Forecasting the Amount of Foreign Tourists of Asean Country Origin in North Sumatera using Monte Carlo Simulation

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Abstract: Forecasting is an important tool in effective and efficient planning to predict future events. The characteristic of forecasting about future values of a variable for planning or decision making of a situation to estimate future values. Monte Carlo simulation is a simulation model that includes a random series and sampling with a probability distribution that can be known and determined, so this simulation can be used. In this study, data was taken from the amount of foreign tourists from ASEAN member countries who visited North Sumatra from 2009 to 2018 which indicated a trend data pattern over time. Then, data processed and analyzed using Monte Carlo Simulation to determine the forecast results for 5 years after that. As a result the amount of foreign tourists who visited North Sumatra from Malaysia, the Philippines, Singapore and Thailand as a whole have increased respectively by 2.61%, 1.14%, 3.10% and 5.66%. The number of foreign tourists who visited North Sumatra origin Brunei, Vietnam and Myanmar as a whole decreased respectively by 3.56%, 4.90% and 28.11%.

1 INTRODUCTION

Tourism is an important economic sector in Indonesia. Tourism placed is third in terms of state foreign exchange earnings after oil and commodities natural gas and palm oil in 2009. One indicator of development tourism can be seen from the growth of foreign tourists, apart from domestic tourist visits and growth revenue from the trade and hotel sector.

Indonesia is a member of the ASEAN (Association of Southeast Asian Nations) with Malaysia, Thailand, Singapore, the Philippines, Laos, Brunei Darussalam, Vietnam, Cambodia and Myanmar where ASEAN leaders agreed to form a single market in the Southeast Asia region at the end of 2015 termed the ASEAN Economic Community (AEC). Foreign tourists in this region much needed to increase foreign exchange reserves in the region of ASEAN member countries.

One of the provinces frequented by foreign tourists, especially the country ASEAN is North Sumatra. In the data of foreign tourists who came to North Sumatra in

2016 were 233,668 people who experienced increase 1.91% from 2015 and in 2017 were 270,792 people experienced increase of 15.96% from 2016 ([BPS] Badan Pusat Statistik Provinsi Sumatera Utara, 2019).

In the framework of the development of international tourism, steps need to be taken steps to increase the flow of foreign tourists by increasing marketing needed to be able to predict the flow of foreign tourists in North Sumatra, with information quantitative and qualitative information about tourism in the past in order to improve tourism promotion in North Sumatra. One forecasting technique used is by using Monte Carlo Simulation. Monte Carlo simulation using data which is already there to estimate important things in the future such as sales, requests, and so on as an overview of past data. From the existing model created a model so that a random number can be generated based on a model made.

Tüzüntürk et al. in his research on forecasting drinking water demand using Monte Carlo simulation, produces estimated values that are close to the actual data, so that the Monte Carlo Simulation can predict requests drinking water in the next 12 months (Tüzüntürk et al., 2015). Research by Alrabadi and Aljarayesh regarding the comparison of simple moving average (SMA) forecasting methods, exponential moving average

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(EMA) and Monte Carlo simulation in forecasting stocks market returns on Amman shares which results in the estimated value with Monte Carlo Simulation is closer to the actual data so that the Monte Carlo simulation can predict stock market return (Alrabadi et al., 2015). Research by Sugiharto regarding the application of Simulation in forecasting demand and management Top Paint brand paint produces an estimated volume of each order and interval the time of arrival of the order for the next 12 months (Sugiharto, 2007).

2 LITERATURE REVIEW

2.1 Forecasting

Forecasting is an important tool in effective and efficient planning for predicting future events (Makridakis et al., 1999). Forecasting has the following objectives (Heizer & Render, 2011):

1. To review company policies that are in force today and in the past and see the extent of influence in the future
2. Forecasting is needed because of the time lag or delay between when a policyoccurs company policy is determined by the time of implementation
3. Forecasting is the basis for preparing a business in a company so that can increase the effectiveness of a business plan.

