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# Feasible Solution for Newspaper Circulation and Sales Forecasting in Sri Lankan Newspaper Industry

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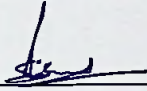
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# Declaration

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

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# Dedication

I would dedicate this thesis to my beloved parents who have never failed to give me a tremendous support, for giving all not only throughout my project but also throughout my life. As well they teach me that even the largest task can be accomplished if it is done one step at a time.

## Acknowledgement

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## Abstract

Newspaper is a one of the key mass media news provider in Sri Lankan society. Newspaper is perishable item that valued only one day. Therefore, newspaper publishing companies need to print accurate quantity of copies of newspapers and deliver the sales point on-time, maintain the minimum returns without oversupply or shortage supply to the market. By this newspaper publishers can enjoy high profitability and reduce unnecessary publishing cost. Therefore, companies need smooth circulation process and accurate newspaper forecasting solution. This research project main objective is to introduce a newspaper circulation system and sales forecasting system in Sri Lankan newspaper industry. Research introduced a web base solution for handling newspaper circulation that include newspaper issuing, returns handling and mode of payment. Circulation system developed PHP scripting language and MySQL used for database. Developing this Circulation system research is used in Waterfall model. This research develop a newspaper sales forecasting solution by using data mining techniques such as classification, prediction and time series regression techniques which will be used to analyse and forecast newspaper sales time dependent data points such as paper wise forecasting in next month issue, customer wise issue, district wise issue, city wise issue etc; on the other hand, newspaper company can identify movement of newspaper buyers between agencies, seasonal changes in demand between newspapers and identify sales patterns regarding to agencies, newspapers, district and nationally wise ; This research use popular Weka (Waikato Environment for Knowledge Analysis) software for time series analysis and its allows to create forecasting models, evaluating and visualizing the results. Finally this research developed Newspaper circulation system that handles by the main circulation process. Evaluation of the sales forecasting this research identified the Linear Regression is most suitable method for forecasting the newspaper sales forecasting. However, Linear Regression and SMO Regression methods can be used for forecast city wise and agent wise newspaper sales, as well as this research identified the sales patterns that help to make management decision. By using this system Newspaper companies may reduce their unnecessary cost relating to Newspaper sales and distribution.

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## Introduction

### 1.1 Introduction

This Chapter provides an introduction to the research. It describe the research background and a brief description about the propose solution. Then, this rese--arch aims and objectives are outline. This chapter concludes with the outline of the remaining chapters.

### 1.2 Background and Motivation

Newspaper is a relatively inexpensive regularly schedule media to written publications with contain essentially news, advertising, current information in politics, business, sports and entertainment [1]. Newspaper industry in Sri Lanka has a proud and prestigious history. It owns publishing news to Sri Lankan society. Sri Lankan newspaper industry plays a very significant role providing information to Sri Lankan Society, even other mass media tools (TV, Radio, Social Media) and technology develops in greater stage till, newspaper demand is high. According to the Central Bank Report of Sri Lanka in year 2013 daily national newspaper circulation is nearly 225,528,000 and weekly national newspaper circulation is nearly 103,572,000 [2].

In Sri Lanka, currently different newspaper publishers published twenty four (24) national newspapers in three main languages and more than seventeen verities of newspapers which cater for the young and sport, etc; [3]. Therefore, Newspaper industry was highly competitive and capturing the market share is highly challengeable. Due to competition, newspapers need to deliver the market on time. Therefore, Newspaper publisher need to maintain a highly efficient and effective circulation system. Newspaper circulation contain following three processes such as,

- Newspaper issuing
- Newspaper return handling
- Payments handling

Newspaper issuing process is the key in the newspaper circulation. Publishers need to issue right quantity at the right time to the market. Generally, newspapers are distributed through Sales Agents, island wide. These main sales agents distribute newspapers through the sub agents and normal sales. In addition newspaper publishers circulate their newspapers through subscription customers, regional sales executives and normal sellers, etc; Publishers follow different returns policies. Some publishers accept only 10% of returns based on the issues. Other publishers accept 100% returns. Likewise publishers follow different return policies. Payment handling is another important process. Mostly newspaper issue in credit basis for newsagents but publishers accept direct payments from normal sales event. Credit policies also differ from publishers to publishers. Therefore, newspaper publishers need an effective and efficient solution to handle their newspaper circulation process. Circulation System needs to handle some of the following process such as issue records and amounts need to keep under correct customers, delivery records need to be recorded. Print order preparation for each paper, issuing delivery labels, returns paper details need to be recorded in to customer wise. Issuing customer wise and newspaper wise reports (issues and returns), record payment details and maintain outstanding reports customer wise etc; Using this reports, company takes some management steps, decisions effectively.

Newspapers are highly perishable item with a self life of one day, because importance of the news is one day. From time to time, world changes and new information and news arise. Therefore, newspaper distribution is same as the other perishable items. At the sales point, newspapers must be available in a given time. In highly competitive market today, newspaper publishers have rushed to supply information to the readers. If newspapers are not available in right time with right quantity, people move to another publisher's house. Compare to other perishable items, newspaper publishers have full control for print and distribute the newspapers. However, newspapers need to supply each sales point in daily basis. Today most of the Sri Lankan newspapers establishments experience a problem of predication and

forecasting the right number of newspapers to print and distribute among their distribution points. Mostly these issues do not arise in the subscription of customers because they are not changing from time to time but sales agents and other distribution point's sales demand are change. Therefore, forecasting plays a major role. In this scenario forecasting newspaper demand as accurately possible to meet customer requirement with minimum number of returns, without shortage of sales and oversupply. Using accurate forecasting system companies can reduce cost and maximize the profits. By oversupply the newspapers companies incur unnecessary cost on newsprint, printing, delivery, returns handling etc; Due to high returns, company reputation is badly affected. Further, once newspaper shortage occurs customers may move to the competitors as well as it effects company reputation and profitability. Therefore, companies need short term sales forecasting system as well as long term forecasting system. It helps companies to get some management decisions because forecast is the Key point of the business planning and the decision making. Forecasting is difficult in the newspaper industry because sales depend on changes in the society. For example on special days, special events, some marketing action sales may differ, as well as return values change. Therefore, prediction is difficult.

Introduce a feasible solution for newspaper circulation and sales forecasting in Sri Lankan newspaper industry is a main target of this project.

### **1.3 Aims and Objectives**

This research project mainly focuses to find out a feasible solution to handle Newspaper Circulation process and develop Newspaper Sales Forecasting solution for Sri Lankan Newspaper Industry.

To achieve these two main objectives, researchers divide the main objectives into the following sub objectives.

- Identify current process of newspaper circulation.
- Identify the issues of current circulation process. Circulation process includes newspaper sales, Newspaper return handling and the payment collections.
- Introduces feasible solution for handle newspaper circulation.
- Identify individual customer's sales, returns, payments and outstanding details.
- Introduces accurate sales forecasting solution and identifying the sales patterns in Sri Lankan newspaper industry,
- Reduced unnecessary cost for newspaper returns and wastage of newspaper printing.

### **1.4 About Solution**

Newspaper Circulation system is a web base solution that developed by using PHP server side scripting language and MySQL relational database management system (RDBMS) use for the system database. WAMP Server is use as web server to run this application. Circulation department staff of the newspaper publication company is main user of this system. In addition management, accounts department, audit department are other users of this system. Mainly this system has four modules such as Newspaper Issue Module, Newspaper Return Module, Payment Module and Newspaper Sales Forecasting Module. In addition this system maintains customer master file that include customer information. In newspaper issue module circulation department staff inputs the newspaper issue details that include customer identification Number, paper name, quantity, issue date and system calculate value of the paper issue itself. Currently company collects returns by monthly basis. Therefore, after newspaper returns received circulation department staff enters

the customer id, return receipt id, paper name, return date, issue month related to the returns, rerun quantity to return module. When receiving the payments circulation department staff input the payment details to the payment module such as customer id, payment amount, payment date. As a results system generate following outputs such as maintains issue records and amounts keep under correct customers, delivery records need to be recorded. Print order preparation for each paper, issuing delivery labels, returns paper details need to be recorded in to customer wise. Issuing customer wise and newspaper wise reports (issues and returns), record payment details and maintains outstanding reports customer wise etc;

Newspaper Sales Forecasting Module based on data mining technologies like preprocessing, classification, clustering and predictions with time series regression techniques. Therefore, this research plan to uses WEKA (Waikato Environment for Knowledge Analysis) data mining software that contains collection of data mining algorithms for forecast the newspaper sales and identifying the various sales patterns. Consider the available data this research planed to forecast the monthly newspaper sales and identified the sales patterns. Currently company maintains monthly newspaper returns quantity. Therefore, daily sales forecasting is not appropriated. Consider of that, this research inputs the data set that include Month wise three year's historical net sales data in each customer/agencies (Different between issue quantity and return quantity). As a result, this research forecast paper wise issue quantity in a month, customer/agency wise issue quantity, District and paper wise issue quantity, agency wise issue quantity within the each city/District as well use of this finding company can identified different sales patterns regards newspaper wise, district wise, city wise and customer wise.

## **1.5 Structure of dissertation**

This Interim Report is organized under main seven chapters. Chapter 2 represents Present Learning of the Newspaper Circulation and Sales Forecasting. Technologies Use for Developing Newspaper Circulation and Sales Forecasting System is discussed in chapter 3. Chapter 4 contains Technologies Use for Developing Newspaper Circulation and Sales Forecasting System. Chapter 5 is representing Approach for Developing Newspaper Circulation and Sales Forecasting System. Implementation Process of Propose Solution discussed in chapter 6 and Chapter 7 consider for assessment of the developed solution and finally chapter 8 represent Conclusion and future works of the project.

## **1.6 Summary**

Newspapers are like a highly perishable item with a shelf life of one day. Because importance of the news is one day, from time to time world changes and new information and news arise. Therefore, at the sales point newspapers must be available in a given time. In other hand publishers need to distribute correct quantity for each seller. Less supply or over supply is effect to the profit of the organization. Therefore, Newspaper publisher need a proper forecasting system. Address above issues, this research project mainly focuses to find out feasible solution for handling Newspaper Circulation process and develop Newspaper Sales Forecasting solution for Sri Lankan Newspaper Industry. Ensure the smooth process this research project developed web based circulation system by using PHP server side scripting languages, MySQL RDBMS and WAMP Server as web server. This system mainly includes newspaper issue module, newspaper return module, and payment module. Newspaper Sales Forecasting Module based on data mining technologies. Therefore, this research plans to uses WEKA (Waikato Environment for Knowledge Analysis) data mining software for sales forecasting. Next chapter is discussed about literatures available in the research area.





# Present Learning of the Newspaper Circulation and Sales Forecasting

## 2.1 Introduction

Previous chapter provide indirection for this research project. It's outlined the project aims and objectives as well as brief description about propose solution. This chapter is focused to review previous work done in this research domain.

## 2.2 Background Literatures

A newspaper is mass media relatively inexpensive daily publications which include important news, articles, business information, advertising, entitlement and other information. Newspapers classify based on the publication as daily or weekly and circulation strategies based on this classification. Newspapers can be classified as daily, weekly, national, international, and online and customize and various interest newspapers (Young, Woman, Children, Sport). National newspapers play significant role in the particular country because it is serving the country and region as well as these newspapers have large customer base compare to other newspapers. Large number of employees' work daily or weekly, in national newspaper establishments, and it need to be up to date frequently. Therefore, national newspapers incurred high cost. Newspaper publication business, is owns by stakeholders. Stakeholders of the newspaper industry are expecting profitability. Newspaper circulation and advertising is main income source of the newspaper industry [1]. Achieving high profitability, industry need to, running smooth process for circulate their publication effectively. Companies need to distribute correct amount of newspapers to their customers and deliver their sales point at right time without any shortage.

In written history great Emperor Julies Caesar published the government bulletins before the 17<sup>th</sup> century [1]. First Newspaper "*Avisa Relation olde Zeitung*" published in Germany in the early 17<sup>th</sup> century. In 1662 first English language newspaper "*The Weekly news*" published in England [4]. Evolutions of the printing technology

newspapers become cheaper and wider available method to communicate the information to the society. Due to technology development newspaper industry popularity was simultaneously improved [1]. Archived the demand of newspapers, publication companies improve their newspaper circulation process efficiency. Therefore, they introduce circulation system to the industry.

Sri Lankan newspaper industry was initiated in colonial era as a recommendation of Colebrook Commission in 11<sup>th</sup> April 1829. In 1832 "*Colombo Journal*" first Sri Lankan newspaper was published during Governor Wilmot Horton's period. The first Sinhala newspaper, "*Lanka Loka*" was published in Galle in June 1860. The first Tamil Newspaper "*Idea Atarī*" was published in 1841 [5].

Today twenty four national newspapers and more than seventeen other newspapers are published in Sri Lanka. National newspapers can classified as ten Sinhala newspapers, five Tamil newspapers and nine English newspapers [3]. According to the Central Bank of Sri Lanka in year 2013 daily national newspaper circulation is nearly 225,528,000 and weekly national newspaper circulation is nearly 103,572,000 [2]. There is a high demand for newspapers in Sri Lankan society. The newspaper publishing companies now adopt the circulation systems and sales forecasting systems as companies target high profitability. Therefore, companies looking for forecasting systems for sales by maximum circulation with less return. .

Business planning and decision making, forecasting plays a significant role. Forecasting is a most important and first stage of the business planning. Accurate forecasting is helps to reduce the risk and ensure the success of the decision making. Newspaper publishing companies forecast the most favorable supply of newspapers that minimize the cost and maximize the profit under the vague newspaper demand with minimum returns. If company supply more than the requirement or demand there will be unnecessary costs such as return costs, stocking, distribution and supply in shortage, company faced sales lost [6].

Incesu at al developed short term forecasting system for predict newspaper net sales by using time series analysis [6]. In this solution they takes records of past time intervals and forecast future time intervals. Incesu at al based to use Gramger and Newbold and Reid finding that including time series methods, exponential smoothing and ARIMA for forecasting [7]. However, Incesu at al findings is difficult to predict

sales increase suddenly situations like special event occurs or special promotional periods (non leaner approach) etc; .

Interim Report “US Newsprint Demand Forecasts to 2020” combining the several forecasting methods and try to predict the newsprint demand in US [8]. First they used Classical model and forecast the structural changes of the newsprint usage patterns by using historical data. Then, they study about Gross Domestic Product (GDP) and newsprint demands. Then, they look to Bayesian Module that accepts to used industry expert knowledge about future demand of the newsprint and predict the estimation. Ad hoc newspaper circulation model used for calculate the predication by using function of circulation that effect to newsprint demand. However, classical model fails to forecast the structural changes in newsprint demand.

‘Just Enough Delivery (JED)’ forecasting system that develop by Heskes et al helps for optimizing the newspaper sales in the companies [9]. This system used for combination of neural and Bayesian methodology. Bayesian helps to figured out the similarities between different sales points and try to forecast the demand in unpredictable market changes. System is robust against unpredictable situations helps of correction terms in prediction model. However, limitation of the data availability this research default to identified the relationships (non linier or linier) between the parameters in time series.

Calli and Weverbergh using censored regression technique for forecasting the newspaper demand [10]. Large fraction of observations at the minimum or maximum had censored variable. It’s a natural approach for newspaper sales furcating and it provide information on key variables and its simple to link with the distribution policy as well as it easy to adopt the existing forecasting and distribution policy. The results of the outcomes are more favorable for comparing traditional moving average approach. It’s more suitable for non liner sales and returns situation in each single newspaper sales outlets [10],[11],[12]. However, this method allowed a straightforward evaluation and applies for all sales points. It not considers about differentiation of the each sales points as well as sudden change situation of the demand.

Forecast the number of users who visit one website domain, Napagoda used data mining techniques that used for time series data forecasting [13]. Use of result researcher analyzed and forecast time dependent data point. Analyzed the time series, these research used Weka (Waikato Environment for Knowledge Analysis) data mining software version 3.7.6., which support to time series sales forecasting environment. This research used two type of data set, one data set contain outlier data and other data set remove outliers. Outlier means sudden changers of data occasionally. In this analysis, this research use following classifiers that contains in Weka such as Gaussian Process, Multilayer perceptron, Linear Regression and SMO Regression. After analyzed this research evaluated the forecast results based on Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), Relative Mean Square Error (RMSE) and Relative Absolute Error (RAE) which available in Weka tool. Research concludes SMO Regression and Linear Regression algorithms are more suitable to forecast the web site related information. Therefore, Newspaper sales forecasting Weka tool can be used. However, Napagoda's research findings based on short time period of past data set. Therefore, accuracy of forecasting results makes doubtful.

Similar to above research Kumar and Balara use Weka Tool version 3.7.8 times series forecasting module for forecast the Indian stock market NIFTY index in next ten days [14]. This research used past three month stock market values. This research predicts Market open value, close value, high and low value of particular date by using history data. Data preprocessing researchers used minimum, maximum mean and standard deviation in previous mention attributes. Then this research used stock values lies in between standard deviation range. This research study and used Jena and Swasti 's findings in weka tool usage on data preprocessing, classification and clustering [15]. Then researchers applied Gaussian process, Linear regression, Multilayer perceptron and SMO regression methods on three month past data forecast the values. These methods are already available in Weka tool. Then researchers are compared results with actual and error percentage. Consider evaluation researchers conclude SMO regression is more suitable method to forecast the stock price. Sureshkumar and Elango also did the similar kind of research for forecast the Indian stock market by using Weka tool [16]. However, Kumar and Balara used only three month data,

increase the accuracy of forecasting results researchers must use more historical data.

Kannan et al forecast the rainfall by using data mining techniques [17]. They used data mining techniques such as clustering, classifying, multiple linear regression method used for forecast the rainfall in the future and measures the rainfall they used Pearson correlation coefficient. Kannan et al based on findings in Guhathkurta that contain on time series data and natural networking model [18]. During the testing they figure out some results vary from actual because of uncertainty of the weather.

Perez et al studied about the natural network forecasting methods such as RBFN and CO2RBFN for short term forecasting of extra virgin olive oil price in the Spanish Market [19]. First researchers analyzed olive oil price time series means of ARIMA method. This analysis shows the non stationary of time series and the convenience of the differentiate it. The results of CO2RBFN were compared with ARIM models and the data mining methods such as a fuzzy system developed with GA-P etc; the results output most equal but slightly different from data mining method and ARIMA method.

This above study shows numerous limitations of forecasting related to newspaper sales as well as similar areas. Among other issues are, selecting the accurate forecasting methods, sudden changes in sales demand, demand changes in client point and client geographical locations can be highlighted. These issues are summarized in table 2.1.

Research	Limitation
Sales Forecasting System for Newspaper Distribution Companies in Turkey- Incesu et al	Difficult to predict sales increase suddenly situations like special event occurs or special promotional periods.
“US Newsprint Demand Forecasts to 2020”- Hetemäki, L., Obersteiner	Findings fail to forecast the structural changes.
Bayesian learning for sales rate prediction for thousands of retailers- Heskes et al	Limitation of the data availability this research default to identified the relationships (non linier or linier) between the parameters in time series.
Forecasting newspaper demand with censored regression -Calli and Weverbergh	<ul style="list-style-type: none"> <li>• Forecasting method allowed a straightforward evaluation and applies for all sales points.</li> <li>• It not considers about differentiation of the each sales points as well as sudden change situation of the demand.</li> </ul>
Web Site Visit Forecasting Using Data Mining Techniques- Napagoda, C	Research findings based on short time period of past data set.
Time Series Forecasting Of Nifty Stock Market Using Weka -Kumar, R., Balara, A.	Research findings based on short time period of past data set.
Forecast the Rainfall by Using Data Mining Techniques- Kannan et al	Some results vary from actual because of uncertainty of the weather.
An Study on data mining method for Short- term forecasting of the extra virgin olive oil price in the Spanish Market- Perez et al.	This finding use for short term Forecasting. .

Figure 2. 1 Summarized Forecasting issues in Literatures

Based on the above, the research problem can be defined as how to design the accurate sales forecasting system for newspaper net sales.

### **2.3 Background of the Company**

This research project based on The Associated Newspapers of Ceylon limited (ANCL) is a one of the largest and pioneer newspaper publication company in Sri Lanka. During the first decade of the 19<sup>th</sup> century, late Mr. D.R. Wijewardena founded this company [5]. Currently, company publishes eleven newspapers and magazines. Out of the eleven newspapers, there are 6 national newspapers that cover 3 national languages. “Silumina”, “Dinamina” for Sinhala readers, “Sunday Observer” , “Daily News” for English readers and “Thinakaran”, “Thinakaran Varamanjari” for Tamil readers [20].

ANCL has island wide circulation coverage. ANCL has more than 1087 registered news agencies and under the main agencies there are several sub dealers. They are groceries, railway stations, markets etc; Other than agencies company has six branch offices. Also they have twenty one Regional Sales Executives, Street Sellers, Miscellaneous Customers and Subscriptions.

### **2.4 Summary**

Literature available in newspaper circulation and forecasting are less in Sri Lankan context. In sales forecasting most of the researchers used time series analysis and some of them used other techniques. Some researchers use Weka data mining software and forecast the results. In time series forecasting most of research use following classifiers such as Gaussian Process, Multilayer perception, Linear Regression and SMO Regression. These algorithms already build in the Weka data mining software. Some researchers consider only sales of the newspapers. They not consider the return amount of the paper. Consider net sales (different between issue and returns) only get accurate sales forecast in newspapers. Next chapter consider about adopted technologies that used for solve the research problem.

# Technologies Use for Developing Newspaper Circulation and Sales Forecasting System

### 3.1 Introduction

Previous chapter describe about available literatures related to the research domain. This chapter mainly concern about technologies that use for developing the Newspaper Circulation and Forecasting System. Mainly used PHP server side scripting language for developing the Circulation System and MySQL Relational Database Management System (RDBMS) for maintain the system database. WAMP Server is use as web server to run this application. This research used Weka data mining software for forecast the net sales of the newspapers and identifying sales patterns. Weka contains several data mining algorithms such as preprocessing, Time series analysis algorithms, evaluation algorithms.

### 3.2 About PHP

PHP originally called Personal Home Page but now it's called PHP Hypertext Preprocessor [21]. PHP is an open source server side scripting language with embedded with HTML. It's used to create dynamic web pages [22]. PHP is originally created by Rasmus Lerdorf in 1994 and current major version is PHP5 [21].

PHP programming language has many advantages such as

- PHP is embedded with HTML through PHP special tags there for developers can used both HTML codes and PHP codes in one interface. Its helps to reduces number of codes in HTML [22].
- PHP codes are executed on the server therefore, client cannot see the PHP source code [22].
- PHP can communicate through network by using IMAP, SNMP, NNTP, POP3, HTTP [22].



