COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE

DEPARTMENT OF STATISTICS

LINEAR TREND ANALYSIS ON RETAIL PRICE OF RED PEPPER IN ABESHGE WOREDA

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DECLARATION

This project as presented in this report is our original work and has not been presented for any other university award. We have submitted this research to Wolkite University in partial fulfillment for the Degree of Bachelor of Science.

Name of Student (1)	Signature	Date
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Approval Sheet 1

This is to certify that the research entitled **Time series analysis of Retail price of Red pepper in Abeshge woreda** submitted in partial fulfillment for the Bachelor of Science (BSc) Degree in Statistics of Undergraduate program of Department of Statistics in College of Natural Science, Wolkite University, and is a record of the original research carried out by Shifera Shankoru, Simegnew Guadie and Ayantu Endalu, under my supervision and no part of this research has been submitted for any degree or diploma award. The assistance and the help received during the course of this investigation have been duly acknowledged. Therefore, I recommend that it would be accepted as fulfilling the Bachelor of Science in Statistics requirement.

Name of Advisor	Signature	Date
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Approval Sheet-2

I Examiners of the final open defense by Shifera Shankoru, Simegnew Guadie and Ayantu Endalu have read and evaluated their research entitled this is to certify that the research entitled **Time series analysis of retail price of Red pepper in Abeshge woreda** and examined the candidate. This is Therefore to certify that the research had accepted in partial fulfillment of the requirements for the degree of Bachelor of Science in Statistics.

Examiner name	Signature	Date
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ABSTRACT

Retail price for Red pepper is the form of price change that uses Red pepper. It is the actual price demand made on existing Red pepper supply. This research paper primarily focus on the time series analysis for Retail price of Red pepper in Abeshge woreda. Secondary data is used for accomplishment of this research obtained from the Retail price of Red pepper in Abeshge woreda. The researcher used descriptive and time series analysis to analyze the data for Retail price of Red pepper in Abeshge woreda. The model that identify based on Box-Jenkins procedure is ARIMA (1 1, 0) and one can use this model to forecast the future price of Red pepper in Abeshge woreda. Therefore, based on the result of this study concerned bodies are recommended to take remedial action to stabilize the demand and supply for Retail price of Red pepper in Abeshge woreda.

ACRONYMS AND ABBREVIATION

ACF. …. …………. Autocorrelation Function

ARIMA…………. Autoregressive Integrated moving Average

ASTA……………. American Spice Trade Association

AIC……………. Akaike Information criteria

AR……………… Autoregressive

BIC……………….Bayesian Information criteria

CSA……………… Central Statistics Authority

EEPA………………. Ethiopian Export Promotion Agency

GDP…………………. Gross Domestic Product

HH……………………..Household

MSD……………….. Mean Square Deviation

MAPE………………..Mean Absolute Percentage Error

MAD………………..Mean Absolute Deviations

PACF……………….. Partial Auto Correlation functions

SNNPRS……………… Southern Nation Nationalities and Peoples Regional state

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Red Pepper is the world's second important vegetable ranking after tomatoes and it is the most produced type of spice flavoring and color to food while providing essential vitamins and minerals. The nutritional value of Red pepper merits special attention. It is a rich source of vitamin A and E. Both hot and sweet peppers contain more vitamin C to prevent flu colds than any other vegetable crop Bosland & Votava (Addisu Hailu, 2016). The color and flavor extracts from pepper are used in industries, e.g, ginger beer, hot sauces and poultry feed. In some countries, the shoot tips are cooked as herb or as vegetable Rubatzky & Yomaguchi (Astewel Takele, 2010). They also pointed out in addition to their uses as food, uses for cosmetic production, condiment and medicine, and ornamentals in the garden. Pepper has its origin in Mexico and Central America regions, introduced to Europe and it was subsequently spread into Africa and Asia Bosland & Votava (2009).

Red pepper has different names in different countries of Asia. For instance it is called "Emma" in Bhutan, "la-Jiao" in china "cabe" in Indonesia, "prik" in Thailand, and "chili" in India. The early Aztecs of Mexico also called them "chili", and this term is the most commonly used today around the world, with some variant spellings: chili, chili, chilly (bark, 2007).

Pepper is produced in all the continents except Antarctica. In Antarctica there are stories about pepper being kept in flower pots to spice up their food (Bose land and Vltava, 2009). It is believed to have originated in central and south America. Peru and Mexico might have been the second centers of origin, after which it spread into the new world tropics before its subsequent introduction into Asia and Africa in 1493 (Bose land and Vltava, 2009). Tropical Asia (India, Malaysia, Thailand, Indonesia and Philippines), tropical Africa (North Africa, Senegal, Nigeria, Ghana, and Kenya) and South America (México) and the Caribbean are the main producers. Over 48% of the world pepper is produced in Asia, china being the leading country. The production in china alone exceeds the entire production of European countries (Rubatzky and Yamguchi, 1997). India is the major exporter of dry chili peppers, followed by china, and the major importing countries are the U.S.A. and Germany (Bark, 2007).

Farmers in Ethiopia are more focused on the production part without having adequate market information about their products. Agricultural marketing has become highly complex and difficult involving very large and long marketing channels, a large number of middlemen, many types of physical, social, economic and facilitating marketing functions and services. The majority of farmers are marginal, small, scattered, illiterate and unorganized. They do not have sufficient time, knowledge and skills for the scientific marketing of their produce. In the absence of well- developed markets, marketing facilities, and marketing efficiency, farmers are at disadvantage by selling their increased marketable surplus to traders in the market as they get low prices (Jema Haji, 2008).

Ethiopia is the highly an agrarian country. Agriculture is considered as a backbone of the country's economy in Ethiopia. Agriculture contributes about 43% of gross domestic product (GDP) employment generation (80%), share of export (70%) and providing about (70%) raw material for the industries in country in 2012/13(UNDP, 2013).Furthermore, 90% of the poor earn their livelihood from this sector (Yu et al.2011).Thus, it is not surprising that policy action in Ethiopia is largely based on influencing the dynamism of the agricultural sector. Based on the Heckman two-stage model, the study has identifies the main determinants of Red pepper market participation decision and its effect on the quantity supply. One of the most important variables influencing the decision to participate in Red pepper market is pepper production. Consequently, extension work should focus on encouraging farmers to participate in pepper production especially, there is a need to increase new varieties that are disease resistant and develop these technologies to potential areas.

Farmers in Ethiopia are more focused on the production part without having adequate market information about their products. Agricultural marketing has become highly complex and difficult involving very large and long marketing channels, a large number of middlemen, many types of physical, social, economic and facilitating marketing functions and purpose. The deep red colored cultivars have a very high processing demand in the country (EEPA, 2014).

Red pepper and chili are the leading vegetable and spices grown in the country. The central (eastern and southern shoa), western, north western (Wallaga, Gojam) and the southern part of the country are the potential pepper producing areas. Currently most of the product comes from Halaba, Meska as an irrigated crop (MARC, 2004).

Red pepper is widely cultivated in different agro- ecologies of Ethiopia. The Ethiopian Export Promotion Agency (EEPA, 2014) has carried out a spice potential market study in Amhara,

Oromia and SNNPRS, and it identified that the land coverage for pepper in the three regions. The total production of pepper in the country for the year 2016/2017 Ethiopian main cropping season (Meher) was estimated at 3.1 million quintals. On average 75% of pepper production is for market in SNNPRS (CSA, 2016). The share of the region in the total production of red pepper in the country constitutes 69%, followed by Amahara region, which produces about 27% of the total production in the country CSA (2016). In 2014/2015 production year the total cultivated land and production in the region was 67,072 hectare and 1, 970,068 quintal respectively (CSA, 2016).
The production of red pepper in country for the year 2005/2006 Ethiopian main cropping season was estimated at 1,790,283 quintals rain- Red pepper production in 2005/2006 production season was 777,602 quintals in South Nation Nationalities and People Regional State (SNNPRS).

The production system in Abeshge Woreda is predominantly undertaken by the use of traditional farming system. Farmers believe that large quantity of product is obtained from land expanding and the farming is characterized by the low productivity per hectare. Not only the productivity of the red pepper, but also the productivity of the livestock is low. Therefore, the annual income (in terms of money) from farming, especially red pepper is too low that is not sufficient for house hold to live on it. Therefore, Markets are characterizes by low producers' share and high marketing cost. Development of technology, including hybrid technology; increasing water availability through government-funded infrastructural projects; and the supply and use of in organic fertilizer and other farm chemicals are important factors contributing to red pepper production.

1. 2 Statement of the Problem

Red pepper is the major spice and vegetable crop produced by the majority of farmer in SNNPRS, Oromia, Amhara regions (EEPA,2008).Despite the significance of pepper in Ethiopian economy and current income generating capacity of pepper for the small holder producers as compares to its magnificent potential in the country it has not been given due to attention.

In SNNPRS, the production of pepper is constrained by variable seasonal conditions. As a result, the variation in its supply on rural and urban market is considerable. Besides, storage facilities, transportation, linkages with traders; quality controlling mechanisms, market information and price settings are weak in the region and need to be further investigated. Hence, to benefit producers and other marketing agents involved in the production and marketing of red pepper there is a need to have a well-developed infrastructure to keep the product until it reaches the final consumer. Producers face so many interlinked problems such as poor market information and infrastructural problems (storage, transport and processing). Furthermore, the demand side is also highly characterized by highly amont of price of red pepper for consumers. So far how and why the consumer price has been skyrocketed and whether the producers benefit from the progressively increasing price of red pepper were hardly studied. This study, therefore, was initiated with the purpose of investigating the pepper value chains and factors affecting red pepper supply to the market in Abeshge Woreda.

