Project Dissertation

Agricultural Marketing Information System Network: Analysis of Onion Prices and Arrivals

Submitted by

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CERTIFICATE

This is to certify that the dissertation report titled **"Agricultural Marketing Information System Network: Analysis on Onion Prices and Arrivals"** is a bonafide work carried out by **Mr. Bhushan Pant** 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, **Bhushan Pant**, student of **MBA 2015-17** of Delhi School of Management, Delhi Technological University, Bawana Road, Delhi – 42, hereby declare that the dissertation report **"Agricultural Marketing Information System Network: Analysis on Onion Prices and Arrivals"** 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.

Bhushan Pant

Place:
Date:

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ABSTRACT

Onion is an essential vegetable which is grown in India. It is one of the widely available vegetable. Being one of the most important vegetable, it is also highly sensitive commodity. And the price movements affects each and every citizen of the country. Therefore, the study aims to analyze the prices and arrivals trends of onion over the time frame 2012-2016 which is available on AGMARKNET and NHB portals. The study tries to find out if there is any general trend which can be seen in the prices and arrivals of onion in major onion markets of the country.

The study also aim to present a comparative analysis of the data available on the portals and analyze the difference in the values.

This study tries forecast the modal prices of Onion for a particular variety 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 & R programming have been used for time for time series analysis.

The last objective of the study is to develop a diagnostic tool for major markets where onion arrivals are high. The diagnostic tool will help the data quality by monitoring the data reporting process continuously. Microsoft Excel and R Programming was used for developing the diagnostic tool.

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ABBREVIATIONS

AGMARKNET	Agricultural Marketing Information System Network
AMA	Agricultural Marketing Adviser (to the Govt. of India)
APMCS	APMCS (Agricultural Produce Market Committee)
DMI	Directorate of Marketing and Inspection
EDP	Electronic Data Processing (EDP)
FAO	Food and Agriculture Organization
IADP	Intensive Agricultural Development Programme
ICT	Information and Communication Technology
IFFCO	Indian Farmers Fertilizer Cooperative Limited
NHB	National Horticultural Board
NIC	National Informatics Centre
OS	Operating System
SMS	Short Message Service
SQL	Sequential Query Language
WHO	World Health Organization (WHO)

Chapter 1

Introduction

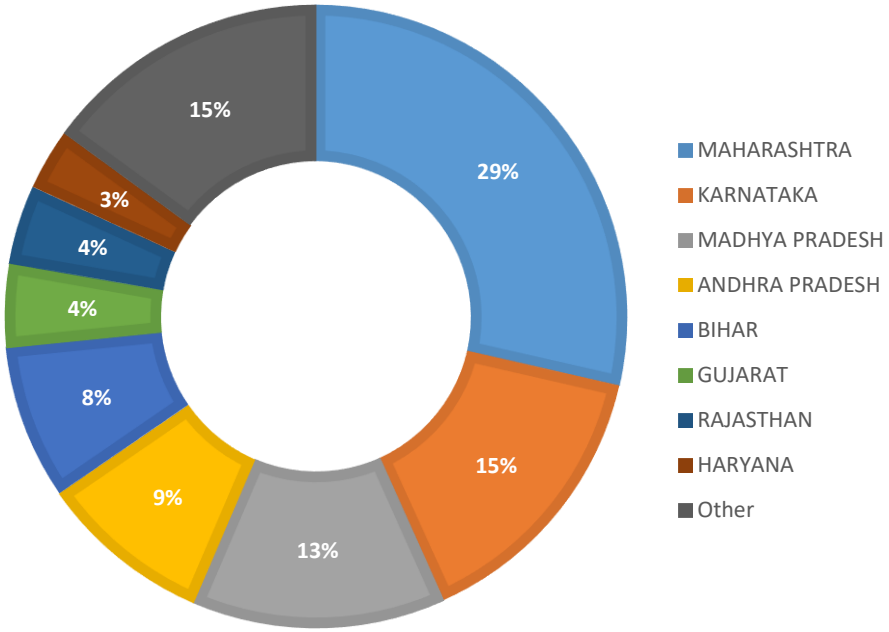
1.1 Introduction to the project

1.1.1 Overview of Onion Markets in India

Onion is one of the essential commodity which is grown in India as per The Essential Commodities Act 1955. India has a vast agricultural sector which accounts for over 16% in GDP and over 10% in the exports earnings (Kadiyala, Harris, Headey, Yosef, & Gillespie, 2014). India has the second largest land area of agriculture 159.7 million hectares after USA and in terms of production of onions it stands second in the world at 19% of the total production of the onion only after China (Lawande, K. E., Khar, A., Mahajan, V., Srinivas, P. S., Sankar, V., & Singh, R. P.,2016). Onion in India is produced both for domestic as well as export use. In the wake of fluctuating price and arrivals of Onion during the year, it is very necessary to comprehend the nature and reasons for change in the values and impact of this change on the customer. Thus, this project is an attempt to find the trends and analyse the reasons for such fluctuations in the prices and arrivals of onion in the different markets. As mentioned above that India has second largest area for onion production despite that the yield is very low and therefore, there is a huge potential for increasing the production of onion in the country by improving the yields. It is also known that India is one of the major exporter of Onion in the world which makes the analysis more important.

The major five states for onion arrivals are Karnataka, Maharashtra, Andhra Pradesh, Madhya Pradesh and Bihar which accounts to near about 85 per cent of the total onion production in the country (Figure 1.1). The next five such states leading in onion arrival are Rajasthan, Gujrat, Tamil Nadu, Haryana and Uttar Pradesh. The top ten states account for about 90 per cent of the onion in India.

Figure 1.1: Onion Arrivals by State (% Share)



Source: www.agmarknet.nic.in

1.1.2 Overview of Agricultural Marketing

Agriculture marketing is primarily concerned with buying and selling of agricultural products through one or the other marketing channels. At the primary level we have 4 broad marketing channels:

1. Selling agricultural products directly to consumers
2. Selling through private wholesalers and retailers
3. Selling through public agencies
4. Selling through processors

The importance of every channel is different for each commodity and also depends on the nature of the commodity and region where the commodity is grown. Marketing structure also depends on the nature of the product thus, differs according the kind of the product. It is observed that among all the channels mentioned above a very major portion of the produce is transacted through regulated means. Food grains are mostly marketed at the primary village market or in the regulated market. The procurement of grains takes place only in the case of rice and through the processing mills. Oil-seeds are largely sold through the regulated markets and directly to the processors. But other commercial crops like onion, banana, arecanut, coconut, sugarcane and cotton have developed specific marketing channels (Mathur, V. C., 1994).

Agricultural marketing in India has come a long way since independence, but still many challenges are present. Market information could be considered as a 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 March, 2000. It aimed to connect together all the agricultural produce wholescale markets throughout the country and the State Agricultural Marketing Boards and Directorates. The project received technical support from National Informatics Centre (NIC).

Till date, a total of 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 which is developed to provide 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 trends for important commodities.”

1.2 Significance of study

The purpose of this project is to analyze and understand the trends in the onion prices and arrivals in the country. There are various methods and techniques that can be used to analyze the data which are also mentioned in the literature review chapter. In

this project trend analysis is performed by comparing the data of every individual year and by comparing all the data together. Another method that might be useful in the study is, where defining, gathering and compiling data are categorized by the value every day over a period of time till they start adding value at each stage.

