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SIMULATION OF MONTE CARLO TO PREDICT WRITING PRODUCTION CAPACITY IN PT. SINAR DUNIA

Riki Ridwan Margana[1]

[1]Industrial Engineering Department, Widyatama University, Indonesia

[1]*riki.ridwan@widyatama.ac.id*

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ABSTRACT

Monte Carlo simulation is a simulation where a solution of a problem is given based on the randomization process. This random process involves a probability distribution of data variables collected based on past data and theoretical probability distributions. Monte Carlo simulation is a method used in modeling and analyzing systems that contain risks and uncertainties. This paper uses the Monte Carlo simulation method to solve the problem by sampling from the process of random numbers. This is done because the increasing interest in products sold by PT. Sinar Dunia. So it is necessary to know the number of products that will be produced in the future in order to facilitate the preparation that must be done beforehand, optimizing the time and funds that will be used to avoid or minimize losses by the company. In the case of predicting the production capacity of writing books at PT. Sinar Dunia, Monte Carlo simulation identifies the production capacity of notebooks to be produced in the range of 6200-7000pcs every month for the next 12 periods. Applying the Monte Carlo simulation method in predicting the production capacity of notebooks using the Microsoft Excel program.

INTRODUCTION

PT. Sinar Dunia is one of the leading brands of Asia Pulp and Paper (APP) Sinarmas which is the largest pulp and paper producer in the world. Producing various types of paper of various sizes and various types, notebooks of various sizes, picture books of various sizes and wrapping paper. The need and interest in using paper both in the fields of education, offices, photocopying business, printing business and so on continue to increase over time.

The number of customer requests, indirectly causes the production process to increase. So that it also increases labor requirements, working hours, production tools to be used, other operational costs. This requires an estimate of the number of products to be produced or production capacity each month, so that it can optimize the time and funds available to meet customer demand. To meet these needs can be done by modeling and simulation. One of them is using the Monte Carlo simulation method.

Monte Carlo simulation methods can analyze, solve and optimize various mathematical or physical problems through a large number of statistical random samples for stochastic event simulations. Monte Carlo simulations have been widely used to carry out various project scheduling, calculation of production costs, etc. Monte Carlo simulations are a broad class of computational algorithms that use random sampling to obtain numerical results, usually multiple simulations are carried out to get distributions from unknown probabilistic entities. Based on the research that has been done, it was found several problems in this study how to apply a Monte Carlo simulation to the estimated number of products to be produced or the monthly production capacity of notebooks.

LITERATURE STUDY

Basic Simulation Concepts

Simulation is a technique that mimics operations or processes that occur in a system with the help of a computer device and is based on certain assumptions so that the system can be studied scientifically. In the simulation the computer is used to study the system numerically, where data is collected to perform statistical estimates to obtain the original characteristics of the system. Simulation is the right tool to use especially if it is necessary to conduct experiments in order to find the best comments from system components. This is because it is very expensive and takes a long time if the experiment is tried in real terms. By conducting a simulation study, in a short time, the right decision can be determined and the cost is not too big because everything is done with a computer. The simulation approach begins with the construction of a real system model. The model must be able to show how the various components in the system interact with each other so that it really describes the behavior of the system. After the model is created, the model is transformed into a computer program so that it is possible to simulate it.

Monte Carlo Simulation

Monte Carlo simulation is defined as all statistical sampling techniques used to estimate solutions to quantitative problems. In a Monte Carlo simulation, a model is built based on the actual system. Each variable in the model has a value that has a different probability, which is indicated by a probability distribution or commonly referred to as a probability distribution function (pdf) of each variable.

The Monte Carlo method simulates the system repeatedly, hundreds or even thousands of times depending on the system being reviewed, by selecting a random value for each variable from its probability distribution. The results obtained from the simulation are a probability distribution of the value of an overall system. Monte Carlo simulations have been applied in various fields including; project management, transportation, computer design, finance, meteorology, biology and biochemistry.

Stages of Monte Carlo Simulation

Monte Carlo Stages If the System contains elements that include possible factors, the model used is the Monte Carlo model. The basis of Monte Carlo simulation is the experiment of possible elements using random samples. This simulation method involves random number users to model the system, where time does not play a substantive role in static models. Random number generator is possible to generate an actual random number (truly random number) with a computer algorithm. Users of the Monte Carlo method need a large number of random numbers so that along with the development of this method, a random number generator is developed which is more effectively used for random number tables that were previously often used for sampling statistics. This method is divided into 5 stages:

a. Make a possible distribution of important variables.
b. Build a cumulative possible distribution for each variable in the first stage.
c. Determines random number intervals.
d. Make random numbers to simulate
e. Make a simulation of a series of experiments.

