

Cat Product Inventory Control to Support Supply Chain Management with the Monte Carlo Method

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Abstract

Japura Gedung Store is a store that provides quality building tools and materials. The recording of transactions at the Japura Gedung Store is only in the form of a purchase receipt. Notes from each purchase should be reprocessed to be used as information, one of which is by utilizing technology which can later be used to predict the purchase of paint products to control paint product supplies. In data processing using the Monte Carlo method with the application of *Supply Chain Management*. The application system built is designing a website that can provide convenience in identifying order levels with the PHP and MySQL programming languages. The data used is the historical sales of paint products from January 2022 to May 2022. From the calculation results of the Monte Carlo Method, it is obtained that the application of *Supply Chain Management* (SCM) and web-based Monte Carlo Simulation makes it easier for stores to manage data in a computerized manner, able to align demand and existing inventory by predicting the number of purchases in the future using Monte Carlo simulation and assisting the owner in completing the inventory at the store according to the predicted results.

Keywords : *Supply Chain Management* , Monte Carlo, Inventory, Computerization, Prediction.

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1. Introduction

Japura Gedung Store is a store that provides quality building tools and materials. Its address is at JL. Lintas Timur, Japura, Rengat, Indragiri Hulu Regency, Riau. The Japura building shop is trusted by the local community in finding building materials and tools, one of which is paint products. The recording of transactions at the Japura Gedung Store is only in the form of a purchase receipt. When it's finished, the notes will just pile up without being processed to be reused. Notes from each purchase should be reprocessed to be used as information, one of which is by utilizing technology which can later be used to predict the purchase of paint products to control paint product supplies.

Inventory is important in supporting the company's operational activities. Without inventory, the company's operational activities will be hampered, this will result in not achieving the target the company wants [1]. Inventories are goods that can usually be found in closed warehouses, fields, open warehouses, or other storage places, either in the form of raw materials, semi-finished goods, finished goods, goods for operational purposes, or goods for industrial purposes. a project [2]. Inventory needs must also be controlled so that there is no shortage or excess of inventory. Inventory control is important in advancing the company. Inventory control is expected to increase profits and minimize costs that can be incurred. Inventory control is an important factor in a company that functions to maintain smooth production.

Inventory control is the most important activity in the survival of the company [3].

In controlling paint products, there is a method called Monte Carlo that can predict the next sale of the product. Based on the results of tests carried out by Bias et al at the UD Building Store. Masdi found that the system used to predict paint product sales revenue with an average accuracy of 89%. With a fairly high level of accuracy, the application of the Monte Carlo method is considered to be able to predict income and demand for each paint product every year. [4]

In research conducted by Riska at IAIN Batu Sangkar, the results of the Monte Carlo Simulation carried out in this study showed an accuracy rate of 96.92% and were able to predict the demand for ATK [5]. In a study conducted by Raja et al., Monte Carlo simulation functions to evaluate a deterministic model repeatedly using a set of random numbers as input [6].

Simulations that predict the level of future sales can be calculated using a mathematical equation. Simulation can predict the behavior of a system that is made using the observed data that has been done [7]. Monte Carlo simulation is a computational algorithm for simulating the behavior of various physical and mathematical systems. This method is commonly performed using a computer and using computational techniques [8].

Monte Carlo simulation is currently widely applied in solving probabilistic problems. The construction of the Monte Carlo simulation model is based on probabilities obtained from historical data. The Monte

Carlo method can also be said as the initial design of a system and can also be used to analyze and solve problems in mathematical form with a number of statistical random examples. A random number is a number whose appearance cannot be predicted [9].

The data set on the Monte Carlo method is randomly generated. The Monte Carlo method is a method that uses a collection of random numbers as input which will continue to be evaluated repeatedly [10]. The stages of the Monte Carlo method consist of 5, namely determining the probability distribution, calculating the cumulative probability distribution, setting random number intervals for each variable, generating random numbers, and making simulations of a series of experiments.