1.3 Objectives of the Study

In the wake of fluctuating price and arrivals of Onion during the year, it is very necessary to comprehend the nature and reasons for change in the values and impact of this change on the customer. Hence, an attempt has been made through this report to bring out the reasons for such change in prices and arrivals of onion. In order to give holistic approach we have taken data from two portals. The analysis of trend in arrivals and prices for the duration of 5 years starting 2012 till 2016 have been discussed in this report with the following specific objectives:

1. To analyse the fluctuation in arrivals and prices of onions in selected markets of the country.
2. To estimate the prices and trends for the year 2017-18 of onion in India
3. To check the data quality and differences in the data between AGMARKNET and NHB portal
4. To develop a tool which will show warning messages for wrong data

Chapter-2

LITERATURE REVIEW

There are many literatures available online on agriculture marketing and how to manage it. As due to the huge volume of literatures available it is not desirable to survey all of them thus, only those studies have been taken into account which support the general idea of the project and provide some ground to this study. Therefore, by the review of literature related to the agricultural markets, it was aimed to highlight the key definitions & features of the agricultural related market information. The other requirements of the projects is to study the forecasting process and how it is modelled to provide significant results.

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. 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 (Tracey, 2003). This requires those involved in marketing chains to understand buyer requirements, both in terms of product and business conditions.

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 nations like India, the different activities especially that of marketing data is prepared by government as a piece of agricultural marketing and agribusiness procedure advancement. Productive market data arrangement can be shown to have positive advantages for farmers, dealers and the government. Up-to-

date, or current, market data strengthens the famer's position to consult with dealers from a place of a better comparative advantage. It also encourages spatial dispersion of items from country territories to urban zones and between urban markets by sending the representation of data in its true form from urban shoppers to rural producers in regards to quantities and varieties required.

Current interchanges innovations open up the conceivable outcomes for market data administrations to enhance data conveyance through SMS on mobile phones and the fast development of FM radio stations in many creating nations offers the possibilities of more localized information services. Radio projects like Kisanvani on All India Radio and Kisan Suvidha on versatile give famers the genuinely necessary data in regards to farm and farm produce delivery.

Also, there has been an increase in penetration of internet over the last 16 years. This is evident from the fact in the year 2000, India had about 0.5% of its population using the internet whereas in July, 2016 34.8% of the total population of India uses internet, be it on desktop, laptop or mobile phones (Kumar, K. J., 2017). As a result, there is rapid flow of information. AGMARKNET is one such portal giving agricultural related information of various varieties of crop to its stakeholders. The information needs to be complete and correct.

2.3 National Horticulture Board

National Horticulture Board (NHB) was started by the Indian Government in 1984 under the Societies Registration Act 1860 as an autonomous society. The core objective of this board is to promote overall integrated development in horticulture which in turn to help in the overall development and improvement of the production and processing of commodities groups such as Fruits and Vegetables and also to provide excellent infrastructure for the production and processing and marketing with an aim on the reduction of losses to the farmers post harvesting (Kaul, G. L., 1997).

2.4 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).

2.5 State Agricultural Marketing Boards

The State Government/ Marketing Boards provided the list of markets to be covered under the Agricultural Marketing Scheme. The selected markets were to provide site for installation comprising facilities for computer installation, telephone connectivity and computer operator.

Market Committees/ Controlling authorities of node at market level were assigned to collect relevant data and information, feed it and transmit it to the State level and AGMARKNET portal. NIC had also trained suitable persons from each node in operating computer and handling software 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.

2.6 National Informatics Centre (NIC)

The National Informatics Centre (NIC) was established in year 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 (Madon, S.,1993). The major activities that are being taken up by the department are: The following major activities are being undertaken:

- Establishing Information Communication Technology Infrastructure in the country
- Implementation of e-Governance Projects at National and State Level e-Governance levels
- Products and Services
- To provide consultancy services to various government departments
- Perform R&D to implement and adopt the latest technologies

Since its inception, NIC has undertaken many software application implementations based on state-of-the-art technology. NIC also has a very important responsibility of managing the information systems and websites of Central Ministries/Departments, Disaster Recovery Centres, Network Operations facility to manage heterogeneous networks spread across States and Districts, Bhawans, Certifying Authority, Video-Conferencing across the country. NIC also has under its belt various initiatives such as Office Management Software (eOffice), Hospital Management System (eHospital), Government eProcurement System (GePNIC), Government Financial Accounting Information System (eLekha), etc. (Source: **NIC**)

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.

2.7 Overview of Onion Production

According to Directorate of Onion and Garlic Research, "Onion is a temperate crop but can be grown under a wide range of climatic conditions such as temperate, tropical and subtropical climate. The best performance can be obtained in a mild weather without the extremes of cold and heat and excessive rainfall. However, onion plant is hardy and in the young stage can withstand freezing temperature also. In India, short-day onion is grown in the plains and requires 10-12 hours day length. The long-day onion is grown in hills requiring 13-14 hours day length.

The climatic conditions suitable for growing wheat are given below:

- Temperature: The optimum temperature for vegetative phase and bulb development is 13-24˚C and 16-25˚C, respectively.
- Rainfall: It can grow well in places where the average annual rainfall is 650-750 mm with good distribution during the monsoon period. Areas with low (< 650 mm) or heavy rainfall (>750 mm) are not particularly suitable for rain-fed crop."

2.7.1 Onion Statistics

As per the data present in Agriculture and Processed Food Products Export Development Authority, India is one of the major onion producing country in world and stands at the second position after China. In India, there are 2 harvesting

cycles for onion production November-January and January-May. Also as per the data available on the website, “the major varieties found in India are Agrifound Dark Red, Agrifound Light Red, NHRDF Red, Agrifound White, Agrifound Rose and Agrifound Red , Pusa Ratnar, Pusa Red, Pusa White Round. There are certain varieties in yellow onion which are suitable for export in European countries Tana F1, Arad-H, Suprex, Granex 55, HA 60 and Granex 429. The Major Onion producing states area Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana and Tamil Nadu. Maharashtra ranks first in Onion production with a share of 27.72%. There is a lot of demand of Indian Onion in the world, the country has exported 12,01,245.29 MT of fresh onion to the world for the worth of Rs. 2,747.41 crores during the year 2015-16”.

2.7.2 Major Onion Producing States (2014-15)

The Major onion producing states for the year 2014-15 according to Directorate of Onion and Garlic Research are:

Table 2.1: Major Onion Producing States

S.No.	State/ UT	Wheat (tonnes)
1	Maharashtra	5361
2	Karnataka	3227
3	Madhya Pradesh	2842
4	Bihar	1247
5	Gujrat	1126
6	Rajasthan	960
7	Haryana	640
8	Andhra Pradesh	575
9	Telengana	450
10	Uttar Pradesh	413

2.8 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.

2.8.1 Exponential Smoothing Models

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

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

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 modelling 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.

Figure 2.1: 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

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 (A_d, 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."

Figure 2.6: Equations in ETS Models

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

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

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, b_t denotes the growth, s_t 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 β ∗ = 0, the slope is constant over time; and if γ = 0, the seasonal pattern is constant over time."

2.9 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 and NHB reports prices

and arrivals to deliver timely information was also noted. It is also noted how the forecasting models can be build up to provide predictions. Now, the methodology involved in the study shall be discussed.

Chapter-3

METHODOLOGY

Research used of any type is always useful to derive information from the raw data. Here, analytical research was used to study the project and get useful information. Analytical research is done to find supportive evidence to the research that is being already conducted in order to verify the results and make it more reliable. Analytical research is also done to form and verify new ideas about an existing topic. It is performed in many ways including meta-analysis, public opinion, secondary analysis etc.