- PHP is high performance language that can save millions of hits per day by using single inexpensive server [21].
- PHP provide interfaces to integrate many database systems apart for MySQL such as Oracle, PostgreSQL, etc; in addition using ODBC user can connect any other databases that support ODBC driver. Therefore, Microsoft products also used in PHP [21].
- PHP have many built in libraries that help to performing many web related activates. Such as send emails, generate PDF documents, etc; [21].
- PHP can download by free of charge [21].
- PHP is easy to learn [21].
- PHP is strong object oriented support language [21].
- PHP support many operating systems therefore, any application written in PHP works many operating systems without any modification [21].
- PHP source code freely available therefore developers modify or add to the language [21].

Consider above advantages this research used PHP scripting language for develop the web base Circulation System.

### **3.3 About MySQL**

MySQL Relational Database Management System (RDBMS) is a fast and robust database management system that invented in 1979 but it's publicly available in 1996. It is most popular open source database that's awarded several times in Linux Journal Readers' Choice award. MySQL is available under free open source license and commercial license. MySQL uses Structured Query Language (SQL) and it ensure the efficient data store, search, sort and retrieve data. It assure the concurrently access to the multiple users as well as ensure the fast and secure access (authorized users) for the users, because MySQL consider as multiuser, multithreaded server [21].

MySQL RDBMS have some advantages consider the other databases such as Oracle, MS SQL Server and PostgreSQL such as [21];

- High performance [21].
- MYSQL and PHP work with many major operating systems as well as minor ones [21].
- MySQL is available free open source license or low price commercial license. Therefore, software available in low cost [21].
- MYSQL is easy to used and setup [21].

Consider above factors this research used MySQL RDBMS as database for Newspaper Circulation system.

### **3.4 WAMP Server**

WAMP Server is a free open source application that works on windows. It's normally used in web server environments. It provides key essentials of web server, such as operating system, database, web server and web scripting software. Combination of these elements is knows as server stack. Microsoft windows works as a operating system, Apache works as a web server, MySQL is the database and PHP, Python, or PERL are the scripting languages [23].

Therefore, WAMP Server is use as web server to run this Newspaper Circulation system.

### **3.5 Preprocessing**

Data Preprocessing is one of the important steps in data mining. It's used to remove unnecessary information that contain in data set that use for forecasting. It also removes or minimizes some noises, incomplete and inconsistent data. Therefore, some time add some data for missing values (add mean value related to the missing field). Later this preprocesses data set further processed by data mining algorithm [13]. Sometime in data set contain data it's not relevant to the common data Patten. As a example newspaper sales suddenly increase in one day due to some reasons

such as bomb explosion, some marketing activities, etc; therefore, this increase not consistent in longer time period. This situation consider as outliers. Depend on the interest of the user outliers can remove or not in data preprocessing. Identify the outliers first similar data values need to be group and then it can identify by human or computer. Remove outlier's first need to be calculating the mean value and standard deviation. In draw the normal distribution curve and considers the 68% of measurements that include the range of  $\mu - \sigma$  to  $\mu + \sigma$ . Remove out of range values not between  $\mu - \sigma$  to  $\mu + \sigma$  and insert mean value when users' interest about outliers [13].

### 3.6 Forecasting Techniques

Newspaper sales forecasting data present in series of time depend data points. Statistical techniques that called Time Series Analysis using to modeling and explaining time dependent set of data points. Based on the past events Time series forecasting generate model for forecasts future events. As well as data has natural temporal order in time series data rather than usual data mining or machine learning applications. Consider the newspaper sales also have natural temporal order. Usual data mining applications not much consider ordering of data points within the data set and each data points is independent point of the concept to be learned [24].

### 3.7 WEKA Data Mining Software

Weka (Waikato Environment for Knowledge Analysis) is data mining software developed at University of Waikato, New Zealand by using Java. This software containing collocation of machine learning algorithms that using data mining such as data pre- processing, classification, regression clustering, association rules and visualization [25]. From Weka version 3.7.3(=> 3.7.3) this data mining software facilitated to developed, evaluated and visualized the time series analysis based forecasting models. Using data mining approach weka time series framework transforming the data into form that standard propositional learning algorithms can process. Weka does this process by removing the temporal ordering of individual inputs values by encoding the time dependency using additional input fields. This field called as "lagged Variables". Various other fields are calculated by automatically and allow the algorithms to model trends and seasonality. To learn the model any of the weka's regression algorithms can be used after the data has transformed. Weka



allowed many methods that capable of predicting continuous target, mainly multiple linear regressions, non linear methods mainly support vector machines for regression trees and model tree. Decision trees with linear regression at the leaves consider as model trees. Weka is containing multiple classifier functions that used for forecasting [24]. This research will be used following four classifiers for forecasting the newspaper sales. Such as

- Gaussian Process
- Multilayer perceptron,
- Linear Regression
- SMO Regression

- **Gaussian Process-**

Regression without hyper parameter tuning this classifier function implements for Gaussian process. Use of global mean/mode values this classifier filled the missing values as well it help to choose the appropriate noise lave easier [26].Gaussian Process is represent as equation (3.1):

$$X_t, t \in T, \tag{3.1}$$

- **Multilayer Perceptron-**

This algorithm uses back propagation to classify instances and this network can developed by manually or algorithm or both. During the training time this network can be monitored and modified [27]. Its shows in equation (3.2):

$$f(a) = f(a) \cdot (1 - f(a)), \tag{3.2}$$

- **Linear Regression-**

This classifier uses for liner regression for prediction and this function allowed to use weighted instances [28]. Its repercented by equation (3.3), in hear Y denoted by dependent variable and X denoted at experimental variable.

$$Y = a + bX, \tag{3.3}$$

- **SVM Regression-**

This function is support for vector machine for regression [29]. SVM Regression shows equation (3.4) and input vector shows in  $x_i, y_i \in \{-1, +1\}$  is binary values related to it, as well as  $\alpha_i$  are Lagrange multipliers.

$$\max_{\alpha} \sum_{i=1}^n \alpha_i - \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n y_i y_j K(x_i - x_j) \alpha_i \alpha_j \quad (3.4)$$

### 3.8 Evaluation Techniques

After forecast results generated this predicted results must evaluate with actual result and select most accurate forecasting algorithm for newspaper sales forecasting. Assure the accurate of forecasting results have been evaluated and analysis following techniques. These evaluation algorithms are already build in Weka data mining tool. Evaluation techniques are

- Mean Squared Error (MSE)
- Mean Absolute Error (MAE)
- Root Mean Squared Error (RMSE)
- Relative Absolute Error (RAE)

- **Mean Squared Error (MSE)-**

This technique measure how closer data point to the fitted line. Measures the distance vertically from the point to the corresponding Y value on curve fit/the error and square the value from every data point. Then all values of data points add and divided by number of points minus two. Especially the squaring is use for stop cancelling negative values from positive values. The smaller the MSE means accuracy of outputs is high [30]. Equation (3.5) illustrates the Mean Squared Error.

$$MSE = \frac{1}{n} \sum_{i=1}^n (Y_i' - Y_i)^2 \quad (3.5)$$

$\hat{Y}$  Vector of  $n$  Predictions and  $Y$  is the vector of observed values corresponding to the inputs which generated the predictions.

- **Mean Absolute Error (MAE)-**

Its measure the forecast data sets average size of the error without considering their directions. It helps to measure the accuracy of continuous variables. If MAE values in linear score its means all individual differences forecast data are weighted equally in the average [31]. Mean Absolute Error figured out in equation (3.6) and  $f_i$  is represent prediction and  $y_i$  is represent actual values.

$$MAE = \frac{1}{n} \sum_{i=1}^n |f_i - y_i| \quad (3.6)$$

- **Root Mean Squared Error (RMSE)-**

This technique takes square root of the mean square error. Its easily interpreted statistic, when it has same units as the quantity plotted on the vertical axis as well it directly shows in terms of measurement units and its measure more fits than the correlation coefficient. It's also observed variation in measurements of a normal point [30]. It also measures the average magnitude of the error. As well its takes difference between forecast and actual values and calculated each squared value. Then calculated averaged over the sample and takes square root of the average. RMSE normally give high weight to large errors. Therefore, RMSE can used for identify the large errors [31]. Equation (3.7) demonstrates the Root Mean Squared Error.

$$RMSE = \sqrt{\frac{\sum_{i=1}^n (Y_i - \hat{Y}_i)^2}{n}} \quad (3.7)$$

$\hat{Y}_i$  Predicted values for  $t$  times of a regression dependent variable  $Y_i$  computed for different predictions of  $n$ .

Mean absolute error and Root Mean Squared Error can both used to identify the error variation in the forecasts data set. Mostly RMSE value is larger or

equal to MAE value. If values are equal all the errors are same weight but if values have difference it mean the variance of the indicial errors are high [31].

- **Relative Absolute Error (RAE)-**

Its relative work as simple predictor and its takes average of the actual values. In hear error is considered as the total absolute error instead of the total squared error. Find out the relative absolute error it takes the total absolute error and normalized [32]. Equation (3.8) illustrate Relative Absolute Error and V denote as some given value and its approximation.

$$\eta = \left| \frac{v - v_{approx}}{v} \right| \quad (3.8)$$

### 3.9 Summary

Newspaper circulation and forecasting system has two main modules such as circulation module and forecasting module. Circulation module contains three sub module for handling newspaper issue, return collection and payments. Develop Circulation module this research used PHP server side scripting language. MySQL RDBMS is used for database and WAMP server is used for web server. These tools are mostly open source and support to work in many operating systems. Forecasting module basically develop by using WEKA data mining software. This software containing collocation of machine learning algorithms that using data mining such as data pre- processing, classification, regression clustering, association rules and visualization. From version 3.7.3 Weka allowed time series analysis base forecasting. First data set need preprocess by using Weka preprocessing algorithm and remove garbage values then apply several classifiers (SMOreg, Liner regression, etc ;) and forecast the values. Then use of evaluation techniques (MSE, MAE, etc ;) find out accurate forecasting algorithm for used. Next chapter describe how adopt technologies solve the research problem.

# Approach for Developing Newspaper Circulation and Sales Forecasting System

### 4.1 Introduction

Chapter three is on technology that adopts to solve the research problem. Following technologies used for solve the research problem, such as PHP, MYSQL, WAMP Server, WEKA data mining software and data mining techniques. In this chapter describe how chapter three mention technologies use to solve research problem.

### 4.2 Approach of the System Development

Software development life cycle (SDLC) is a process that used in software project. This the full detail plan for system development stages such as planning, defining, designing, building, testing and deployment. SDLC helps to improve overall quality of the software as well as process of the development process. Currently software industry used several SDLC models such as Waterfall model, Iterative model, Spiral Model, Agile Model and RAD Model, etc [33];

Waterfall model is used as software development approach for developed the Newspaper Circulation and forecasting system. Mainly this approach phases are completed step by step. Outcome of the one phase is a input of the next phase. Therefore, development processes easily understand, review each stage separately and assure the accuracy. Each step has specific deliverable and scheduling is easy [34]. As well as this model is more suitable for this project because requirements are very clear and not change, problem clearly identify and technology is not dynamically change.

Figure 4.1 represent the different phases of the waterfall model.



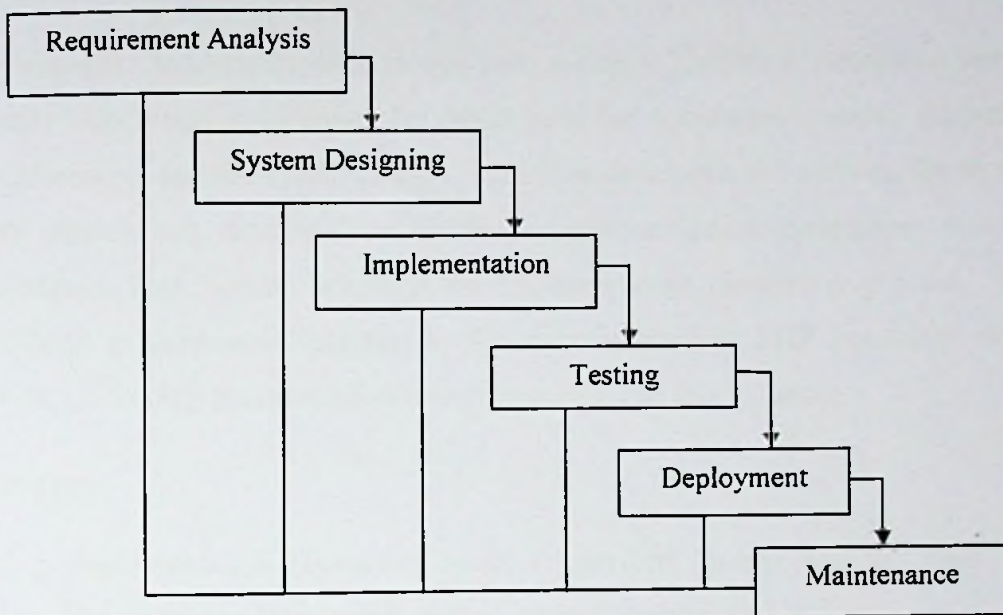


Figure4. 1: Waterfall Model [34]

### 4.3 Circulation Module Development

#### Requirement Analysis-

Conducts interviews with circulation department staff, accounts department staff and observe their process this research project mainly gather the requirements. Then analyzed the data and this research project identified circulation process have three main sub process such as newspaper issuing, return handling and payment handling. Therefore, this system need develop three sub modules to handle above mention three sub processes.

#### System Designing-

According to the requirements researcher design the system. This system mainly web base solution that need to integrated database. System designing researcher used following diagrams such as system high level diagrams, data floor diagrams, use case diagrams etc; Then designing the database by using ER diagram.

## **Implementation-**

Newspaper Circulation system is web base solution. Therefore, researcher used PHP5 server side scripting language for developing the circulation system. According the requirements and the system design researcher developed the system. Three separate sub module are developed to handle newspaper issues, newspaper returns and payments. This module integrates for handle smooth circulation process. MySQL RDBMS is used as a database in this system because PHP smoothly runs with MySQL. WAMP Server used as a web server for run this solution.

## **Testing-**

After implementation researcher needs to perform proper testing. That need to conduct unit testing, integrated testing, system testing and finally user acceptance testing. Therefore researcher needs to create some test cases.

## **Deployment-**

Completing functional and non functional testing system deployed the client environment.

## **Maintains-**

Release patches when some issues arise after the deployments or enhance the system by releasing new versions.

## **4.4 Sales Forecasting Module development**

### **Requirement Analysis-**

Interview with circulation department staff and management and identified their sales forecasting requirements. Basically they need to know agency wise paper sales, required total print quantity in each paper by particular date etc; As well as management needs to get idea about performance of the agents, customer movements between agents, district wise sales etc; This stage researcher analysis the forecasting techniques, available forecasting tools and their features. According to finding researcher identified the WEKA data mining software is more suitable tool for addressing the research problem,

## **Designing-**

Researcher designs the forecasting process and expected outputs of the sales forecasting module. As well researcher designs the data set that used for predictions. Designing the data set is more importance. This research considers previous three years net sales information. Data set include net sales quantity of particular newspaper in particular month belongs to particular agent.

## **Implementation-**

This research use Waikato Environment for Knowledge Analysis – version 3.7.13 (Weka 3.7.13) data mining tool and packaged called Time series forecasting environment that used for build the forecasting modules and performing the predictions. Weka is java based tools therefore researcher needs implement the java virtual machine version 1.7. After the input the data set then need to preprocess the dataset and remove the garbage values and generated Attribute-Relation file format (AEFF) that support to Weka. Then using time series forecasting techniques that already build in weka such as Gaussian, Linear Regression, Multilayer Preceptron Regression and SMO Regression researcher can predict the newspaper sales forecasting.

## **Testing-**

Consider the forecasting values and actual data research may identify the accuracy of the predications that maid by each forecasting techniques, then researcher can select more accurate technique that uses for newspaper sales forecasting. However, Weka has in build testing and evaluation algorithms that helps to check the accuracy of the forecasting techniques that used for sales forecasting. The following are the example of the available techniques such as Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE).

## **Deployment-**

After identify the accurate sales forecasting technique researcher can deploy the system with required forecasting features in client site.

## **Maintains-**

Time to time system need to be upgrade by introducing more accurate forecasting techniques.

## **4.5 Summary**

Researcher use waterfall model as system development life cycle for develop the Newspaper Circulation and forecasting system. This system has two main module such as Circulation module and forecasting module. Circulation module has three sub modules such as newspaper issue handling, returns handling and payment handling. This system developed as a web base system by using PHP, MySQL used for handling database and WAMP server used as a web server. After implementation researcher need to conduct proper testing mechanism. In forecasting this reach used Weka 3.7.13 data mining tool that include time series forecasting package that allowed to perform time series related forecasting mechanism by using Gaussian, Linear Regression, Multilayer Preceptron Regression and SMO Regression and predict the newspaper sales forecasting. Then use of testing and evaluation algorithms that available in Weka, (Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE)) researcher identify more accurate forecasting technique that use for newspaper sales forecasting. Next chapter discussed about details of the designs about Newspaper circulation and forecasting system.

## Design of Newspaper Circulation and Sales Forecasting System

### 5.1 Introduction

Previous chapter discussed about how use various technologies are used. It's mention in chapter 3 such as PHP, My SQL, Weka data mining software, etc; uses for solve the research problem. Design details of the propose system describe in this chapter.

### 5.2 System Design

Newspaper Circulation and forecasting system is a web based system and MySQL use for database. This system has two main modules such as

- Circulation module
- Forecasting module

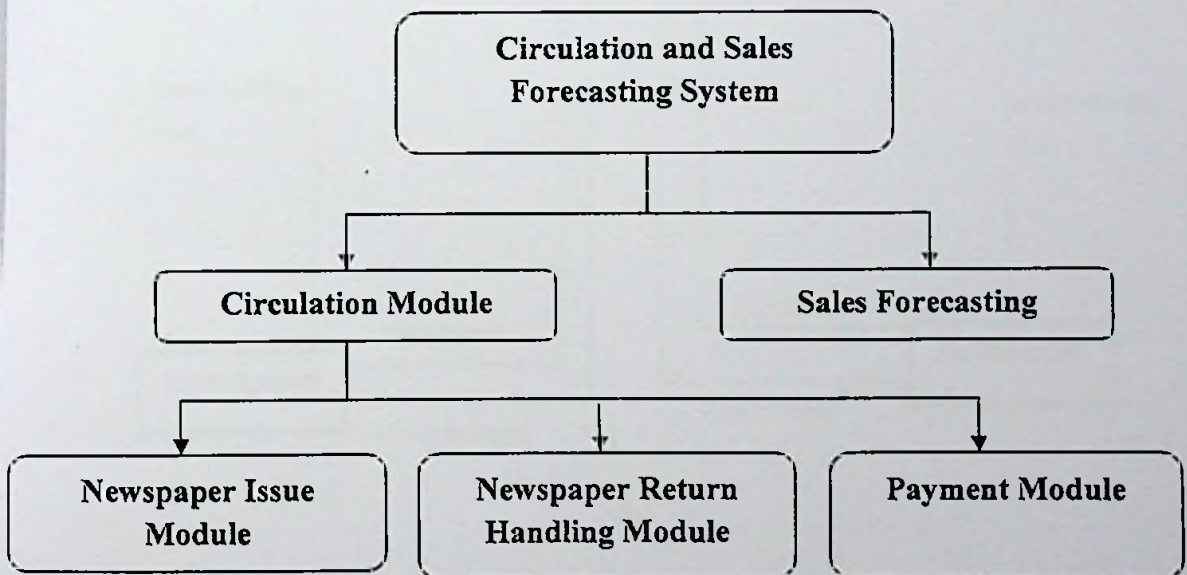


Figure5. 1: Top Level Design for Newspaper Circulation and Sales Forecasting System

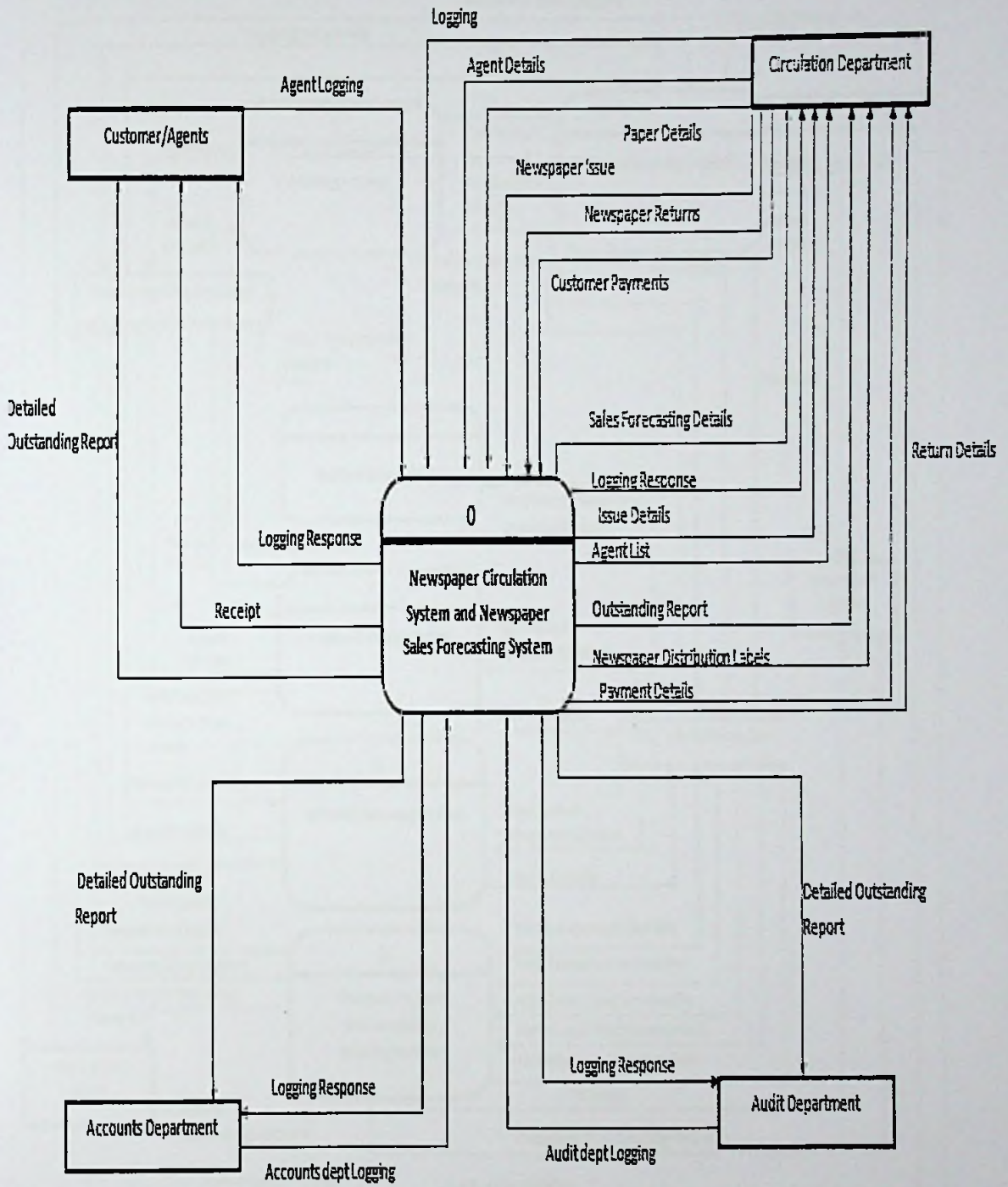


Figure 5. 2: Level 0 Data Flow Diagram for Newspaper Circulation and Sales Forecasting System

