Descriptive Analytics and Naïve Bayes Algorithm on Mobile Implementation for Sales and Inventory Marketing

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Abstract

The Descriptive Analytics and Naïve Bayes Algorithm on Mobile Implementation of Sales and Inventory Marketing is tool that solved the burden of J9ntel Computer Marketing personnel in handling their daily transactions. Updated sales and inventory of products in all branches that can be viewed on desktop computers and mobile phone. An evaluation instrument derived from ISO 9126 was utilized in testing the system and obtained the mean rating of 4.10 with an adjectival rating of Very Good. The testing result indicates that the system passed the software quality evaluation and possesses the quality of a good software. It has been demonstrated that the system can manage product sales and inventory, including the identification of the most-to-least selling products as part of the implementation of business analytics and forecasting. However, the system needs more features that will support decision making.

Keywords: **Descriptive Analytics, Forecasting, Mobile Implementation, Sales and Inventory, Naïve Bayes**

1. Introduction

Prediction is a statement about what will happen in the future as defined by (Cambridge, n.d.) dictionary. In the field of business and marketing this prediction has placed an important role for the success of the business establishment. In sales and inventory, forecasting is a big help to keep the business sales on its peak. With the aid of the newest available technology in the market forecasting was made easily. Forecasting was made simple with the help of the most recent available technology on the market. Many things come to its instant through the aid of these technology advancements and innovations. Nonetheless, it is a continuing process of improvement as human intelligence keeps on moving forward to sustain its wants and needs.

Massive urbanization in any part of the world has brought a perpendicular growth to demands of products and services. To sustain these demands as stated in the study of Mohan that suitable technology policies might mobilize urbanization (Mohan, 1988). Business firms whose primary purpose is not only to gain more profit but to satisfy customers' needs must provide competitive Point of Sale and Sale and Inventory System as well.

Inventory management in a supply chain is a challenging problem (Plinere, 2015). Finding quantity of inventories to fulfill customers need and to avoid overstocking is the major purpose of inventory management. Sustaining enough level of inventory might result in a better financial performance (Shin, Ennis, & Spurlin, 2015). Since the overstocking may result in increases in cost while understocking may result in loss of sales. The inventory management should not also take much capital to invest despite from its necessity since the return of investment might be longer.

Sales and inventory system is a very important tool to make file updated and easy to locate because it is accurate and orderly organize (Abacahin & etal, 2012) . Report for various personnel in the warehouse become easy since data were available electronically and very accessible anytime needed. In such manner, the better productivity of the employee that the company had benefited.

Despite the advancement of technology and inventory management system had mentioned above, J9ntel Computer Marketing is still using manual process in doing all their sales transactions and product inventory. The company is using paper and pencil in providing customers receipt and using spreadsheets for their stocks inventory. Monitoring of stocks available and stocks on a critical level is not readily available with just one click of the fingertip in computer keyboards. This issue had repercussion more complicated problem such as overstocking that affects product cost and under stocking that resulted in a loss of company sales.

It cannot be denied that there are lot of existing automated sales and inventory management on the market nowadays. It becomes very common to most establishments who are engaged in sales and marketing. However, creating such with additional features like analytics and business intelligence might be a very helpful. Analytics and its related fields have grown tremendously and now there are wide varieties of industry participants that use analytics. They range from industries that provide data infrastructure, data warehousing solutions, middleware, data aggregation, and analytics software developers to analytics user organizations and academics. There are three types of analytics: descriptive, predictive, reporting, and prescriptive. In this system descriptive analytics were used to the collected data from the database to provide trends of sales and product inventory. This type of analytics focused on the business intelligence and has been significant technology around visualization.

Implementation of Analytics and Naïve Bayes Algorithm on Mobile Sales and Inventory System aims to provide a competitive inventory of stocks and management of sales transaction. It also includes timely reports needed for documentation and future references to orders and daily sales target. Monitoring of the most to least selling products was also included in the system by integrating Naïve Bayes algorithm in forecasting and other business analytics.