However, there is a critical problem that stands in the course of formulating appropriate policies and procedures for the purpose of increasing marketing efficiency. This has to do with lack of pertinent marketing information and other marketing facilities, like storage, transportation, etc.

1. What was the periodic pattern and trend for weekly retail price of Red pepper?

2. What would be the future trend for weekly retail price of Red pepper in Abeshge woreda?

3. Which time series model is appropriate to fit the model that examines for retail price of Red pepper in Abeshge woreda?

1.3 Objectives of the study

1.3.1 General Objective

The general objective of this study would be to analyze the retail prices of Red pepper in Abeshge woreda.

1.3. 2 Specific Objectives

- To estimate the amount of price change of the consecutive retail prices.
- To forecast the weekly retail price for Red pepper by using best model.
- To estimate seasonal factors for retail price of red pepper in Abeshge woreda September 2011E.C to august 2013E.C.

1.4 Significance of the Study

The possible significance of study was

- Give the general description for Retail price of Red pepper in Abeshge woreda.
- It’s important to know whether the price of the Red pepper is increased from time to time and what did to keep the Market price stability if there is price fluctuation.

- ❖ The study would also help to plan future operation and formulation of strategic decision making on demand and supply of retail price for Red pepper in the woreda.
- ❖ Used to understand the past behavior of the series in the price change.
- ❖ This study gave the way for other research who wants to make further study on this topic.

1.5. Scope of the study

This study would be conducted in Abeshge woreda to analysis time series data of the change in price of cereal crop. However, the study focused on only particular commodities like Red pepper to assess the individual weekly price from 2011 to 2013 in Woreda.

1.6 Limitation

In doing, different types of research and project there may be different kind of limitations faces the researcher. The followings were the problem that faces us in the study.

- ✓ Unavailability of internet service.
- ✓ Lack of many other research topics done related to our study in the Abeshge woreda.
- ✓ Not having the experience to do research before.
- ✓ Inaccessibility of different statistical software.
- ✓ Shortage of time, and insufficient resources.
- ✓ Difficulty of getting clear and accurate information about data.

CHAPTER TWO

LITERATURE REVIEW

2.1. THEORETICAL BACKGROUND ON MARKET PERFORMANCE

Red pepper is an important vegetable and spice crop which is produced by smallholder farmers for both commercial and consumption purposes at local, national and international markets. Therefore, analysis of market chain on Red pepper plays an important role in an ongoing or future Red pepper marketing, production and supply development plan. However, the production and marketing of Red pepper are constrained by various socioeconomic, institutional, biological factors. The finding also revealed that red pepper production is carried out by different actors via different market channels. However, the majority (60.2%) of Red pepper transaction was handled by district wholesalers and reached final consumers through different market channels. The result from the economy analysis also revealed that various socioeconomic, demographic and institutional variables such as experience in red pepper production, access to extension, yield and market price of Red pepper were found to have a positive and significant effect on the volume of Red pepper supplied to the market, while amount of off-farm income negatively and significantly influenced the volume of red pepper marketed.

According to Lumpkin et al. (2005), Red pepper production is a labor-intensive task and generates high employment opportunities for different classes of households. However, in most of the developing countries including Ethiopia, production of horticultural product is seasonal in nature and price is inversely related to the amount of supply. This implies that during the peak season, prices decline and vice versa. The situation is worsened by the perishability of the products and poor storage facilities. Thus, 25% of the product is damaged along the marketing channel before reaching the final consumers (Emana and Gebremedhin 2007).

2.2. Factors Affecting Market Supply of Red pepper

The market supply refers to the amount actually taken to the markets irrespective of the needs for home consumption and other requirements. Whereas, the market surplus is the residual with the producer after meeting the requirement of seed, payment in kind, and consumption by farmer also significantly and positively affected quantity supplied of teff and wheat while it negatively affected quantity supplied of maize. The factors that affect the market supply of red pepper are the number of sellers in the market, time of production, availability of the factors of production, its price, physical factors such as diseases, chili eating insects and animals etc.

2.3 Factors for the seasonality of the price of red pepper (agricultural products)

Market price is affected by various external and internal factors. The external factors cannot be controlled by business organization but, simply assumptions take in business whereas the internal factors could be measured with business men's strengths and weakness. However the main factors that can be listed are production time, environmental conditions, demand situation, marketing system, Public inference and Price policy. Marketing price of agricultural products will be affected if these factors mismatched and this directed to inflation i.e. generally, considered to give rise to economic cost to society. This includes physiological and political costs which arise from the redistribution of income in society. Some economists believe that inflation also results in higher unemployment and lower of growth in the long run. Therefore, marketing information has a power to address the right information at the right time for business opportunities and the acts to be versioned.

2.4 Market performance for price of Red pepper

A commonly used measure of the performance of a marketing system is the marketing margin. Marketing margin was calculated by taking the difference between producers and retail prices. The performance of markets through the evaluation of marketing activities along the different marketing channels of the crop and evaluation of market integration, which could be a major input to formulate appropriate marketing policies and procedures. The findings from this study was believed to be helpful in reducing the information gap on red pepper and contributing to work better understanding on improved strategies for reorienting marketing system for the benefit of small holder farmers, traders, and other market participants. Analyzing the challenges in pepper marketing would indicate the gaps to improve pepper production and marketing and benefit policy makers and implementers in the area to fill the gaps. In addition to this, it will also help to make appropriate marketing decisions by the producers, consumers, traders, investors, and others.

The study is also used to suggest strategies for smooth integration among production and marketing by referring to root causes for supply and marketing problems starting from production till the consumption of the product. This study, therefore, is initiated with the purpose of investigated the pepper value chains and factors affecting Red pepper supply to the market in Abeshge woreda. In addition to this red pepper price currently increase more than previous time so study on market chain of red pepper today is important to identify whether producers gets the right share or not.

CHAPTER THREE

METHODS AND MATERIALS

3.1 DESCRIPTION OF THE STUDY AREA

Abeshge is one of the woredas in the Southern Nations, Nationalities, and Peoples Region of Ethiopia. Part of the Guragie Zone, Abeshge is bordered on the south by the Wabe River which separates it from Cheha district, on the west and north by the Oromia Region, and on the east by

Kebena district .The area lies at a latitude and longitude of 08°19′N 37°28′ E and 07°56′N 37°37′ E, respectively, at 1500– 1800 masl. The district has generally a midland climate with an altitudinal rage of 1100–2300 masl, although there are some lowland areas (1100–1500 masl). It covers an area of 61,016 ha of which the mid- and lowlands constitute roughly 85 and 15 %, respectively EIAR (2011).Based on the 2015 Census conducted by the CSA, the total population of the district, which constitutes two urban and 26 rural *kebeles*, is 72,917 of which 37,187 (51 %) and 35,730 (49 %) were females and males, respectively. Four rural kebeles (Walga, Borer, Dargie, and NachaQulit) with a total population of 13,861 in 1761 HHs were involved in the study. Each village has, on average, 487 HHs and 3465 people.

3.2. Source and Method of Data Collection

A combination of quantitative and qualitative data will collected from primary and secondary source data. The Primary source will have obtained directly from the respondents through questionnaire while secondary data will be obtained from documents, books, internets and governmental sector. The data which will be used for this study is a secondary source which obtained from Guraghe Zone Trade and Commerce Agency.

The analysis of data series has further been organized into Preliminary analysis, Model fitting, Model diagnostic, predicting in-sample forecast and evaluating the accuracy of the forecast for the period of 2011 September 1st week to June 2013 40th week. The statistical software package used for most of the analysis in the study was Eviews 9 and MINTAB.

3.3 Study Variables

Dependent variable: Average weekly Retail prices of Red pepper from 2011 E.C to 2013 E.C in Abeshge woreda.

Independent variable: time measure of those prices.

3.4 Methods of Data Analysis

3.4.1. Descriptive Statistics

Descriptive statistics enables us to determine about the general information on retail price of Red pepper in Abeshge woreda. It can proceed with summary calculations, graphs, charts and tables. It would be compute by the measures of central tendency (mean, median, mode, and etc) and measures of variation (range, variance, and maximum, minimum).

3.4.2. Inferential statistics

Inferential statistics is a kind of statistical method which deals with analysis, interpretation and conclusion of population parameters based on sample statistics. The Box-Jenkins methodology (time series models including AR, ARMA and ARIMA) is appropriate for this study.

3.5 Trend Analysis

Trend is general tendency to increase or decrease during a long period of time. There are several methods to estimate trend. From these methods moving average method and quadratic estimation method are used for determine the trend.

Moving average method: - is the average of n consecutive values of a time series.

In order to measure trend we try to eliminate seasonal components from the time series data. Trend analysis fits general trend model to time series data and provides forecasts. The appropriate model is selected by using different measures of accuracies like mean absolute percentage Error (MAPE), Mean square deviation (MSD) and mean absolute deviation (MAD). We choose the one with minimum MAPE as appropriate model for each category.

