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Sales Prediction Based on Sales Data Analysis Using the Moving Average Algorithm (Case in hawada refill drinking water)

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Abstract

Hawada refill drinking water depot is a line of business providing hygienic refill drinking water, which is packaged in gallon packaging which in its transaction activities still uses the SMS feature. The problem faced by the Hawada refill drinking water depot is that there is no distributed application that can assist transaction management activities, so that data input and transaction data are still manually calculated for report generation. Previous sales data has not been processed into useful information. The solution to this problem is to predict sales of refill drinking water based on sales data analysis using a moving average algorithm. By designing applications that can manage consumer transaction activities, so that data input and sales data calculations can be done automatically for report generation. As well as analyzing previous sales data, so as to get useful information to predict sales for the next period. The method is to create a mobile application to monitor online transaction activities using Hybrid Programming Technology based on the Ionic Framework, with analysis of previous sales data which will be processed by the Moving Average Algorithm to predict sales data for the next period. The designed application can process transaction activities and process previous sales data using a moving average algorithm, producing accurate predictive data in the form of sales graph reports.

Keyword: *drinking water depot, sales prediction, moving average algorithm, sales graph.*

1. Introduction

Hawada refill drinking water depot is a provider of hygienic refill drinking water, which is packaged in gallons. In managing transaction activities at the Hawada refill drinking water depot, they still use the SMS feature, which is not well used in managing transaction activities. In this case, to increase sales productivity, a system that can manage transaction processes is needed, which can be directly connected to report generation, including order transactions to manage report generation. So the author provides a solution to create an online ordering application using Hybrid Programming Technology based on the Ionic Framework, with analysis of previous sales data which will be processed by the Moving Average Algorithm to predict sales data for the next period. So it can be identified that the problem is, there is no distributed application that can assist transaction management activities, and previous sales data has not been processed into useful information for business activities. Based on these problems, the solution to the problem is to create applications that can manage consumer transaction activities, so that data input and sales data calculations can be done automatically for report generation. As well as analyzing previous sales data as a reference for applying the moving average algorithm to the prediction system, so as to get useful information to predict sales for the next period. The method used is the V-Model method. This method is a development of the Waterfall method, the difference is that the Waterfall method is carried out linearly, while the V-Model method is carried out in a branching manner into 2 outlines and in the form of a "V". The V-Model is also known as the Verification and Validation model. The

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Verification (Design) stage refers to the adjustment of the software specifications to consumer needs, while the Validation (Testing) stage refers to the suitability of the software with the specified specifications. The V-Model method detailed in Figure 1 [1].

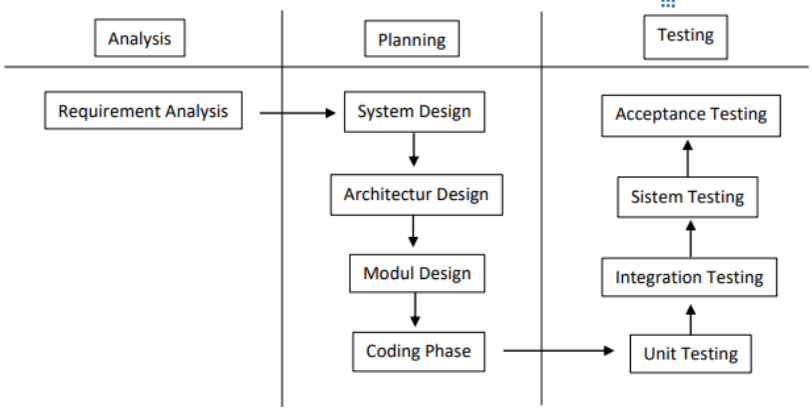

Figure 1. V-model method diagram

The detailed description of the stages of the V-Model method, following the flow of the stages of the method compiled by the author in Figure 1.1 is as follows.

Table 1. Sales results for the month period

Step	Description
Requirement analysis	Collect the required data related to research materials using literature studies and interviews
System design	Details the hardware and communication set-up used
Architecture design	Design system architecture
Module design	Adding and setting module relations
Coding phase	Implement moving average scripts and algorithms
Unit testing	Module testing
Integration testing	check The Connectivity and compatibility
System testing	Checking system performance and compliance with requirements
Acceptance testing	Implementing the system in the user environment

The purpose of achieving the expected results from this research is that the application can support business progress including transaction activities, providing convenience for consumers, employees, and business owners in transactions, making data from the previous period more processed into useful information for the next period.

2. Research Methodology

2.1. Sales

Selling is the science and art of influencing a seller to persuade someone to buy the goods or services he offers [2].

2.2. Sales Forecast

Forecasting is a calculation of the situation that occurs and by using previous data, to determine something that will happen in the future [3]. Sales forecasting is a real estimate of sales that occur in the future period according to the marketing plan and the external environmental conditions that have been taken into account [2].