2. Related Literature

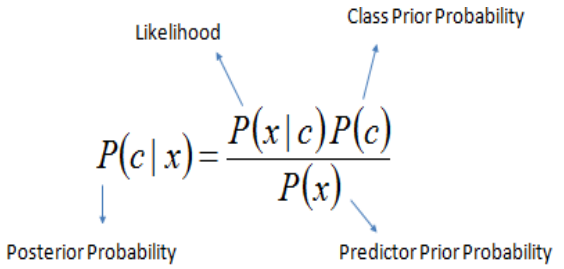
The rapid growth of population has emerged huge demands for products and services. These rising demands have enabled technology a necessity for human life. Papers and pencils which is usually used to document daily transaction such as sales, inventory and reports were converted into an electronic file. Long queuing to service counter on grocery stores is no longer a problem since Point of Sale were developed that is more efficient than manually writing receipt using pencil and papers. The electronic copy of inventory that can be easily retrieved has replaced the previous pencil and logbooks.

In manufacturing firm inventory is the second largest assets (Raphella, Gomathi, & Chitra, 2014), ABC analysis of inventory is a method to categorize the valuable items into three categories: A- item with highest consumption value, B- items with medium consumption value, and C- items with the least consumption value. Maintaining sufficient stocks resulted to smooth sales operations and efficient customer service. In such manner, the system for J9ntel Marketing can monitor the top to the least selling products so that overstocking and under-stocking be avoided.

Olap.com defined Business Intelligence (BI) as technologies, applications, and practices to collect, integrate, analyze, and presents business information to the prescribed client. Supporting to create a better decision making is the main objective of Business Intelligence. Basically, the term Business Intelligence systems are data-driven Decision Support Systems (DSS). It is sometimes interchangeably used with consulting books, report, and querying tools. For most of the executive information systems, it contains historical, current, and forecast views of the future business operations and enhancement. In such manner, the developed system can forecast sales and even graphically displays the most to the least selling products.

The accurateness of sales forecasting can be enhanced by predictive analytics as mentioned in an article Predictive Monthly: Sales Forecasting—How Algorithms Are Putting an End To Guessing (Leroux, 2015). This predictive analytics is a tool used by salespersons to identify

on how and when to approach customers based on an algorithm that controls variable that influences customer's decision to buy. Forecasting in many aspects especially the economy is a risky and sometimes humbling task (Litterman, 1986). Using the current and previous data to generate possible future events is one problem in forecasting. However, there are a lot of statistical procedures developed and had successfully forecasted a variety of context. The Naive Bayesian classifier is based on Bayes' theorem with independence assumptions between predictors. The absence of iterative parameter estimation that makes it suitable for a huge dataset and the model is easy to build. The sophisticated classification methods used and its surprising performance in forecasting made it widely used by the industries. Bayesian theorem provides a way of calculating the posterior probability, *P(c|x), from P(c), P(x), and P(x|c)*. (Litterman, 1986); (Sayad, 2017) Naïve Bayesian theorem assumes that the values of each predictor are independent of each other.



$$P(c \mid \mathrm{X}) = P(x_1 \mid c) \times P(x_2 \mid c) \times \cdots \times P(x_n \mid c) \times P(c)$$

Figure 1: Conditional Independence

where:

- P(c|x) is the posterior probability of class (target) given predictor (attribute).
- P(c) is the prior probability of class.
- P(x|c) is the likelihood which is the probability of predictor given class.
- P(x) is the prior probability of predictor.

Figure 1 shows the formula used in Naïve Bayes algorithm in forecasting. The posterior probability can be calculated by first, constructing a frequency table for each attribute against the target. Then, transforming the frequency tables to likelihood tables and finally use the Naive Bayesian equation to calculate the posterior probability for each class. The class with the highest posterior probability is the outcome of prediction.