The research in this project focusses on secondary data obtained from the AGMARKNET.GOV.IN and NHB.GOV.IN portal. Through this analysis, project try to see the trends in the prices and arrivals of onion in the markets, compare the data present in the two portals, develop a diagnostic tool to provide a first check on the data being entered into the system and to develop a model for onion price forecast for the next year.

The phases into which the project was divided were as follows:

3.1 Project Phases

3.1.1 Understanding Phase

Step 1: To comprehend the broader purpose(s) of the project.

The first objective of the project is to analyze the time series trends of onion prices and arrivals in the major onion market of the country. This analysis will help the decision makers as well as the customer to take preventive measures such that these fluctuation do not affect them. The second objective of the project is to compare the data present on AGMARKNET and NHB for the same commodity (onion) and analyze the difference between them. The third objective of the project is to develop a diagnostic tool for a particular commodity (onion) in order to improve the quality of the data reported in future. Developing a diagnostic tool will help farmers and citizens of the country to have correct information regarding the crop commodity as it will help address the issues such as modal prices reported as zeros and modal prices with

extreme values. Thereby reducing the error in reporting. The fourth and final objective of the project is to forecast the prices of the chosen commodity. This activity will help farmers and government to understand the prices in the coming months of 2017.

Step 2: To look into the data reporting fields of AGMARKNET and NHB portal.

The AGMARKNET portal reports Arrivals (in tonnes) and Prices (in Rs/Quintal) along with crop commodities' state, district, variety, grade and date of reporting whereas the NHB portal reports the arrivals (in quintals) and prices (in Rs/Quintal) along with crop category, variety and market. The data reported in the NHB portal either weekly, monthly or annually.

3.1.2 Defining Phase

Step 1: To choose a commodity. The commodity chosen for the project was Onion.

Step 2: To define a time frame of the data reporting period for that commodity.

The time frame to for the data so that to analyze the trends in the commodity was 1st January 2012 to 31st December 2016. The same time frame was used for comparison analysis of the two portals and developing the diagnostic tool. Whereas, the time period for data forecasting for the year 2017 was chosen to be 1st January 2015 to 31 December 2016 to keep the latest trends live in the commodity.

Step 3: To identify the key data term(s) to be worked upon for analysis from amongst maximum price, modal price and minimum price.

As the data reporting on the AGMARKNET portal consists of maximum price, minimum price and modal price, so, the out of them modal prices were chosen for the analysis part.

3.1.3 Data Preparation and Analysis Phase

Step 1: To find the state, district and market with maximum arrivals within the reporting period.

As the project was primary focused on the AGMARKNET portal. Thus, the data was taken from the portal to select the market for the analysis.

The state with maximum arrivals for onion was found out. Then within that state the district and market with maximum arrivals for wheat were found.

Step 2: Check for the reporting frequency of the data fields (modal price and date).

The plot of prices reported per month was done for the whole reporting period to check the consistency in the data. Daily date wise data is present in the AGMARKNET portal for every month thus, average for every month data is taken for uniformity whereas the data present in the NHB portal is average for every month.

Step 3: Clean the data for better analysis.

The data gaps i.e. some fields in the data obtained from the portal were blank and they were filled using the average method in order to have a consistently reported past data which can be worked upon easily to analyze the trend uniformly, compare the data on two portals ,develop diagnostic tool and forecast model.

3.1.4 Developing Phase

Step 1: To analyze the time series trends in the prices and arrivals of the commodity

To analyze the trends the time series data was plotted in the graph for every market individually for every year of the time frame that is taken into consideration to analyze trend on yearly basis and also for all the years of data in a single graph to analyze the overall trend

Step 2: To compare data of AGMARKNET and NHB portal

To compare the data the plot of two portals were drawn simultaneously and the difference between them is noted. Also, the difference were drawn and based on that the comparison is done.

Step 3: To develop a diagnostic tool incorporating outlier extraction by using box plot analysis.

To develop a diagnostic tool with the objective of keeping out the garbage values from the system example 0 price value or some extremely high value. Thus it is important to define a range for values which should be accepted by the system directly, various literatures

were studied to do to find out the correct way of doing this, with 2 methods on the list i.e. statistical control procedure and box plot analysis. Box plot analysis is adopted for the project as defining range for individual market is very efficient in that.

Step 4: 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.

3.1.5 Testing Phase

Step 1: Test the plotting the time series data for every selected market for the analysis.

Step 2: Test the diagnostic tool which was developed for one market on other markets reporting the same commodity.

Step 3: Check the accuracy of the forecast model.

To check the movement of actual values and predicted values by the model Mean Absolute Error (MAE) and Mean Absolute Percentage Error(MAPE) were used.

3.1.6 Findings and Recommendations Phase

After the holistic analysis on onion prices the general trend of the price and arrival movements can be identified which can be recommended to the stakeholders. Also, after going through such in depth analysis recommendations on the data quality can be provided to AGMARKNET and NHB portals.

Chapter-4

Data Analysis

4.1 Introduction

Onion data on price and arrival was collected from AGMARKNET and NHB portal to analyze trends of onion prices and to analyze the difference in the figures between the two platforms. Five markets are selected for the analysis **Ahemdabad, Banagalore, Delhi, Lasalgaon and Pimpalgaon.** Firstly, the data was analyzed for each market for each year and by combining all the data. This helped in identifying trends in the data. Secondly, the data from both the portals were plotted simultaneously to analyze the differences in the data. Thirdly, considering the last two-year data for each market the data for the next year is forecasted. This helped to obtain in-depth insight into the data. Following propositions were made before the analysis:

1. Onion data in any market follow a trend is prices.
2. There is no difference in the data in the two portals (AGMARKNET and NHB).
3. Negative relation between the onion price and onion arrival in the markets.

4.2 Analysis Tools

Microsoft Excel 2016

Microsoft excel is a part of Microsoft package which is developed by Microsoft. It is a spreadsheet which is available on multiple operating systems like Windows, MAC OS X, iOS and android. The main functionality of the software is fast calculation, interactive graphing and efficient presentation of information using pivot table, pivot graphs, power pivot etc. It also has support of an inbuilt macro programming language called Visual Basic. It is one of the most widely used software in the industry and as well as in academics.

Microsoft Excel has been used in this project for analyzing and comparing data collected on individual days.

R Programming

R programming successor of S programming is an open source language and also an environment specifically to perform statistical analysis. The language is supported by

R foundation for statistical computing and it is widely known in the data miners and statisticians community because of the powerful environment it provides to develop statistical model and perform the analysis.

4.3 Data Analysis

Onion Price and Arrival Trends

Data for Onion is analyzed for 5 markets Ahemdabad, Bangalore, Delhi, Lasalgaon and Pimpalgaon starting from January 2012 to December 2016. The data was analyzed individually for each year as well as for all the year combined for each market individually to see the trend in the prices and arrivals.

The Figure 4.1 depicts the onion price trend for the Delhi market for 5 years starting from 2012 till 2016. It can be seen that there is a general trend in the prices going higher starting in June and more steeper in July for year 2013, 2014, 2015 and 2016 where the prices increased marginally in June but remained constant in July. Thus, a trend in onion price fluctuations in Delhi market can be easily observed.