Supply Chain Management is a unified production process and activity starting from raw materials obtained from suppliers, the process of adding value that converts raw materials into finished goods, the process of storing inventory of goods to the process of sending finished goods to retailers and consumers [11]. Supply chain management is a modification of traditional practices of logistics management that are adversarial (patterns that emphasize individual parties rather than referring to overall performance) towards coordination and partnership between the parties involved [11] .

Eko et al said that the role of information technology can provide various advantages and conveniences in running a business, one of which is the application of supply chain management. *Supply Chain Management* (SCM) is a system that can coordinate the process of moving materials, information and finances within a company. One of the factors that require costs in marketing products is logistics management which consists of product design, material procurement, production, inventory control and storage of goods. This coordination occurs not only within the company, but also for all activities outside the company. The goal is for the management of raw material inventory needs to be more effective and efficient [13].

With SCM, of course, it can help launch business activities. SCM of course can be implemented into a web form that can be developed using existing programming languages. Visual Studio Code is software that can develop a web with code editors. The developed web can predict the purchase of paint products to control the supply of paint products, so that each demand can be aligned with the existing supply of goods.

2. Research methodology

The research framework is the order in a study. Where the purpose of this framework is to make a design so as not to cross the boundaries of the subject matter and to make it easier to understand the contents of the

research. The sequence of these steps is made into a framework that will facilitate the completion of this research. The research framework that the authors conducted in the research will be described in Figure 1.

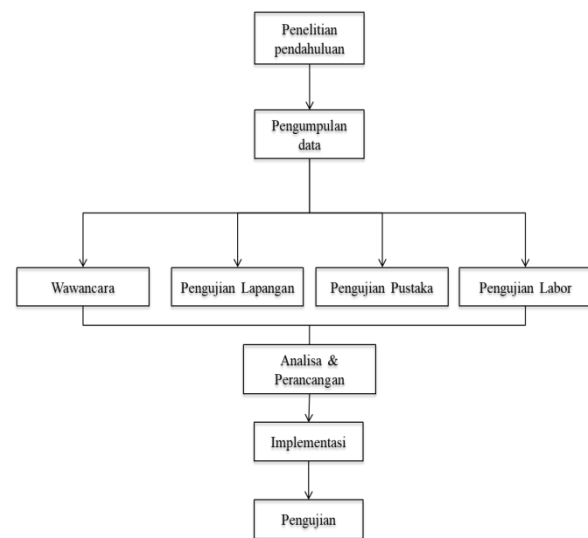


Figure 1. Research Framework

The research stage is a sequence of processes or steps that will be carried out in completing this research. The stages of this research are as follows:

1. Field Research

Field research is research that aims to obtain primary data, by going directly to the research object of the Literature Study

2. Research Library (Library Research)

Library research is research conducted to obtain secondary data by reading or studying books, literature, journals, and other reading sources related to the research being conducted

3. Analysis

This data analysis stage collects data at the Japura Gedung store, this information is extracted through the results of direct interviews with the owner of the Japura Gedung store. After collecting data, it is analyzed to obtain the steps that will be used during the design, so that it is in accordance with the desired research objectives.

4. System planning

When conducting a system analysis, we will analyze whether the system design is suitable to be designed at the Japura Gedung store, so that the system designed is in accordance with the needs.

3. Results and Discussion

3.1 Monte Carlo Simulation

The following is a presentation of the calculation results according to the method used.

1. Calculating Probability Distributions

The probability distribution calculation is obtained from the first number sold divided by the total sold, and so on

$$\text{Probabilitas} = \frac{\text{Penjualan/Minggu}}{\text{Total Penjualan}}$$

The following table presents the probability distribution calculation based on the data presented in the sales history table.