Scientifically, the forecasting method can be classified in two groups there are qualitative methods and quantitative methods. Quantitative methods can be divided into two, there are:

1. Forecasting methods based on the use of the analysis of the relationship patterns between variables to be estimated with time variables (Time Series). The methods included in this type are Smoothing Methods, Methods Box Jenkins, Trend Projection Method with Regression and Monte Carlo Method.
2. Forecasting methods based on the use of the analysis of the relationship patterns between variables to be estimated with no time variables (correlation method or cause and effect). Forecasting methods included in this type are Regression and Correlation Methods, Econometric Methods and Input Output Methods.

2.2 Monte Carlo Simulation

Simulation is one way to solve various problems in real life that is full of uncertainty by not using or using models or certain methods and more emphasis on using computers to get the solution (Kakiay, 2004). One method that plays a role in computer simulations is the Monte Carlo method. The Monte Carlo method is a withdrawal involves a series of random numbers namely variations of $U(0,1)$, which are used for solving stochastic or deterministic problems where the role of time is not requires substantive rules, so the Monte Carlo method is generally static rather than dynamic (Law & Kelton, 2000).

The Monte Carlo method illustrates the possibility of using sample data already exists and can be known or estimated distribution. With words it is different if the simulation model includes a random series and sampling with a probability distribution that can be known and determined, then this simulation can be used (Kakiay, 2004). In operation, Monte Carlo involves a direct election randomly repeating each other's output so that a solution is obtained certain approach. The increasing number of experiments carried out then the error rate for the results obtained will be smaller (Rubiensten, 1981).

2.3 Random Number Generator

In the Monte Carlo technique, artificial data is generated through random number generator and cumulative distribution. Random numbers generated actually not really random, so it is called a random number generator means that what can actually be produced is not random and makes has criteria that must be met, namely:

1. Uniform distribution and does not correlate between numbers
2. Generating quickly, storage is not large
3. Can be produced repeatedly
4. A large period, because random numbers may be generated repeatedly.

The random number is symbolized by U, its value from 0 to 1 which is expressed in $U(0,1)$. The method for random numbers is usually the Linear Congruential Generator (LCG), and Multiplicative Congruential Generator (MCG). LCG and MCG have formula:

$$X_i = (aZ_{i-1} + c)\ mod\ m \quad (1)$$

$$X_i = (aZ_{i-1})\ mod\ m \quad (2)$$

with:

X_i = random number n-series

X_{i-1} = previous random number
a = multiplier factor
c = constant number
m = modulo number

From the LCG and MCG formulas a random number (U_i) is desired (for $i = 1,2,3, ...$) in $[0,1]$, then the formula is (Law & Kelton, 2000):

$$U_i = \frac{Z_i}{m} \quad (3)$$

2.4 Generate Random Variate

In generating random numbers through a computer is very dependent on function or distribution of the data being investigated. Then from the distribution functions this can be found or derived random variate from the distribution function (Kakiay, 2004). On this study discussed random distribution of normal distribution. Algorithm generate random numbers from the normal distribution, i.e.

1. Generate U_1 and U_2, where U_1 and U_2 are independent random numbers $U(0,1)$
2. Calculate X_1 and X_2, using the formula:

$$X_1 = \sqrt{-2 \ln U_1} \cos 2\pi U_2 \quad (4)$$

$$X_2 = \sqrt{-2 \ln U_1} \cos 2\pi U_2 \quad (5)$$

3. Placed $X^0 = \mu + X_i\sigma$
4. Then X^0 is random data from $N(\mu,\sigma^2)$.

3 METHODOLOGY

The data used in this study are secondary data, namely the amount foreign tourists who came to North Sumatra from ASEAN member countries in 2007-2018 obtained from the Central Statistics Agency (BPS) of North Sumatra. The calculation is done by numerical calculations and simulated using Monte Carlo simulation so that optimal forecasting results are obtained. As for who carried out with data that has been collected are as follows:

a Test the normality of data on the number of foreign tourists from member countries ASEAN with Liliefors Normal Test.
b Determine the parameters that are useful for generating random numbers in terms of normal contribution.
c Perform a simulation of 10 times.
d Test the average similarity of the two related variables to find out whether there is a difference between the simulation data and the actual data.
e Perform simulations to determine the results of forecasting.
f Formulating conclusions.

4 RESULTS AND DISCUSSION

4.1 Data Collection

The data to be analyzed in this study is the number of foreign tourists from the country ASEAN members who visited North Sumatra in 2007-2018 were obtained from the Central Statistics Agency of North Sumatra Province. The data can be seen in Table 1 follows.