Figure 4.1: Onion Price Trends for Delhi (2012-2016)

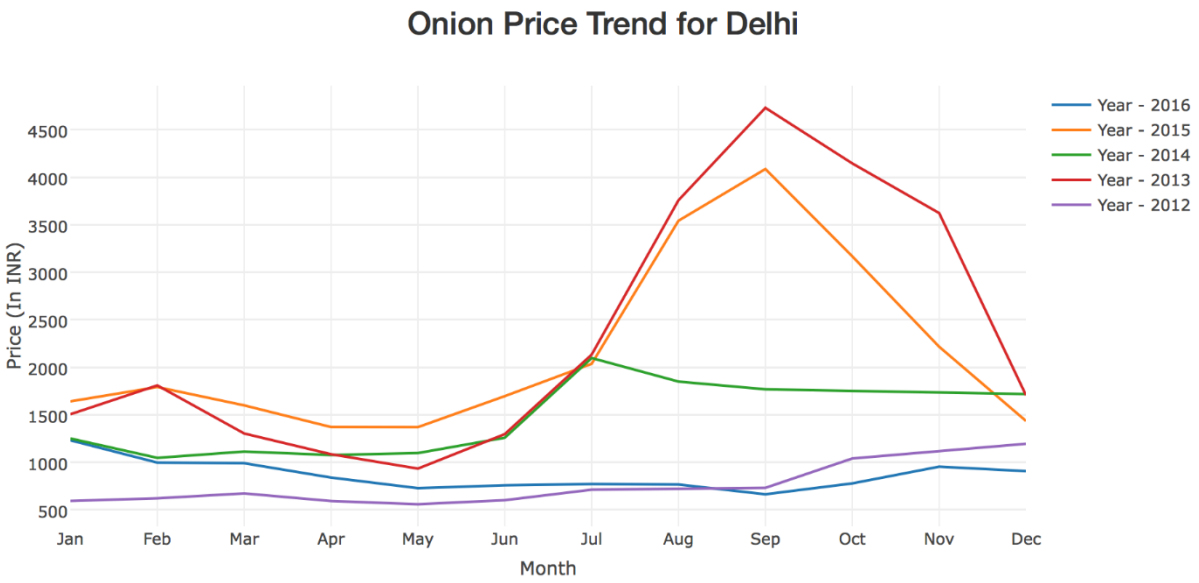
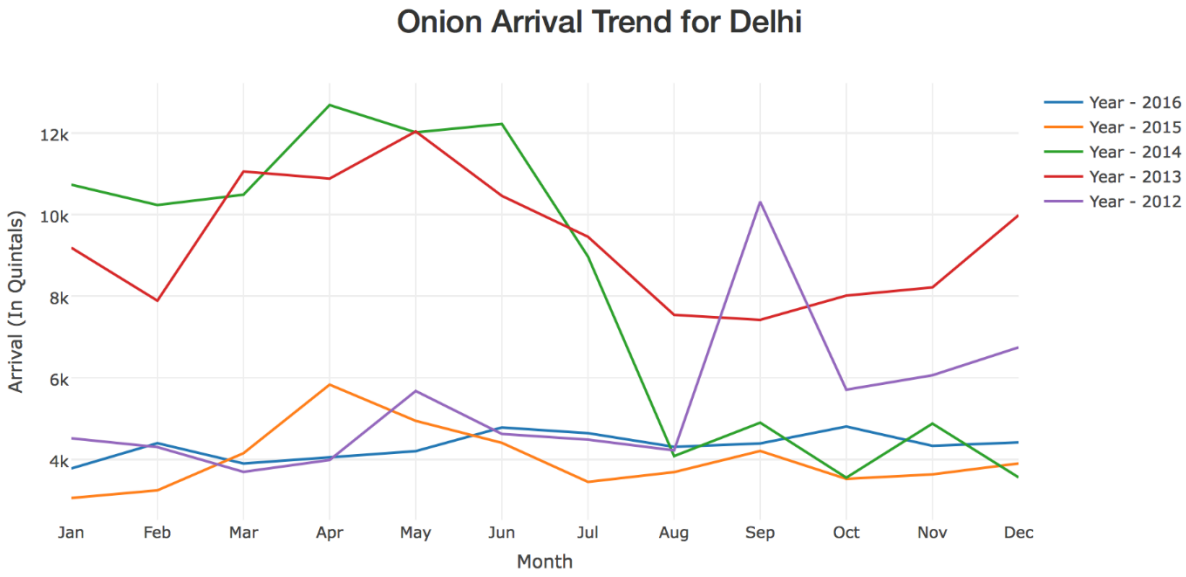


Figure 4.2 shows the arrivals trends in the Delhi Market for 5 years starting from 2012 till 2016. It can be seen from the figure that the arrivals follow a general trend in the market where the arrivals starts increasing in the initial months of the years and starts to drop down starting June.

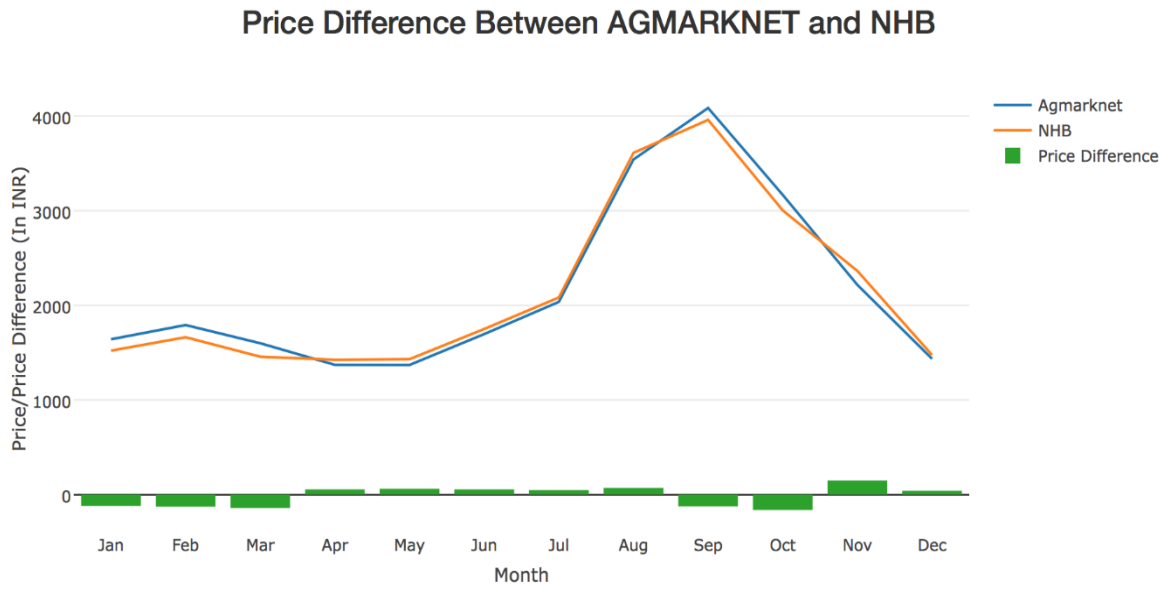
Figure 4.2: Onion Arrival Trends for Delhi (2012-2016)



Onion data for all the markets for the entire 5 year duration was taken from AGMARKNET and NHB portal to perform the next task that is to analyze the differences if any in the values of the two portals for the same commodity and for the same year. Data was analyzed for both prices as well as arrival for all the years individually.