Table 1. Preliminary Data Table

Sunday	Sales/Week	Probability
1st week	3	3/70 = 0.04
2nd week	2	2/70 = 0.03
3rd week	2	7/70 = 0.03
4th week	3	3/70 = 0.04
5th week	3	3/70 = 0.04
6th week	3	3/70 = 0.04
7th week	2	2/70 = 0.03
8th week	2	2/70 = 0.03
9th week	5	5/70 = 0.07
10th week	2	2/70 = 0.03
11th week	3	3/70 = 0.04
12th week	1	1/70 = 0.01
13th week	12	12/70 = 0.17
14th week	9	9/70 = 0.13
15th week	7	7/70 = 0.10
16th week	2	2/70 = 0.03
17th week	0	0/70 = 0.00
18th week	2	2/70 = 0.03
19th week	4	4/70 = 0.06
20th week	3	3/70 = 0.04
Total	70	

2. Calculating the Cumulative Distribution

The following is the calculation of the cumulative distribution. The cumulative distribution for week 1 is the same as the probability distribution for week 1. As for the cumulative distribution for week 2, it is obtained by adding the cumulative distribution values for week 1 with the probability distribution for week 2, and so on.

Table 2. Cumulative Distribution Table

Sunday	Sales/Week	Probability
1st week	3	3/70 = 0.04
2nd week	2	2/70 = 0.03
3rd week	2	7/70 = 0.03
4th week	3	3/70 = 0.04
5th week	3	3/70 = 0.04
6th week	3	3/70 = 0.04
7th week	2	2/70 = 0.03

8th week	2	2/70 = 0.03
9th week	5	5/70 = 0.07
10th week	2	2/70 = 0.03
11th week	3	3/70 = 0.04
12th week	1	1/70 = 0.01
13th week	12	12/70 = 0.17
14th week	9	9/70 = 0.13
15th week	7	7/70 = 0.10
16th week	2	2/70 = 0.03
17th week	0	0/70 = 0.00
18th week	2	2/70 = 0.03
19th week	4	4/70 = 0.06
20th week	3	3/70 = 0.04
Total	70	

3. Define Random Number Intervals

The following table presents the determination of random number intervals.

Table 3 . Interval Determination Table

Sale/ Sunday	Probability	Cumulative	intervals
3	0.04	0.04	0-4
2	0.03	0.07	5-7
2	0.03	0.10	8-10
3	0.04	0.14	11-14
3	0.04	0.18	15-18
3	0.04	0.22	19-23
2	0.03	0.25	24-26
2	0.03	0.28	27-29
5	0.07	0.35	30-34
2	0.03	0.38	35-37
3	0.04	0.42	38-42
1	0.01	0.43	43
12	0.17	0.61	44-61
9	0.13	0.74	62-74
7	0.10	0.84	75-84
2	0.03	0.87	85-87
0	0.00	0.87	87
2	0.03	0.90	88-90
4	0.06	0.96	91-96
3	0.04	1.00	96-100
70			

4. Calculating and Generating Random Numbers

After calculating the random number interval, the next step is to generate random numbers (random numbers). Determination of random numbers using the formula excel = randbetween(bottom;top) where bottom is the lowest number in the interval and top is the highest number in the interval.

Table 4 . Random Number Block Table

87	94	85	87
92	80	82	13
8	84	91	68
23	15	74	37

5. Prediction Results

Simulate a series of experiments by choosing pre-generated random numbers. Because in this manual calculation the author uses daily historical data, so each random number represents sales per day. The same thing applies if the data used is monthly historical data, so each random number represents monthly sales. The following is the sales forecast for the next few weeks

Table 5. Table of Test Prediction Results 1

Sunday	Random Numbers	predictions
21st week	94	4
22nd week	80	7
23rd week	84	7
24th week	15	3
Total		21

Table 6. Table of Test Prediction Results 2

Sunday	Random Numbers	predictions
21st week	85	2
22nd week	82	7
23rd week	91	4
24th week	74	9
Total		22

Table 7. Table of Test Prediction Results 3

Sunday	Random Numbers	predictions
21st week	87	0
22nd week	13	3
23rd week	68	9
24th week	37	2
Total		14

3.2 Testing System Interfaces

Interface testing is testing the Monte Carlo application design that will be implemented into a web application. Testing for color compatibility, the main display and everything that will be designed into the web application later.

1) Admin login view

Figure 2. Login

Figure 2 displays the *admin login page*. The *admin login* page is an initial display of process performance,

before the admin manages the Toko Japura Bangunan system

2) Goods Data Display

Figure 3. Goods Data

Figure 3 displays the item data page. The item data page displays the products available at the Japura Gedung Store. Admin can delete and edit data as needed. Admin can also add item data.