3.5.1 Linear Trend

This trend is applies when the trend show a constant change by one direction it also use for short

Period data

$Y1 = bo + b1t + \varepsilon t$

Where Bo is the intercept,

b_1 is the slope,

ε_t is a random error

Where;

E ($\varepsilon_{t)} =$0

Cove (ε_{ti}, ε_{tj}) =0

Var (ε_t) =σ^2

3.5.2. Linear Trend Estimation

The trend estimation by using mathematical equations which is different from other types of trends. Thus, linear least square estimation is simple to estimate the trend assumption of linear trend. We use moving average method for this purpose because the graph is easily understandable.

3.6. Stationary of time series data

Time series Stationary is an important point to be described in time series analysis. A series is said to be stationary if the mean and autocovariances of the series do not depend on time. If both are constant over time, then the series is said to be a stationary process i.e. is not a random walk (has no unit root), otherwise, the series is described as being a non-stationary process i.e. a random walk or has unit root. Time series plot ADF test, ACF, PACF, PP test are what we are going to use in our study to check stationarity of time series data.

3.6.1Time series plot

If a time series is plotted and if there is no evidence of a change in a mean over time then we say the series is stationary on the mean. If the plotted series shows no obvious change in the variance time then we say the series is constant variance.

3.6.2 Augmented Dickey Fuller (ADF) Test

The ADF test is used to test for unit root. The testing procedure for the ADF test is the same as for the Dickey–Fuller test but it is applied to the model.

By including lags of the order *p,* the ADF formulation allows for higher-order autoregressive processes. This means that the lag length *p* has to be determined when applying the test. One possible approach is to test down from high orders and examine the t-values on coefficients

The testing procedure for the ADF test is applied to the model. A random walk with drift and trend is represented as;

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \delta 1 \Delta Yt - 1 + \cdots + \delta_p - 1 \Delta Yt - p + 1 + \varepsilon_t \cdots \cdots (3.1)$$

3.6.3 Phillips-Perron (PP) Test

It is used in time series analysis to test the null hypothesis that a time series is integrated of orders one. It builds on the Dickey–Fuller test of the null hypothesis $\delta = 0 \;\; in \; \Delta yt \;\; = \delta yt - 1 \; + ut$ where Δ is the difference operator. Like the augmented Dickey–Fuller test, the Phillips–Perron test addresses the issue that the process generating data for yt might have a higher order of autocorrelation than is admitted in the test equation - making y_{t-1} endogenous and thus invalidating the Dickey–Fuller test Zero. The testing procedure for the PP test is applied to the model:

$$\boldsymbol{Y_t = \alpha + \rho_{yt-1} + \delta t + \mu t \cdots \cdots\cdots (3.2)}$$

3.7 Univariate Time Series Models

Linear time series analysis provides a natural framework to study the dynamic structure of a time series$\{y_t\}$. A time series model will typically describe the path of a variable y_t in terms of contemporaneous (and perhaps lagged) factors,x_t, disturbances (innovations), ε_t, and its own past lags,$y_{t-1}, y_{t-2}, \cdots$.

A Univariate time-series model describes the behavior of a variable in terms of its own past values and disturbance term. Thus, the general expression for the Univariate time series model is $y_t = f(y_{t-1}, y_{t-2}, \ldots, \varepsilon_t)$. To make the above equation operational, three things must be specified: the functional form, the number of lags, and a structure for the disturbance term.

Autoregressive (AR) models: Autoregressive models are based on the idea that the current value of the series, Y_t, can be explained as a function of *p* past values, y_{t-1}, y_{t-2}. . . y_{t-p}, where *p* determines the number of steps into the past needed to forecast the current value.

An autoregressive model of order *p,* abbreviated AR (p), can be written as: highest order *p* is referred to as the order of the model.

$$Y_t = \varphi_{1yt-1} + \varphi_{2yt-2} + \ldots . + \varphi_{pyt-p} + \varepsilon_t \quad \cdots\cdots (3.3)$$

Where $\{\varepsilon_t\}$ is white noise, i.e., $\{\varepsilon_t\} \sim$ WN $(0,\sigma_e^2)$, and ε_t is uncorrelated with Ys for each s < t...

Since AR is autoregressive, writing equation above in terms of the lag operator *L*, the above equation given as shown below $yt = (\varphi 1L + \varphi 2L2 + \cdots + \varphi pLP)\, yt + \varepsilon t$.

Now using the backward shift operator, we obtains $Z_t = X_t - \varphi X_{t-1} - \varphi_2 X_{t-2} \ldots \varphi_p X_{t-p}$. It is noted however that y_t is replaced by x_t; $and\ y_{t-1}$ is also replaced by x_{t-1} and so on. This simplifies to: $Zt = Xt\,(1 - \varphi 1B - \varphi 2B2 - \ldots \ldots - \varphi PBB)$

Suppose, we let $Z_t = \varphi$ (B) Xt. Therefore, this equation becomes Xt = 1/φ (B) Zt. Since Zt = φ (B) Xt then an AR of order P can be simplified as $\varphi (B) = 1 - \varphi_1 B - \varphi_2 B_2 - \ldots \ldots . - \varphi_p B_P$.

Moving average (MA) Models: As an alternative to the autoregressive representation in which the Y_t on the left-hand side of the equation are assumed to be combined linearly, the moving average model of order *q*, abbreviated as MA (*q*), assumes the white noise (w_t) *on* the right-hand side of the defining equation are combined linearly to form the observed data. A series is said to follow a moving average process of order q, or simply MA (q) process if

$$Y_t = \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \cdots + \theta_q \varepsilon_{t-q} + W_t \quad \cdots\cdots\cdots (3.4)$$

Where θ_1, $\theta_2 \ldots$ θ_P are the MA parameters. MA (q) models immediately define stationary; every MA process of finite order is stationary.

Autoregressive –Moving average (ARMA): We now proceed with the general development of autoregressive, moving average, and mixed autoregressive moving average (ARMA), models or stationary time series. In most case, it is best to develop a mixed autoregressive moving average model when building a stochastic model to represent a stationary time series. The order of an ARMA model is expressed in terms of both *p* and *q*. The model parameters relate to what happens in period *t* to both the past values and the random errors that occurred in past time periods. A general ARMA model can be written as follow:

$yt = \varphi 1yt-1 + \varphi 2yt-2 + \cdots, +\varphi pyt-p + \theta 1\varepsilon t-1 + \theta 2\varepsilon t-2 + \cdots, +\theta p\varepsilon t-q + \varepsilon t$**………………………….. (3.5)**

By using backward shift operator B to obtain (B)y_t = (B)ε_t

The ARMA model is stable i.e., it has a stationary 'solution' if all roots of (*B*) =0 are less than one in absolute value. The representation is unique if all roots of **(***B*) =0 lie outside the unit circle and (*B*) not have common roots.

Stable ARMA models always have an infinite order MA representation. If all roots of (*B*) are larger than one in absolute value, it has an infinite order AR representation. The process is invertible only when the roots of (*B*) lie outside the unit circle .Furthermore, a process is said to be causal when the roots of (*B*) lie outside the unit circle.

Autoregressive Integrated Moving Averages (ARIMA) Models: Autoregressive integrated moving average (ARIMA) models are specific subset of Univariate modeling, in which a time series is expressed in terms of past values of itself (the autoregressive component) plus current and lagged values of a 'white noise' error term (the moving average component). ARIMA models are Univariate models that consist of an autoregressive polynomial, degree of differencing (d), and a moving average polynomial.

A process (Y_t) is said to be an autoregressive integrated moving average process, denoted by ARIMA (p, d, q) if it can be written as: (*B*) $^{d}y_t$= (*B*) w_t Where, B^d= $(1-B)^{d}$ with $B^d y_t$ and d^{th} consecutive differencing.

If $E(\nabla dyt) = 0$, we write the model as $(B)dyt = \alpha + (B)\,wt$ where α is a parameter related to the mean of the process $\{Y_t\}$, by $\alpha = \mu\,(1 - 1 - \cdots - p)$ and this process is called a white noise process, that is, a sequence of uncorrelated random variables from a fixed distribution (often Gaussian) with constant mean $E(Y_t)= \mu$ usually assumed to be "zero" and constant variance. If d=0, it is called ARMA (p, q) model while when d=0 and q=0, it is referred to as autoregressive of order *p* model and denoted by AR *(p)*. When p=0 and d=0, it is called Moving Average of order *q* model, and is denoted by MA (q).

3.8 Building ARIMA Models: To identify an ARIMA model for a particular time series data, Box and Jenkins (1976) proposed a methodology that consists of four phase:

i) Model identification

ii) Estimation of model parameter

iii) Diagnostic checking for the identified model

iv) Application of the model (i.e. forecasting).

***i)* Model Identification:** The purpose of the identification stage is to determine the differencing required achieving Stationary and also the order of both the seasonal and the non- seasonal AR and MA operators for the residual series. There are a number of identification methods proposed in the literature. The autocorrelations function (ACF) and the partial autocorrelation functions (PACF) are the two most useful tools in any attempt at time series model identification.

Autocorrelation Function *(*ACF*)*: The sample ACF (r_k) measures the amount of linear dependence between observations in a time series that are separated by a lag k. To use the ACF in model identification, estimate r_k and then plot r_k series against lag k up to a maximum lag of about five times the seasonality interval and this should be less than to one fourth of the series under study.