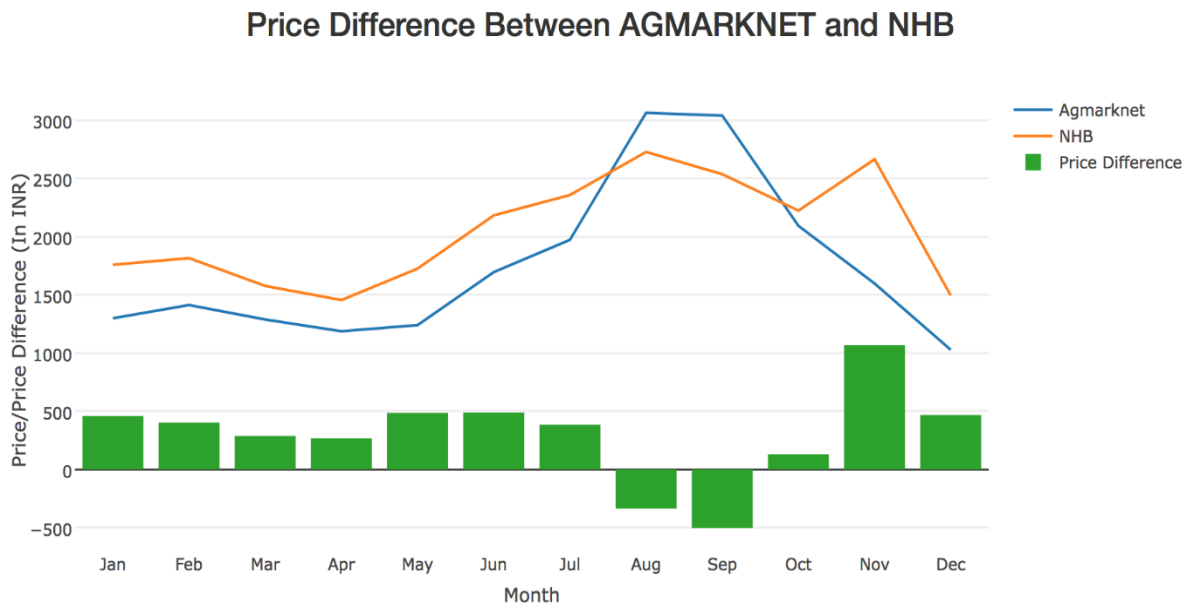
In cases like in Figure 4.3, the difference was very minimum thus, acceptable considering the differences in number of days of data reporting in the two platforms.

Figure 4.3: Acceptable Price Difference between AGMARKNET and NHB



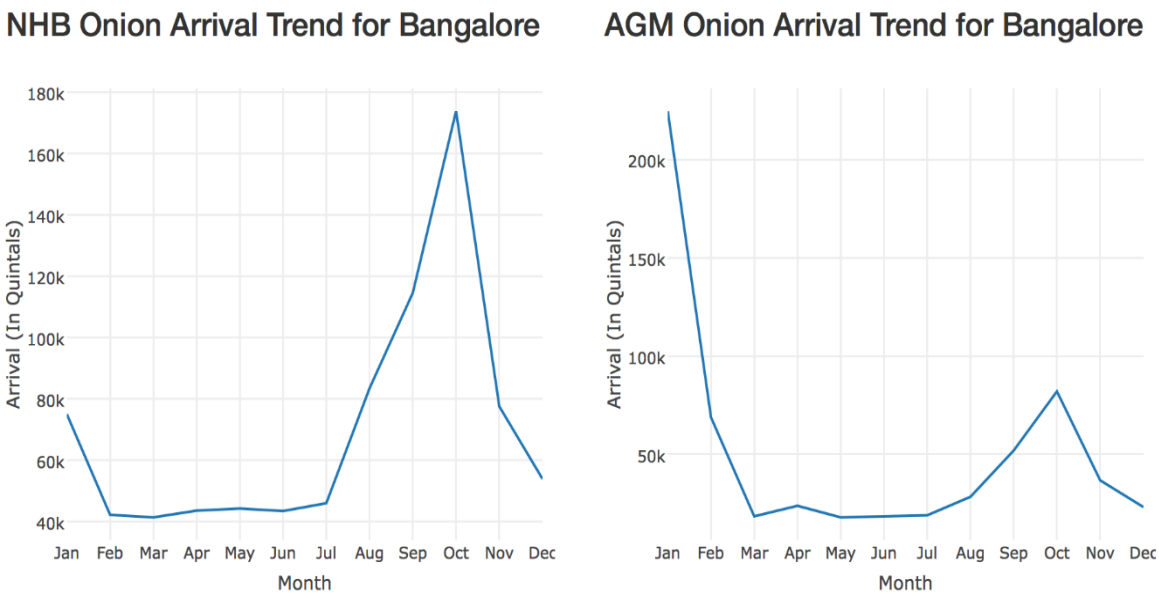
In cases like Figure 4.4, the difference in the data is very high which is not acceptable in any case. The difference in the prices ranges from 10% to over 100%.

Figure 4.4: Unacceptable Price Difference between AGMARKNET and NHB



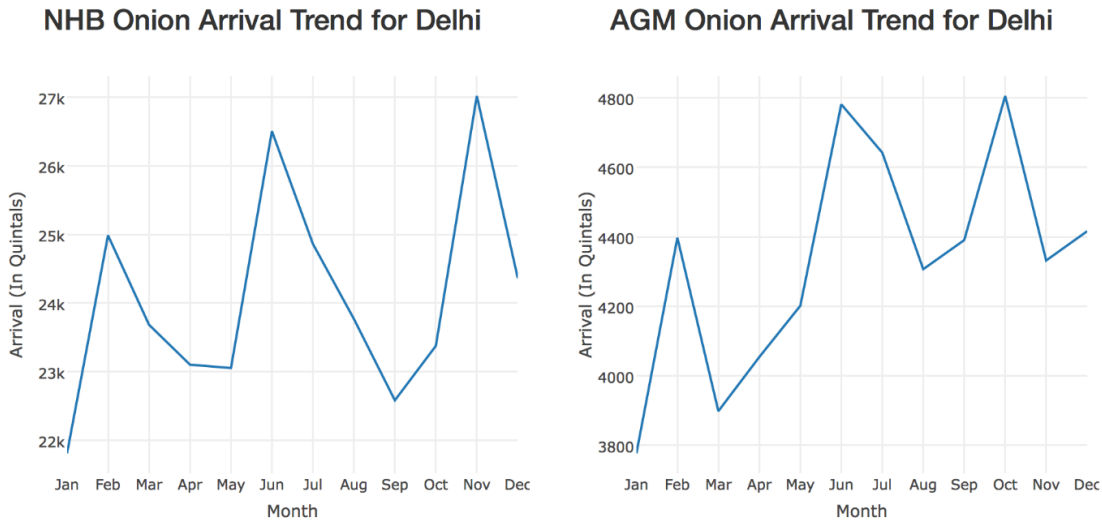
In the case of arrival data, the difference between the data on the two portals is very much significant. In few cases like Figure 4.5 the trend is just opposite on both the platforms for some market with very significant differences in the arrival values.

Figure 4.5: NHB and AGMARKNET Arrival Data Comparison for Bangalore



In cases like Figure 4.6 the variation in arrivals are extremely significant but both the data follow a common trend.