Table 1: Data of Foreign Tourists from ASEAN member countries in North Sumatra in 2007-2018.

No	Year	Brunei Darussalam	Malaysia	Philippines
1	2007	133	81.347	899
2	2008	79	84.387	991
3	2009	94	102.685	986
4	2010	79	109.320	970
5	2011	103	132.037	942
6	2012	140	143.644	1.041
7	2013	248	148.465	1.341
8	2014	124	152.389	1.279
9	2015	218	129.203	1.551
10	2016	91	115.007	1.094
11	2017	172	128.761	1.541
12	2018	221	139.878	1.612
Total		1.702	1.467.033	14.247
No	Year	Singapore	Thailand	Vietnam
1	2007	7.622	988	147
2	2008	9.946	1.460	124
3	2009	10.361	1.677	102
4	2010	11.187	2.686	167
5	2011	11.592	2.180	250
6	2012	13.579	2.757	237
7	2013	18.276	3.906	337
8	2014	18.066	4.844	369
9	2015	12.516	3.087	405
10	2016	14.322	3.027	311
11	2017	17.312	3.688	1.356
12	2018	18.620	3.605	752
Total		1.702	163.399	33.905
No	Year	Myanmar		
1	2007	59		
2	2008	120		
3	2009	149		
4	2010	1.014		
5	2011	127		
6	2012	157		
7	2013	158		
8	2014	182		
9	2015	202		
10	2016	147		
11	2017	259		
12	2018	317		
Total		2.891		

Source: Central Statistics Agency of North Sumatra Province

4.2 Solution using Monte Carlo Simulation

In doing simulations, the first thing to do is determine the distribution that become a benchmark in generating the number of foreign tourists in step next. Data in the simulation generated depend on the distribution known for such distribution. The distribution used in this study is a Normal distribution. After the distribution is known, the simulation is carried out as much as you want. In this study the simulation was carried out 10 times so that the simulation results are expected to represent actual data. This simulation works from each country, as follows:

4.2.1 Data Simulation of Tourists from Brunei Darussalam, Malaysia, Philippines and Singapore

In the data of tourists from Brunei Darussalam, the average (μ) and standard deviation (σ) are 141,8333 and 59,4869. For tourists from Malaysia, the values μ and σ are 122.252,7500 and 23.859,4190. For tourists from the Philippines, the values μ and σ are 1.187,2500 dan 264,4817. For tourists from the Singapore, the values μ and σ are 13.616,5833 and 3.766,2653. First the values of U_1 and U_2 are raised using the RAND function in Microsoft Excel. Then taken as example to determine the value of X using the formula (4), i.e:

$$\begin{aligned} X &= \sqrt{-2\ln U_1}\cos(2\pi U_2) \\ &= \sqrt{-2\ln 0{,}6327}\cos(2\pi \times 0{,}2634) \\ &= -0{,}0803. \end{aligned}$$

Then the random number obtained is converted to the amount of arrivals foreign tourists:

$$\begin{aligned} X^0 &= \mu + \sigma X \\ &= 141{,}8333 + \left(59{,}4869 \times (-0{,}0803)\right) \\ &= 137{,}0545 \\ &\approx 137. \end{aligned}$$

So on up to 10 times the simulation. Table 2 explains the summary simulation data on the number of foreign tourists from Brunei Darussalam, Malaysia, the Philippines, and Singapore.

Table 2: Simulation of foreign tourists from Brunei Darussalam, Malaysia, Philippines and Singapure.

No	Simulation	Brunei Darussalam	Malaysia
1	I	1.924	1.455.333
2	II	1.410	1.521.579
3	III	1.645	1.465.864
4	IV	1.285	1.537.491
5	V	1.761	1.457.245
6	VI	1.993	1.691.073
7	VII	1.826	1.405.846
8	VIII	1.747	1.501.732
9	IX	1.806	1.311.412
10	X	1.655	1.540.604
Average		1.705	1.488.818

No	Simulation	Philippines	Singapore
1	I	16.247	158.282
2	II	13.019	165.122
3	III	15.062	156.121
4	IV	12.655	170.356
5	V	14.998	199.850
6	VI	13.942	164.224
7	VII	15.142	143.236
8	VIII	15.283	164.490
9	IX	14.205	178.277
10	X	12.560	157.354
Average		14.311	165.731