Evaluation is an essential procedure done prior to the implementation of any developed software. With this regard, the researcher makes use of an evaluation instrument adapted from ISO 9126 that composed of six quality characteristics. Functionality which is defined as the essential purpose of the study. Reliability characteristic defines the capability of the system to maintain its service provision under defined conditions for defined periods of time. Usability refers to the ease of use for a given function. Efficiency is focused on the resource being used when providing the required functionality. Maintainability is the ability of the system to identify and fix a fault within a software component. Portability refers to how well the software can adapt to changes in its environment or with its requirements. The evaluation instrument used five-point Likert Scale in which the highest rating is 5 and 1 is the lowest (Vagias, 2006). The total of 100 respondents evaluated the system using 14 indicators and rated numerically using a scoring system in Table 1. The respondents were chosen using purposive random sampling (Kemper, Stringfield, & Teddlie, 2003). This is a combination of two methods purposive and random sampling. Purposive sampling is a method choosing respondents based on the characteristics of a population and the objective of the study (Palys, 2008); (Crossman, 2017). Random sampling is a technique of choosing a sample in which the respondents of an accessible population have an equal opportunity to be chosen (Teddlie & Yu, 2007).

Numerical Rating	Descriptive Rating
5	Excellent
4	Very Good
3	Good
2	Fair
1	Poor

Table 1: Five Point Likert Scale

The Central Limit Theorem (CLT) was one of the bases in getting the sample size. According to Investopedia Central Limit Theorem is a statistical theory that states for given a sufficiently large sample size from a population with a finite level of variance, the mean of all samples from the same population will be approximately equal to the mean of the population. Most sources state that for most application N=30 is sufficient as sample size [6]. The minimum sample size is 100 to obtain a meaningful result and the maximum of 10% of the total population for as long as it will not exceed to 1000 [10].

The result of the software evaluation from the respondents was counted and the mean was computed using the formula:

Mean = $\Sigma wx/\Sigma w$

where:

Σ is the sum of,

w is the weights, and

x is the value[11].

The result of the computation was interpreted based on the distribution as shown in Table 2. This matrix will be used to identify the score and the corresponding adjectival rating.

Weighted Mean	Adjectival Rating
4.21 - 5.00	Excellent
3.41 - 4.20	Very Good
2.61 - 3.40	Good
1.81 - 2.60	Fair
1.00 - 1.80	Poor

Table 2: Mean Interpretation Table

3. Methodology

Peter DeGrace originated the Sashimi model as a modified version of waterfall model (Matkovic & Tumbas, 2010). It consists of six overlapping phases: requirements, design and architecture, developing and coding, quality assurance and software testing, implementation, and maintenance and support as shown Figure 2. An overlapping phase allows on-time identification of errors while development is still in progress. In addition, the model treats the documentation as a unified document that results to a significant reduction in documentation volume.

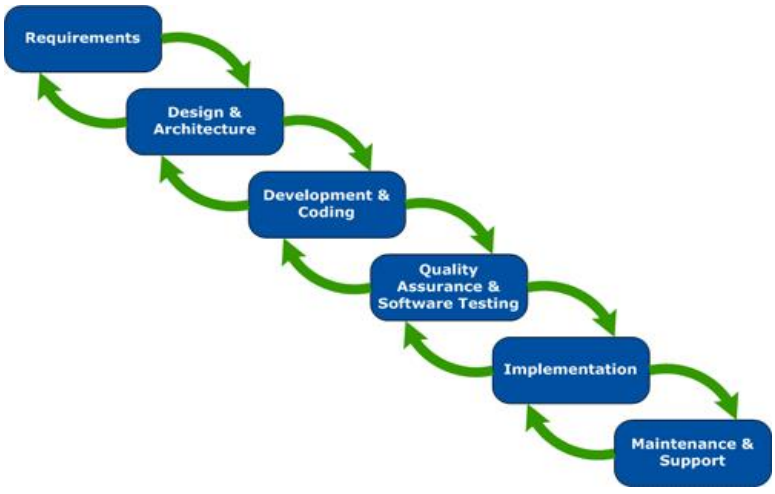


Figure 2: Sashimi Waterfall (DeGrace, 2010)

This model was used and served as a guide for the researcher to set deadlines of deliverables and outputs. Timelines for every phase was also studied and scheduled so that breach of contract to the client must be avoided.

Requirements. The researcher gathered data through interview of the branch head and employees of J9ntel Computer Marketing to know how they do their daily manual transactions.