Partial Autocorrelation Function (PACF)*:* Partial autocorrelation function can also be used for determining the possible order of seasonal autoregressive, non-seasonal autoregressive, moving average and seasonal moving average that should be incorporated in the model by the help of Table-3.1 multiples of s, this suggests that the incorporation of a seasonal moving average component in to the model. The failure of the partial autocorrelation function to truncate at other lags may imply that a non seasonal MA term is required

Table-3.1 Behavior of ACF and PACF for ARMA models

	AR(P)	MA(q)	ARMA(P, q)
ACF	Tails off	Cuts off after lag q	Tails off
PACF	Cuts off after lag p	Tails off	Tails off

To obtain an estimate for partial autocorrelations (PACF) at lag *k*, we can employ successive autoregressive estimation procedure. The first step is to model the Y_t series by finite autoregressive models of order K given by $Yt = \varphi 1yt - 1 + \varphi 2yt - 2 + \cdots, +\varphi pyt - p$ Where φ_k is the k^{th} autoregressive coefficient and k =1, 2,..., K. Estimate of these coefficients by ordinary least squares or maximum likelihood estimation method gives the k^{th} sample partial autocorrelation.

3.9 Model selection criterion

3.9.1 Akaike Information Criterion (AIC)

Given a set of model for the data, the preferred model is the one with the minimum AIC and BIC value. Hence AIC not only rewards goodness of fit, but also includes a penalty that is an increasing function of the number of estimated parameters. This penalty discourages over fitting (increasing the number of free parameters in the model improves the goodness of the fit, regardless of the number of free parameters in the data-generating process).

3.9.2 BIC (Bayesian Information Criterion)

The BIC is an asymptotic result derived under the assumptions that the data distribution is in the exponential family.

BIC=-2*ln (L) +kln (n)

n = sample size

k = the number of free parameters to be estimated

L = the maximized value of the likelihood function for the estimated model given any two estimated models, the model with the lower value of BIC or AIC is the one to be preferred

3.9.3 Parameter Estimation:

After choosing the most appropriate model, the model parameters are estimated by using several estimation procedures. The estimation-stage results will be used to check: (i) parameter estimates (ii) the appropriateness of coefficient estimates which includes the statistical significance of estimated coefficient and standard error and correlation matrix.

In maximum likelihood methods, the likelihood function is maximized in order to obtain the parameter estimates.

3.9.4 Model Diagnostic Checking

It involves testing the assumptions of the model to identify any areas where the model is inadequate. Estimated model(s) will be considered most appropriate if it typically simulate historical behavior as well as constitute white-noise innovations. Historical behavior will be tested by ACF and PACF of estimated series and choose the one which best describes the temporal dependence in the series i.e., the model(s) whose residuals show no significant lags.

3.9.5 Forecasting

The Box-Jenkins methodology requires that the model to be used in describing and forecasting a time series should be both stationary and invertible. Thus, in order to tentatively identify a Box-Jenkins model, we must first determine whether the time series we wish to forecast is stationary.

Forecasting is an important application of time series analysis which defined as Process of predicting a future event. The series of conditional correlation forecasts for the period of January 2020 to April 2020 is compared to the realized values for the same period. Starting with an initial estimation from period T a forecast is made for the following months (T + 1). The estimation window is moved one month and another forecast is made for (T+ 2).

More generally expressed, the estimation period reaches between the first observation at time $\boldsymbol{t}$ and the last observation of the first period at time$\boldsymbol{T}$. This means that the length of the period $\boldsymbol{t}$ is $\Delta \boldsymbol{t} = \boldsymbol{T} - \boldsymbol{t}$. The last observation of the evaluation period is denoted T *. The forecast loop continues until the starting point $\boldsymbol{t}$ and the ending point $\boldsymbol{T}$ of the first period both have moved a number of steps equal to$\boldsymbol{T} * - \boldsymbol{T} - \mathbf{1}$, which results in a series of $\boldsymbol{T} * -(\boldsymbol{T} + \mathbf{1})$ forecasts.

3.10 Differencing

Differencing is a procedure of converting a non-stationary time series data (Y_t) in to another stationary time series data (X_t), Differencing may be ordinary or seasonal differencing or both, but to apply the appropriate differencing, it is necessary to identify whether the data is seasonal or not. Differencing data is a common step in assessing to ARIMA model. Differencing is used in variance for different time period, and it is the characteristic is stationary time series. In stationary time series data there is no difference in the mean for the different time period. It simply duplicate that the data is the stationary one. But for non stationary data, the mean of the data vary with different time period.

The need for transformations in time series is:

To analyze time series data, first is to draw the plot of the observations with respect to time. The time plot shows whether the data need transformation or not.

We need transformation for three main purposes

-To stabilize variance.

-To make seasonal effect additive.

- To make the data normally distributed.

There are different techniques of transforming time series data, some of them are differencing, logarithmic and root transformation. In our case we will use differencing technique.

3.10 Measures of Accuracy

A measure of accuracy refers to goodness of fit. The three measure of accuracy are MAPE, MAD and MSD for each the forecasting and smoothing models. From the thus three measures the value is small the model is better fit. In general, the value of thus three measure of accuracy (MAPE, MAD and MSD) is small or less than 5% the model is good fit while the measure of accuracy has large value the model is not much good fit.

3.10.1 Mean absolute percentage error (MAPE)

MAPE measures the accuracy of fitted time series values it expressed accuracy as a percentage

$$\textbf{MAPE}= \frac{\sum_{t=1}^{n}\left|\frac{(Yt-\hat{Y}t)}{Yt}\right|*100}{n} \ldots \text{(3.6)}$$

Where Yt=the actual value, $\hat{Y}_t$=the forecasted estimated value, n=the number of forecasts

3.10.2 Mean square deviation (MSD)

MSD is very similar to mean square error commonly used to measure of accuracy of fitted time series values. Because MSD is always computed using the same denominator n regardless of the model. You can compare MSD values across models, because MSE are computed different degrees of freedom for different models. we cannot always compare MSE values across models (Kendal, 1998).

$$MSD = \frac{\sum_{t=1}^{n}(Yt-\hat{Y}t)^2}{n} \ldots \text{(3.7)}$$

Where Yt=the actual value,$\hat{Y}_t$= the forecasted estimated value, n=the number of forecasts

3.10.3Mean absolute deviation (MAD)

MAD is measuring the accuracy of fitted time series values. It expressed accuracy in the same units as the data, which helps, conceptualize the amount of error.

$$MAD = \frac{\sum_{t=1}^{n} \left|(Yt - \hat{Y}t)\right|}{n} \ldots (3.8)$$

Where: Yt=the actual value,$\hat{Y}_t$= the forecasted estimated value,n=the number of forecasts.

CHAPTER FOUR

CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1 DESCRIPTIVE STATISTICS

To analyze the retail price of Red pepper data in Abeshge woreda trade office we use different statistical methods that were mentioned in methodology part and the MINTAB output. Secondary data for the retail price Red pepper in Abeshge woreda is collected weekly in three years (2011, 2012 and 2013).For the three years data the mean, standard deviation, minimum and maximum of each year are described in below table.

Descriptive Statistics: price by week

Table 4.1: General Summary Statistics Results.

variables	obs	Mean	minimum	maximum	St. dev	skewness	kurtosis
Retail price of red pepper	148	13083.33	3800	33000	7755.274	0.997037	2.960292
Retail price of redpepper(1st d/ce)	147	12947.84	3800	33000	7603.999	0.995150	2.9697752

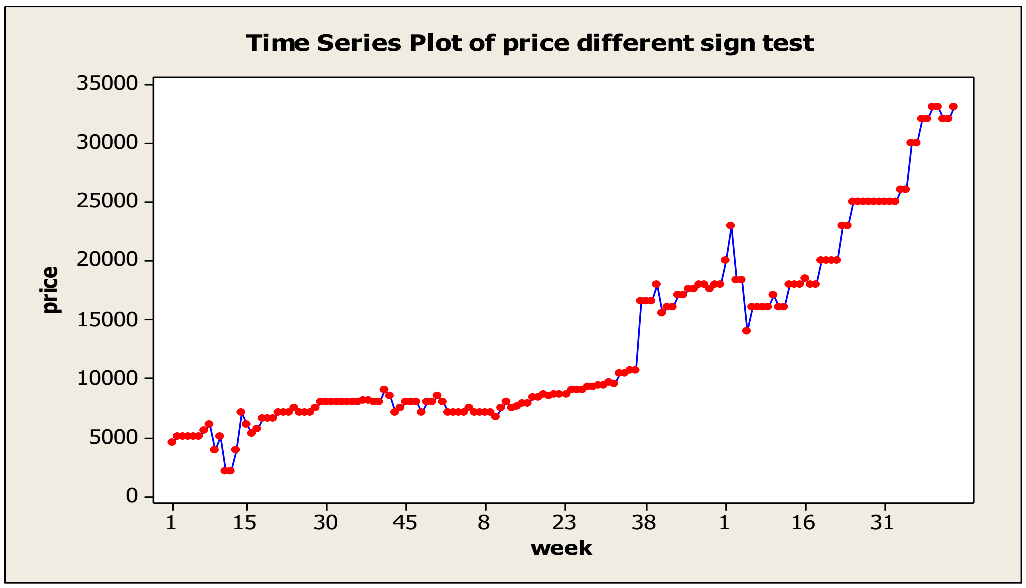
Table 4.1 shows the summary statistics for Retail price of red pepper and Retail price of red pepper (first difference). It can be seen that the estimated total average weekly Retail price of red pepper is 13083.33 with the St.dev,minimum and maximum values of 7755.274, 3800 and 33000 respectively.