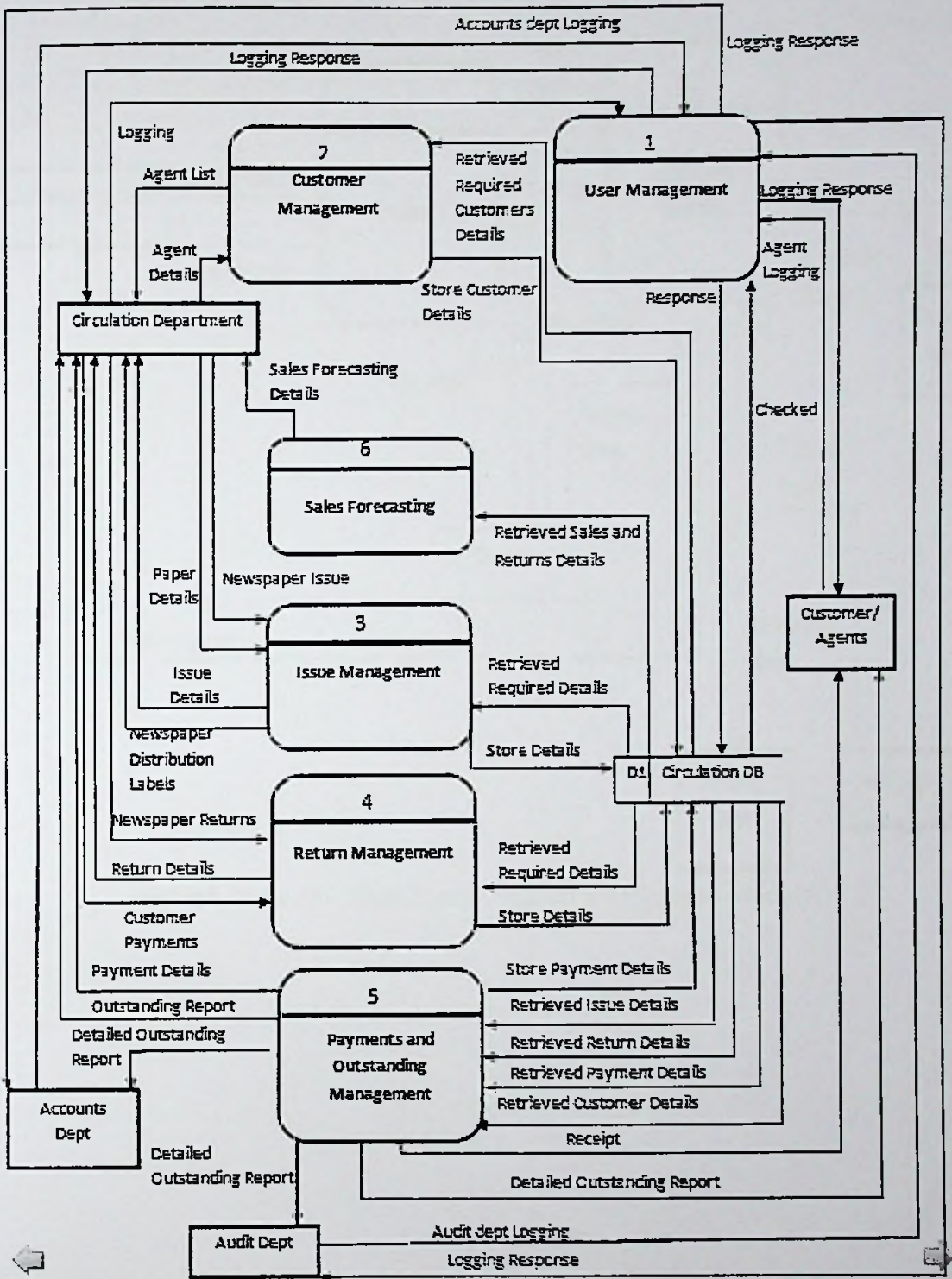


Figure 5. 3: Level 1 Data Flow Diagram for Newspaper Circulation and Sales Forecasting System

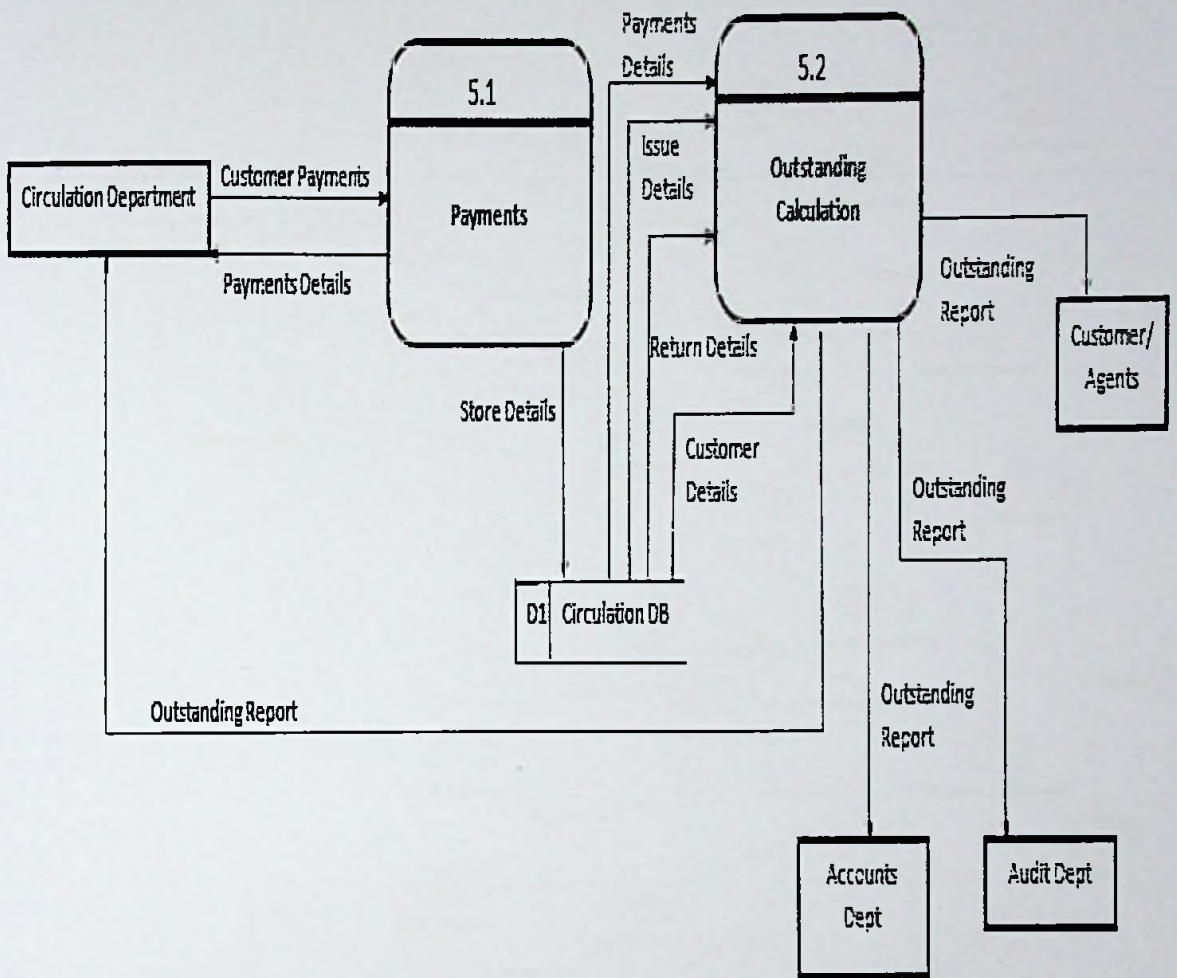


Figure 5. 4: Level 2 Data Flow Diagram for Payment Module





Figure 5.1 elaborate top level design of the Newspaper Circulation and Sales forecasting system. Level 0 and Level 1 data flow diagrams for propose system elaborate in figure 5.2 and 5.3 respectively. Figure 5.4 and 5.5 figure out Level 2 data flow diagram for payment handling module and use case diagram in propose system respectively.

### 5.3 Circulation Module

Circulation System main users are Circulation Department, Accounts Department, Audit Department and Agents. As well as Circulation System mainly maintains three sub modules such as Newspaper Issue Module, Newspaper Returns Handling Module, Payment Module and Customer Master File.

Customer Master Files maintains customer's basic details such as name, address, type and deposit details etc; Company has different type of customers such as News Agencies, Regional Sales Executives, Subscription Customers, Street Sellers and Miscellaneous Customers.

According to the management approval Circulation Department, staff member can add customer details to the system. According to customer type, staff members are issued unique customer identification number. System will prevent duplications of the customer identification number.

#### **Newspaper Issue Handling Module-**

In newspaper issuing staff member is allowed to enter the number of copies issue to each customer on particular paper and the date according to their requested amount or the company approved amount. Company allowed issuing free newspaper copies for some customers due to various reasons such as promotions, discounts, free copies for senior staff members etc. Therefore, these copies are not debited to the newspaper distributors. Therefore, this system allowed entering the free copies to staff members.

System provides reissuing facility for daily or weekly or monthly issuing newspapers. Using this facility, staff member simply transfer the current issuing details to next issuing date and modify the number of copies according to customer request or the forecasting details. Therefore, staff needs not to enter same details repeatedly.



At times, customers are requested previous newspapers (last year newspapers). Therefore, this system facilitates to maintain late alternations for issuing.

### **Newspaper Return Handling module-**

Newspaper returns, system facilitated to staff members to entered returns amount according to the customer identification number, newspaper and issuing date or the month. Time to time company changed their "Return Policy". For example, sometime company allowed 100% returns or sometime company allowed 10% returns, based on issuing quantity. Therefore, this system allowed to change return limitation and prohibit to enter the exceed values.

### **Payment Handling Module-**

In payments, Staff member can enter customer's payments details based on the relevant month and particular newspaper. This system calculates each customer outstanding amount (monthly/yearly/total) according to difference between value of issuing newspapers, returns and payments.

### **Reports**

This circulation module needs to produce various reports. Daily, system need to issue dispatch report to the press for each paper. This report contains the print order and delivery details. Newspapers packing as a bundle and each bundle have hundred papers. Therefore, system will print label for each bundle. These labels include the customer details and delivery details that help for delivery staff. According to the company request, system can precede return reports, payment reports, outstanding reports and other reports.

In general system maintains authentication levels and staff members belong to each level. Each levels allowed some activities that were approved by the management.

Figure 5.6 elaborate the Entity Relationship (ER) diagram for Newspaper Circulation Module database.

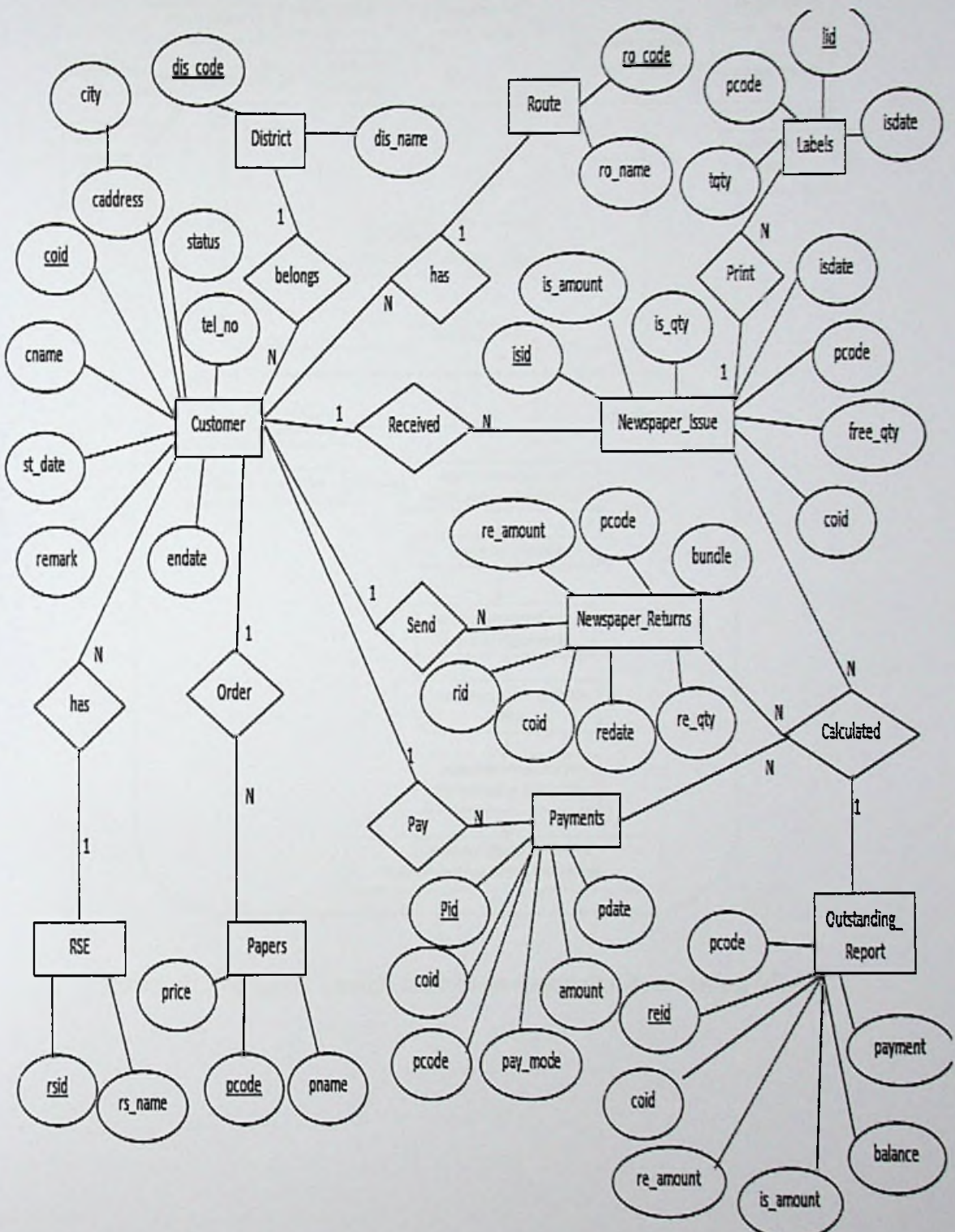


Figure5. 6: Entity Relationship Diagram for Circulation Module

### 5.4 Newspaper Sales Forecasting Module

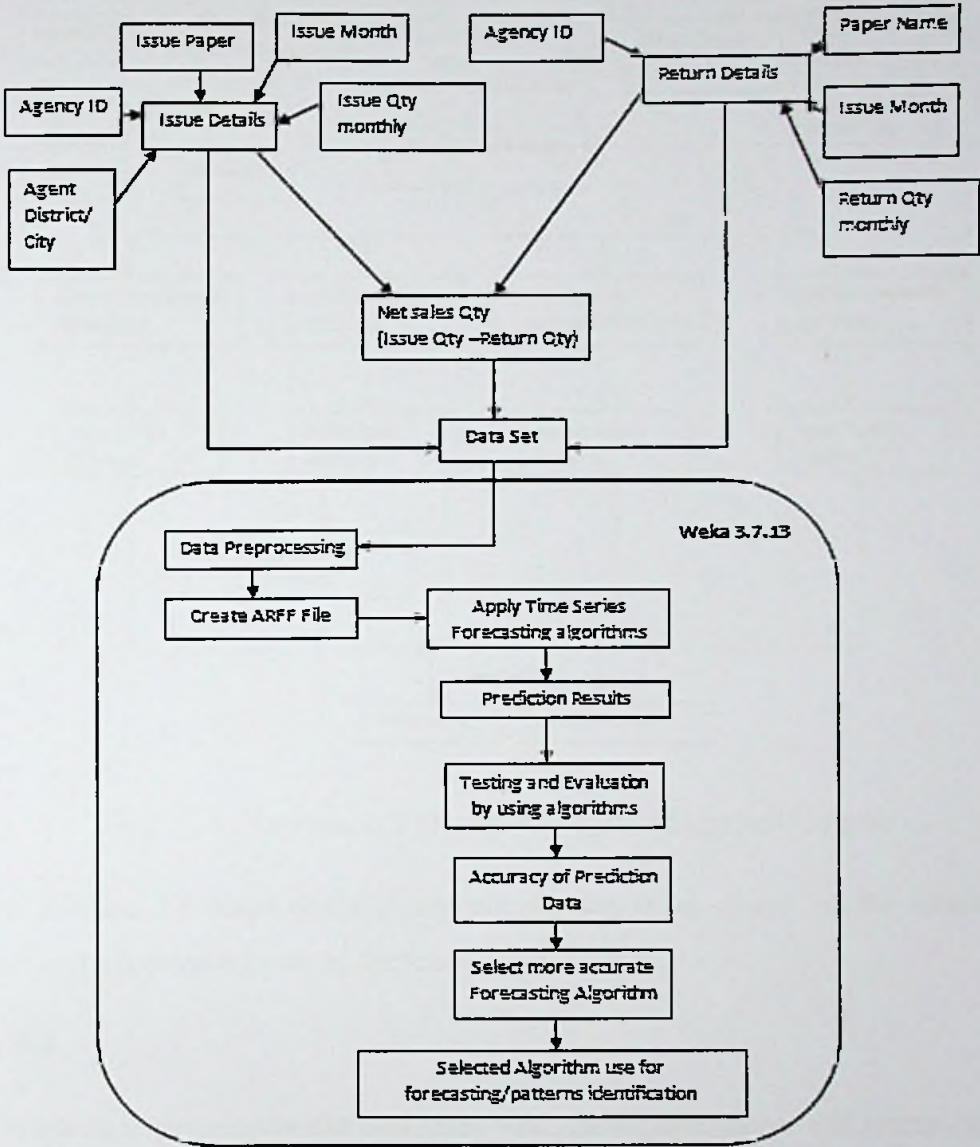


Figure5. 7: Top Level Design for Newspaper Sales Forecasting Module

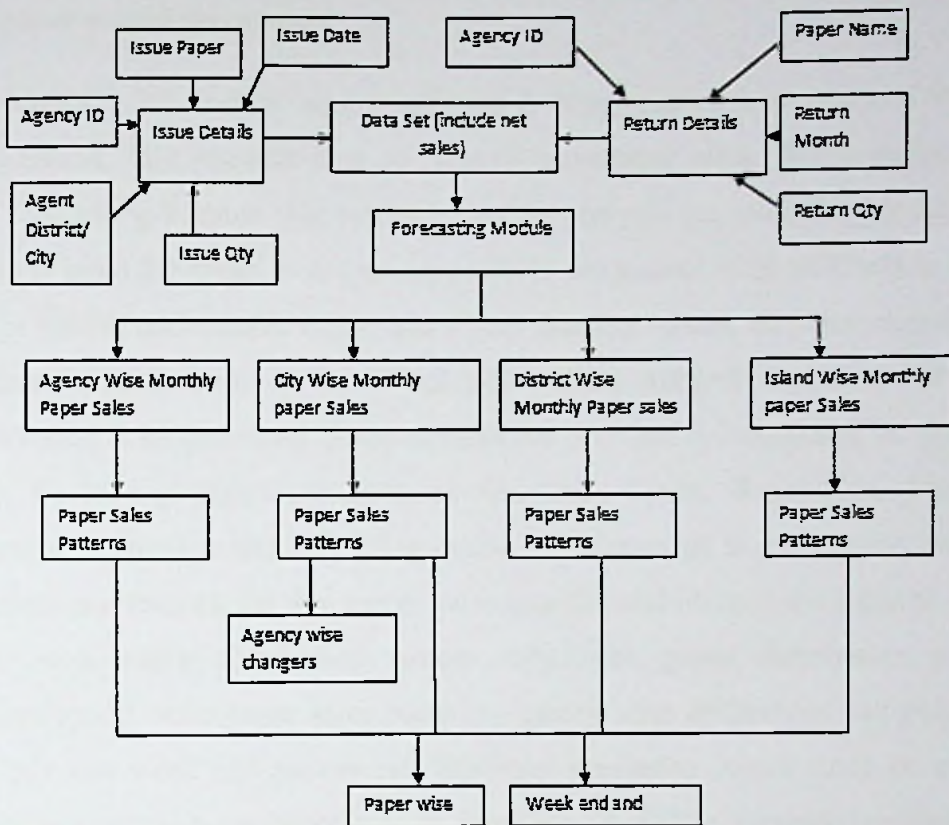


Figure5. 8: Newspaper Forecasting Module Expected Outputs

Figure 5.7 and 5.8 respectively figure out the top level design of the forecasting module and expected outputs of the forecasting module.

### Data Set-

This research is planning to use past three years newspaper issues and return quantity values in one leading newspaper publisher. Forecast newspaper issues in future period researchers need to consider both issue and return quantity in particular month, because newspaper return data available in monthly basic in each customer. Newspaper company collect returns in monthly basis. Therefore this research calculates monthly net sales in each customer. This data set arrange according to particular paper in particular month under particular customer. In addition this data set include customer basic information such as city, district. According to requirement data set need to be rearrange or create new dataset. Use of this information and research may develop several forecasting outputs and sales patterns used by newspaper publisher for their decision making.

