukhera	Wheat	Other	FAQ	29-05-2017	1625
42	Jind	Pillukhera	Wheat	Other	FAQ	30-05-2017	1625
43	Jind	Pillukhera	Wheat	Other	FAQ	31-05-2017	1625

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 2017. To develop a better tool the data horizon can be widened to include previous year data.
- The data used for forecasting the modal prices of 2018 was taken from 01 January 2014 to 31 December 2017, giving a forecast horizon of only four years which can be made large.
- The forecast was done only for one market and one specific variety of wheat. Thus, it can only be applied to that market and that variety of wheat (market-Pillukhera, wheat variety-Other).

4.5 Concluding Remarks and Recommendations

After the data analysis, the diagnostic tool was created for wheat market of Haryana. Additionally, the time series forecasting for the wheat variety was done. To conclude the data analysis of the undertaking, here are a few proposals:

- The price data reporting frequency ought to be checked every day as it can help give the genuine information. This real information can thus help in creating powerful diagnostic tool and precise forecast models.
- The time series forecast in the case of this study was done for a specific variety of wheat and for a specific market but instead the forecast model needs to be developed for all varieties of wheat across various markets.
- The variety terms of wheat on AGMARKNET portal like “Others” need to be classified as well to maintain effective tracking on the wheat arrivals.
- In the discoveries of the investigation it was seen that the information announced verifiably relating to agricultural commodity can be altered and changed. The altering of officially revealed information can aggravate and hamper the whole information investigation of the project and consequently, the changing of the information ought to be done in a prohibitive way to guarantee uprightness of announced information.

Chapter 5

Conclusion of the Study

The task started by understanding the offices related with AGMARKNET. Additionally, the significance of the examination and destinations of the investigation were featured which gave a direction to build up a very much arranged methodological way to deal with the task contemplate.

Further on in the undertaking, the review of literature had featured the significance of the data especially with regards to the part of agricultural information data. The review of literature had additionally uncovered the need to oversee and enhance the nature of information being accounted for. Different meanings of marketing data were obtained. The working of AGMARKNET, an agrarian item information revealing entryway which can help in conveying adroit data to the farmers, government and buyers was comprehended. It was additionally perceived how the information is being accounted for on this entryway. The agrarian item's information chipped away at in this task was that of wheat. It was additionally important to see a few realities identified with wheat like significant wheat delivering states, temperature and precipitation conditions and exchange strategies, and the same was done in this investigation.

The study had also highlighted how statistical process control can be used in non-manufacturing sector to continuously monitor the data being reported. 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 wheat arrival market of Madhya Pradesh.

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 wheat for the year 2018. 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 1%. Then the ETS exponential model was applied on the entire data set to get the forecasted values for the year 2018. The mean absolute error percentage was also less than 1%. The forecasting of time series was done for one particular market of Haryana and for one specific variety of wheat. The study also highlighted the findings and recommendations of the study.

Thus, we tend to see that by developing a diagnostic tool for numerous markets will facilitate in up the standard of knowledge being reported because it can produce a mechanism of checks and balances. The requirement for developing these forms of diagnostic tools across all markets and for all types of agricultural commodities was stressed within 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 had been additionally highlighted that with a wider vary of knowledge set the forecasted model therefore developed is additional correct.

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