4.2 Time series analysis

4.2.1 Test of randomness by difference sign test

The first and the most important step in any time series is to plot the observation against time That shows an important feature of the series such as trend, seasonality, outlier overall sales increased over the three years. Sales may be cyclical, with lower sales in the first week of each year.

Figure 4.1 time series plot for Retail price of Red pepper by different sign test.



The above figure revels that the retail price of red pepper showed weekly or yearly increment from2011 1th Week to 2013 10 thweek E.C. This indicates that the series has trend pattern. Therefore, the randomness of the series will be tested by difference sign test as well as the trend component should estimate by one method which described in the software. This test of randomness is consisting of counting the number of positive first differences of the series that is to say, the numbers of points. Where the series increase (we shall ignore the points when there is neither an increase nor decrease) with a series of N terms we have N-1 terms and the variables defined as follows:-

$X_i = 1$ if $X_{i+1} > X_i$ where i=1, 2…N

0 if $X_{i+1} < X_i$

Then, the number of point's increase, say W is given by

$W = \sum x_i$

When the number of observation is 148 and the number of point increase by lag one are 52

The distributions of W tends to standard normal, as N tends to infinity, consequently

Hence, the hypothesis to be tested is

Ho: The series is random

H1: The series is not random

Test of statistic $z_{cal} = \frac{w - E(W)}{\sqrt{var(w)}}$

Where

$E(w) = \frac{N-1}{2}$

$Var(w) = \frac{N+1}{12}$

From our data the number of points increase W=52

E (w) = (148-1)/2=73.5

Var (w) = (148+1)/12=12.41667

$Zcal = \frac{w - E(W)}{\sqrt{var(w)}} = \frac{52 - 73.5}{\sqrt{12.41667}} = -6.107$

Critical value $z_{\alpha/2} = z_{0.025} = 1.96$

Test rule:

Note: Let the level of significance use in this case is take α=0.05

Since Z_{cal} is less than 1.96 the comparison is in a critical value $z_{\alpha/2} = z_{0.05} = 1.96$

We accept the null hypothesis since -6.107<1.96.

Then the series is random, as we see the result from the data for retail price of red pepper is random.

4.2.2. Trend analysis

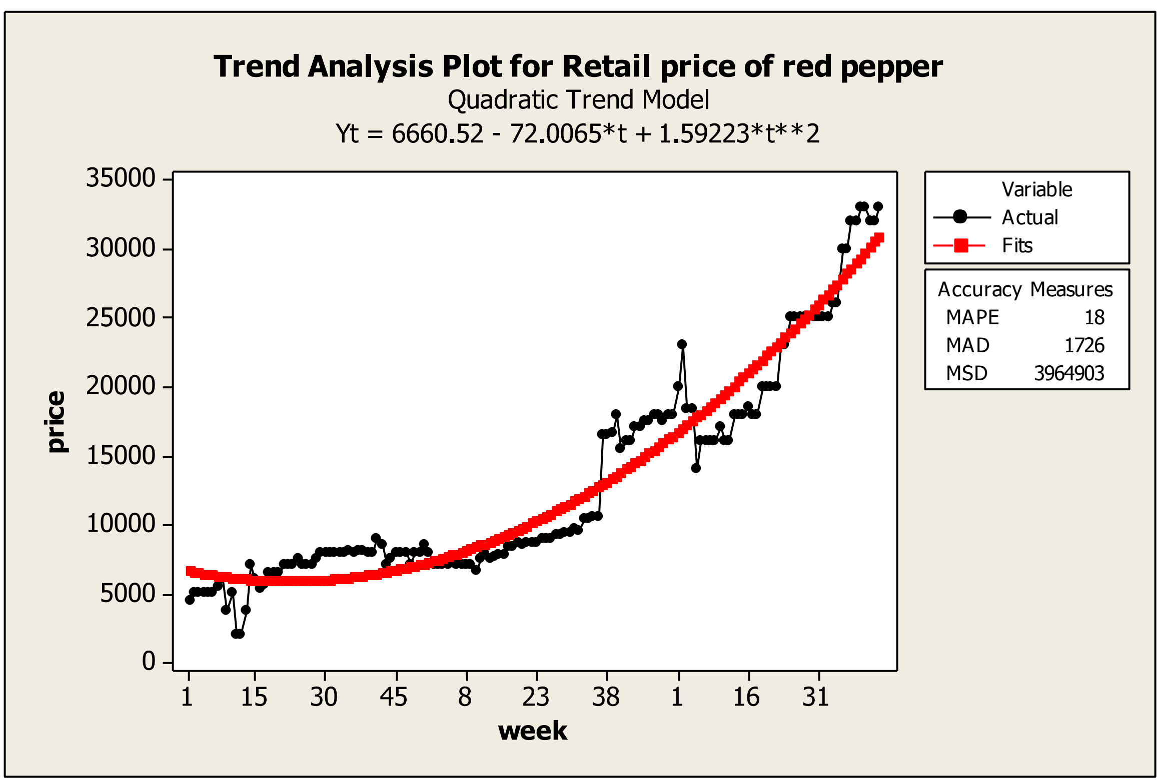
Trend is general tendency to increase or decrease during a long period. In order to measure trend we have to eliminate seasonal, cyclical, and irregular components from time series data. Trend analysis is different types such as linear, Exponential and Quadratic trend. Then see one by one.

Table 4.2: Accuracy Measures of Linear trend and quadratic trend for the series.

Accuracy Measures	Linear Trend	Quadratic Trend	Exponential Trend
MPE	28	18	18
MAD	2730	1726	1881
MSD	10720900	3964903	4993246

The three measures are not informative by themselves, but they are used to compare the fits obtained by using different trend models. From two measures, smaller value generally indicates better fit model. The outputs display the fitted trend equation and other measures to help you to determine the accuracy of the fitted value for MAPE, MAD and MSD. To select the most potential trend analysis from the above trend value, it is necessary to consider at least two measure of accuracy checking. So that the three measures have different results for the linear, quadratic and Exponential trend analysis. In this case, we can select quadratic trend analysis method. Because, quadratic trend analysis is best accuracy of fitted value for MPE (18), MAD (1726) and MSD (10720900).

Figure 4.2 Trend Analysis for Retail price of Red pepper



The trend plot that shows the first difference for retail price of Red pepper data, the fitted trend line and forecasts. The Session window output also displays the fitted trend equation and three measures to help you determine the accuracy of the fitted values: MAPE, MAD, and MSD. The Retail price of Red pepper data shows a general increasing trend, though with an evident seasonal component. The trend model appears to fit well to the overall trend, but the seasonal pattern is well fit.

4.3 Unit root test for Non-Stationarity Series

4.3.1 Test of stationary

The first logical step to make inference is checking the Stationarity of the time series data. Many of the various methods in time series analysis assume that the data with respect to the mean, variance and autocorrelation structure do not change over time. In this study, Time series plot, Augmented Dickey–Fuller (ADF) and Phillip–Perron (PP) tests are used to check the Stationarity of the weekly retail price of Red pepper. The results are presented in table 4.2

Thus, the hypothesis to be tested is Ho: the series is non-stationary against H_1: the series is stationary. The null hypothesis of the test of non-stationary (unit root) is rejected if the absolute value of the t-statistic is greater than the critical value or p-value is less than a given level of significance.

4.3.1.1 Time series plot

If a time series is plotted and if there is no evidence of a change in a mean over time then we say the series is stationary on the mean and no variation.

Figure 4.3: Time series plot for Retail price of Red pepper in Abeshge woreda

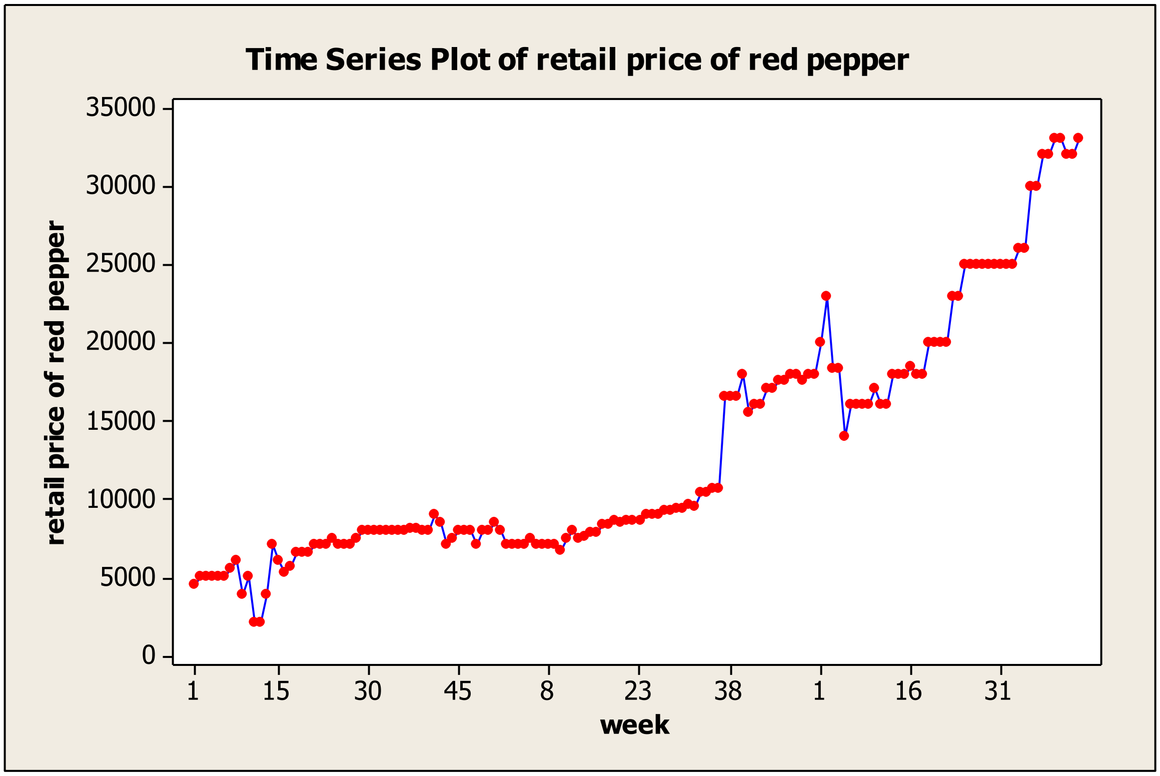


Figure 4.3: Time series plot for retail price of red pepper from 2011 1^{th} *Week to 2013 10* th*week*