## **Newspaper sales Forecasting-**

Use of WEKA 3.7.13 data mining software is developed by University of Waikato, New Zealand, this research plan to forecast newspaper sales. Weka support time series forecasting because this research used to analysis the sales day by day. After data set is input the Weka tool, data set needs to preprocess. This will help to remove garbage values, undesirable values and filling missing values, etc; this preprocessing algorithms already build in the Weka tool. Then Attribute Relation file format (ARFF) need to be generated. Then move to the time series forecasting. In Weka has inbuilt forecasting algorithms such as Gaussian, Linear Regression, Multilayer Preceptron Regression and SMO Regression. This research is planning to use these algorithms and forecast the newspaper sales quantity and identify the patterns such as district wise paper distribution pattern, city wise paper distribution patterns, customer/agency wise paper sales patterns, agency wise differences and patterns in week day and week end papers etc; However prediction results need be evaluate because accuracy is more importance in forecasting. Therefore, forecasting results need to be analyzed and evaluate. Mostly compare the actual value and predicted value. Assure the high accuracy research can use Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE) methods to analysis and evaluated the predict data. These algorithms are also built in the Weka data mining software. Consider the evaluation researcher identify the most accurate algorithm for forecast the newspaper sales. Used of selected algorithm researcher make predict data in full fill the variance accepts. Figure 5.8 figure out some expected forecasting outcomes. Such as, agent wise newspaper sales and district wise demand changers etc; as well as use of this forecasting tool company management make some management decisions. Other than above mention forecasting outputs system, can predict and analyze followings

- Agent wise customer movements within the city. Because city overall demand is may not be change but agent wise demands may change.
- Analysis the demand changers within the time period (seasonal effect)

- Identify the agent wise selling patterns.
- Patterns changers in weekday and weekends

## 5.5 Summary

A newspaper Circulation and Sales Forecasting system main user is staff of Circulation Department, Accounts Department, Audit Department, Management and Agents. This system has two main modules such as Circulation module and Sales forecasting module. In circulation model contain the sub modules such as newspaper issue module, Returns handling module and payment handling module. In forecasting module this research Weka data mining software with using time series forecasting package. First, need to prepare the data set according to full fill requirement. This research used net sales value in monthly basis because company collect returns on monthly basis. Data preprocessing is done after input the data set into WEKA. Then create ARFF file and used of time series forecasting algorithms predict the sales, then the results are analysis and evaluated checked the accuracy by using Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE) methods. Then researcher select most accurate algorithm for newspaper sales forecasting. Then use of this forecasting technique this research create various predicted outputs that can use for company future decision making. Next chapter discussed implementation details about this solution.



# Implementation Process of Propose Solution

## 6.1 Introduction

Previous Chapter is about details of design of the propose solution. This chapter discussed about details related to the implementation of the solution.

## 6.2 Circulation Module Implementation

Circulation module developed by PHP scripting language and MySQL used as database and WAMP server used as the web server. This solution is web base solution therefore; we need to installed WAMP server 2.0 or similar version that helps to run this solution and need to be installed MySQL RDBMS.

This solution has three sub modules that integrated together. Sub modules are newspaper issue handling, returns handling and payment handling.

System has login interfaces for the Circulation System. It's used encryption password mechanism to store the password in database. After successful login, system direct to Home page of the system. Home page provides navigation to Newspaper issue page, return acceptance page and payment handling page. It also links to reports and system setting page.

Use of Issue Management interface system users/ Circulation Department staff can add newspaper issue details customer wise, edit and delete issue details. In addition this interface provides links to get issue related reports and label and dispatch report. User first select paper name, customer id, issue date and enter issue quantity and free issue quantity. (Amounts are calculated automatically) Then click save button all data save in the data base. Then click continue button then this interface redirect to enter new recode interface. System have facilitated to reissue facilitate. Use of this option system user can repost the previous issue details as batch. This function make users to handle the paper issue process effectively because circulation staff needs not

the retype the same data that related to pervious. After reposting they need only to modify and add new issue details.

After entered the paper issue details circulation staff print the labels and dispatch report. Dispatch report includes the transport details of the newspapers as well they issue print order to the press. According to the print order press print the papers. In labels mainly use for delivery purposes. Its include delivery address, paper name, quantity, delivery route number and date. Normally, papers distribute as bundles to the agents. According to the paper quantity request by agent's numbers of bundles are organized. Generally, in one bundle contain 100 papers; however, it has grass amount currently its concern 10 papers. Example, if agent ordered 109 papers system print only print one label and mention paper quantity 109 in label interface. If customer request 111 papers, system print 2 labels in one label include 100 as paper quantity and other label print 12 as quantity.

Use of return management interface users can enter the returns quantity, edit, and delete entered details as well. This interface linked with return related reports. User can enters retunes amount related to the particular issue by using system interface. This system restricted enters return quantity over the issue quantity. The interface provide current return amount in particular issue related to agent/customer.

Payment management interface handle payment related actives. That includes payment details. Mainly enter customer payment than if user has relevant paper wise payment details, user may enter the paper wise payment details.

Customer/Agent information are maintained separately. Its include customer ID, Customer name, address, district, related Regional Sales Executive name, agent status whether active and inactive user etc; It has separate interfaces for paper information such as newspaper name, price. Regional Sales Executive details and System user details etc;

Refer related interfaces in appendix A

### 6.3 Forecasting Module implementation

This module basically depends on Weka data mining software. Walkato Environment for knowledge Analysis data mining software that written in Java and it's developed by University of Walkato in New Zealand [25]. This research used Weka version 3.7.6 before implement this software Java virtual machine 1.7 needs to be installed. Time series analysis algorithms need to be used when forecasting time depended variables. After Weak version 3.7.3, this data mining tools have already inbuilt package called Time series forecasting environment. It allows performing the time series related forecasting [24]. Initially research crate data set include three years newspaper net sales details belong to each customer. Then crate Attribute Relation file format (ARFF). Then use time series algorithms (Gaussian, Linear Regression, Multilayer Preceptron Regression and SMO Regression) forecast the results then used of Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE) methods checked the accuracy of forecasting results. Then find out more accurate forecasting classification and used it for newspaper sales prediction. (Following figure 6.1 figured out sample ARFF file.) Then use of outputs users identified the different sales pattern, such as national wise sales variances, district wise sales changers, city wise changers, customer wise sales changes, inter customer wise sales patterns and paper wise sales changers.

```
@relation'countryfullsales'  
@attribute Date date'yyyy-MM'  
@attribute CDN numeric  
@attribute COM numeric  
@attribute DIN numeric  
@attribute SIL numeric  
@attribute TKN numeric  
@attribute TKV numeric  
@data  
2012-1 405971      208581      479665      220373      121444  
      27102  
2012-2 334317      187213      386310      209070      100470  
      25745
```

Figure6. 1 Sample ARFF file

## **6.4 Summary**

This Chapter mainly focuses to discuss the implementation details related to the Newspaper circulation module and Newspaper Sales forecasting module. Next chapter provide evaluation details about propose solution.

# Assessment of the Newspaper Circulation and Sales Forecasting System

## 7.1 Introduction

Chapter 6 mainly focuses to describe the implementation details in Newspaper Circulation and Sales Forecasting System. This Chapter contains details related to the evaluation of the developed Newspaper Circulation and Sales Forecasting system. It mainly assess developed system achieved and objectives of the project. In evaluating the Newspaper Circulation system this research used test cases developed by research and checked whether expected outputs executed or not. Forecasting module accurate tested by comparing actual data and predicted test data. This research used Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE)) methods for checked the accuracy in each forecasting techniques. These methods are already build in Weka Tool.

## 7.2 Evaluation of the Newspaper Circulation System

Consider the project objectives first four objectives mainly focus to the Newspaper Circulation System. Such as

- Identify current process of newspaper circulation.
- Identify the issues of current circulation process. Circulation process includes newspaper sales, Newspaper return handling and the payment collections.
- Introduces feasible solution for handle newspaper circulation.
- Identify individual customer's sales, returns, payments and outstanding details.

In first two objectives mainly link to the pre steps of the system development. Its known as requirement gathering, Achieved this task researches used interview method with open ended questioner (Reefer Appendix B) and observation. Use of this questioner researcher identified the issues in circulation process. Circulation Process

has mainly three sub process such as newspaper issuing, newspaper return collection and payment handling. To run this sub process smoothly Company need good system. Handling customer smoothly, is key objectives in the company. Current system has some draw back are following,

- System not update on time in payment handling. Users need to manually update the Circulation Department cash system.
- Less user-friendly interface.
- Less efficiency for information processing.
- Inability to predict next issues.

In order to address these issues this research develops newspaper circulation and forecasting system. Evaluate the accuracy of the Circulation system researcher developed the following test cases and test the circulation system accuracy.

Test Case No	1	Test Case Name	User logging	
Short Description	Test the User Logging the system			
Pre-Condition:	<ul style="list-style-type: none"> <li>• Current username is admin</li> <li>• Current password is 123</li> <li>• The System display the index page (logging page)</li> </ul>			
Step	Action	Expected System Response	Pass/ Fail	Com ment
1	Enter user name 'admin'			
2	Enter password '123'			
3	Click the logging button	System display the home page	Pass	
Post-Condition	User Log the system			

Test Case No	2	Test Case Name	User logging		
Short Description	Test the User Logging the system unsuccessfully				
Pre-Condition:	<ul style="list-style-type: none"> <li>• Current username is admin</li> <li>• Current password is 123</li> <li>• The System display the index page (logging page)</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Com ment	
1	Enter user name 'admin2'				
2	Enter password '1123'				
3	Click the logging button	Display error message and asked re enter correct one.	Pass		
Post-Condition	User re direct the index page.				

Test Case No	3	Test Case Name	Customer Creation		
Short Description	Test the New customer creation for system successfully.				
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Customer creation page</li> <li>• The System display the customer creation page</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Com ment	
1	Enter customer id 1001	Pass the next tab	pass		
2	Enter sub id 1	Pass the next tab	pass		
3	Enter customer Name Nimal perera	Pass the next tab	Pass		
4	Enter Address and other details	Pass the next tab			
5	Click OK button	System display successful store mage and refresh the page	pass		
Post-Condition	Customer relative information store under customer id 1001-1				

Test Case No	4	Test Case Name	Customer Creation	
Short Description	Test the New customer creation for system unsuccessfully.			
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Customer creation page</li> <li>• The System display the customer creation page</li> </ul>			
Step	Action	Expected System Response	Pass/ Fail	Com ment
1	Enter customer id 1001 (make empty filed)	Pass the next tab	pass	
2	Enter sub id 1	Pass the next tab	pass	
3	Enter customer Name (make empty filed)	Pass the next tab	Pass	
4	Enter Address and other details	Pass the next tab		
5	Click OK button	System display error message with mention required filed	pass	
Post-Condition	System shows need to fill required field to store.			

Test Case No	5	Test Case Name	Customer Creation	
Short Description	Test the New customer creation for system unsuccessfully.			
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Customer creation page</li> <li>• The System display the customer creation page</li> <li>• System already store customer id 1001-1</li> </ul>			
Step	Action	Expected System Response	Pass/ Fail	Com ment
1	Enter customer id 1001	Pass the next tab	pass	
2	Enter sub id 1	Pass the next tab	pass	
3	Enter customer Name (make empty filed)	Pass the next tab	Pass	
4	Enter Address and other details	Pass the next tab	pass	



5	Click OK button	System display error message for duplicate ID	pass	
Post-Condition	User re direct the customer creation page.			

Test Case No	6	Test Case Name	Newspaper issue		
Short Description	Test the Paper Issue				
Pre-Condition:	<ul style="list-style-type: none"> <li>User log the system</li> <li>Navigate to Newspaper issue page</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Com ment	
1	Enter customer id 1001-1	Pass the next tab	pass		
2	Enter sub paper code Dinamina	Pass the next tab	pass		
3	Select Issue date	Pass the next tab	Pass		
4	Click OK Button	Display interface to enter issue quantity	pass		
5	Enter Quantity 50		pass		
6	Click OK Button	Display success message	pass		
Post-Condition	Store issue details under customer 1001-1 and redirect interface to enter new issue.				

Test Case No	7	Test Case Name	Newspaper issue		
Short Description	Test the Paper Issue unsuccessfully				
Pre-Condition:	<ul style="list-style-type: none"> <li>User log the system</li> <li>Navigate to Newspaper issue page</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Com ment	
1	Enter customer id 1001-2 (not in system)	Pass the next tab	pass		
2	Enter sub paper code Dinamina	Pass the next tab	pass		

3	Select Issue date	Pass the next tab	Pass	
4	Click OK Button	Display error message customer id not exists.	pass	
Post-Condition	Redirect issue enter interface			

Test Case No	8	Test Case Name	Newspaper re-issue	
Short Description	Test the Paper re-Issue			
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper re-issue page</li> <li>• Issue date 2016-01-02</li> <li>• Reissue date 2016-02-01</li> <li>• Paper Dinamina</li> </ul>			
Step	Action	Expected System Response	Pass/Fail	Comment
1	Enter paper name Dinamina	Pass the next tab	pass	
2	Select issue date 2016-01-02	Pass the next tab	pass	
3	Select reissue date 2016-03-01	Pass the next tab	Pass	
4	Click OK Button	Display Confirmation	pass	
5	Click OK Button	Confirmation Acknowledgement	pass	
Post-Condition	Store Reissue details under relevant customers.			

Test Case No	9	Test Case Name	Newspaper re-issue
Short Description	Test the Paper re-Issue unsuccessful		
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper re-issue page</li> <li>• Issue date 2016-01-02</li> <li>• Reissue date 2016-02-01</li> <li>• Paper Dinamina</li> </ul>		
Step	Action	Expected System Response	Pass/ Fail Comment
1	Enter paper name Dinamina	Pass the next tab	pass
2	Select issue date 2016-01-03	Pass the next tab	pass
3	Select reissue date 2016-03-01	Pass the next tab	Pass
4	Click OK Button	Display Error message relevant data not available	pass
Post-Condition	Redirect reissue interface		

Test Case No	10	Test Case Name	Newspaper Return
Short Description	Test the Paper Return handling		
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper return handle page</li> <li>• Customer id 1001</li> <li>• Issue month 2016-01-02</li> <li>• Paper Dinamina</li> </ul>		
Step	Action	Expected System Response	Pass/ Fail Comment
1	Enter paper name Dinamina	Pass the next tab	pass
2	Select issue month 2016-01	Pass the next tab	pass
3	Enter Customer id 1001	Pass the next tab	Pass
4	Click OK Button	Display Return enter interface	pass



5	Enter return amount		pass	
6	Click OK Button	Display success message	pass	
Post-Condition	Store returns quantity under relevant customers.			

Test Case No	11	Test Case Name	Newspaper Return	
Short Description	Test the Paper Return handling over issuing			
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper return handle page</li> <li>• Customer id 1001</li> <li>• Issue month 2016-01</li> <li>• Paper Dinamina</li> <li>• Issue quantity 25</li> </ul>			
Step	Action	Expected System Response	Pass/ Fail	Comment
1	Enter paper name Dinamina	Pass the next tab	pass	
2	Select issue month 2016-01	Pass the next tab	pass	
3	Enter Customer id 1001	Pass the next tab	Pass	
4	Click OK Button	Display Return enter interface	pass	
5	Enter return amount 50		pass	
6	Click OK Button	Display error message over quantity	pass	
Post-Condition	System redirect to return page			

Test Case No	12	Test Case Name	Newspaper Return		
Short Description	Test the Paper Return handling				
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper return handle page</li> <li>• Customer id 1001</li> <li>• Issue month2016-01</li> <li>• Paper Dinamina</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Com ment	
1	Enter paper name Dinamina	Pass the next tab	pass		
2	Select issue month 2016-02	Pass the next tab	pass		
3	Enter Customer id 1001	Pass the next tab	Pass		
4	Click OK Button	Display error message data not available	pass		
Post-Condition	Redirect to return page				

Test Case No	13	Test Case Name	Payment Handling		
Short Description	Test the Paper payment handling				
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper payment handle page</li> <li>• Customer id 1001</li> <li>• Issue month2016-01</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Com ment	
1	Enter Customer id 1001	Pass the next tab	pass		
2	Select issue month 2016-01	Pass the next tab	pass		
3	Click OK Button	Display payment enter interface with last payment amount	Pass		
4			pass		
5	Enter payment amount		pass		
6	Click OK Button	Display success message	pass		

Post-Condition	Store payment details under relevant customers.
----------------	---

Test Case No	14	Test Case Name	Payment Handling		
Short Description	Test the Paper payment handling				
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper payment handle page</li> <li>• Customer id 1001</li> <li>• Issue month 2016-01</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Comment	
1	Enter Customer id 1001	Pass the next tab	pass		
2	Select issue month 2016-03	Pass the next tab	pass		
3	Click OK Button	Display Error message. Data not available.	Pass		
4			pass		
Post-Condition	Redirect payment enter interface.				

Test Case No	15	Test Case Name	Outstanding		
Short Description	Test the Customer outstanding				
Pre-Condition:	<ul style="list-style-type: none"> <li>• User log the system</li> <li>• Navigate to Newspaper outstanding check page</li> <li>• Customer id 1001</li> <li>• Current month 2016-01</li> </ul>				
Step	Action	Expected System Response	Pass/ Fail	Comment	
1	Enter Customer id 1001		pass		
2	Display Error message. Data not available.	Display Outstanding balance	pass		
Post-Condition					

Above test cases are related to the main functions of the developed system. This test cases are successfully pass by the develop system. Therefore, accuracy of the develop Newspaper Circulation system was high and above mention sub objectives are achieved.

### 7.3 Evaluation of the Newspaper Sales Forecasting System

This section consider for achieving the following sub objectives of this project

- Introduces accurate sales forecasting solution and identifying the sales patterns in Sri Lankan newspaper industry,
- Reduced unnecessary cost for newspaper returns and wastage of newspaper printing.

This research used Weka version 3.7.13 tool for newspaper sales forecast and pattern identification.

In this research researcher used 4 years of net sale information monthly basis in six main newspapers published by the ANCL. Such as Daily News (CDN), Dinamina (DIN), Thinakaran (TKN) for weekdays and Observer (COM), Silumina (SIL), Thibakaran Varamangari (TKV) for weekends. This research used 2012 to 2014 monthly basis data for training and 2015 data for test.

This results output get sample form customer basis, city basis, district basis and island wide

This research selects randomly ten agents in cover ten cities and ten districts in the data set and applies the weak tool. This instant research used following forecasting methods that available in Weka and try to figure out suitable forecasting method. This instant research used following forecasting methods that available in Weka and try to figure out suitable forecasting method. Such as Gaussian, Linear Regression, Multilayer Perceptron Regression and SMO Regression Then use of testing and evaluation algorithms that available in Weka, (Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE)).

Mean Absolute Error and Mean Squared Error figured out the closer between actual and forecast result. Relative Mean Squared Error and Relative Absolute Error are used for measure the accuracy. This research separately measure the error in customer wise, city wise, district wise and island wide. Then calculate average value of error in each algorithm based on customer wise, city wise, district wise and island wide. Selected sample illustrate in table 7.1.

Customer ID	City	District
1118	Colombo 6	Colombo Inner
1107		
1374	Kaduwellla	Colombo Outer
5166	Ampara	Ampara
7122	Anuradhapura	Anuradhapura
2221	Kandy	Kandy
3117	Galle	Galle
6107	Kurunagalla	Kurunagalla
8329	Monaragala	Monaragala
4128	Jaffna	Jaffna
	Kegalle	Kegalle

Table 7. 1 Selected Sample

Following tables and graphs illustrate forecasting results.



Year	Linear	SMOREG	Gaussian	Multi	Actual
2015-01*	193.4087	195.1935	189.7551	172.8702	184
2015-02*	171.4937	170.3049	173.1084	172.8702	171
2015-03*	185.0872	183.6829	184.7535	172.8702	183
2015-04*	169.7336	168.6115	172.41	172.8702	169
2015-05*	184.1069	187.3886	188.6398	172.8702	192
2015-06*	178.4568	191.9586	184.6528	172.8702	182
2015-07*	159.6084	175.2591	173.5976	172.8702	175
2015-08*	168.7272	181.9931	181.6188	172.8702	172
2015-09*	166.9416	166.0016	177.1377	172.8702	164
2015-10*	210.3318	198.7551	201.1633	172.8702	183
2015-11*	182.9141	175.8885	178.0576	172.8702	181
2015-12*	182.5784	182.9912	180.5887	172.8702	190

Table 7. 2 Forecasting Results of Daily News-Agent 1107

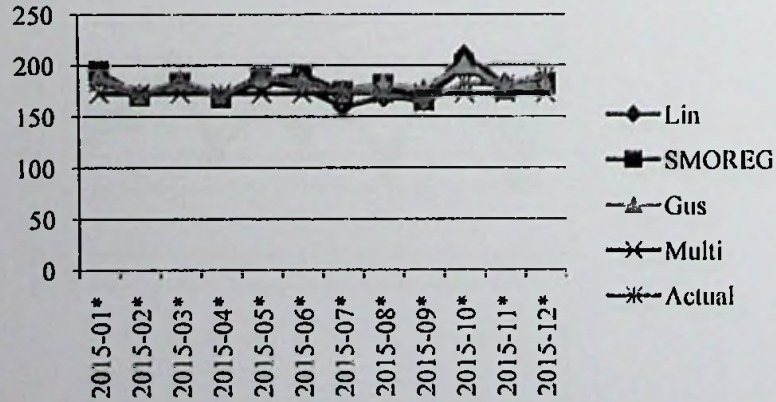


Figure7. 1 Forecasting Result of Daily News- Agent 1107

Year	Linear	SMOREG	Gaussian	Multi	Actual
2015-01*	130.8244	139.4198	118.0923	125.7705	125
2015-02*	97.0085	92.9602	116.1424	125.7705	120
2015-03*	155.8787	130.3796	128.5778	125.7705	172
2015-04*	116.9018	105.7713	102.4055	125.7583	100
2015-05*	90.5395	79.0676	97.8279	125.7418	108
2015-06*	137.8608	139.6836	125.2686	125.7476	139
2015-07*	109.0921	103.1986	128.3728	125.6446	99
2015-08*	150.1761	121.0072	98.9398	125.5137	128
2015-09*	103.4824	136.9322	117.0619	125.5124	99
2015-10*	119.3918	129.6247	142.6557	125.3344	152
2015-11*	166.8637	151.0769	124.3067	124.7067	142
2015-12*	69.2884	58.4793	97.6033	123.3617	108