Design & Architecture. The feature of the system was created on this phase. Different modules were designed to satisfy the requirements of the client as shown in figure 4.

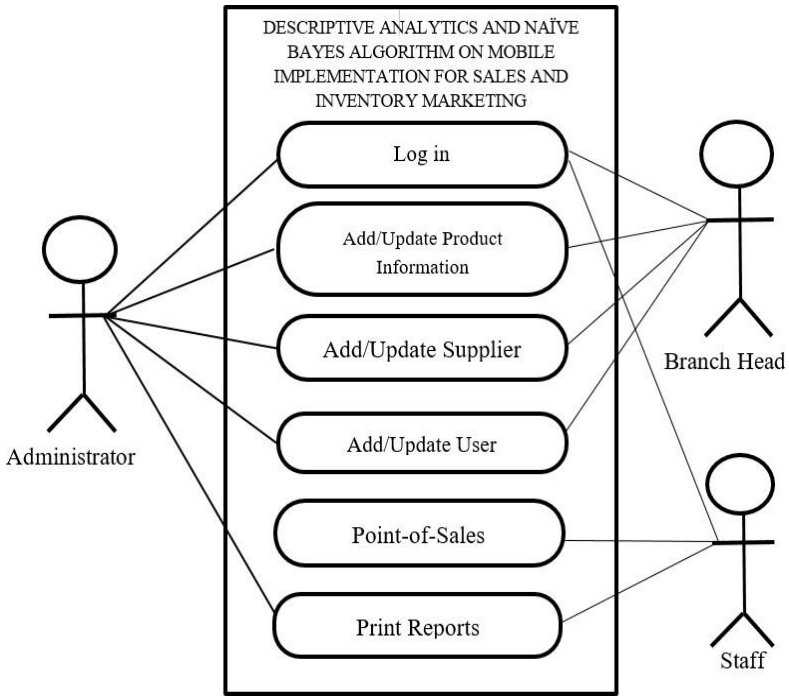


Figure 3: Use Case Diagram of the System

Figure 3 shows the different types of users that will interact with the systems together with its major functions. The stickman indicates the user and a box which indicates boundaries between user and the system. The major functions of every user can be identified by a straight line connecting to the user which is symbolized by a stickman.

Development and Coding. The designed served as a basis for the project development. Every unit of code was tested and debugged immediately to comply the requirements of the system.

Quality Assurance and Software Testing. Before implementation of every developed software, a series of testing should be administered. This is to ensure that the software complies all the requirements and follows the standard of a good quality software.

Unit testing is done to verify the internal logic of code if it satisfies the known functions of the website.

System testing the second state of a testing process where the user was allowed to navigate the software and test the system functionality, reliability, usability, efficiency, maintainability, and portability.

Acceptance the third and last stage of a testing process where the client was allowed to navigate the system and test if it satisfies the specified requirements as approved in the memorandum of agreement.

Implementation. In this phase, the software was deployed to the client and a user's manual was also provided for the users to further understand the program work through.

Maintenance and Support. After the software is deployed to the client, the development team have agreed that a six-month maintenance will be provided pertaining to problems encounter but not limited to the scope stated in the memorandum of agreement.

The study made use of PHP as the main language for development, MySQL for the database, JavaScript as a scripting language, and different plugin available on the internet for design and most functions.

The Descriptive Analytics and Nave Bayes Algorithm for Mobile Implementation of Sales and Inventory Marketing is a four-module system that includes User Account Modules, Sales and Inventory, Setting Modules, and Report Modules.

The user account modules are a module where the administrator can add or edit user accounts. Viewing of orders, generating order slip, viewing of the volume of orders graphically, and forecasting of delivery volume can be found in the order and delivery module. The third module, setting modules is where the administrator can add news and events, add products, and edit prices, product descriptions, add and edit supplier information, add, and edit branch, and content management of the website. Lastly, the report modules consist of sales report and inventory reports on a daily, weekly monthly, and annually.