Not Stationary time series

As we see from the above figure 4.3 of average weekly retail price of Red pepper(Y) is increased through time (t) and it is not stationery, so we must be transform it in to stationery form of time series plot by using difference method

Stationery through differencing

$\Delta Y_t = y_t - y_{t-1}$

$\Delta^2 \ Yt = y_t - _1 - y_{t-2}$

ΔY_t is a measure of the change or growth in Y b/n period's t-1 and t.

If Ytis the log of a variable, then $\Delta Y_t$is the percentage change.

ΔY_t is the difference of Y (or 1st difference)

Δ^2 Yt is the difference of Y (or 2nd difference)

ΔYt is often called “delta Y”

Then after the transforming the data by differencing at successive lags, it becomes stationery series. This means that it does not rend away or drift away from the mean and the time plots appears similar at different points.

Then, we conclude the above figure reveals that the retail price of red pepper showed weekly or yearly increment from 2011 1th Week to 2013 10 thweek E.C

Table 4.2: ADF and PP Test for retail price of red pepper and retail price of red pepper of first difference

variables	ADF Test		PP Test		Critical value		
	t-statistic	p-value	t-statistic	p-value	1%	5%	10%
Retail price of red pepper	1.132236	0.9976	1.595108	0.9995	-3.475500	-2.881260	-2.577365
Retail price of red pepper (1st d/ce)	-14.34644	0.0000	-14.79032	0.0000	-3.475500	-2.881260	-2.577365

As we can see from Table 4.2, the null hypothesis of unit root would not be rejected for retail price of red pepper in both the ADF and PP tests at 1%, 5% and 10% level of significance. However, the first differences of the series were found to be stationary which is an indication that the series is integrated of order one ($I_{(1)}$).

Figure 4.4 the order of integration is the number of unit roots that should be contained in the series so as to be stationary.

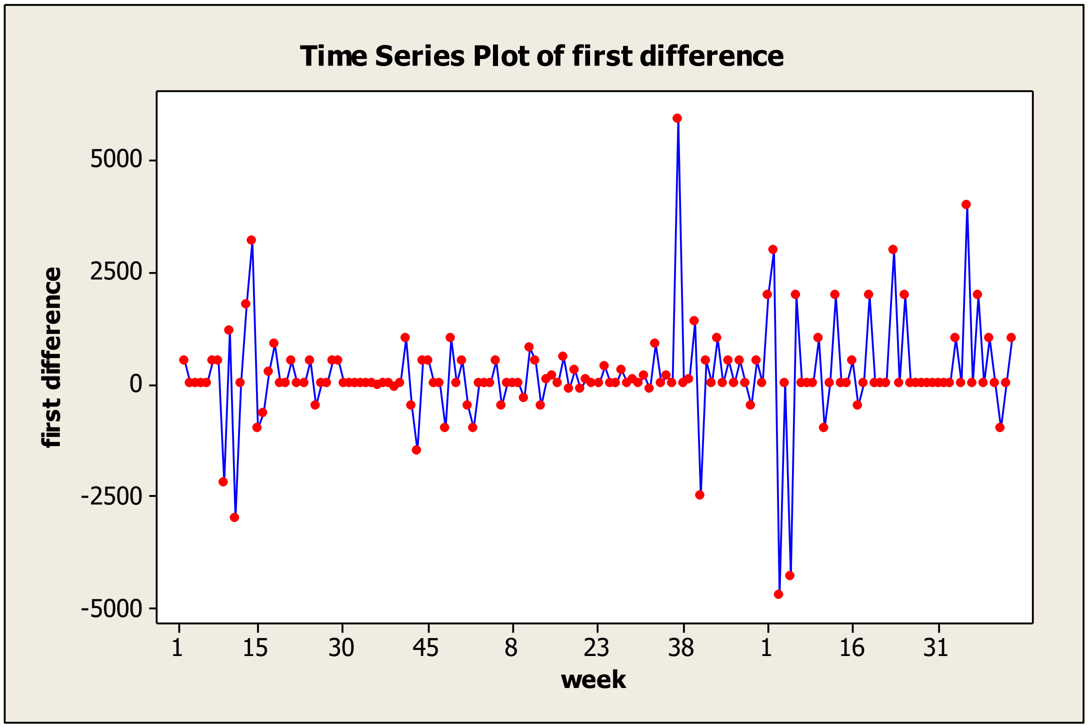


Figure 4.4: Time series plot of retail price of red pepper data (after differencing data of retail price of red pepper).

As we had seen from fig.4.4: the weekly retail price of red pepper is almost similar from weekly to weekly after differencing the original data (d=1).this indicates the time series would be stationary after first differenced.

4.4 Model Identification and Selection

Statistical method used to select the appropriate model.

4.4.1. AIC (Akaike Information Criterion)

Given a set of model for the data, the preferred model is the one with the minimum AIC.

Computing different model selection statistics in order to suggest the best of all the ARMA alternatives at the in-sample stage for the series is useful. Hence, the two statistics, Akaike

Information Criterion (AIC) and Bayesian Information or Schwarz Criterion (BIC) are used for this study. So, a model with minimizing the AIC and BIC is selected. Thus, $\boldsymbol{ARIMA}(\mathbf{1},\mathbf{1},\mathbf{0}) \approx$ I***AR (1, 1, 0)*** model is the selected model based on the two criterion (see table 4.3).

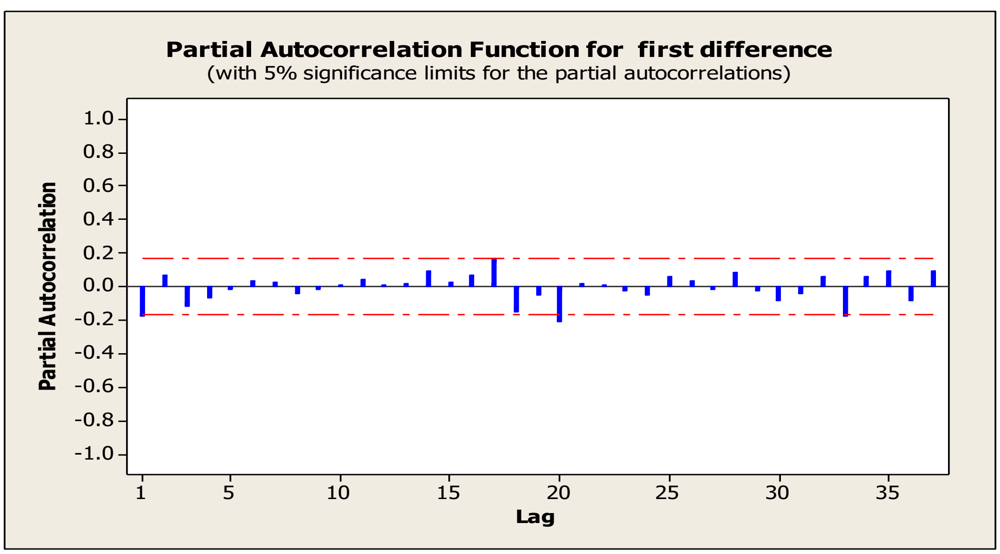
Table 0.3: Model selection criteria for ARIMA (p, 1, q) based on AIC and BIC results

Model	LogL	AIC	BIC
ARMA(0 1 0)	-1242.394325	16.930536	16.971222
ARMA(0 1 1)	-1240.298094	16.915620	16.976650
ARMA(1 1 0)	-1240.045716	16.912187	16.973216
ARMA(2 1 0)	-1239.714208	16.921282	17.006554
ARMA(0 1 2)	-1240.093104	16.9263437	17.007809
ARMA(1 1 1)	-1239.346438	16.916278	16.997750
ARMA(1 1 2)	-1239.346419	16.929883	17.031599
ARMA(2 1 1)	-1239.346425	16.929883	17.031599
ARMA(2 1 2)	-1239.030733	16.939194	17.061252

From the above table ARIMA (1 1 0) for Retail price of Red pepper has smallest AIC value.

The autoregressive and moving-average orders are selected by examining the sample autocorrelation and partial autocorrelation functions. If a time series is characterized by seasonal fluctuations, then the correlogram would also exhibit oscillations at the same frequency, means if the series follows sinusoidal patterns, then does so the autocorrelation function.