Table 7. 3 Forecasting Result of Sunday Observer- Agent 1107

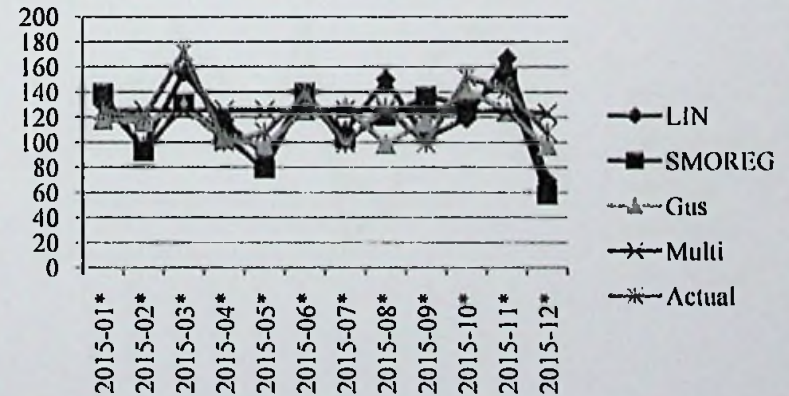


Figure7. 2 Forecasting Result of Sunday Observer- Agent 1107

Year	Linear	SMOReg	Gaussian	Multi	Actual
2015-01*	26.0126	22.4822	24.5037	28.4863	24
2015-02*	27.4013	25.2261	26.0949	28.4863	28
2015-03*	34.7333	32.5976	30.4527	28.4863	30
2015-04*	27.2545	20.6414	22.9164	28.4863	28
2015-05*	26.3777	27.2365	27.9894	28.4863	29
2015-06*	25.8811	23.4994	24.5416	28.4863	23
2015-07*	28.9661	27.3495	25.9664	28.4863	34
2015-08*	16.9624	20.1667	21.1808	28.4863	28
2015-09*	31.5313	30.2489	30.2553	28.4863	28
2015-10*	29.5439	28.1823	29.6051	28.4863	27
2015-11*	24.5002	15.7106	20.6712	28.4863	23
2015-12*	37.1519	31.4337	27.3646	28.4863	32

Table 7. 4 Forecasting Result of Dinamina- Agent 1107

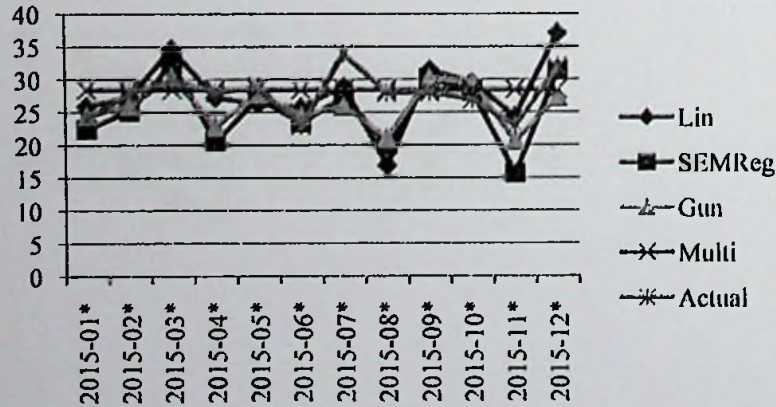


Figure 7. 3 Forecasting details of Dinamina- Agent 1107

Year	Linear	SMOReg	Gaussian	Multi	Actual
2015-01*	15.1755	12.894	11.6777	13.4785	14
2015-02*	15.9011	12.7007	14.2235	13.4786	14
2015-03*	21.1927	14.0846	14.6392	13.4785	19
2015-04*	16.7628	11.994	10.9397	13.4785	15
2015-05*	12.8011	10.5663	11.1372	13.4785	13
2015-06*	20.4979	21.47	14.9333	13.4785	17
2015-07*	1.1767	6.9254	7.1856	13.4784	14
2015-08*	4.7715	4.6857	5.7319	13.4784	11
2015-09*	18.3194	15.8545	14.9198	13.4785	15
2015-10*	20.8341	13.7933	17.5618	13.4785	17
2015-11*	16.9898	11.2766	9.7071	13.4785	18
2015-12*	9.0266	7.1344	6.5788	13.4785	12

Table 7. 5 Forecasting details of Silumina- Agent 1107

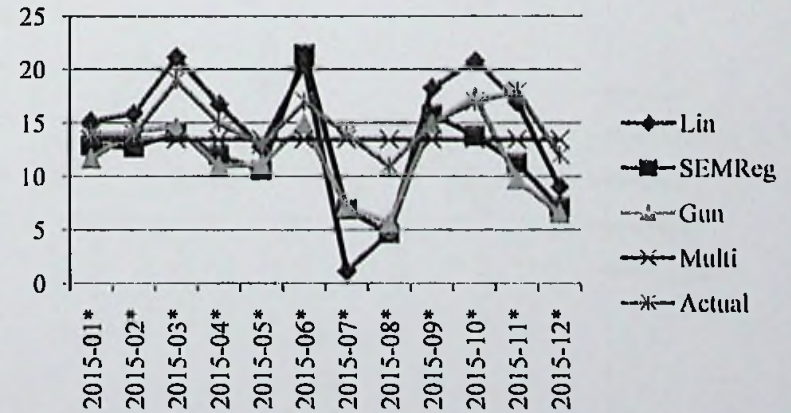


Figure 7. 4 Forecasting details of Silumina- Agent 1107

Year	Linear	SMOReg	Gaussian	Multi	Actual
2015-01*	39.2899	36.59	30.805	33.8344	38
2015-02*	15.8616	16.746	19.1508	33.8344	27
2015-03*	19.5204	12.4798	19.3729	33.8344	27
2015-04*	27.9707	10.0592	16.9098	33.8344	28
2015-05*	41.6278	30.1739	31.8656	33.8344	38
2015-06*	29.5352	27.6829	23.4753	33.8344	23
2015-07*	26.172	36.2231	26.8949	33.8344	32
2015-08*	9.406	17.6392	18.4183	33.8344	24
2015-09*	18.5692	15.3784	21.151	33.8344	23
2015-10*	38.0472	33.7125	36.0426	33.8344	32
2015-11*	35.8259	16.3958	19.0861	33.8344	30
2015-12*	33.3019	23.2416	18.5024	33.8344	32

Table 7. 6 Forecasting details of Tinakaran- Agent 1107

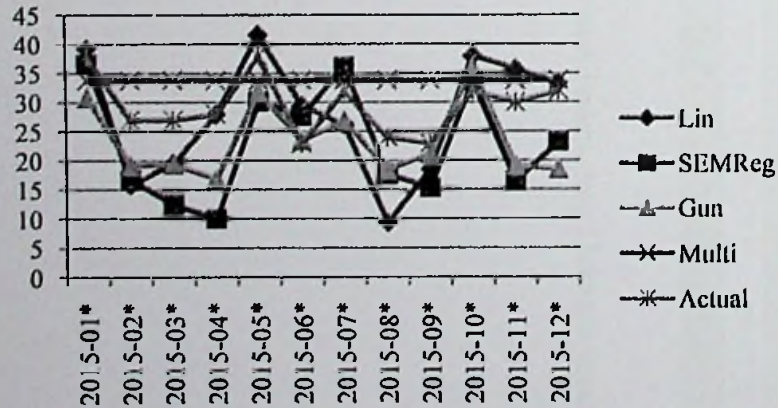


Figure7. 5 Forecasting details of Tinakaran- Agent 1107

Year	Linear	SMOReg	Gaussian	Multi	Actual
2015-01*	3.896	4.1551	4.4746	7.8054	4
2015-02*	8.0284	6.5146	7.4075	7.8054	7
2015-03*	16.0682	8.8938	8.2711	7.8054	7
2015-04*	9.4608	3.5482	3.5006	7.8054	8
2015-05*	7.7353	3.8267	5.6539	7.8054	7
2015-06*	17.9005	13.2804	8.4987	7.8054	9
2015-07*	5.522	6.3032	4.3117	7.8054	6
2015-08*	0.7734	2.8408	1.7535	7.8054	4
2015-09*	8.3098	9.4838	7.4809	7.8054	5
2015-10*	9.6962	5.588	9.2506	7.8054	8
2015-11*	8.6857	1.472	2.3564	7.8054	8
2015-12*	10.1176	7.7258	5.2015	7.8054	7

Table 7. 7 Forecasting Details of Tinakarn Varamanjari- Agent 1107

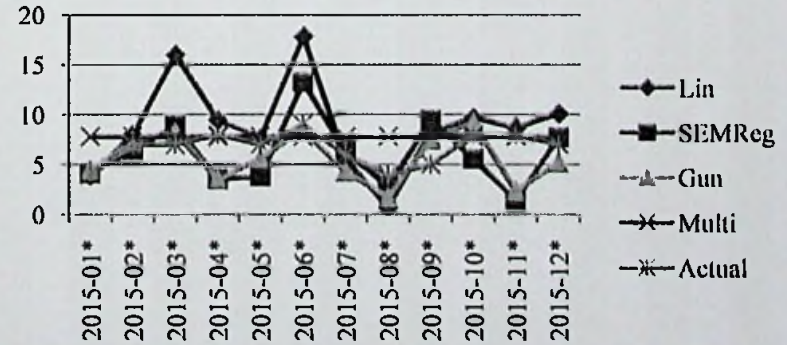


Figure7. 6 Forecasting details of Tinakaran Varamangari Agent 1107

## Customer Wise Performance Evaluation-

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	0.0702	1.8635	12.5633
	RMSE	0	0.0767	2.4164	15.3698
	RAE	0	0.4317	11.7045	77.4635
	MSE	0	0.0059	5.839	236.2313
COM	MAE	0	0.1204	5.6122	22.6658
	RMSE	0	0.1275	7.4382	26.2852
	RAE	0	0.3899	17.2962	72.3946
	MSE	0	0.0162	55.3262	690.9107
DIN	MAE	0	0.0288	1.1904	5.8706
	RMSE	0	0.0315	1.5263	7.053
	RAE	0	0.4002	15.6838	79.6413
	MSE	0	0.001	2.3296	49.7447
SIL	MAE	0	0.0388	1.0549	1.1945
	RMSE	0	0.0415	1.442	1.6976
	RAE	0	0.641	17.3089	20.5238
	MSE	0	0.0017	2.0794	2.882
TKN	MAE	0	0.0587	2.2787	7.4567
	RMSE	0	0.0636	2.9338	9.907
	RAE	0	0.4653	17.3664	60.6313
	MSE	0	0.004	8.6071	98.1484
TKV	MAE	0	0.0323	0.8875	3.757
	RMSE	0	0.0343	1.2135	7.253
	RAE	0	0.7273	19.9537	89.9728
	MSE	0	0.0012	1.4727	52.6055

Table 7. 8 Performance Comparison with Forecasting Output Agent1107

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	0.9086	18.6461	0.0002
	RMSE	0	0.9948	23.5181	0.0002
	RAE	0	0.2609	5.2228	0
	MSE	0	0.9897	553.1001	0
COM	MAE	0	0.5698	14.4332	32.4019
	RMSE	0	0.5983	18.5043	43.539
	RAE	0	0.4512	11.4632	25.1209
	MSE	0	0.358	342.4083	1895.6463
DIN	MAE	0	0.3952	12.4636	0.0001
	RMSE	0	0.435	14.6701	0.0001
	RAE	0	0.4184	13.6874	0.0001
	MSE	0	0.1892	215.2126	0
SIL	MAE	0	0.2271	7.7526	0.0442
	RMSE	0	0.2417	10.5337	0.054
	RAE	0	0.4012	13.7659	0.0744
	MSE	0	0.0584	110.9591	0.0029
TKN	MAE	0	0.1037	6.0555	24.2364
	RMSE	0	0.1127	7.3066	29.0197
	RAE	0	0.384	22.4364	91.8924
	MSE	0	0.0127	53.3871	842.1411
TKV	MAE	0	0.0583	1.8922	0.4556
	RMSE	0	0.0635	2.3998	0.7112
	RAE	0	0.5052	17.1274	3.9635
	MSE	0	0.004	5.7592	0.5057

Table 7. 9 Performance Comparison with Forecasting Output Agent1118



		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	0.8007	29.8155	70.2634
	RMSE	0	0.9157	54.8979	139.0475
	RAE	0	0.6899	27.4745	63.4166
	MSE	0	0.8384	3013.7847	19334.1977
COM	MAE	0	0.8296	36.6368	91.2315
	RMSE	0	0.9459	50.7914	146.4898
	RAE	0	0.6035	26.3516	66.838
	MSE	0	0.8948	2579.7638	21459.2702
DIN	MAE	0	1.5639	45.8294	118.375
	RMSE	0	1.641	85.6988	219.0988
	RAE	0	0.7362	22.32	57.9514
	MSE	0	2.6929	7344.29	48004.3005
SIL	MAE	0	1.1384	34.0951	144.5883
	RMSE	0	1.2377	41.5163	196.7005
	RAE	0	0.6394	19.5823	85.222
	MSE	0	1.532	1723.6009	38691.0682
TKN	MAE	0	0.0773	2.397	6.4712
	RMSE	0	0.0847	4.5548	12.6012
	RAE	0	0.8017	24.1768	66.7088
	MSE	0	0.0072	20.7464	158.7902
TKV	MAE	0	0.0209	0.9412	3.8089
	RMSE	0	0.023	1.403	5.0712
	RAE	0	0.4511	19.9689	81.0684
	MSE	0	0.0005	1.9683	25.7172

Table 7. 10 Performance Comparison with Forecasting Output Agent1374

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	2.5276	87.6133	87.6133
	RMSE	0	2.7048	159.0936	159.0936
	RAE	0	0.8645	30.3047	30.3047
	MSE	0	7.316	25310.764	25310.764
COM	MAE	0	0.6284	26.2136	26.2136
	RMSE	0	0.7005	39.5991	39.5991
	RAE	0	0.5713	23.3166	23.3166
	MSE	0	0.4907	1568.0879	1568.0879
DIN	MAE	0	1.1682	45.8642	45.8642
	RMSE	0	1.2237	73.5418	73.5418
	RAE	0	0.6854	26.8971	26.8971
	MSE	0	1.4975	5408.4002	5408.4002
SIL	MAE	0	0.2476	8.1982	8.1982
	RMSE	0	0.2643	14.0577	14.0577
	RAE	0	0.7702	24.8383	24.8383
	MSE	0	0.0698	197.619	197.619
TKN	MAE	0	0.1694	6.3343	6.3343
	RMSE	0	0.1772	10.0246	10.0246
	RAE	0	0.7285	28.1988	28.1988
	MSE	0	0.0314	100.4923	100.4923
TKV	MAE	0	0.0787	2.4396	2.4396
	RMSE	0	0.0828	3.826	3.826
	RAE	0	0.8496	26.3145	26.3145
	MSE	0	0.0068	14.6386	14.6386

Table 7. 11 Performance Comparison with Forecasting Output Agent 2221

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	5.8898	262.0153	478.016
	RMSE	0	6.6528	462.4878	1084.7203
	RAE	0	0.6767	30.3208	54.3578
	MSE	0	44.2595	213895	1176618.2
COM	MAE	0	4.0228	185.7365	427.0196
	RMSE	0	4.2544	258.8987	655.1291
	RAE	0	0.6258	28.6747	67.4839
	MSE	0	18.1003	67028.56	429194.17
DIN	MAE	0	8.12	302.0842	642.5064
	RMSE	0	9.0081	523.1345	1313.7311
	RAE	0	0.6546	23.3939	51.4655
	MSE	0	81.1463	273669.72	1725889.5
SIL	MAE	0	2.6229	153.9126	376.2465
	RMSE	0	2.7964	200.4137	491.7429
	RAE	0	0.508	29.1657	73.5373
	MSE	0	7.82	40165.654	241811.06
TKN	MAE	0	2.4138	91.0932	190.8389
	RMSE	0	2.5949	155.0707	374.246
	RAE	0	0.8124	30.9106	64.427
	MSE	0	6.7335	24046.914	140060.06
TKV	MAE	0	0.3758	20.643	48.6402
	RMSE	0	0.4031	27.262	79.4072
	RAE	0	0.4769	26.4795	63.9017
	MSE	0	0.1625	743.2159	6305.4991

Table 7. 12 Performance Comparison with Forecasting Output Agent 3117



		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	0.3904	12.161	0.3614
	RMSE	0	0.4186	16.8499	0.4235
	RAE	0	0.7131	21.6037	0.6538
	MSE	0	0.1753	283.9193	0.1793
COM	MAE	0	0.1123	3.1551	0.0044
	RMSE	0	0.1195	4.5705	0.0054
	RAE	0	0.7082	19.9285	0.0265
	MSE	0	0.0143	20.8897	0
DIN	MAE	0	0.0408	1.0363	0.0054
	RMSE	0	0.0449	1.3682	0.0076
	RAE	0	0.7232	19.0802	0.0964
	MSE	0	0.002	1.872	0.0001
SIL	MAE	0	0.0096	0.2857	0.3447
	RMSE	0	0.0099	0.3519	0.5612
	RAE	0	1.1657	33.6958	41.0374
	MSE	0	0.0001	0.1238	0.315
TKN	MAE	0	0.1502	4.3141	10.8269
	RMSE	0	0.1654	6.3438	12.8002
	RAE	0	0.707	18.8601	48.4324
	MSE	0	0.0274	40.2444	163.8446
TKV	MAE	0	0.0272	1.0058	0.0027
	RMSE	0	0.0287	1.3259	0.0033
	RAE	0	0.5676	21.0699	0.057
	MSE	0	0.0008	1.758	0

Table 7. 13 Performance Comparison with Forecasting Output Agent 4128

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	0.0364	1.015	0.3614
	RMSE	0	0.0404	1.3753	0.4235
	RAE	0	0.6497	19.3191	0.6538
	MSE	0	0.0016	1.8914	0.1793
COM	MAE	0	0.0258	0.4157	0.0044
	RMSE	0	0.0272	0.5008	0.0054
	RAE	0	1.0066	16.8975	0.0265
	MSE	0	0.0007	0.2508	0
DIN	MAE	0	0.4473	12.8265	0.0054
	RMSE	0	0.4771	19.5107	0.0076
	RAE	0	0.6562	19.4824	0.0964
	MSE	0	0.2276	380.6687	0.0001
SIL	MAE	0	0.0683	1.508	0.3447
	RMSE	0	0.0748	2.1788	0.5612
	RAE	0	0.5482	12.6362	41.0374
	MSE	0	0.0056	4.7474	0.315
TKN	MAE	0	0.0893	1.7783	10.8269
	RMSE	0	0.0946	2.2759	12.8002
	RAE	0	1.7404	33.5309	48.4324
	MSE	0	0.009	5.1799	163.8446
TKV	MAE	0	0.0161	0.3935	0.0027
	RMSE	0	0.017	0.4956	0.0033
	RAE	0	0.7762	18.8597	0.057
	MSE	0	0.0003	0.2456	0

Table 7. 14 Performance Comparison with Forecasting Output Agent 5166

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	6.0081	184.1637	447.2631
	RMSE	0	6.458	320.7967	914.2386
	RAE	0	0.7912	24.5029	61.134
	MSE	0	41.7054	102910.49	835832.29
COM	MAE	0	2.97	125.9071	407.1491
	RMSE	0	3.2787	187.2788	543.3066
	RAE	0	0.5006	21.5335	71.6138
	MSE	0	10.7499	35073.364	295182.09
DIN	MAE	0	8.1801	248.7097	627.0917
	RMSE	0	8.5791	426.6135	1215.1307
	RAE	0	0.7091	21.8236	56.344
	MSE	0	73.6017	181999.11	1476542.5
SIL	MAE	0	2.21	77.8892	293.2083
	RMSE	0	2.4032	113.5436	403.1527
	RAE	0	0.5021	18.799	68.7429
	MSE	0	5.7755	12892.154	162532.07
TKN	MAE	0	0.3937	20.226	10.518
	RMSE	0	0.4425	31.1197	13.033
	RAE	0	0.5014	25.6979	13.4639
	MSE	0	0.1958	968.4383	169.8593
TKV	MAE	0	0.1825	9.8016	9.4996
	RMSE	0	0.1919	12.9841	11.8105
	RAE	0	0.4825	24.8152	26.0732
	MSE	0	0.0368	168.5874	139.488

Table 7. 15 Performance Comparison with Forecasting Output Agent 6107

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	0.8753	21.4267	53.4292
	RMSE	0	0.9223	43.0119	125.2137
	RAE	0	0.9231	23.5823	59.7748
	MSE	0	0.8506	1850.0262	15678.472
COM	MAE	0	0.1245	3.8946	14.2969
	RMSE	0	0.1316	6.345	22.0575
	RAE	0	0.5842	18.0863	68.3513
	MSE	0	0.0173	40.2588	486.5342
DIN	MAE	0	1.3653	37.4292	107.9272
	RMSE	0	1.4488	68.4357	198.6846
	RAE	0	0.8466	24.2916	68.8793
	MSE	0	2.0991	4683.4437	39475.568
SIL	MAE	0	0.0816	2.7498	12.1764
	RMSE	0	0.0906	4.4758	17.2485
	RAE	0	0.4519	15.604	69.5198
	MSE	0	0.0082	20.0324	297.5095
TKN	MAE	0	0.0363	1.8782	5.4656
	RMSE	0	0.0395	2.9586	7.0812
	RAE	0	0.5501	30.45	86.2614
	MSE	0	0.0016	8.7531	50.1437
TKV	MAE	0	0.0085	0.3528	2.2688
	RMSE	0	0.0093	0.4258	2.4847
	RAE	0	0.3822	16.5852	103.6438
	MSE	0	0.0001	0.1813	6.1737

Table 7. 16 Performance Comparison with Forecasting Output Agent 7122

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	0.1586	7.3518	30.9289
	RMSE	0	0.174	9.2837	39.1245
	RAE	0	0.3635	16.3235	70.7011
	MSE	0	0.0303	86.1878	1530.7288
COM	MAE	0	0.137	5.2679	1.6483
	RMSE	0	0.1417	7.1197	1.9477
	RAE	0	0.4641	18.5261	5.5685
	MSE	0	0.0201	50.6897	3.7934
DIN	MAE	0	0.5896	19.3816	120.3379
	RMSE	0	0.6219	24.4765	162.3353
	RAE	0	0.6161	19.8942	128.6858
	MSE	0	0.3868	599.1005	26352.747
SIL	MAE	0	0.1418	4.8744	0.0521
	RMSE	0	0.1504	6.8834	0.0685
	RAE	0	0.55	18.6805	0.2033
	MSE	0	0.0226	47.3806	0.0047
TKN	MAE	0	0.1932	5.1952	0.0689
	RMSE	0	0.2113	6.9466	0.0813
	RAE	0	0.706	18.4184	0.2455
	MSE	0	0.0447	48.2558	0.0066
TKV	MAE	0	0.0294	0.8466	0.0367
	RMSE	0	0.0313	1.1287	0.0483
	RAE	0	0.5935	16.831	0.6874
	MSE	0	0.001	1.274	0.0023