Figure 4.6: NHB and AGMARKNET Arrival Data Comparison for Delhi



The third propositions is that the price and the arrival data should always have negative relationship which means when the more the arrival of the onion in the market for any month lesser the price of the onion in the market for that particular month. But the relationship seen is quite different for different market different relationship is observed. The relationship varies from negative to a straight horizontal line and even positive relationship is also observed in the data.

Figure 4.7 shows for the Delhi market there is negative relationship between price and arrivals which is ideal i.e. the prices of onion should go down with increase in the arrival of onion in the market.

Figure 4.7: Price Arrival Data Relationship (Negative Relationship)

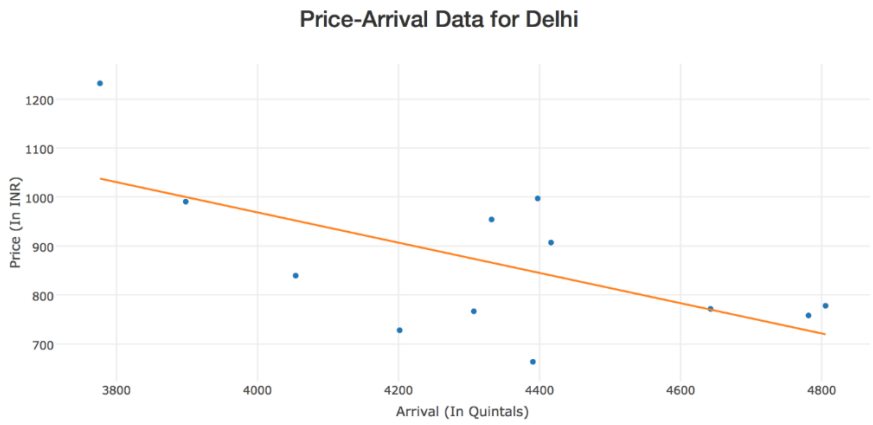


Figure 4.8 shows contrasting relationship which is observed in Figure 4.7. Figure 4.8 shows for Bangalore market there is relationship between price and arrival is positive and with arrival of more onions in the market the price of onion should rise.

Figure 4.8: Price Arrival Data Relationship (Positive Relationship)

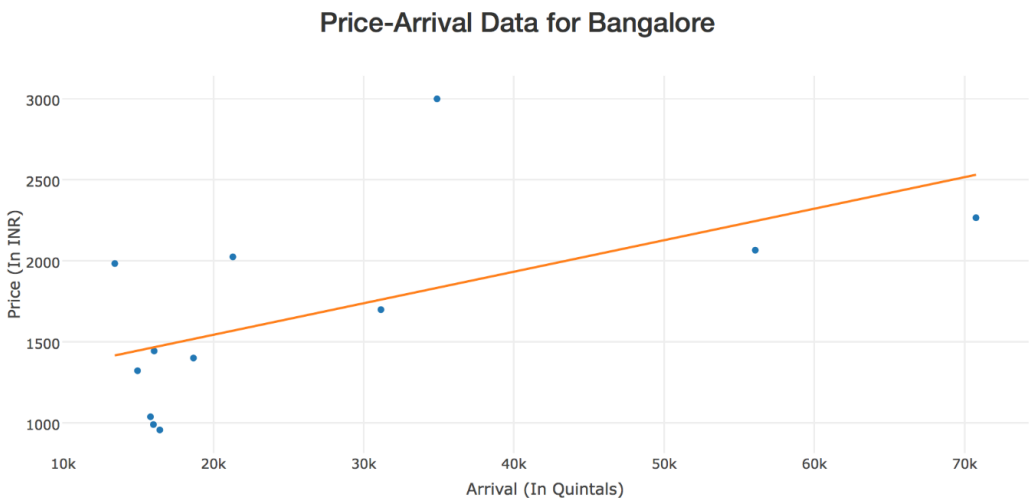
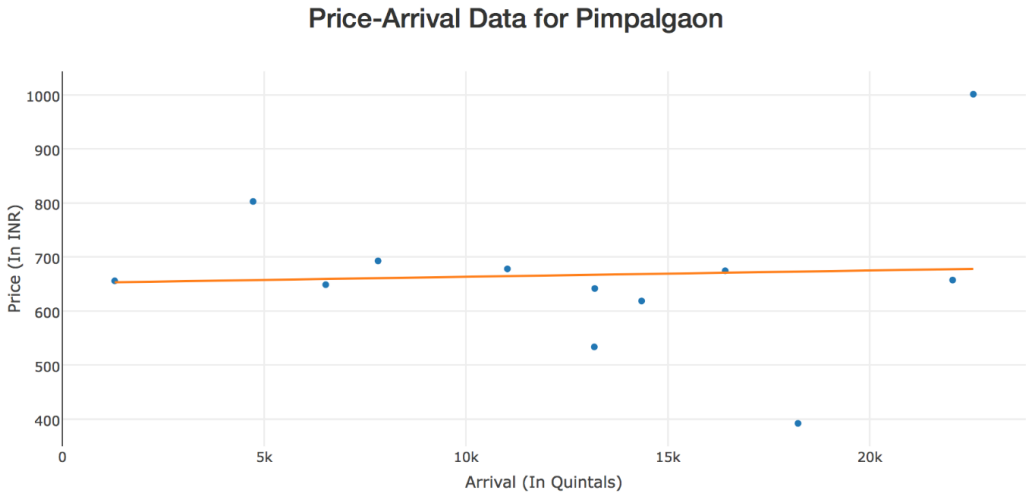


Figure 4.9 shows that for Pimpalgaon market there is no relationship in arrivals and prices of onion.

Figure 4.9: Price Arrival Data Relationship (No Relationship)



The next part of the analysis is to forecast the data for the next year i.e. 2017-18 based on the data of previous years. To forecast the data only previous 2 year data values are taken into consideration so as to keep the importance of the latest trend alive in the forecast data. We have used third order exponential smoothing to forecast the

values. The smoothing is used to keep the seasonal trend of the prices alive in the forecasted data (Figure 4.10).

Figure 4.10: Forecasted Onion Price Trend for the year 2017-18

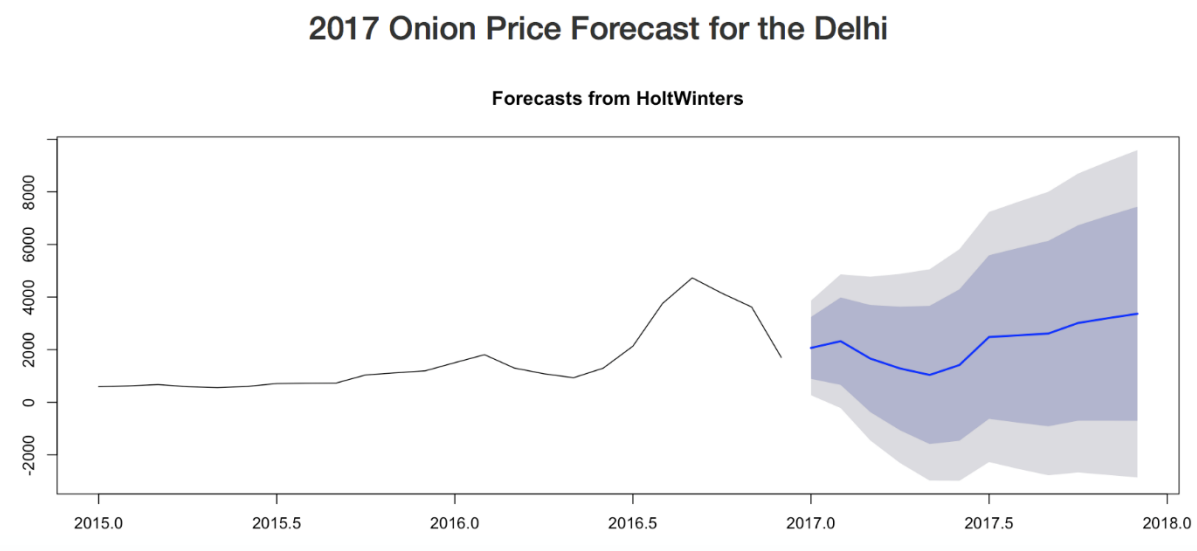


Figure 4.11 depicts the plot of actual arrival value and predicted arrival value using the model. It also shows the differences in the arrivals using the bar graph.