Figure 4.5: Partial Autocorrelation function for Retail price of Red pepper after 1st differencing.



Partial Autocorrelation Function: retail price of red pepper

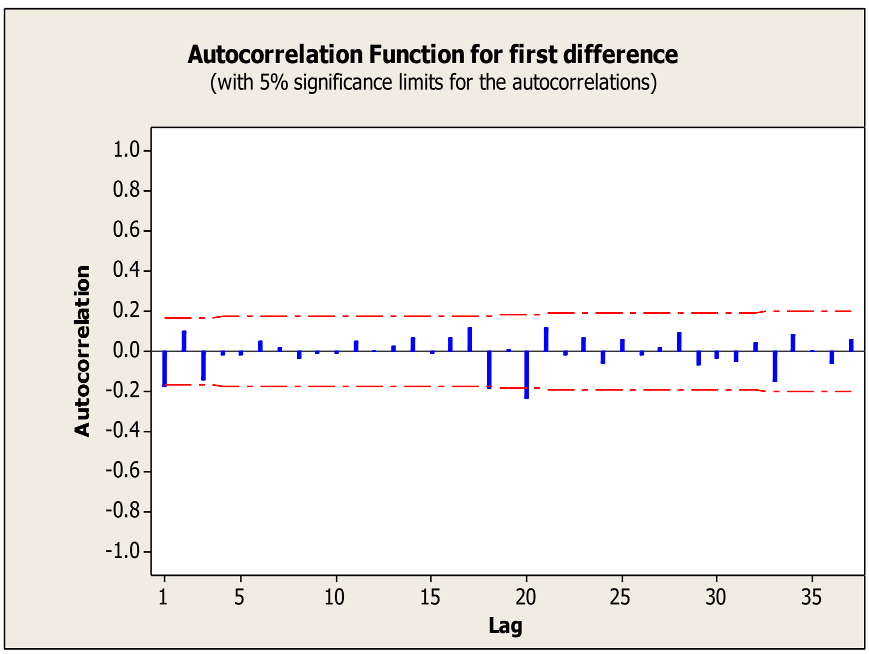
Partial auto correlation (PACF) is auto correlation of time series observation separated by a lag of k time units with effect of the intervening observation eliminated. It helps to develop good Model using sample plot can involve much trial and error. There is a method designed to exploit such dependents which givens superior result. Among such method the Box Jenkins approach is the one.

Partial Autocorrelation Function: for Retail price of Red pepper (1st difference)

Minitab generates a partial autocorrelation function with critical bands at approximately α = 0.05 for the hypothesis that the correlations are equal to zero. In the data window, Minitab stores the partial autocorrelations and associated t-statistics.

In the Retail price of red pepper, there is a single large spike of -0.210218 at lag 20, which is typical of an autoregressive process of order 1. There is also a significant spike of -2.55 at lag 20, but you have no evidence of a nonrandom process occurring there.

Figure 4.6: Autocorrelation Function: for Retail price of Red pepper after first difference.



Autocorrelation for Retail price of red pepper

The above Autocorrelation function graph Figure 4.6

Show that the weekly retail price of red pepper correlated with time. However Minitab generates an autocorrelation function (ACF) with approximate a = 0.05 critical bands for the hypothesis that the correlations are equal to zero. The ACF for these data shows large positive implies significant spikes at lags 1,18and 20 with subsequent positive autocorrelations that do not die off quickly. This pattern is typically of an autoregressive process. Testing autocorrelations of the null hypothesis that the autocorrelations for all lags 1, 18 and 20.

4.5 Estimation of Model Parameters

Once the order of ARIMA (p, d, q), model has been specified the next step is estimating the model parameters.

Table 4.5: Final Estimates of model Parameters

type	Coefficient	SE.coefficient	T -statistic	Prob.
AR (1)	-0.1956	0.0823	-2.38	0.019
MA(1)	0.9916	0.0019	534.11	0.000
constant	2.604	2.342	1.11	0.268

$Y_t = 2.604 - 0.1956Y_{t-1} + 0.9916\varepsilon_{t-1} + \varepsilon_t$ Is fitted model for ARIMA (1, 1, 1)

For coefficients

Hypothesis: H_0: All Coef vs $H_{1:}$ not $H_{0.}$

Decision: We reject H_0 which says all Coef were zero if p-value were less than 0.05 and acceptH_0 otherwise.

Discussion: We reject H_0 because p-value is less than 0.05 for all coefficients and conclude that all coefficients are statistically significant.

For constant: H_0: constant=0 vs H_1: not H_0

Decision: Reject H_0 IF P-value were less than 0.05, and acceptH_0 otherwise.

Discussion: We fail to reject H_0 because p-value is greater than 0.05 for constant and conclude that constant was not statistically significant.

Therefore the model was $Y_t = -0.1956Y_{t-1} + 0.9916\varepsilon_{t-1} + \varepsilon_t$

4.5: ARIMA Model

The acronym ARIMA stands for "Auto-Regressive Integrated Moving Average." Lags of the differenced series appearing in the forecasting equation are called "auto-regressive" terms, lags of the forecast errors are called "moving average" terms, and a time series which needs to be differenced to be made stationary is said to be an "integrated" version of a stationary series.

Random-walk and random-trend models, autoregressive models, and exponential smoothing models (i.e., exponential weighted moving averages) are all special cases of ARIMA models.

A no seasonal ARIMA model is classified as an ARIMA (p, d, q) model,

Where:

- **p** is the number of autoregressive terms,
- **d** is the number of no seasonal differences, and
- **q i**s the number of lagged forecast errors in the prediction equation

To identify the appropriate ARIMA model for a time series, you begin by identifying the order(s) of differencing needing to stationeries the series and remove the gross features of seasonality, perhaps in conjunction with a variance- end series is constastabilizing transformation such as logging or deflating. If you stop at this point and predict that the differencing, you have merely fitted a random walk or random trend model. (Recall that the random walk model predicts the first difference of the series to be constant, the seasonal random walk model predicts the seasonal difference to be constant, and the seasonal random trend model predicts the first difference of the seasonal difference to be constant--usually zero.) However, the best random walk or random trend model may still have auto correlated errors, suggesting that additional factors of some kind are needed in the prediction equation.

ARIMA Model: for Retail price of Red pepper.

Estimates at each Iteration

Iteration	SSE	Parameters	
0	443769218	0.100	0.100
1	322546581	- 0.050	0.250
2	297423539	0.006	0.400
3	270435180	0.042	0.550
4	242550329	0.057	0.700
5	214707585	0.048	0.850
6	193169911	-0.010	1.000
7	183752294	-0.146	1.000
8	183534626	-0.154	1.000
9	183495012	-0.155	0.999
10	183469204	-0.156	0.999

11	183450825	-0.157	0.999
12	183439921	-0.159	0.998
13	183436924	-0.160	0.998

Unable to reduce sum of squares any further
Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag	12	24	36	48
Chi-Square	4.7	26.3	35.5	41.7
DF	10	22	34	46
P-Value	0.910	0.240	0.399	0.652

The Ljung-Box statistics give no significant p-values, indicating that the residuals appeared to uncorrelated. The ACF and PACF of the residuals corroborate this. You assume that the spikes in the ACF and PACF at lag 13 are the result of random events. The AR (1) model appears to fit well so you use it to forecast retail price of Red pepper.

4.6: Model Diagnostic Checking for Retail price of Red pepper

The diagnostic analyses using the ACF of residuals and PACF residuals as shown in Figure (4.7, 4.8, and 4.9) reveal that the residuals of the Model have zero mean and constant variance. The ACF of the residuals depicts that the Autocorrelation of the residuals are all zero. That is to say that they are uncorrelated. Imposing an inevitability condition ensures that there is a unique MA process for a given ACF. Hence, it can be concluded that there is a constant variance among residuals of the selected model and the true mean of the residuals are approximately equal to zero.

Figure 4.7: ACF of Residuals for Retail price of Red pepper after 1st differencing.

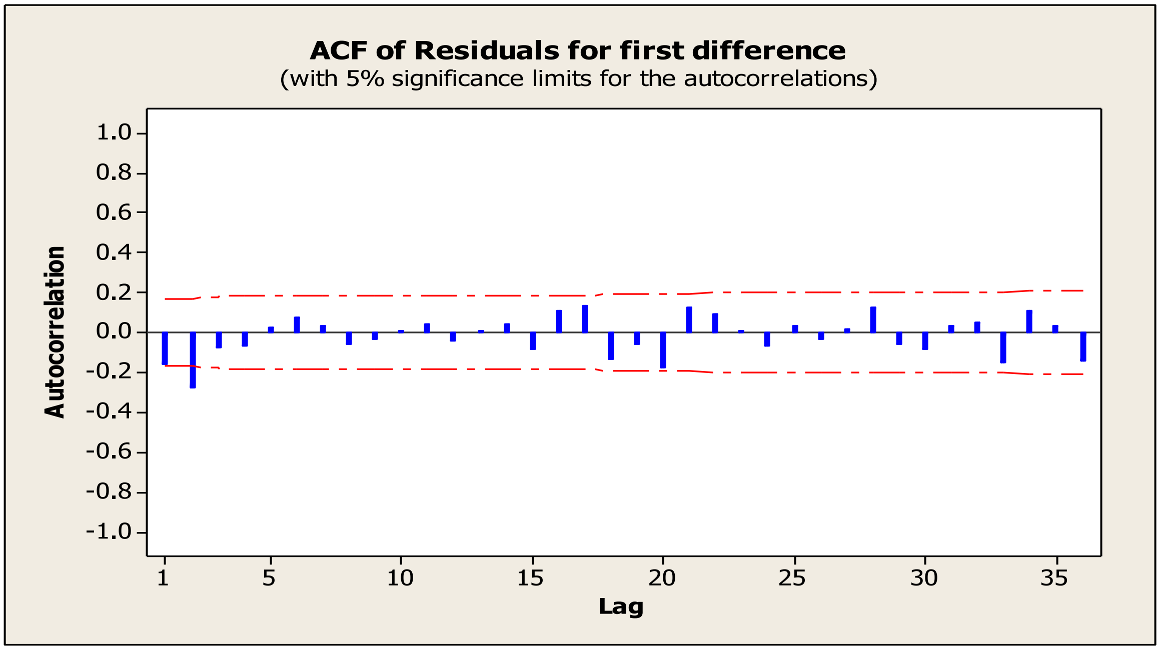


Figure 4.8: PACF of Residuals for Retail price of Red pepper after 1st differencing.