Table 7. 17 Performance Comparison with Forecasting Output Agent8329

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	1.76657	62.60719	119.1632
	RMSE	0	1.93581	109.37313	248.88962
	RAE	0	0.63643	21.03588	61.97814
	MSE	0	9.61727	34791.1	207467.71
COM	MAE	0	0.95406	40.72727	102.42605
	RMSE	0	1.03253	58.10465	148.03237
	RAE	0	0.59054	20.20742	46.72224
	MSE	0	3.06623	10675.96	75048.436
DIN	MAE	0	2.18992	72.68151	174.16165
	RMSE	0	2.35111	123.89761	327.75039
	RAE	0	0.6446	20.65542	57.91792
	MSE	0	16.18441	47430.414	332945.28
SIL	MAE	0	0.67861	29.23205	84.48531
	RMSE	0	0.73105	39.53969	113.77976
	RAE	0	0.61777	20.40766	45.75251
	MSE	0	1.52939	5516.4351	44368.913
TKN	MAE	0	0.36856	14.15505	27.61379
	RMSE	0	0.39864	22.95351	48.28757
	RAE	0	0.73968	25.00463	73.72277
	MSE	0	0.70673	2530.1018	14184.177
TKV	MAE	0	0.08297	3.92038	7.3604
	RMSE	0	0.08849	5.24644	11.402
	RAE	0	0.58121	20.8005	52.73522
	MSE	0	0.0214	93.9101	655.62211

Table 7. 18 Performance Comparison with Forecasting Output Agent Average

**City wise Performance Evaluation-**

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	1.5938	53.8139	125.9851
	RMSE	0	1.6938	88.6259	237.701
	RAE	0	0.8179	28.6332	65.6958
	MSE	0	2.869	7854.5578	56501.761
COM	MAE	0	0.6332	21.7128	78.7782
	RMSE	0	0.6681	31.4696	109.7965
	RAE	0	0.7033	24.3666	91.2213
	MSE	0	0.4463	990.3343	12055.275
DIN	MAE	0	3.6729	133.9526	413.7636
	RMSE	0	4.0608	225.6233	655.039
	RAE	0	0.6672	25.4843	77.5286
	MSE	0	16.4899	50905.855	429076.08
SIL	MAE	0	0.5997	25.3157	85.25
	RMSE	0	0.6425	35.0051	114.4951
	RAE	0	0.5368	23.0877	76.1456
	MSE	0	0.4128	1225.3601	13109.136
TKN	MAE	0	0.7908	25.2446	60.648
	RMSE	0	0.8248	45.0024	119.0338
	RAE	0	0.7565	24.6683	59.5173
	MSE	0	0.6803	2025.2175	14169.041
TKV	MAE	0	0.0687	3.3597	4.7435
	RMSE	0	0.0747	4.6322	6.4469
	RAE	0	0.5497	26.2349	39.4119
	MSE	0	0.0056	21.4571	41.562

Table 7. 19 Performance Comparison with Forecasting Output City Ampara

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	1.7454	46.6843	0.0184
	RMSE	0	1.8538	51.9384	0.0067
	RAE	0	0.7577	19.9246	0.0003
	MSE	0	3.4366	2697.596	0.003
COM	MAE	0	1.8483	40.9311	0.0034
	RMSE	0	1.969	56.8742	0.0011
	RAE	0	0.665	14.5186	0
	MSE	0	3.8768	3234.6711	376.6979
DIN	MAE	0	5.714	178.3223	436.6578
	RMSE	0	5.9833	232.8165	45.1088
	RAE	0	0.7198	22.24	190670.05
	MSE	0	35.8002	54203.521	128.5536
SIL	MAE	0	0.7383	23.2416	161.8668
	RMSE	0	0.8219	28.7828	65.8495
	RAE	0	0.3652	11.7717	26200.853
	MSE	0	0.6755	828.4521	0.0236
TKN	MAE	0	0.447	10.4354	0.0302
	RMSE	0	0.4801	11.9196	0.0278
	RAE	0	0.5277	12.2035	0.0009
	MSE	0	0.2305	142.0773	0.0027
TKV	MAE	0	0.0924	3.4677	0.0035
	RMSE	0	0.1006	4.3604	0.0108
	RAE	0	0.3562	13.232	0
	MSE	0	0.0101	19.0131	41.562

Table 7. 20 Performance Comparison with Forecasting Output City Anuradhpura



		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	3.9734	150.6664	0.0203
	RMSE	0	4.1512	205.3734	0.0346
	RAE	0	0.6001	21.8483	0.0032
	MSE	0	17.2325	42178.222	0.0012
COM	MAE	0	1.3086	33.3488	205.2255
	RMSE	0	1.3886	42.371	240.0139
	RAE	0	0.5681	14.606	87.5686
	MSE	0	1.9283	1795.3014	57606.675
DIN	MAE	0	1.1527	43.079	0
	RMSE	0	1.2311	56.987	0
	RAE	0	0.6044	22.2879	0
	MSE	0	1.5157	3247.5179	0
SIL	MAE	0	0.4585	12.1665	6.4354
	RMSE	0	0.4865	16.1096	7.7647
	RAE	0	0.5305	14.4228	7.2111
	MSE	0	0.2367	259.5186	60.2903
TKN	MAE	0	0.153	6.0558	1.4007
	RMSE	0	0.1662	7.1448	1.7585
	RAE	0	0.4194	16.3347	3.8837
	MSE	0	0.0276	51.0482	3.0923
TKV	MAE	0	0.0664	2.6236	0
	RMSE	0	0.0686	3.2631	0.0001
	RAE	0	0.5199	20.2406	0.0003
	MSE	0	0.0047	10.6475	0

Table 7. 21 Performance Comparison with Forecasting Output City Colombo 6

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	2.0874	64.1475	40.9039
	RMSE	0	2.2602	76.9102	56.3354
	RAE	0	0.4397	13.4321	8.5171
	MSE	0	5.1085	5915.1737	3173.6734
COM	MAE	0	2.0903	101.4821	0
	RMSE	0	2.3198	124.6454	0
	RAE	0	0.3693	18.6036	0
	MSE	0	5.3813	15536.482	0
DIN	MAE	0	2.8888	77.4215	0.0104
	RMSE	0	3.1655	90.1454	0.0194
	RAE	0	0.3423	8.7878	0.0012
	MSE	0	10.0204	8126.1968	0.0004
SIL	MAE	0	2.8408	95.211	0.0346
	RMSE	0	3.0525	113.7037	0.0409
	RAE	0	0.5188	17.9456	0.0061
	MSE	0	9.3178	12928.529	0.0017
TKN	MAE	0	0.8723	23.5378	0.0002
	RMSE	0	0.916	29.1545	0.0002
	RAE	0	0.6389	17.7617	0.0002
	MSE	0	0.8391	849.9837	0
TKV	MAE	0	0.2931	11.3702	9.2528
	RMSE	0	0.3155	14.9749	13.4823
	RAE	0	0.4335	17.4216	14.2772
	MSE	0	0.0996	224.2473	181.7729

Table 7. 22 Performance Comparison with Forecasting Output City Galle

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	1.7488	95.1455	0.2012
	RMSE	0	1.9119	121.0209	0.2634
	RAE	0	0.4876	26.0858	0.0526
	MSE	0	3.6552	14646.054	0.0694
COM	MAE	0	0.9734	55.0987	0.1177
	RMSE	0	1.0468	64.9822	0.1599
	RAE	0	0.4565	25.0499	0.0536
	MSE	0	1.0958	4222.6814	0.0256
DIN	MAE	0	0.4338	18.0255	0.3915
	RMSE	0	0.4819	24.8106	0.5485
	RAE	0	0.7853	34.8092	0.741
	MSE	0	0.2322	615.5642	0.3009
SIL	MAE	0	0.1184	5.0702	0.0113
	RMSE	0	0.1288	6.9893	0.0176
	RAE	0	0.899	38.1439	0.0874
	MSE	0	0.0166	48.8502	0.0003
TKN	MAE	0	0.8199	43.4431	1.698
	RMSE	0	0.921	52.9355	2.1922
	RAE	0	0.4047	20.5735	0.8511
	MSE	0	0.8482	2802.1645	4.8057
TKV	MAE	0	0.1363	10.1844	0.3505
	RMSE	0	0.155	11.7143	0.4665
	RAE	0	0.2751	20.2627	0.703
	MSE	0	0.024	137.2253	0.2176

Table 7. 23 Performance Comparison with Forecasting Output City Jaffna

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	1.1339	38.3415	91.5238
	RMSE	0	1.2566	70.97	193.0204
	RAE	0	0.7329	25.5918	61.2031
	MSE	0	1.579	5036.7363	37256.873
COM	MAE	0	1.4089	48.4038	138.7333
	RMSE	0	1.4883	71.4514	213.8382
	RAE	0	0.6677	23.276	69.33
	MSE	0	2.2151	5105.2994	45726.776
DIN	MAE	0	1.7472	58.7473	144.2144
	RMSE	0	1.8558	98.1215	258.0401
	RAE	0	0.7149	23.588	58.5213
	MSE	0	3.4441	9627.8251	66584.67
SIL	MAE	0	1.3691	53.2814	173.5988
	RMSE	0	1.4751	73.5005	228.7114
	RAE	0	0.6341	23.6	79.6344
	MSE	0	2.1761	5402.3308	52308.91
TKN	MAE	0	0.0726	2.4629	7.269
	RMSE	0	0.0769	3.7086	12.1301
	RAE	0	0.7286	23.2083	74.4251
	MSE	0	0.0059	13.7536	147.1389
TKV	MAE	0	0.0254	1.1205	4.2573
	RMSE	0	0.0278	1.7121	5.8213
	RAE	0	0.4394	19.2206	73.0326
	MSE	0	0.0008	2.9312	33.8871

Table 7. 24 Performance Comparison with Forecasting Output City Kaduwela

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	4.8252	112.8432	66.288
	RMSE	0	5.4086	134.728	85.1303
	RAE	0	0.3881	9.368	5.1661
	MSE	0	29.2532	18151.632	7247.1603
COM	MAE	0	6.7729	190.7608	101.5769
	RMSE	0	7.2704	239.7107	131.0464
	RAE	0	0.5348	14.899	8.0664
	MSE	0	52.8581	57461.218	17173.162
DIN	MAE	0	6.1778	223.6125	57.9398
	RMSE	0	6.5738	281.1229	64.306
	RAE	0	0.4346	15.9105	4.0813
	MSE	0	43.2142	79030.11	4135.2618
SIL	MAE	0	3.5956	108.1114	542.3093
	RMSE	0	3.8106	144.1602	656.2315
	RAE	0	0.4744	14.947	73.5901
	MSE	0	14.5204	20782.154	430639.83
TKN	MAE	0	0.96	28.4414	17.7675
	RMSE	0	1.0184	36.3382	21.2408
	RAE	0	0.3103	9.3644	5.8831
	MSE	0	1.0371	1320.4637	451.1736
TKV	MAE	0	0.5835	24.7931	0
	RMSE	0	0.6277	32.0127	0
	RAE	0	0.4225	18.0568	0
	MSE	0	0.394	1024.8101	0

Table 7. 25 Performance Comparison with Forecasting Output City Kandy

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	1.4764	28.7163	0.809
	RMSE	0	1.5498	35.8733	0.9709
	RAE	0	1.2368	23.9403	0.6825
	MSE	0	2.4018	1286.8966	0.9427
COM	MAE	0	1.0648	36.7816	155.5417
	RMSE	0	1.1763	46.8301	198.2968
	RAE	0	0.5627	19.9271	86.5626
	MSE	0	1.3836	2193.0541	39321.638
DIN	MAE	0	3.4987	90.7096	180.9557
	RMSE	0	3.8666	110.8556	221.8893
	RAE	0	1.0351	26.4966	52.2125
	MSE	0	14.9507	12288.959	49234.854
SIL	MAE	0	1.8266	46.6684	174.29
	RMSE	0	1.908	55.2245	187.8413
	RAE	0	0.9657	25.2762	95.399
	MSE	0	3.6407	3049.7502	35284.352
TKN	MAE	0	0.1651	3.8353	0.0452
	RMSE	0	0.177	4.8425	0.053
	RAE	0	0.9424	21.337	0.2511
	MSE	0	0.0313	23.4498	0.0028
TKV	MAE	0	0.0625	1.4265	0
	RMSE	0	0.0696	1.7021	0
	RAE	0	0.9962	22.2852	0
	MSE	0	0.0048	2.8972	0

Table 7. 26 Performance Comparison with Forecasting Output City Kegalle

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	2.0093	46.4739	187.5156
	RMSE	0	2.1138	61.7647	241.6641
	RAE	0	0.5308	12.2846	51.0029
	MSE	0	4.4682	3814.8827	58401.542
COM	MAE	0	2.17	73.607	421.7926
	RMSE	0	2.3368	89.6028	449.7419
	RAE	0	0.434	14.9386	84.5555
	MSE	0	5.4607	8028.6604	202267.81
DIN	MAE	0	3.0306	90.2026	0.0028
	RMSE	0	3.2454	117.1802	0.0031
	RAE	0	0.3978	12.4986	0.0004
	MSE	0	10.5328	13731.204	24
SIL	MAE	0	2.4315	61.951	285.2568
	RMSE	0	2.6441	78.4293	335.0235
	RAE	0	0.6563	17.201	81.1238
	MSE	0	6.9912	6151.1486	112240.72
TKN	MAE	0	0.4802	9.4981	44.3833
	RMSE	0	0.5082	11.6541	53.135
	RAE	0	0.6537	11.9998	59.9346
	MSE	0	0.2583	135.819	2823.3285
TKV	MAE	0	0.2241	7.6094	32.2059
	RMSE	0	0.2368	9.5587	37.7314
	RAE	0	0.5701	19.2021	79.4187
	MSE	0	0.0561	91.3681	1423.6585

Table 7. 27 Performance Comparison with Forecasting Output City Kurunagala

		<b>Linear</b>	<b>SMOReg</b>	<b>Gaussian</b>	<b>Multilayer</b>
CDN	MAE	0	0.2824	4.032	77.3528
	RMSE	0	0.3135	5.5702	98.0799
	RAE	0	0.4736	6.6788	128.2784
	MSE	0	0.0983	31.0272	9619.6696
COM	MAE	0	0.2295	13.0219	8.9334
	RMSE	0	0.2543	14.5132	14.4025
	RAE	0	0.3601	20.3109	14.1684
	MSE	0	0.0646	210.6335	207.4319
DIN	MAE	0	0.8327	20.9122	102.6696
	RMSE	0	0.9142	26.2488	130.0705
	RAE	0	0.3608	8.9284	45.8851
	MSE	0	0.8357	689.0008	16918.329
SIL	MAE	0	0.2566	9.4807	36.68
	RMSE	0	0.2769	10.9303	41.1398
	RAE	0	0.3886	14.5752	55.9535
	MSE	0	0.0767	119.4715	1692.4802
TKN	MAE	0	0.3817	6.6474	1.2133
	RMSE	0	0.4154	8.7899	1.5058
	RAE	0	0.8983	15.5595	2.7137
	MSE	0	0.1725	77.2621	2.2676
TKV	MAE	0	0.1477	6.9571	42.1168
	RMSE	0	0.1634	8.3549	46.1916
	RAE	0	0.5553	25.0067	156.3135
	MSE	0	0.0267	69.8045	2133.6646

Table 7. 28 Performance Comparison with Forecasting Output City Monaragla



		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	2.0876	64.0865	59.06181
	RMSE	0	2.25132	85.2775	91.32067
	RAE	0	0.64652	18.7788	32.0602
	MSE	0	7.01023	10161.3	17220.17
COM	MAE	0	1.84999	61.5149	111.0703
	RMSE	0	1.99184	78.2451	135.7297
	RAE	0	0.53215	19.0496	44.15264
	MSE	0	7.47106	9877.83	37473.55
DIN	MAE	0	2.91492	93.4985	133.6606
	RMSE	0	3.13784	126.391	137.5025
	RAE	0	0.60622	20.1031	19090.9
	MSE	0	13.7036	23246.6	56610.2
SIL	MAE	0	1.42351	44.0498	146.5733
	RMSE	0	1.52469	56.2835	163.7115
	RAE	0	0.59694	20.0971	2667
	MSE	0	3.80645	5079.56	64533.57
TKN	MAE	0	0.51426	15.9602	13.44554
	RMSE	0	0.5504	21.149	21.10772
	RAE	0	0.62805	17.3011	20.74608
	MSE	0	0.41308	744.124	1760.085
TKV	MAE	0	0.17001	7.29122	9.29303
	RMSE	0	0.18397	9.22854	11.01509
	RAE	0	0.51179	20.1163	36.31572
	MSE	0	0.06264	160.44	381.4763

Table 7. 29 Performance Comparison with Forecasting Output City Average



## District Wise Performance Evaluation-

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	1.964	60.9326	322.5559
	RMSE	0	2.0718	73.4719	381.6751
	RAE	0	0.3165	10.1525	50.5653
	MSE	0	4.2924	5398.1236	145675.89
COM	MAE	0	1.6433	48.6814	0.0229
	RMSE	0	1.8762	57.3244	0.0283
	RAE	0	0.4769	13.6903	0.0062
	MSE	0	3.5201	3286.0871	0.0008
DIN	MAE	0	2.2718	73.3863	0
	RMSE	0	2.4414	89.2158	0
	RAE	0	0.3732	12.5024	0
	MSE	0	5.9606	7959.4571	0
SIL	MAE	0	0.5601	18.9798	0
	RMSE	0	0.6145	23.877	0
	RAE	0	0.3398	11.3407	0
	MSE	0	0.3776	570.1106	0
TKN	MAE	0	7.3137	197.7756	8.5814
	RMSE	0	7.7771	233.4776	12.4012
	RAE	0	0.2924	8.1327	0.3478
	MSE	0	0.4831	54511.797	153.7909
TKV	MAE	0	2.7825	130.453	0.0001
	RMSE	0	2.9354	157.4248	0.0001
	RAE	0	0.3134	15.5835	0
	MSE	0	8.6163	24782.566	0

Table 7. 30 Performance Comparison with Forecasting Output Ampara District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	2.4258	77.8384	0
	RMSE	0	2.5935	105.4759	0
	RAE	0	0.2974	8.5307	0
	MSE	0	6.7261	11125.165	0
COM	MAE	0	2.011	69.2024	0.0458
	RMSE	0	2.1132	79.2935	0.057
	RAE	0	0.4351	14.7804	0.0098
	MSE	0	4.4657	6287.4539	0.0033
DIN	MAE	0	8.7581	384.7429	0.0034
	RMSE	0	9.6365	486.2765	0.0043
	RAE	0	0.3065	13.7366	0.0001
	MSE	0	9.8627	236464.87	0
SIL	MAE	0	2.7828	70.6892	7.6513
	RMSE	0	2.9224	89.7634	9.661
	RAE	0	0.426	11.0526	1.1726
	MSE	0	8.5402	8057.4722	93.3351
TKN	MAE	0	2.0656	69.5582	164.232
	RMSE	0	2.2409	87.8737	218.6393
	RAE	0	0.345	11.7996	28.9474
	MSE	0	5.0216	7721.7932	47803.164
TKV	MAE	0	0.8772	38.7674	0.0106
	RMSE	0	0.9241	45.9856	0.0133
	RAE	0	0.4355	18.6461	0.005
	MSE	0	0.8539	2114.6734	0.0002

Table 7. 31 Performance Comparison with Forecasting Output Anuradhapura District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	18.8197	655.0767	0.0487
	RMSE	0	20.3881	861.8049	0.0641
	RAE	0	0.358	12.5963	0.001
	MSE	0	415.6744	742707.67	0.0041
COM	MAE	0	12.0655	376.9201	0.0005
	RMSE	0	12.5152	473.4457	0.0007
	RAE	0	0.4863	15.8854	0
	MSE	0	156.6307	224150.82	0
DIN	MAE	0	11.7887	399.643	374.0212
	RMSE	0	12.867	471.8775	492.169
	RAE	0	0.4693	16.0314	15.0673
	MSE	0	165.5584	222668.36	242230.31
SIL	MAE	0	3.9252	101.0928	2.8524
	RMSE	0	4.2247	141.3364	3.4548
	RAE	0	0.5908	15.7242	0.4095
	MSE	0	17.848	19975.989	11.9355
TKN	MAE	0	3.7036	161.8678	0.0126
	RMSE	0	3.9853	196.4655	0.0171
	RAE	0	0.4459	19.5448	0.0016
	MSE	0	15.8826	38598.708	0.0003
TKV	MAE	0	0.6926	25.3296	0.3907
	RMSE	0	0.7402	37.7038	0.554
	RAE	0	0.4898	18.1501	0.2863
	MSE	0	0.5478	1421.5736	0.307

Table 7. 32 Performance Comparison with Forecasting Output Colombo inner District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	38.5737	814.1361	5477.4877
	RMSE	0	41.7789	1002.8572	6675.8157
	RAE	0	0.3811	8.0833	54.8468
	MSE	0	1745.4729	1005722.6	44566516
COM	MAE	0	51.2463	1745.1346	2288.7994
	RMSE	0	53.2625	2156.1724	2713.1373
	RAE	0	0.4918	16.2715	21.5627
	MSE	0	2836.8888	4649079.3	7361114
DIN	MAE	0	27.4121	498.2395	2934.1849
	RMSE	0	28.4903	607.5224	3526.8873
	RAE	0	0.3779	7.2131	41.5006
	MSE	0	811.6949	369083.52	12438934
SIL	MAE	0	51.2343	1406.9829	6565.4622
	RMSE	0	55.3335	1768.9827	7834.6559
	RAE	0	0.6086	17	80.1346
	MSE	0	3061.7914	3129299.7	61381833
TKN	MAE	0	2.8432	91.3683	539.7902
	RMSE	0	3.0119	140.1068	629.293
	RAE	0	0.4057	13.3922	78.9597
	MSE	0	9.0714	19629.907	396009.7
TKV	MAE	0	0.8033	37.9996	0.0274
	RMSE	0	0.8926	49.1361	0.0325
	RAE	0	0.312	14.6321	0.0098
	MSE	0	0.7967	2414.3612	0.0011