3) Display of User Data

The display of user data contains actors who can enter the system at the Japura Gedung Store. Admin can add data, edit data and delete data.

Figure 4. User Data

Figure 4 displays the user data page. The user data page contains information on who can access the web. Admin can edit or delete previously stored user data. Admins can also add new users on the add new data menu.

4) Sales Data Display

No	Kode Penjualan	Tanggal Penjualan	Nama Pelanggan	Total Harga	Aksi
1	INV-260722124336	03 Januari 2022	-	138400	Hapus Detail
2	INV-260722124551	06 Januari 2022	-	167200	Hapus Detail
3	INV-260722124623	09 Januari 2022	-	86900	Hapus Detail
4	INV-260722124724	14 Januari 2022	-	83500	Hapus Detail
5	INV-260722124806	19 Januari 2022	-	91300	Hapus Detail

Figure 5. Sales Data

Figure 5 displays the sales data page. The sales data page contains sales transactions at the Japura Gedung Store. *admin* can add data, view details and delete data.

5) Purchase Data Display

No	Kode Pembelian	Tanggal Pembelian	Nama Supplier	Total Harga (Rp)	Aksi
1	INV-260722133117	05 Mei 2022	PT. Berkah	3.150.000	Hapus
2	INV-260722133043	09 Mei 2022	PT. Citra Abadi	5.000.000	Hapus
3	INV-260722132958	16 Desember 2021	PT. Berkah	3.750.000	Hapus

Figure 6 . Purchasing data

Figure 6 displays the purchase data page. The purchase data page contains the purchase transaction for the Japura Gedung Store to the *admin* supplier can add data and delete data.

6) Sales Prediction Display

No	Tanggal Hitung	Nama Barang	Tanggal Awal Perhitungan	Tanggal Akhir Perhitungan	Aksi
1	27 July 2022 23:19:50	AVIAN	03 Januari 2022	17 April 2022	Hapus Detail

Figure 7. Sales Predictions

Figure 7 Display of sales prediction data containing historical sales calculations at the Japura Gedung Store using a monte carlo simulation . The results of this calculation will display sales predictions for the next 4 weeks. *admin* can add data, view details and delete data.

7) Display Detailed Sales predictions

No	Minggu	Total Penjualan	Probabilitas	Kumulatif	Interval
1	Minggu Ke-1	2	2/56 = 0.04	0.035714285714286	0 - 3
2	Minggu Ke-2	2	2/56 = 0.04	0.071428571428571	4 - 7
3	Minggu Ke-3	2	2/56 = 0.04	0.107142857142857	8 - 10
4	Minggu Ke-4	2	2/56 = 0.04	0.142857142857143	11 - 14
5	Minggu Ke-5	3	3/56 = 0.05	0.196428571428571	15 - 19
6	Minggu Ke-6	3	3/56 = 0.05	0.25	20 - 25
7	Minggu Ke-7	2	2/56 = 0.04	0.285714285714286	26 - 28
8	Minggu Ke-8	3	3/56 = 0.05	0.339285714285714	29 - 33
9	Minggu Ke-9	3	3/56 = 0.05	0.392857142857143	34 - 39

Figure 8. Sales Predictions Details

Minggu Ke	Bilangan Acak	Hasil Predial
4	79	1
5	5	3

Figure 9. Sales Prediction Details

Figures 21 and 22 display the sales forecast detail page. This page displays the predicted results from calculations that have been done before.

4. Conclusion

Based on the descriptions and explanations that have been done, it is hoped that this research can be useful for readers. From the research results that have been concluded, the application of Web-based Supply Chain Management (SCM) and Monte Carlo Simulation makes it easier for stores to manage computerized data, so that owners can shorten the time in adding inventory for future sales transactions . SCM is able to align existing demand and supply by predicting the number of future purchases using Monte Carlo simulations and SCM by predicting the number of future sales using Monte Carlo simulations assists owners in completing inventory at the store according to the predicted results.

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