PREDICTION

Prediction is the process of predicting a variable in the future based on data considerations in the past. Data that is often used to make predictions is data in the form of quantitative data. Prediction does not have to give a definite answer to the event that will occur, but rather tries to find the answer as close as possible to what will happen

RESEARCH METHODOLOGY

The research methodology contains an overview or steps to be carried out in conducting research. This needs to be determined so that research can be done in a structured manner. The steps to be taken must include starting from studying the problem until it is present a system that can be produced so that the problem can be resolved.

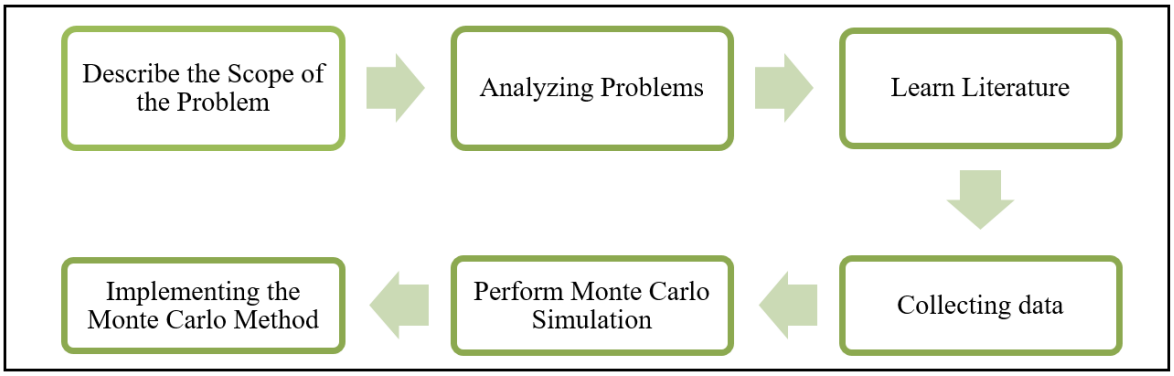

Figure 1. Research Framework

The first step that must be done in the research is to describe the scope of the problem, in the case faced in this study is to predict the demand for writing notebooks. Next analyze the problem to be able to understand the problem that has been determined the scope or limitations. By analyzing the problem that has been determined, the problem is expected to be well understood.
The next step in the study of literature is the actions taken to study scientifically and theoretically the problems that have been limited previously sourced from books, journals, scientific papers, articles, theses and various sources from the internet by experts who can be justified.

Next data collection is done to collect all the data needed in the study. The technique used in collecting data in this study is to use random numbers and data calculation techniques. Calculation technique is a data calculation technique available to produce information that is useful in this study.

After data collection, a simulation of the number of products sold is done to predict the number of products that will be produced in the future. Simulating means trying to adjust to the actual situation in a computerized manner so that it can describe the condition of the system in real terms in the field. Simulating the number of products sold is done to predict the number of products to be produced in the future in order to assist in decision making.

The last step is to implement a Monte Carlo simulation method, in order to optimize the PT. Rays of the world in making decisions during the implementation of the upcoming production process.

DISCUSSION

Data Demand

The first step taken in this study is that researchers collect customer demand data or demand using random or random numbers can be seen in Table 1.

Table 1. Random Demand Data

	1	2	3	4	5
1	6400	6900	6300	6500	6800
2	6800	6800	6400	6800	6800
3	6600	7000	6800	6500	6600
4	6800	6900	6900	7100	6900
5	6800	6700	6900	6800	6500
6	6500	6700	6800	6900	6700
7	6700	6200	6900	6300	6800
8	6800	6800	6500	7200	6400
9	6700	6800	6700	6700	6700
10	6800	6400	6900	6800	6700
11	7000	6400	6900	6600	6600
12	7100	6600	6300	6900	6900
MIN =		6200	MAX =		7200

Monte Carlo simulation is to make the value of each variable that is part of the model studied. One common way to make the probability distribution for a variable is to calculate past results. In this Monte Carlo simulation, the variable exemplified in the table above is customer demand or demand. Customer demand or demand must approach normal distribution so that Monte Carlo simulations can be carried out.

Determination of Frequency Distribution, Cumulative Function Distribution and Interval

The next step is to determine the frequency with the probability distribution and the cumulative distribution function can be seen in Table 2.