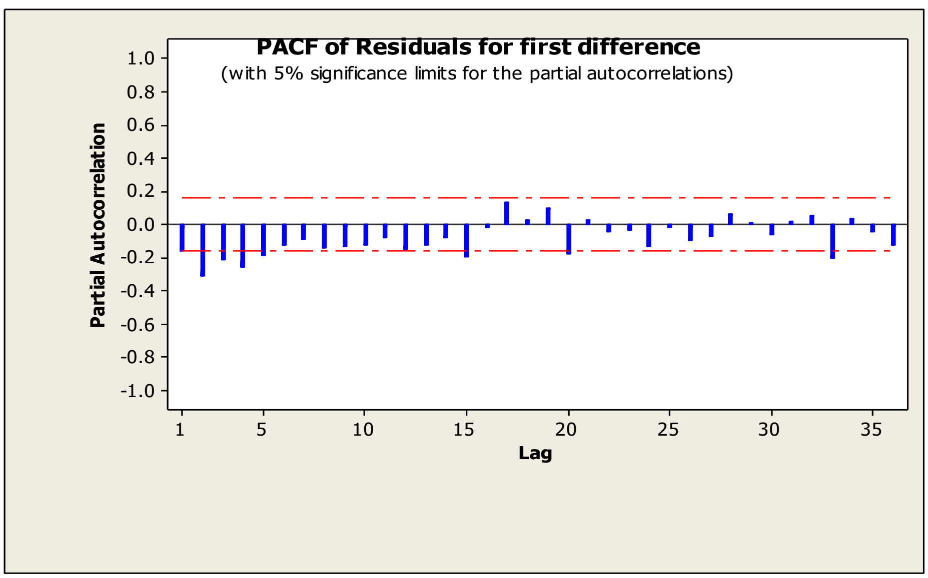


Figure 4.9: Normal Probability Plot of Residuals for Retail price of Red pepper after 1st differencing.

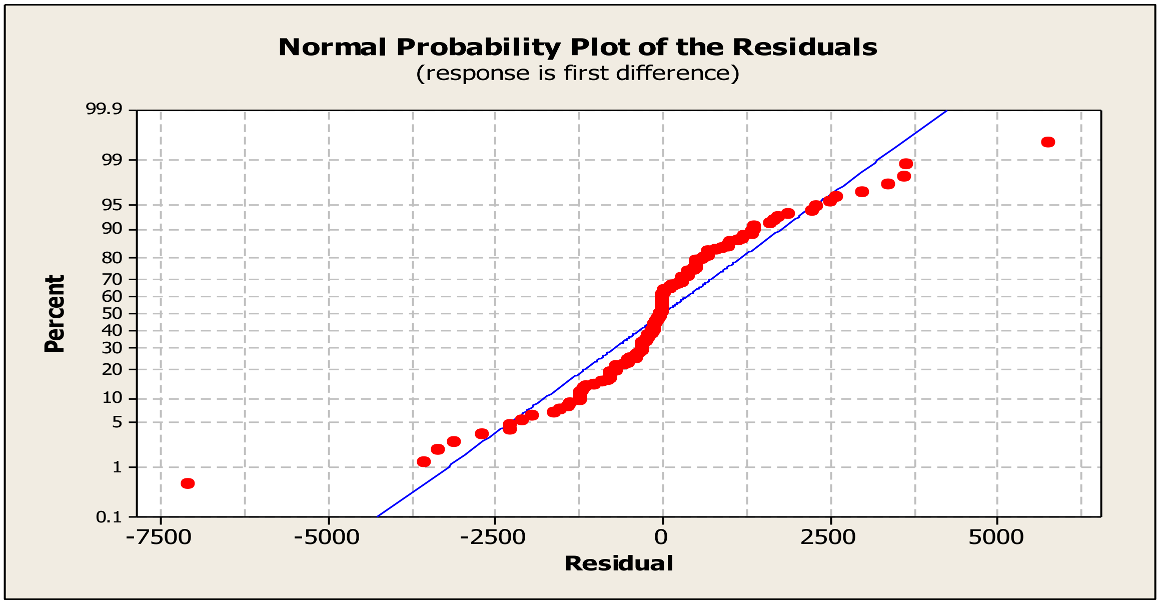


Figure 4.9: Normal Probability Plot (p-p) of the Residuals for ARIMA (1, 1, 0)**.**The above figure shows that most of the residuals are not much far from the line showing randomness so; this implies that the fitted model is appropriate for the data.

4. 7 Forecasting

One of the fundamental applications of time series analysis or developing a time series model is forecasting. In this section we examine the forecasting accuracy of the fitted model and then make a forecast for April 1st week to June the end week 2013.

Forecasts from period 148

Table 4.6: The forecasting for Retail price of Red pepper

period	forcest	95 Percent Limits	
		lower	upper
149	28.86	-2183.02	2240.75

150	184.52	-2054.89	2423.93
151	159.57	-2080.66	2399.80
152	163.57	-2076.66	2403.81
153	162.93	-2077.31	2403.17
154	163.03	-2077.21	2403.28
155	163.02	-2077.23	2403.26
156	163.02	-2077.23	2403.27
157	163.02	-2077.24	2403.27
158	163.02	-2077.24	2403.28
159	163.02	-2077.24	2403.28
160	163.02	-2077.25	2403.28
161	163.02	-2077.25	2403.29
162	163.02	-2077.25	2403.29
163	163.02	-2077.26	2403.29

ARIMA gives forecasts, with 95% confidence limits, using the AR (1) and MA (1) in both model the Session window. The seasonality dominates the forecast profile for the next 15 weeks with the forecast values being slightly higher than for the previous 15 weeks. Or we can check the accuracy of the forecasted value by using the above 95% confidence interval (CI) as follows: The forecasted value of September 1st week for the year 2011 is found between the lower (-2077.25) & the upper (2403.29) limits, and then we can say the forecasted value is accurate. Similarly for the forecasted value is between the lower (-2077.26) & the upper (2403.29) limits, and then since the forecasted value is in the interval it is accurate. By similar procedures we can conclude that the above forecasted value is accurate.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The main objectives of this study were to analyze and asses the time series data of price change of cereal crop namely Red pepper from September, 1st week 2011 to June 2013 in Abeshge woreda. Based on the data analysis and interpretations of the study, the conclusions were as follows: the quadratic and exponential trend model analysis shows that there an increasing patterns of price for selected cereals from time to time on basis of data obtained from Abeshge woreda trade office over three years in woreda. Among selected cereal crop the Red pepper had highest fluctuation or increasing pattern of weekly price than other woreda.

As we have seen from the time series plot and different test of stationary like ADF Test, and PP Test for original data, there exist prices fluctuation from week to week (time to time) which indicates the non-stationarity of original data, But by differencing the price of Red pepper is become significant from week to week (time to time) which shows the stationarity of data. Therefore time series analysis is necessary for the analysis of price change of cereal crops. After differencing one series is stationary, therefore any analysis is made now. Firstly fit the model which is ARIMA (1, 1, 1) and by using model selection criteria which is called AIC.

Secondly, using ACF residuals and standard residuals of Red pepper shows that the model is adequate. Because after lag two.ACF residuals and standard close to zero. Therefore, we conclude that the model of cereal crop is appropriate. Thirdly, use the model we can estimate the parameter of the model and forecasting the future price of Red pepper .Finally using time series analysis easily determines the price change of cereal crop and recommends the concerned bodies.

5.2 Recommendation

Based on the above conclusions we can recommend that the trend analysis for Retail price of Red pepper in Abeshge woreda follows a linear and positive relation between price and time. From this result of the study the retail price of Red pepper was increased from week to week as well as from year to year. Therefore the concerned body should take the following remedial actions. Therefore, based on the result of this study the bodies are recommended to take remedial action that decreases (minimize) the market price inflation. Let we make the following remedial actions.

- ✓ Government should interfere in the free market economy to stable the market condition.
- ✓ All community should have awareness on commodities price market.
- ✓The Abeshge woreda Agricultural office should advice the farmers use fertilizer or other mechanisms to increase productivity.
- ✓ To advice the Abeshge woreda trade office to take Red pepper product to other region or any place which has less pepper product in order to stable price.
- ✓ To advice the customer's to buy pepper at week where price is cheap.
- ✓ Policy makers should make appropriate marketing policy.

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