Table 7. 33 Performance Comparison with Forecasting Output Colombo Outer District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	3.9448	113.6357	0.7153
	RMSE	0	4.1873	146.8905	0.8923
	RAE	0	0.3067	8.9062	0.0538
	MSE	0	17.5335	21576.819	0.7962
COM	MAE	0	5.409	203.4526	0
	RMSE	0	5.6445	239.0706	0
	RAE	0	0.4596	17.5994	0
	MSE	0	31.8607	57154.759	0
DIN	MAE	0	12.8169	289.56	0.014
	RMSE	0	13.4997	378.5197	0.018
	RAE	0	0.369	8.7183	0.0004
	MSE	0	182.2425	143277.15	0.0003
SIL	MAE	0	9.8924	288.9503	1326.3213
	RMSE	0	10.7405	354.2533	1541.3526
	RAE	0	0.5512	16.3759	75.8105
	MSE	0	115.3593	125495.38	2375768
TKN	MAE	0	1.0071	26.3807	6.2786
	RMSE	0	1.0598	31.6373	7.5915
	RAE	0	0.4257	11.3375	2.6081
	MSE	0	1.1232	1000.9188	57.6312
TKV	MAE	0	0.4081	15.2946	0.0001
	RMSE	0	0.4341	20.6091	0.0001
	RAE	0	0.4708	18.2682	0.0001
	MSE	0	0.1885	424.734	0

Table 7. 34 Performance Comparison with Forecasting Output Galle District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	2.5402	53.5708	288.0427
	RMSE	0	2.7076	68.5653	356.5044
	RAE	0	0.6874	14.6219	79.4967
	MSE	0	7.3311	4701.1941	127095.41
COM	MAE	0	1.3684	49.4779	232.4531
	RMSE	0	1.4534	62.2237	256.399
	RAE	0	0.456	16.9984	76.6804
	MSE	0	2.1125	3871.7884	65740.47
DIN	MAE	0	1.5009	45.8408	30.0695
	RMSE	0	1.6088	56.4465	38.1107
	RAE	0	1.4284	44.0941	27.4162
	MSE	0	2.5882	3186.2037	1452.4285
SIL	MAE	0	0.1681	6.7893	0.0036
	RMSE	0	0.1824	9.0702	0.0043
	RAE	0	0.7596	32.318	0.017
	MSE	0	0.0333	82.2684	0
TKN	MAE	0	4.0716	74.0975	321.378
	RMSE	0	4.4179	91.7814	391.5064
	RAE	0	1.0749	19.0111	83.7938
	MSE	0	9.5174	8423.83	153277.27
TKV	MAE	0	1.0885	28.2356	0.0006
	RMSE	0	1.1221	37.4504	0.0007
	RAE	0	1.0059	26.4298	0.0005
	MSE	0	1.2592	1402.5303	0

Table 7. 35 Performance Comparison with Forecasting Output Jaffna District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	8.5079	193.4748	0
	RMSE	0	9.1805	241.0748	0.0001
	RAE	0	0.3557	8.389	0
	MSE	0	84.2816	58117.079	0
COM	MAE	0	12.7209	363.5621	1595.0922
	RMSE	0	13.3865	442.6317	2079.4577
	RAE	0	0.5391	15.4886	65.4626
	MSE	0	179.1975	195922.8	4324144.2
DIN	MAE	0	15.5958	513.3358	2294.8476
	RMSE	0	16.3749	664.3474	2600.4147
	RAE	0	0.3732	12.4649	54.3238
	MSE	0	268.1362	441357.45	6762156.7
SIL	MAE	0	8.2567	256.1257	0.0001
	RMSE	0	8.7789	336.1384	0.0001
	RAE	0	0.4463	14.2424	0
	MSE	0	77.0699	112989.04	0
TKN	MAE	0	3.4413	124.9269	28.5277
	RMSE	0	3.7591	150.4107	33.7135
	RAE	0	0.2384	8.7784	1.9324
	MSE	0	14.1308	22623.37	1136.6034
TKV	MAE	0	2.8291	99.6819	0.139
	RMSE	0	2.9965	128.4238	0.2082
	RAE	0	0.4275	15.7142	0.0218
	MSE	0	8.9792	16492.673	0.0433

Table 7. 36 Performance Comparison with Forecasting Output Kandy District



		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	2.9129	60.6004	0.0073
	RMSE	0	3.1611	71.6738	0.013
	RAE	0	0.4837	10.5586	0.0012
	MSE	0	9.9928	5137.1304	0.0002
COM	MAE	0	4.5798	128.6801	0.0237
	RMSE	0	4.7734	158.5327	0.0276
	RAE	0	0.6947	20.1536	0.0036
	MSE	0	22.7857	25132.6257	0.0008
DIN	MAE	0	16.1015	320.0628	0.0033
	RMSE	0	16.8252	372.2555	0.0042
	RAE	0	0.6834	13.387	0.0001
	MSE	0	283.0863	138574.194	0
SIL	MAE	0	6.8004	198.4989	932.5066
	RMSE	0	7.4081	253.2962	1004.4066
	RAE	0	0.6313	18.2766	85.6799
	MSE	0	54.8799	64158.9757	1008832.67
TKN	MAE	0	3.7532	101.7449	0.0444
	RMSE	0	4.136	132.9938	0.0535
	RAE	0	0.534	14.6676	0.0061
	MSE	0	17.1068	17687.3607	0.0029
TKV	MAE	0	2.0338	71.1253	0.0006
	RMSE	0	2.1706	96.1081	0.0007
	RAE	0	0.6292	22.0898	0.0002
	MSE	0	4.7113	9236.772	0

Table 7. 37 Performance Comparison with Forecasting Output Kegalle District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	4.842	136.7575	683.24
	RMSE	0	5.444	164.7927	822.9025
	RAE	0	0.4006	11.0003	56.6231
	MSE	0	29.6374	27156.638	677168.58
COM	MAE	0	6.8357	225.8321	10.2076
	RMSE	0	7.293	267.3829	11.9346
	RAE	0	0.5011	16.7389	0.7074
	MSE	0	53.1882	71493.594	142.4355
DIN	MAE	0	21.7624	501.5379	2610.2715
	RMSE	0	24.2754	589.8726	3007.5345
	RAE	0	0.4835	11.4231	55.8591
	MSE	0	589.2966	347949.72	9045263.8
SIL	MAE	0	11.143	306.9604	0.2964
	RMSE	0	11.7349	366.2528	0.363
	RAE	0	0.6575	17.8651	0.0177
	MSE	0	137.7087	134141.12	0.1318
TKN	MAE	0	2.774	101.7644	507.2772
	RMSE	0	3.0289	121.3501	603.8839
	RAE	0	0.3074	11.2958	55.1765
	MSE	0	9.1745	14725.858	364675.72
TKV	MAE	0	2.2987	74.745	0
	RMSE	0	2.3848	100.3534	0
	RAE	0	0.5024	16.9	0
	MSE	0	5.6872	10070.807	0

Table 7. 38 Performance Comparison with Forecasting Output Kurunagala District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	0.6242	13.7516	67.9757
	RMSE	0	0.683	16.5031	76.6712
	RAE	0	0.4215	9.3783	45.984
	MSE	0	0.4665	272.353	5878.4687
COM	MAE	0	0.4074	20.3034	0.0989
	RMSE	0	0.4509	24.6218	0.2028
	RAE	0	0.3279	15.8202	0.0804
	MSE	0	0.2033	606.2308	0.0411
DIN	MAE	0	1.6924	51.5164	0
	RMSE	0	1.8757	62.1823	0
	RAE	0	0.2392	7.6005	0
	MSE	0	3.5184	3866.6392	0
SIL	MAE	0	0.6779	18.7674	0
	RMSE	0	0.7428	24.0504	0
	RAE	0	0.3621	10.4107	0
	MSE	0	0.5517	578.423	0
TKN	MAE	0	0.6346	24.7245	3.7549
	RMSE	0	0.6652	30.4804	4.3867
	RAE	0	0.4869	19.3361	2.8045
	MSE	0	0.4425	929.0539	19.243
TKV	MAE	0	0.2231	7.6516	47.3714
	RMSE	0	0.2411	9.2412	53.9937
	RAE	0	0.5903	20.0663	125.5751
	MSE	0	0.0581	85.3996	2915.3246

Table 7. 39 Performance Comparison with Forecasting Output Monaragal District

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	8.51552	217.977	684.0073
	RMSE	0	9.21958	275.311	831.4538
	RAE	0	0.40086	10.2217	28.75719
	MSE	0	232.141	188191	4552234
COM	MAE	0	9.82873	323.125	412.6744
	RMSE	0	10.2769	396.07	506.1245
	RAE	0	0.48685	16.3427	16.45131
	MSE	0	329.085	523699	1175114
DIN	MAE	0	11.9701	307.787	824.3415
	RMSE	0	12.7895	377.852	966.5143
	RAE	0	0.51036	14.7171	19.41676
	MSE	0	232.194	191439	2849004
SIL	MAE	0	9.54409	267.384	883.5094
	RMSE	0	10.2683	336.702	1039.39
	RAE	0	0.53732	16.4606	24.32418
	MSE	0	347.416	359535	6476654
TKN	MAE	0	3.16079	97.4209	157.9877
	RMSE	0	3.40821	121.658	190.1486
	RAE	0	0.45563	13.7296	25.45779
	MSE	0	8.19539	18585.3	96313.31
TKV	MAE	0	1.40369	52.9284	4.79405
	RMSE	0	1.48415	68.2436	5.48033
	RAE	0	0.51768	18.648	12.58988
	MSE	0	3.16982	6844.61	291.5676

Table 7. 40 Performance Comparison with Forecasting District Average

## Island wide Performance Evaluation-

		Linear	SMOReg	Gaussian	Multilayer
CDN	MAE	0	129.4807	2811.4811	2811.4811
	RMSE	0	141.7618	3567.2613	3567.2613
	RAE	0	0.3728	8.1326	8.1326
	MSE	0	20096.402	12725353	12725353
COM	MAE	0	152.056	4887.4228	4887.4228
	RMSE	0	163.8941	6020.5419	6020.5419
	RAE	0	0.4997	16.3198	16.3198
	MSE	0	26861.261	36246925	36246925
DIN	MAE	0	173.1683	4570.3538	4570.3538
	RMSE	0	196.7004	5689.3357	5689.3357
	RAE	0	0.3833	10.1886	10.1886
	MSE	0	38691.056	32368541	32368541
SIL	MAE	0	174.359	4936.633	4936.633
	RMSE	0	187.8463	6114.5225	6114.5225
	RAE	0	0.5469	15.852	15.852
	MSE	0	35286.235	37387386	37387386
TKN	MAE	0	39.6276	1249.7997	1249.7997
	RMSE	0	44.1335	1607.6154	1607.6154
	RAE	0	0.2682	8.5753	8.5753
	MSE	0	1947.7632	2584427.1	2584427.1
TKV	MAE	0	24.8073	953.9316	953.9316
	RMSE	0	26.201	1285.8863	1285.8863
	RAE	0	0.443	17.3227	17.3227
	MSE	0	686.4928	1653503.7	1653503.7

Table 7. 41 Performance Comparison with Forecasting Output Island Wide

Consider the results in average error values of each Agent Wise (Table 7.18), City Wise (Table 7.29), District Wise (Table 7.40), Island Wide (Table 7.41) newspaper Sales forecast, Linear Regression and SMO Regression methods are best match technique for forecast the Agent Wise and City Wise newspaper forecasting. As well as District Wise and Island Wide sales forecast more suitable method is Linear Regression. However, base on the average error values Linear Regression method can used as a common method for forecasting newspaper sales in agent wise, city wise, district wise and country wide.

Use of this prediction method (Linear Regression) company can may save huge amount of money or reduce wastage in 2015. Following table 7.8 shows the wastage. in this table actual newspaper issue mention as actual and prediction mention as predicted sales values based on previous year's net sales.

fullyera	CDN			COM			DIN			SIL			TKN			TKV		
	Actual	Predict	Variance	Actual	Predict	Variance	Actual	Predict	Variance	Actual	Predict	Variance	Actual	Predict	Variance	Actual	Predict	Variance
2015-1	378231	348444	29787	186645	151207	35438	561525	431398	130127	179350	153941	25409	144410	104628	39782	33732	22944	10788
2015-2	353521	286423	67098	179338	151852	27486	534620	352068	182552	174728	158332	16396	136613	87394	49219	27964	23785	4179
2015-3	353474	310981	42493	211027	217582	-6555	436764	379272	57492	171183	214470	-43287	116203	102992	13211	27223	35259	-8036
2015-4	342011	292853	49158	142511	137488	5023	428027	344360	83667	158377	132064	26313	115720	91226	24494	22935	20012	2923
2015-5	367703	324842	42861	172506	145364	27142	460079	395336	64743	158223	144005	14218	111010	103171	7839	22380	21663	717
2015-6	341090	276630	64460	180339	166343	13996	434003	354474	79529	173066	169360	3706	106832	89134	17698	27777	27699	78
2015-7	378231	332278	45953	186645	169153	17492	561525	406432	155093	179350	173407	5943	144410	100432	43978	33732	25558	8174
2015-8	378231	342510	35721	186645	157489	29156	561525	414367	147158	179350	164270	15080	144410	99797	44613	33732	23459	10273
2015-9	342011	279775	62236	142511	119587	22924	428027	327900	100127	128377	113737	14640	115720	90768	24952	22935	18895	4040
2015-10	353474	321725	31749	181027	226385	-45358	436764	389935	46829	171183	225868	-54685	116203	101898	14305	34223	37046	-2823
2015-11	341090	289442	51648	180339	185160	-4821	434003	360310	73693	173066	167200	5866	106832	90250	16582	29777	28510	1267
2015-12	367703	331349	36354	142506	162756	-20250	460079	410478	49601	178223	159811	18412	111010	106821	4189	29380	25446	3934
	4296770	3737250.4	559520	2092039	1990363.7	101675	5736941	4566330.7	1170610	2024476	1976464.9	48011	1469373	1168511.8	300861	345790	310274.5	35515

Table 7. 42 2015 Newspaper actual issue and Variances in island wide sales



## Patterns Identification-

Use of this forecasting modules company can identified deffrent sales pattens in newspaper sales. Aids of these outputs, mangement of the company can developed their future strategic planing. Sample identified patterns are figure out and describe in following graphs.

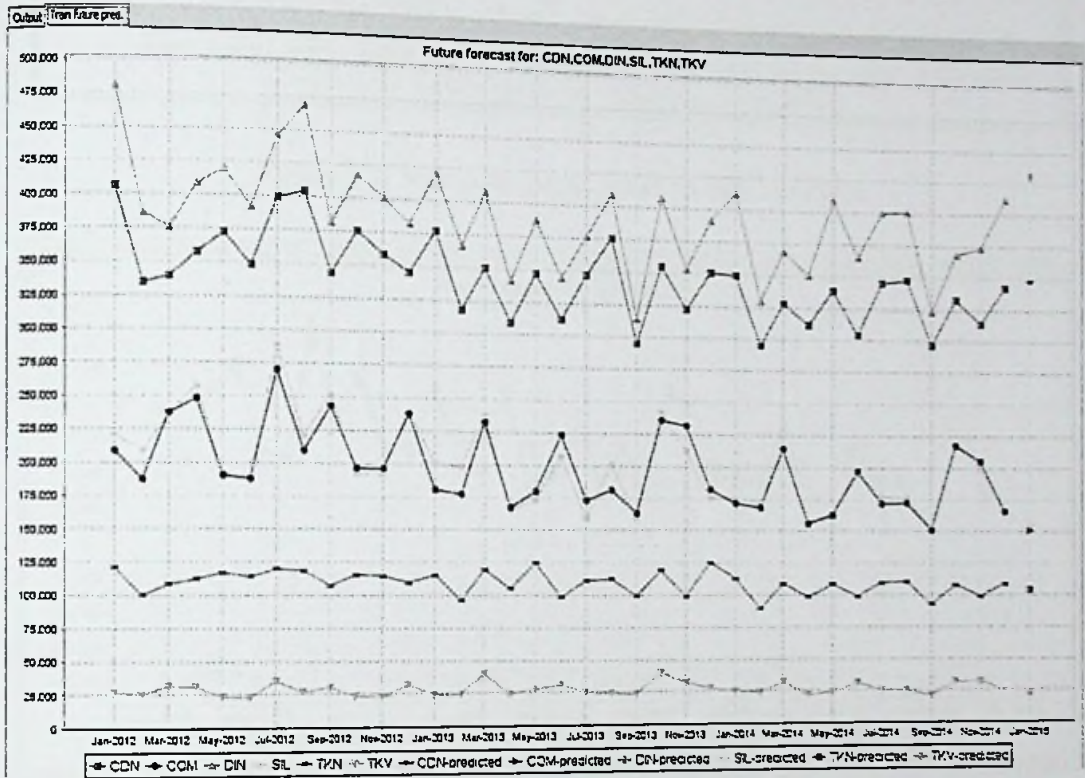


Figure7. 7 Sales Variance in 2012 to 2014

Consider the above graph Company can identify the sales patens.

- According to graph, all newspaper have same pattern. If the sales increase generally all the newspaper sales increase.
- Currently Company newspaper demand declining.



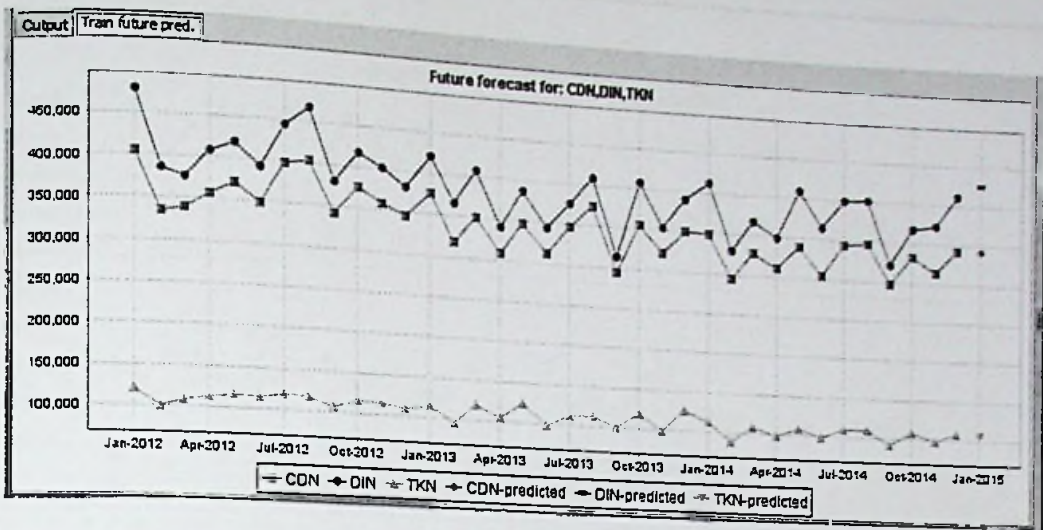


Figure7. 8 Weekday paper Sales in 2012 to 2014

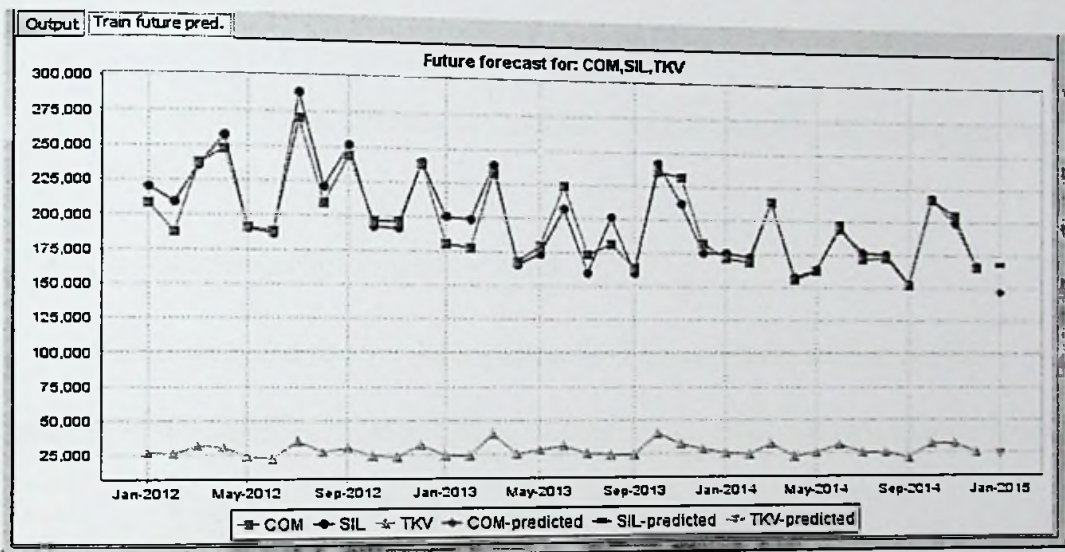


Figure7. 9 Weekend Newspaper Sales in 2012 to 2014

- Consider above two figures normally Sinhala newspapers have more demand than other language.
- Weekend papers Sinhala and English papers have same sales demand.
- Tamil papers have less demand compare to others.

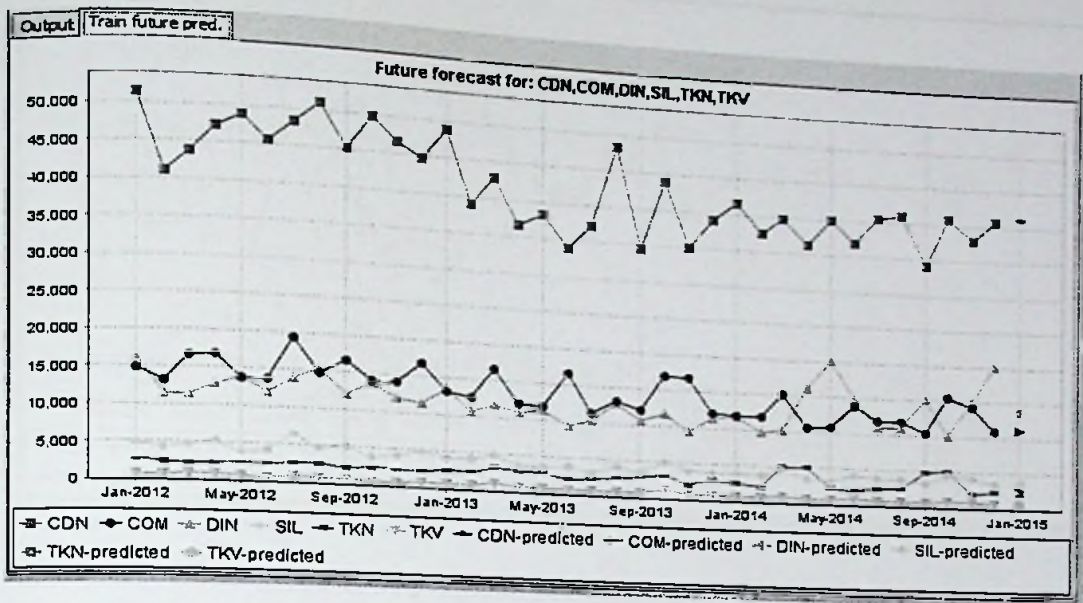


Figure7. 10 Colombo Inner District Sales in 2012 to 2014

- This pattern little difference, Colombo inner district English newspapers have more demand.
- Newspaper decline in slightly occur
- Tamil weekend and weekday papers have same demand in this district.