Sales forecasting is a business function in the line of business that predicts product sales, so that these products can be made in the right amount for a certain need. [4].

2.3. Drinking Water Depot

Drinking water depot is an industrial business that processes raw water into drinking water and sells it directly to consumers. The water treatment process at the drinking water depot is principally filtration and disinfection. The filtration process is intended not only to separate suspended contaminants but also to separate colloidal mixtures including microorganisms from the water, while disinfection is intended to kill microorganisms that were not filtered in the previous process [5].

2.4. Android

Android is *platform open source* operating on cellular phones or mobile phones based on *linux* [6].

2.5. Algoritma Moving Average

Moving average algorithm is an algorithm used to estimate the next data based on existing data. The parameters for using this algorithm are:

1) Determine the number of subsequent periods that need to be calculated.
2) Determine the amount of data in each calculation.
3) Determine the smoothing factor as the weight of the decrease in the period, with a value between 0 to 1. This algorithm has several methods, namely:

a. *Step of Simple Moving Average*:
   1) The result of the first period sales prediction is the data itself.
   2) Add up all the data as much as the previous data, in each data row.
   3) Calculate with the formula "average /=sumData"

b. *Step of Cummulative Moving Average*:
   1) The result of the first period sales prediction is the data itself.
   2) Add up all the data as much as the previous data, in each data row.
   3) Calculate with the formula "average /=sumData"

c. Step of *Weighted Moving Average :*
   1) The result of the first period sales prediction is the data itself.
   2) Determine the weight value of each period The weight value will always be sequential from the lowest weight to the highest weight. The difference between the weight values is the same and the sum of the weight values must be 1.
   3) Add up the multiplication value of the data and the weight of the period on all data as much as the number of previous data, in each data row.

d. Step of *Exponential Moving Average*:
   1) The result of the first period sales prediction is the data itself.
   2) Calculate the sales using
      "St = alpha * Y1 + (1 – alpha) * St-1" [7].

3. Results and Discussion

The results obtained by processing the previous sales data which are processed using moving average algorithm methods to produce a graph report predicting data for the next period are in Table 2.

Table 2. Sales results for the month period

Period	Total Sales
Jan	2370
Feb	2105
Mar	2699
Apr	2592
May	2771
June	2600
Jul	2879
Agt	2913
Sep	2769

Period	Total Sales
Oct	1181

3.1. Simple Moving Average

Look for the predicted value for the periods of June, July, and August, using the Simple Moving Average method from the data for the March, April, and May periods. According to the predefined parameters. Using the formula:

June period prediction:

$$= \frac{\text{total Index Data (Mar, Apr, May)}}{\text{Amaount of data}}$$

$$= \frac{2699 + 2592 + 2771}{3}$$

$$= \frac{8062}{3}$$

Jun's Prediction Results $= \mathbf{2687}$

Jul period prediction:

$$= \frac{\text{total index data (Apr, May, June)}}{\text{Amount Data}}$$

$$= \frac{2592 + 2771 + 2687}{3}$$

$$= \frac{8050}{3}$$

Jul Prediction Result $= \mathbf{2683}$

Augst Period Prediction :

$$= \frac{\text{total Index Data (Mei, June, Jul)}}{\text{Amount of data}}$$

$$= \frac{2771 + 2687 + 2683}{3}$$

$$= \frac{8141}{3}$$

August Period Prediction $= \mathbf{2714}$

Table 3. Simple moving average prediction results

Data			Prediction		
Mar	**Apr**	**May**	**June**	**Jul**	**August**
2699	2592	2771	2687	2683	2714

3.2. Cumulative Moving Average

Look for the predicted value for the period June, July, and August, using the Cumulative Moving Average method from data for the January, February, March, April, and May periods. According to the predefined parameters. Using the formula:

June Period Prediction:

$$= \frac{\text{total Index Data (Jan, Feb, Mar, Apr, May)}}{\text{Amount of data}}$$

$$= \frac{2370 + 2105 + 2699 + 2592 + 2771}{5}$$

$$= \frac{12537}{5}$$

June Period Prediciton $= \mathbf{2507}$

Jul Period Prediction:

$$= \frac{\text{total Index Data (Jan, Feb, Mar, Apr, May, June)}}{\text{Amount Of Data}}$$
$$= \frac{2370 + 2105 + 2699 + 2592 + 2771 + 2507}{6}$$
$$= \frac{15044}{6}$$

Jul Period Prediction $= \mathbf{2507}$

Agust periode Prediction:

$$= \frac{\text{total Index Data (Jan, Feb, Mar, Apr, May, June, Jul)}}{\text{Amount of data}}$$
$$= \frac{2370 + 2105 + 2699 + 2592 + 2771 + 2507 + 2507}{7}$$
$$= \frac{17552}{7}$$