Table 2. Distribution Frequency Table

Frequency	Probability Distribution	Cumulative Distribution Function	Tag Number
1	0.02	0.02	1-2
3	0.05	0.07	3-7
5	0.08	0.15	8-15
5	0.08	0.23	16-23
5	0.08	0.32	24-32
9	0.15	0.47	33-47
16	0.27	0.73	48-73
11	0.18	0.92	74-92
2	0.03	0.95	93-95
2	0.03	0.98	96-98
1	0.02	1.00	99-100

Viewed from the table above, it can be described the probability distribution obtained from the number of frequencies divided by the total frequency. For

example, the probability distribution of customer demand or demand is obtained from the frequency part 1 divided by the total frequency of 60 so the result is 0.02. The cumulative distribution is obtained from the sum of the previous probability distributions plus the probability distribution afterwards and so on. Then determine the random number interval for each variable. After that make a random number interval.

The random number interval for customer demand or demand is obtained from the cumulative distribution. Where the cumulative distribution is multiplied by 100. So that 0.02 x 100 = 2, so that the interval range is 1 - 2 which means the number of customer demand simulations or demand is 6200. If random numbers appear in intervals 3 - 7 then the number of customer demand simulations or demand is 6300. And so on until the interval to 100. After getting a random number, then a simulation can be carried out from the trial set.

Monte Carlo Simulation

From the results of the numbers stated randomly, an experimental simulation can be performed by matching random numbers that appear with interval tables obtained from the cumulative distribution so that the simulation results based on data demand obtained randomly can be seen in Table 3.

Table 3. Interval *Random*

Month	Bill Random	Demand
1	0.67	6800
2	0.30	6600
3	0.35	6700
4	0.44	6700
5	0.51	6800
6	0.80	6900
7	0.59	6800
8	0.89	6900
9	0.93	7000
10	0.90	6900
11	0.08	6400
12	0.01	6200

So that, it can be seen in Figure 2 the number of products that must be produced by PT. Sinar Dunia for the next 12 periods.

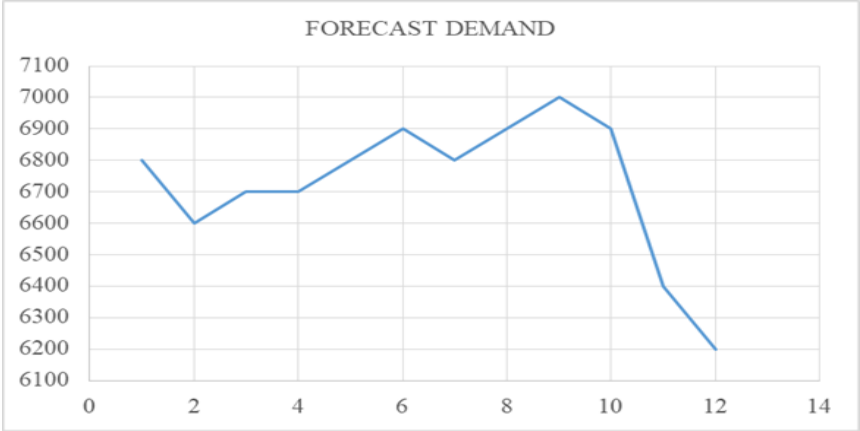

Figure 2. Demand Forecast

After the simulation based on past data using random numbers, it can be seen that the production capacity of notebooks for the 12 periods in the future has a range of 6200-7000pcs per month.

CONCLUSION

As with other simulation methods, the accuracy of the Monte Carlo simulation results is strongly influenced by the accuracy of the input variables which in the example case in this paper are customer demand or demand. Also note that Monte Carlo simulation is not a solution provider, this method only helps us in predicting the behavior of a system by taking into account the elements that contain risks and uncertainties. Monte Carlo simulation results can help determine the number of products to be produced so that costs or needs can be calculated that will help the production process in the future.

SUGGESTIONS

For progress in conducting further research it is necessary to have the following suggestions:

a. The Monte Carlo simulation in the next study is expected to not only be applied to predict production capacity but can also be applied to scheduling, the concept of yield values, estimated project costs and so on. So that, the utilization of the Monte Carlo method can be maximally used in order to minimize financial losses that may occur in the future.

b. When doing Monte Carlo simulations, other tools can be used besides Microsoft Excel such as Visual Basic, Microsoft Access, Java, PHP programming etc.

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