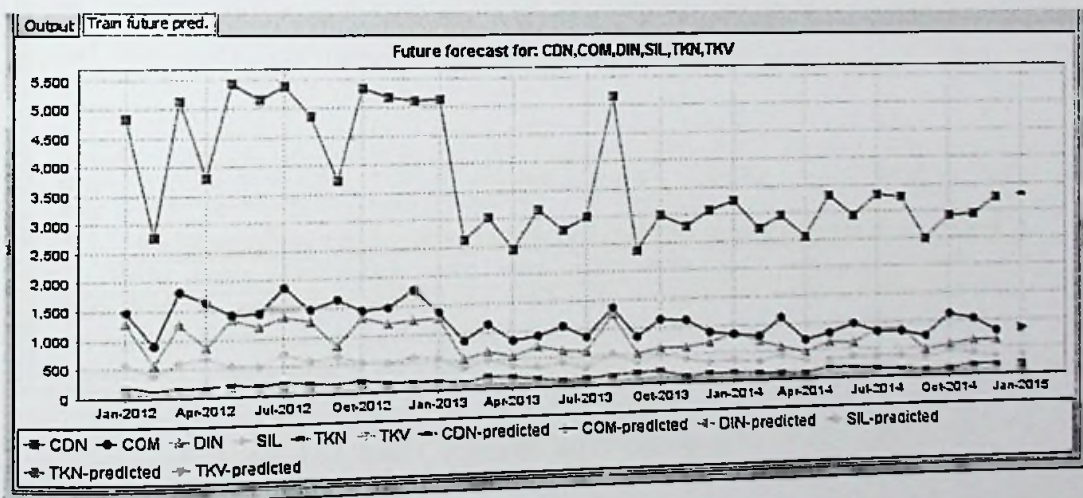


Figure7. 11 Colombo 6 Sales in 2012 to 2014

- In City wise also have same sales pattern. All newspaper sales changes same pattern.
- IN here also English papers have more demand than other papers.

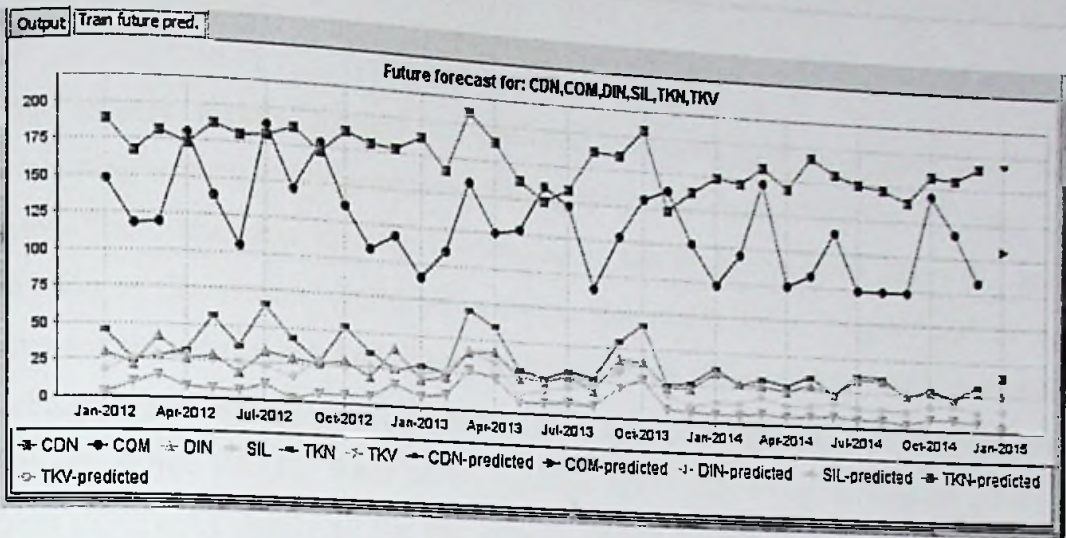


Figure7. 12 Agent 1107 Sales in 2012 to 2016

- This agent has different patterns. Apart of the two English papers other papers have same pattern.
- Sometime Weekend paper sales high rather than weekend papers.

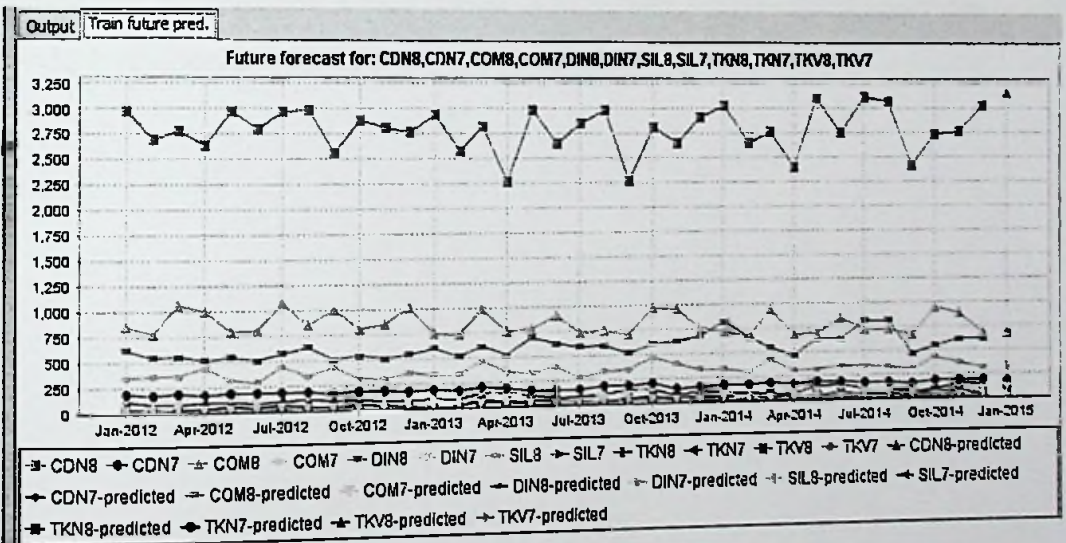


Figure7. 13 Cross Customer Sales changers in 2012 to 2014

- This instants use two customers in same city (Colombo 6 agents- 1107 and 1118). Hear also have pervious mention Patten. (Increase and decrees happened same manner)
- Some instants can identified, if one agent sales decrease in perspective other agent sales will increase. (This will not clearly visually because this research considers monthly details.)

## 7.4 Summary

This chapter mainly focuses to evaluate the developed newspaper sales and forecasting system. Newspaper circulation system evaluates accuracy by using test cases. These test cases develop by developers and these test cases forces to main function of the system. Customer creation, Newspaper issue, Return handling and payment are mainly checked. Then evaluate forecasting system by using evaluation techniques that already build in Weka, such as Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE). As finally all the test cases successfully executed. As well comparing the forecasting and actual data, results of testing algorithm this research identified Linear Regression predict the more accurate data related to the newspaper sales forecasting. However Linear Regression and SMO Regression predict the more accurate results related to the newspaper sales forecasting in agent wise and city wise. Finally this system also identified the some sales patterns that helpful to decision making for the company. Chapter eight discuss about achievement about this project as well limitation and future work of this research area.

# Conclusion and Future Work

### 8.1 Introduction

Previous chapter contain the evaluation details about the newspaper circulation and sales forecasting system. This Chapter contains the overall achievement of this research, limitation and future woks of the project.

### 8.2 Achievement

Newspaper is a one of the key news providing source in the Sri Lankan society. Due to technology development today most of electronic mass media is popular but still newspaper played significant role in Sri Lankan as well as in global society. Newspaper is perishable item that valued only one day. Therefore, newspaper publishing companies need to print accurate quantity of copies of newspapers and deliver the sales point on-time, maintain the minimum returns without oversupply or shortage supply to the market. By this newspaper publishers can enjoy high profitability and reduce unnecessary publishing cost. Therefore, companies need smooth circulation process and accurate newspaper forecasting solution. Considering matter this reach project mainly focused to develop feasible solution for newspaper circulation and sales forecasting in Sri Lankan Newspaper Industry. To introduce this solution this research project selected The Associated Newspapers of Ceylon Limited, one of the key newspaper publishers in Sri Lanka. Address the research problem this research introduced web based solution for newspaper circulation. Newspaper circulation has three main processes such as newspaper issuing, return collection and payment collection. Propose solution have two modules such as circulation module and forecasting module. In Circulation module have three sub modules. Such as newspaper issue handling module, newspaper returns handling module and payment handling module. Three modules integrated together and it's generated several reports that need to Circulation Departments such as issue details reports, paper dispatch reports and customer outstanding report etc; this web base solution developed by using PHP server side scripting language and MySQL RDBMS used for Database

handling and WAMP server used for web server. Most of these technologies open source freely available tools. Forecasting module is other main module in this solution. Newspaper sales forecasting in day by day consider as time dependable matter. Therefore, this research plans to use time series analysis to forecast the data. This reach used data set that contains net sales value of particular paper in particular month under particular customer. This research used past three years sales data to forecast.

Data Preprocessing is a most importance and it remove garbage values in the dataset. Weka (Waikato Environment for Knowledge Analysis) is data mining software developed at University of Waikato, New Zealand by using Java. This software containing collocation of machine learning algorithms that using data mining such as data pre- processing, classification, regression clustering, association rules and visualization. From Weka version 3.7.3(=> 3.7.3) this data mining software facilitated to developed, evaluated and visualized the time series analysis based forecasting models. Weka 3.7.13 data mining tool that include time series forecasting package that allowed to perform time series related forecasting mechanism, by using Gaussian, Linear Regression, Multilayer Preceptron Regression and SMO Regression and predict the newspaper sales forecasting. Then use of testing and evaluation algorithms that available in Weka, (Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE)) researcher identify more accurate forecasting technique is Linear Regression that use for newspaper sales forecasting. However, Linear Regression and SMO Regression can used for sales forecast in customer wise or city wise. Used of selected technique this system forecast various outputs that needed by publishing company. Most of research conducts only for forecasting but this research considers both forecasting and circulation of the newspapers. Use of this solution publishing companies can transfer forecasting data to the circulation system.

The main objective of this research is to find out feasible solution for handle Newspaper Circulation process and develop Newspaper Sales Forecasting solution for Sri Lankan Newspaper Industry. To achieve this main objective, this research has following sub objectives. Such as,

- Identify current process of newspaper circulation.
- Identify the issues of current circulation process. Circulation process includes newspaper sales, Newspaper return handling and the payment collections.
- Introduces feasible solution for handle newspaper circulation.
- Identify individual customer's sales, returns, payments and outstanding details.
- Introduces accurate sales forecasting solution and identifying the sales patterns in Sri Lankan newspaper industry,
- Reduced unnecessary cost for newspaper returns and wastage of newspaper printing.

Achieved the first two objectives this research used interviews and observation techniques for gather information. Then identify the process of the circulation process and current issues of the process. Address this issues researcher then design system. Circulation process has three sub processes such as newspaper issue, newspaper returns and payment handling.

Then address the issues researcher developed the web base solution. PHP use as quarry lunge, MYSql for data base. This system has three main module for handling issues, retunes and payments. In addition maintain customer master file. After developing the system, researcher tests the system by using test cases. Finally evaluate system run smoothly handle newspaper sales, returns, payments and outstanding details.

This research achieved final two objectives by using sales forecasting module. After developing the data set in monthly basis sales details this research used the Weka data mining software and predict result by using several forecasting techniques such as Gaussian, Linear Regression, Multilayer Preceptron Regression and SMO Regression. Consider the prediction results and actual as well as output of the evaluation algorithms that build in Weka (Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Relative Absolute Error (RAE)) this research identified the most suitable algorithms for newspaper sales forecasting. Therefore, researcher identified Linear Regression is most suitable techniques for newspaper sales forecasting. However, forecast the city and customer wise newspaper sales both Linear Regression and SMO Regression method can be used.

Use of this accurate techniques company can reduce the unnecessary cost regarding to newspaper printing and distribution, it helps to company gain profit.

Finally this research identified some patterns for newspaper sales that help for decision making for company management. That include paper wise demand changers, customer wise changers, district wise as well as nation wise changers can be identified. Use of these patterns company management can make effective decisions for newspaper sales, promotions, cost management etc;

### **8.3 Limitations and Future work**

This research mainly focuses to forecast the accurate sales prediction. Therefore, this research tries to predict day by day sales forecast. However, currently Company gathers returns in monthly basis, therefore, identify returns in date is difficult. Based on that this, research cannot predict the sales in particular date. This was the main limitation.

Increase the accuracy of this forecasting method future researchers may use data related to the day as well as may used large data set. As well as researchers may find out more sales patterns that helps to decision making to the company management.

### **8.4 Summary**

This chapter considers the overall achievement of the project as well this chapter describes limitation and future work related to this project.



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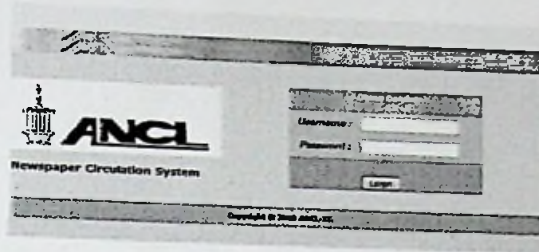
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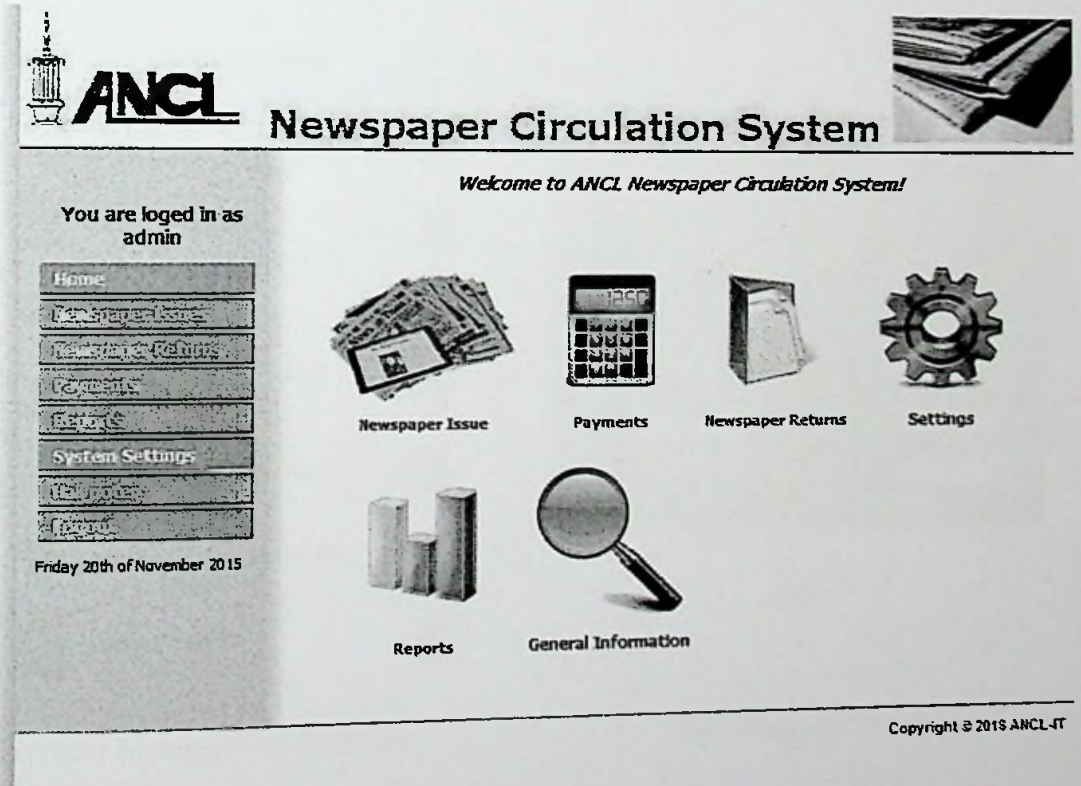
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System Login Interface



Home Page

### Newspaper Issue Management



Issue Newspapers



Edit Issue Newspapers



Delete Issue Newspapers



Issue Details



Label Print and Despatch Report



RE-Issue Newspapers (Weekly)



### Issue Management Interface

Newspaper Issue			
Customer ID	<input type="text"/>	Issue Date	<input type="text"/>
School Name	<input type="text"/>	Issue Month	<input type="text"/>
		Newspaper Name	<input type="text"/>
Number of Copies Issue	<input type="text" value="50"/>	Number of Free Copy Issue	<input type="text" value="30"/>
<input type="button" value="Cancel"/>		<input type="button" value="Save"/>	

Back

### Newspaper Issue Interface

### Newspaper Payments



Payments



Edit Paper Payments



Unidentified Payments



Payment Details



Payment Details (Paper Wise)



Payment Details (Customer Wise)



Payment Reports









### Payment Management Interface

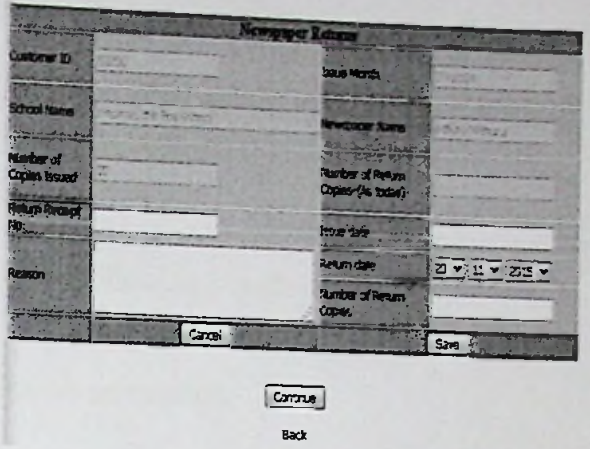
Newspaper Payments			
Customer ID	<input type="text"/>	Issue Month	<input type="text"/>
School Name	<input type="text"/>	Payment Mode	<input type="text" value="Cash"/>
Issue Value	<input type="text"/>	Payment (in Rupee)	<input type="text"/>
Return Value	<input type="text"/>		<input type="text"/>
Receipt No	<input type="text"/>	Location	<input type="text" value="Head Office"/>
Payment date	<input type="text" value="20/11/2015"/>	Signature	<input type="text"/>
<input type="button" value="Cancel"/>		<input type="button" value="Save"/>	

Back

### Add Payment Details

### Newspaper Returns

-  Return Newspapers
-  Edit Return Newspapers
-  Delete Returns
-  Unidentified Returns
-  Return Details
-  Customerwise Return Report



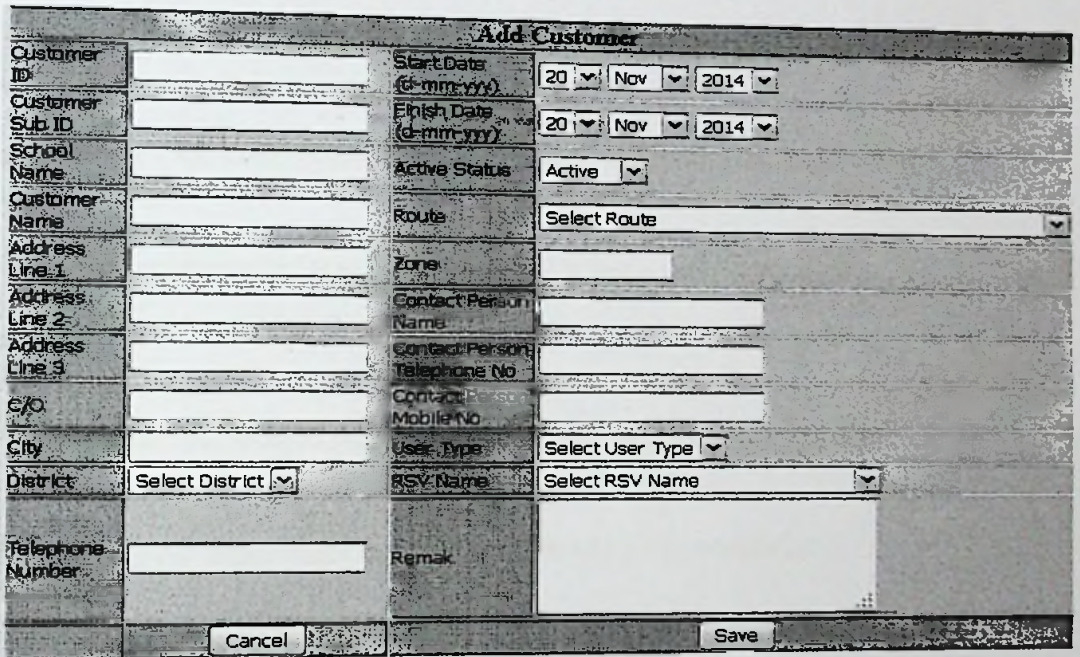
The screenshot shows a 'Newspaper Returns' form with the following fields:

- Customer ID
- School Name
- Member of Copies Issued
- Return Receipt No.
- Reason
- Issue Month
- Newspaper Name
- Number of Return Copies (As Issued)
- Issue Date
- Return Date (dropdown: 20, 11, 2015)
- Number of Return Copies

Buttons: Cancel, Save, Continue, Back

Return Management Interface

Add Return Details



The screenshot shows an 'Add Customer' form with the following fields:

- Customer ID
- Customer Sub ID
- School Name
- Customer Name
- Address Line 1
- Address Line 2
- Address Line 3
- G/O
- City
- District (dropdown: Select District)
- Telephone Number
- Start Date (d-m-yy): 20 Nov 2014
- Finish Date (d-m-yy): 20 Nov 2014
- Active Status (dropdown: Active)
- Route (dropdown: Select Route)
- Zone
- Contact Person Name
- Contact Person Telephone No.
- Contact Person Mobile No.
- User Type (dropdown: Select User Type)
- RSV Name (dropdown: Select RSV Name)
- Remark

Buttons: Cancel, Save

Customer Details Input Interface

## Interview questionnaire

This interview guide prepare for the achieve following objectives

- Identify current process of newspaper circulation.
  - Identify the issues of current circulation process. Circulation process includes newspaper sales, Newspaper return handling and the payment collections.
- 1) What are the major functions exists in Circulation Department?
  - 2) What are the main processes being present in above-mentioned functions?
  - 3) What are the issues that you are facing in this existing process?
    - a) How you solved those issues?
  - 4) What are the benefits that you're gained by the existing processes?
  - 5) Is that your department users familiar to basic IT operations?