August Period Prediction $= \mathbf{2507}$

Table 4. cumulative moving average Prediction Result

Data					Prediction		
Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**Jul**	**August**
2370	2105	2699	2592	2771	2507	2507	2507

3.3. Weighted Moving Average

Look for the predicted value for the periods of June, July, and August, using the Weighted Moving Average method from the data for the March, April, and May periods. In accordance with the parameters and processes of using predetermined arithmetic weights. Using the formula:

June periode Prediction:

$$= \frac{\text{Total Index Data (Mar} \times \text{total sales, Apr} \times \text{Total sales, Mei} \times \text{Total sales)}}{\text{total Sales}}$$
$$= \frac{(2699 \times \frac{1}{3}) + (2592 \times \frac{2}{3}) + (2771 \times \frac{3}{3})}{\frac{1}{3} \times \frac{2}{3} \times \frac{3}{3}}$$
$$= \frac{900 + 1728 + 2771}{2}$$
$$= \frac{5399}{2}$$

June Prediction result $= \mathbf{2699}$

Jul Periode Prediction :

$$= \frac{\text{Total Index Data (Apr} \times \text{total sales, May} \times \text{total sales, June} \times \text{total sales)}}{\text{total sales}}$$
$$= \frac{(2592 \times \frac{1}{3}) + (2771 \times \frac{2}{3}) + (2699 \times \frac{3}{3})}{\frac{1}{3} \times \frac{2}{3} \times \frac{3}{3}}$$
$$= \frac{864 + 1847 + 2699}{2}$$
$$= \frac{5410}{2}$$

Jul Prediction Result $= \mathbf{2705}$

August Prediction result:

$$= \frac{\text{total Index Data (Mei} \times \text{tolat sales, Jun} \times \text{total sales, Jul} \times \text{total sales)}}{\text{total sales}}$$

$$= \frac{(2771 \times \frac{1}{3}) + (2699 \times \frac{2}{3}) + (2705 \times \frac{3}{3})}{\frac{1}{3} \times \frac{2}{3} \times \frac{3}{3}}$$

$$= \frac{924 + 1800 + 2705}{2}$$

$$= \frac{5429}{2}$$

August Prediction result = **2714**

Table 5. weighted moving average Prediction result

Data			Prediction		
Mar	Apr	Mei	Jun	Jul	Agt
2699	2592	2771	2699	2705	2714

3.4. Exponential Moving Average

Look for the predicted value for the period June, July, and August, using the Exponential Moving Average method from the data for the January, February, March, April, and May periods. In accordance with predetermined parameters, and the smoothing factor (alpha) used is 0.8.

Using the formula: Alpha×data+(1-Alpha)×previous data)

The data obtained after using the smoothing factor

Table 5. The result of applying the formula to the data

Jan	Feb	Mar	Apr	May
2370	2105	2699	2592	2771

June Prediction Periode:

$= (\text{Alpha} \times (\text{Mei Alpha})) + ((1 - \text{Alpha}) \times (\text{Mei Alpha}))$

$= (0{,}8 \times 2735) + ((1 - 0{,}8) \times 2735)$

June Prediction result = **2735**

Juli Prediction periode:

$= (\text{Alpha} \times (\text{Jun Alpha})) + ((1 - \text{Alpha}) \times (\text{Jun Alpha}))$

$= (0{,}8 \times 2735) + ((1 - 0{,}8) \times 2735)$

Jul Prediction result = **2735**

August Prediction result:

$= (\text{Alpha} \times (\text{Jul Alpha})) + ((1 - \text{Alpha}) \times (\text{Jul Alpha}))$

$= (0{,}8 \times 2735) + ((1 - 0{,}8) \times 2735)$

Augst prediction result = **2735**

Table 6. exponential moving average Prediction result

Data					Prediction		
Jan	Feb	Mar	Apr	May	June	Jul	Agt
2370	2105	2699	2592	2771	2735	2735	2735

4. Conclusion

The conclusions obtained by the author in writing this final project are as follows. The Hawada refill drinking water depot mobile application is designed using the ionic framework so that owners can monitor transaction activities, by viewing transactions made by consumers and employees. The mobile application can analyze previous sales data as a reference for the moving average algorithm to calculate predictions for the next period. The activities are carried out by analyzing transaction data and grouping them in periods per month, then the data obtained is processed by the moving average algorithm by entering it into several moving average algorithm methods, namely Simple Moving Average, Cumulative Moving Average, Weighted Moving Average, and Exponential Moving Average. The mobile application then displays the predicted sales data for the period in a line chart report.

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