4. Results and Discussion

The system is composed of four different modules and can be viewed using desktop and mobile phones. It consists of three different landing pages. The home page that allows three different types of users to log in: administrator, branch head and staff (Fig. 4). The administrator can view inventory, sales, suppliers of products in all branches and can add branches, branch head has almost the same access level of the administrator except it only view only records from the assigned branch. The distinct function of a branch head is adding new products, category, and brand name. Sending request for products to the administrator also done by branch head only (Fig. 5 and Fig. 6).

Figure 4 is the home page. This is where the user can log in by supplying the valid username and password. It prompts error message if the user did not provide the username and password correctly however if it is correct the system itself can identify the type of user.

Figure 5 shows the home page for branch head. The dashboard shows the total monthly sales of every product and the most selling products of the branch in a graphical form. As an application of business intelligence, the system can identify products in critical stock and out of stock and it can be shown in the product tab.

Figure 4: Home Page

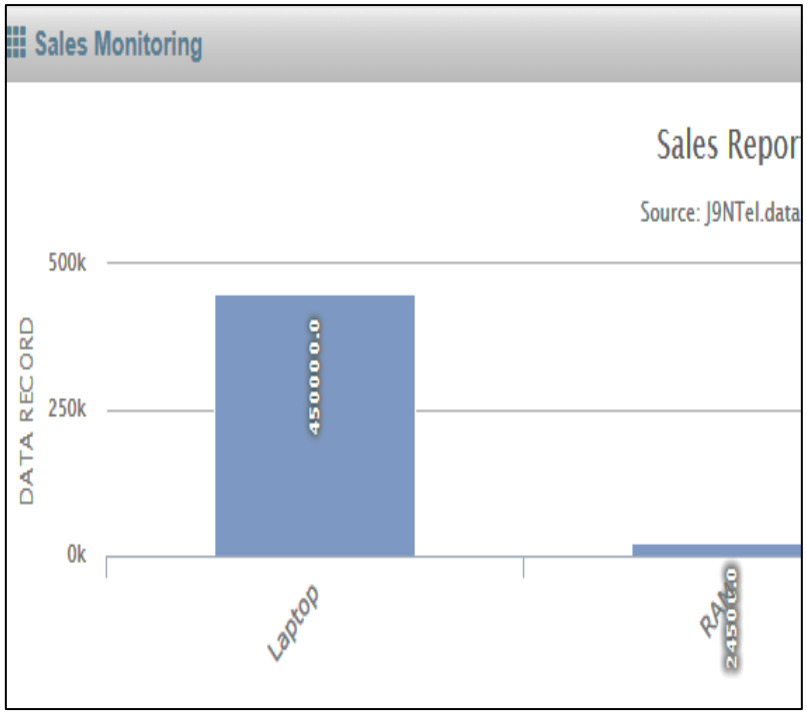


Figure 5: Home Page for Branch Head

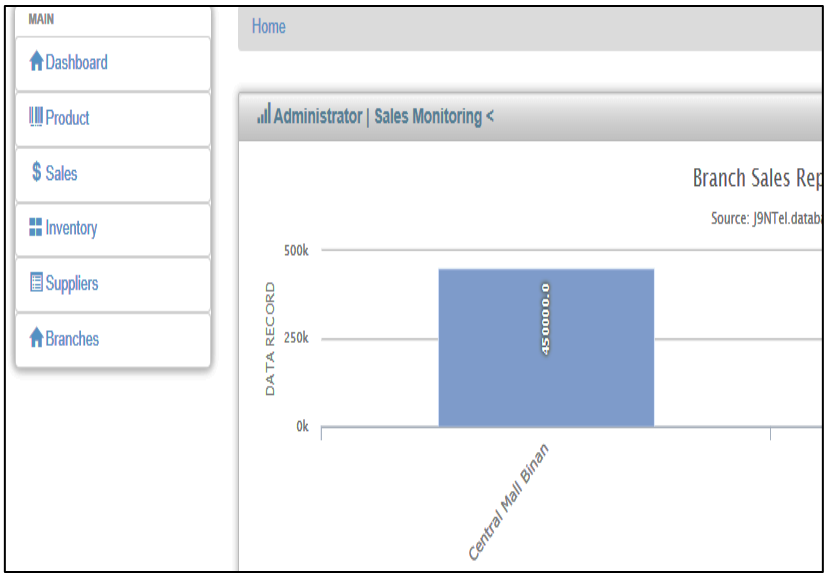


Figure 6: Home Page for Administrator

Figure 6 shows the home page of the administrator. The total sales for every branch and the top selling products for all branches were also shown.