Figure 4.11: Actual and Predicted Arrival Data of Ahmedabad Market for 2017

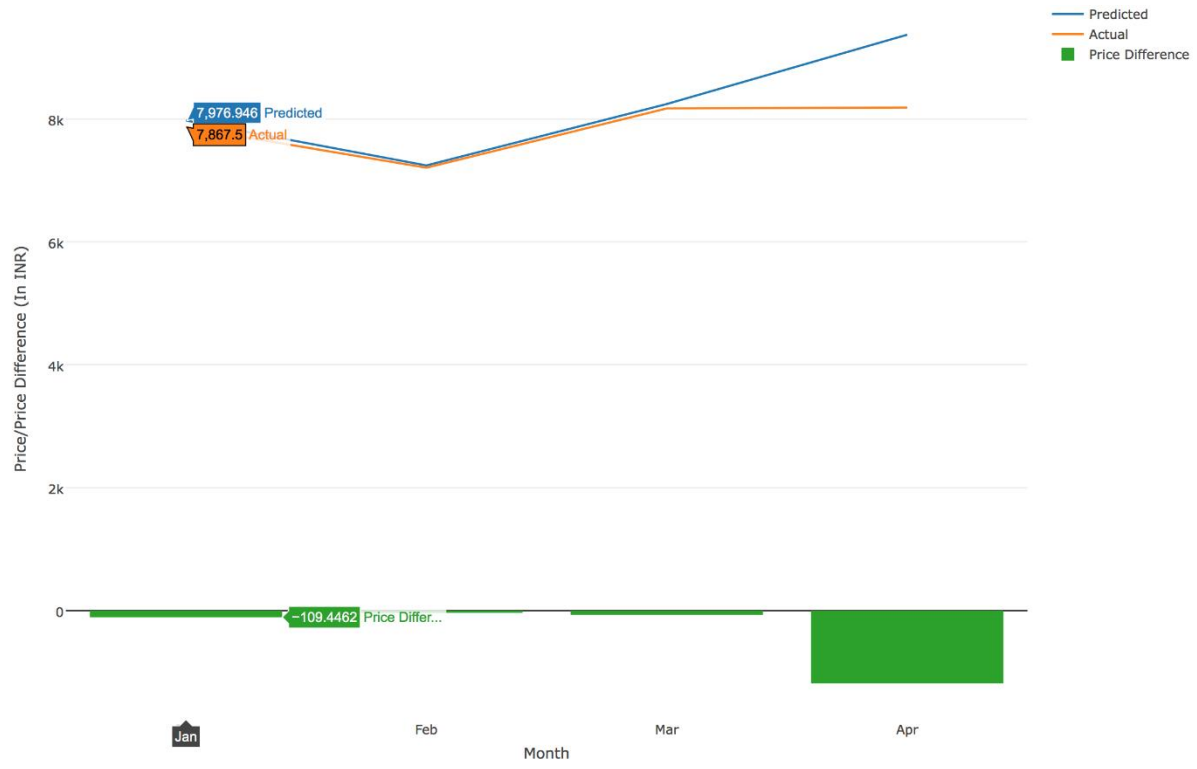


Table 4.1 lists down the actual and predicted arrival values for Ahmedabad Market of 2017 data for January, February, March and April.

Table 4.1: Actual and Predicted Values of Ahmedabad Market (2017)

Arrival Values for Ahmedabad Market (2017-18) (In Quintals)				
Month	**Actual Value**	**Predicted Value**	**Absolute Error**	**Percentage Error**
January	7867	7976	109	1.3%
February	7208	7187	21	0.3%
March	8173	8207	34	0.4%
April	8187	9834	1647	20%

The last part of the project is to develop a tool to create warning messages in case of data input is either of the below lower side or high upper side of the range for each market. Figure 4.12 and Figure 4.13 shows the input and warning message.

Figure 4.12: Market Data Upload Form

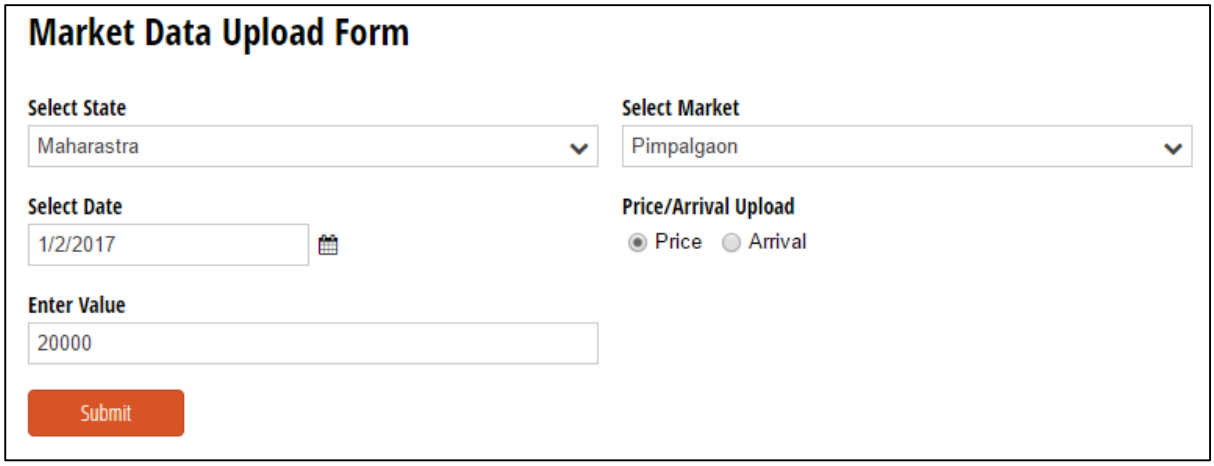
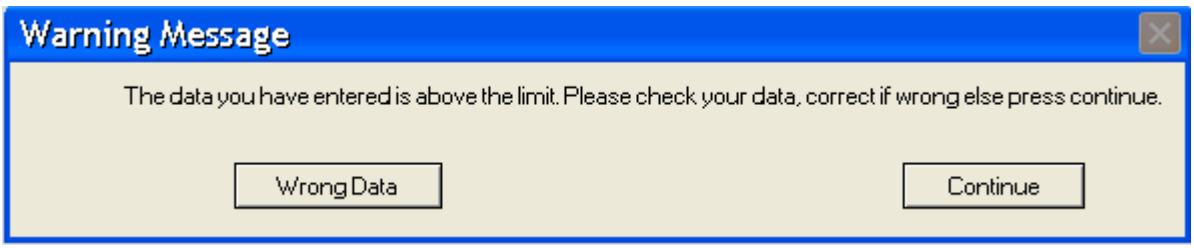


Figure 4.13: Warning Message



The process of building up the diagnostic tool is as follows:

1. Select the market and the collect the data for that market. For example: For Delhi Market collect the data starting from 1st January 2012 to 31st December 2016.