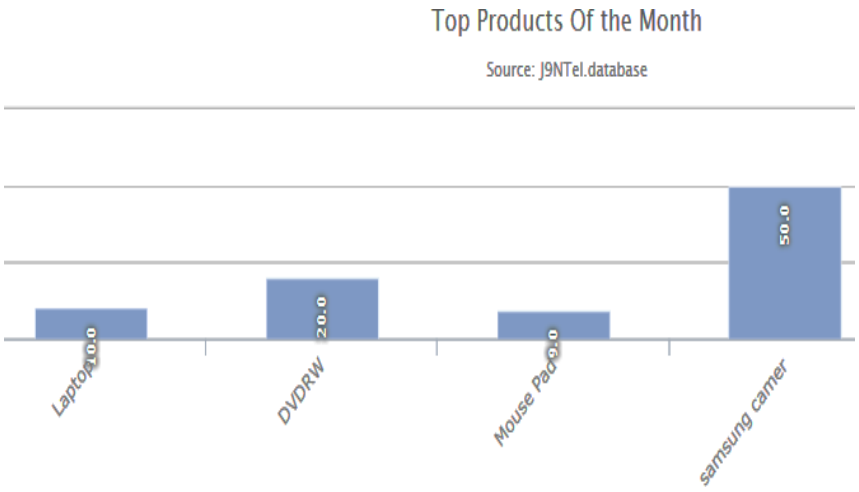


Figure 7: Most to Least Selling Products

Figure 7 is the application of business intelligence, and it can be found both the administrator and the branch head dashboard. Most to least selling products are graphically displayed for the management to easily find out some measures to improve sales on least selling products and somewhat be the basis for the number of orders to the supplier. Monitoring historical data of a product to predict future sales is very essential to a business (Rotenberg & K, n.d.). Such monitoring can help managers set a more realistic expectations on what to order and which product should be given enough stock every sales cycle.

Figure 8: Forecast of Sales of Products

Figure 8 shows the forecast of a product to be sold the following month. Since sales forecasting is very essential to a company especially when it comes to sales and marketing business (Rotenberg & K, n.d.). It can help visualize the targets more realistic. In addition, this will allow managers foresee how relative is the sales to the goals and may somehow set common goals among the members of the team. The basis is the previous month record. The percentage of the chances to be ordered are also indicated. This figure is an application of the Bayesian algorithm in forecasting.

In order determine if the system complied both the requirements of the client and the requirement of a good quality website a project evaluation was conducted. Using the questionnaire derived from ISO 9126 a total of 40 respondents which consist of thirty different customers and ten employees of J9ntel Computer Marketing. They were advised to navigate the system functionalities to determine if it satisfies their needs. The overall results as shown in table 3.

Criteria	Mean	Adjectival Rating
Functionality	4.28	Excellent
Reliability	3.96	Very Good
Usability	3.95	Very Good
Efficiency	4.05	Very Good
Maintainability	4.12	Very Good
Portability	4.26	Excellent
Mean	**4.10**	**Very Good**

Table 3: Overall results of the evaluation

Functionality criterion highest among all criteria which indicate that the system is working and have complied all the required functionalities of a good quality software. However, usability criterion got the lowest among all criteria which still indicates that the system is user-friendly and easy to navigate.

5. Conclusions

In the view of the summary of findings, and incognizant with the general objective of the developed system the following conclusions were derived: the system was able to monitor inventory, manage sales transactions, identify the most to least selling products, generate printable reports and official receipt, forecast monthly sales in a graphical form, and successfully passed the evaluation using the instrument adopted from ISO 9126 to be Very Good with the mean 4.10.

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