2. Using the box plot analysis get the 25th and 75th percentile value of the data.

3. Take any value M (integer value) which fits the data.

4. To define a broad range, for lower limit divide the 25th percentile value by m and for higher limit multiple the 75th percentile value by m.

5. Any value that lies within the range of this will be directly accepted by the system and values that lies outside it will generate a warning message while uploading in the system.

4.4 Findings

(i) Every year the prices and arrivals of onion depends on the production of it. The fluctuations in arrivals mainly occur because of increase or decrease in the production, early harvesting, poor storage, exports and lack of retention power by growers. Keeping in mind the various instances of the price of onion, the seasonality of arrivals and prices were analysed for various markets for a period from 2012 up to the latest month for which data was available in 2016.

Delhi Market:

The largest arrivals were during June-July in the years 2013, 2014 and 2015 and November-December for 2012 and 2013 in the Delhi market and surprisingly the market prices were highest during the months of high arrivals (November-December). Arrivals and prices started declining marginally from January to February. However, prices were higher during June and July, despite an increase in the values of arrivals in the corresponding period.

Pimpalgaon Market:

The seasonal behaviour of the arrivals and prices of onions in the market is observed. The highest arrivals were generally during April-July in the Pimpalgaon market and the prices were random in these months. "The value of arrivals started declining from October onwards and the trend continued up to

March. It is also interesting to note that since onion is grown in the rabi season in Maharashtra, the values of arrivals were maximum during April-May.

Bangalore and Other Markets:

A peculiar situation could be observed from the trend in arrivals and prices of onions in the Bangalore market. The values of arrivals started increasing from September and touched a peak during October for the years 2015 and 2016 this can be seen in the relationship figure. Similarly, prices started increasing during August and the trend continued up to January. Trends in arrivals and prices of onions in different markets for November and December 2013. It is evident from the figures that during the third week of December, prices of onions skyrocketed and the arrivals reduced drastically. The selected markets are mainly consuming markets and receive secondary arrivals in sizeable amounts. The pattern of reduction in arrivals in this particular period (November and December) might be due to retaining of stocks by onion traders.

(ii) **Variation in arrivals and prices:** The analysis of price movement of commodity in the corresponding and liked markets helps in judging of the extent of efficiency of the marketing system in the country for the selected commodity. It has been noticed that when major portion of the produce reaches the market during peak season, the price generally rule low which depress the farmers income to a great extent. Seasonal variations are the results of such factors, which uniformly and regularly rise and fall in the magnitude. The variation can be per hour, per week or per month but for our study we have considered per month variations. This clearly indicates that although there was a steady increase in arrivals and prices over a period of time, their fluctuation from year to year were very high. Similar results were observed for vegetables by Mali et al. (1999) and Nawadkar et al. (1999). The higher fluctuations in arrivals might have resulted in wide variations in prices of onion.

(iii) **Relationship between monthly arrivals and wholesale prices:** To study the overall relationship between monthly arrivals and average wholesale prices of onion in selected markets, the correlation coefficient between arrivals and prices of corresponding months as well as subsequent months were worked

out. It is clear from the that negative relationship between arrivals and prices were noticed in Ahmedabad and Delhi markets in corresponding months indicating the increase in arrival leads to decline in onion price and vice versa. In case of Bangalore market positive relationship was noticed indicating increase in arrivals leads to increase in price and vice versa. This might be due to good demand for consumption of onion by local consumer as well as neighboring states (Andhra Pradesh, TN and Kerala). Whereas in case of arrivals and subsequent month prices, positive relationship was noticed in Bangalore and Delhi markets which indicates that the arrival of onion in a month is positively influenced by the previous month price". However, in Ahmedabad and Pimpalgaon markets previous month prices are not influencing on current month arrivals.

(iv) **Future Data Forecasting:** It is visible that data of the next year can be easily forecasted with very little variation using the data points for the previous 2-year data with the help of third exponential smoothing algorithm.

(v) **Warning Tool:** The tool which developed is used to create warning message for every wrong data input which is different for every market.

4.5 Recommendations

(i) Automation of Uniform Data Upload Process across all platforms: In the current situation, all the data of the day's trade in the various markets, is uploaded to the AGMARKNET and NHB portal at the end of the day. Each market compiles the data of all the transactions held throughout the day, identifies the minimum, maximum and modal prices of the commodities, calculates the total arrival of the various commodities, and, only then, can the data be uploaded to the portal.

However, such a method of manual compilation of data leaves room for human errors and also makes the entire process very challenging for the markets, as the amount of data generated in a single day for all the commodities is huge.

It is therefore recommended to make use of Information Technology Solutions to the problem such that each and every transaction that occurs in any given market, should occur through electronic channels only and also with due record keeping. This will ensure that the market personnel do not have to spend

considerable time in compiling the data at the end of each working day. This will also ensure that chances of human error are minimized.

In the long run, it will ensure that all data is uploaded to the AGMARKNET or any other portal in due time and can even reach lengths as far as real time updation of data on the portal. Additionally, since all transactions will be processed electronically, it will be possible to record even more aspects of the transactions that occur in the agricultural markets. This will lead to better analyses of the collected data, which is likely to give the policy makers deeper insight into the functioning of agricultural markets.

ii) For the short term solutions, the data being uploaded onto the AGMARKNET portal from the different markets across the country, needs to constantly monitored for discrepancies. Periodic checks need to be placed in action by taking a sample of data and checking for irregularities such as late updation of data, uploading arithmetic mean of minimum and maximum prices in place of modal price, markets which upload erroneous data repeatedly, etc. In addition, the existing system needs to be modified such that proper alerts are generated and sent to the concerned authorities whenever such irregularities in the data are brought to the surface.

(iii) The tool developed for creating warning messages should be implemented on both the ends i.e. from where the data is being uploaded to the platform and where the data is being checked. This is an initial check that can be taken to prevent the platform from filling up with wrong and garbage values.

Chapter 5
Conclusions

An in-depth analysis of trends in arrivals and prices of onion by visualizing the plots and variations of the plots showed that there is seasonality in the prices and in the arrivals of onion in various parts of the country. Considerable amount of variations both in prices and arrivals were observed in onion in all the selected markets. The pattern of trend both in arrivals and prices of onion was observed to be not similar in all the markets. The markets behave differently for example in Bangalore market the prices of onion rises with increase in the arrival of onion in the market whereas in Delhi market the prices drop with increase in arrival of onion in the market. There was significant change in arrivals over the period in all the markets and there was increasing trend over years with ups and downs. In case of prices, there was a marginal increase in trend over the period with mild fluctuations in all the markets with fluctuations in the prices occur throughout the year in all the market for all the years except the recent 2016.

In terms of data quality in the platforms, there is a huge problem that is also figured out in the data available in the two portals AGMARKNET and NHB. There is huge variation in the data which rises to problem of credibility of data on either of the two platforms as both of them are being operated under government of India. There should be a uniform data uploading tool for all the web portals thus maintaining the uniformity in the data.

The diagnostic tool that is developed as a part of the project is very useful as it acts as a first level filter in the platform. It helps in preventing the platform from piling up unwanted garbage data. This tool should be implemented live on the platform as soon as possible.

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