In Table 2, the average of Brunei Darussalam tourists from the simulation results is equal to 1.705 people, compared to the actual data which is 1.702 people. The average of Malaysian tourists from the simulation result is equal to 1.488.818 people, compared to actual data that is equal to 1.467.033 people. The average of Filipinos tourists from the simulation results is equal to 14.311 people compared to the actual data which is 14.247 person. Meanwhile, the average of Singapore tourists from the simulation results is equal to 165.731 people compared to the actual data that is equal to 163.399 people.

4.2.2 Data Simulation of Tourists from Thailand, Vietnam and Myanmar

In the data of tourists from Thailand, the average (μ) and standar deviation (σ) is 2.825,4167 and 1.116,1298. In the data of tourists from Vietnam, the values μ and σ are 379,7500 and 353,9571. In the data of tourists from Myanmar, the values μ and σ are 240,9167 and 252,3772. Generate U_1 and U_2 values using the RAND function on Microsoft Excel. Then taken as an example to determine the value of X with using the formula (4), i.e:

$$X = \sqrt{-2\ln U_1}\cos(2\pi U_2)$$
$$= \sqrt{-2\ln 0{,}9118}\cos(2\pi \times 0{,}2187)$$
$$= 0{,}0840.$$

Then the random number obtained is converted to the amount of arrivals foreign tourists:

$$X^0 = \mu + \sigma X$$
$$= 2.825{,}4167 + (1.116{,}1298 \times 0{,}0840)$$
$$= 2.919{,}1861$$
$$\approx 2.919.$$

So on up to 10 times the simulation. Table 3 describes the summary simulation data on the number of tourists from Thailand, Vietnam and Myanmar.

Table 3: Simulation of foreign tourists from Thailand, Vietnam dan Myanmar.

No	Simulation	Thailand	Vietnam	Myanmar
1	I	35.431	4.765	4.149
2	II	37.089	4.958	3.397
3	III	29.186	5.657	3.214
4	IV	26.867	5.045	3.844
5	V	32.284	4.861	5.652
6	VI	32.192	5.595	4.051
7	VII	34.966	4.202	3.173
8	VIII	33.858	4.965	3.375
9	IX	38.344	5.317	2.867
10	X	35.940	4.275	3.569
Average		1.705	33.615	4.964

In Table 3, the average of Thai tourists from simulation results is 33.615 people compared to the actual data of 33.905 person. The average of Vietnamese tourists from simulation results is 4.964 people compared to the actual data of 4,557 people. Meanwhile, the average of Myanmar tourists from simulation results is 3.729 people compared to the actual data of 2.891 people.

4.3 Forecasting Results

The data simulated again to make predictions about the number of foreign tourists. The data has reached optimal results because it has been simulated by using use existing parameters. The following forecasting results will be displayed Monte Carlo Simulation of 2019-2023 in Table 4.

Table 4: Forecasting Results the tourists using Monte Carlo Simulation.

No	Year	Brunei Darussalam	Malaysia	Philippines
1	2019	163	121.087	1.269
2	2020	180	123.351	1.287
3	2021	195	124.615	1.294
4	2022	171	125.752	1.304
5	2023	200	134.688	1.333

No	Year	Singapore	Thailand	Vietnam
1	2019	14.068	3.303	300
2	2020	14.614	3.375	435
3	2021	15.044	3.524	323
4	2022	15.112	3.558	528
5	2023	15.898	3.800	512

No	Year	Myanmar
1	2019	338
2	2020	340
3	2021	374
4	2022	406
5	2023	416

In Table 4, the amount of foreign tourists who visited North Sumatra from Malaysia, Philippines, Singapore and Thailand as a whole have increased respectively 2,61%, 1,14%, 3,10%, and 5,66% compared to the number of foreign tourists who visited from Brunei Darussalam, Vietnam and Myanmar which as a whole have decreased respectively 3,56%, 4,90% dan 28,11%.

5 CONCLUSION

5.1 Conclusion

Based on the analysis and discussion that has been done, conclusions can be taken that the forecast results of the number of foreign tourists coming to North Sumatra from ASEAN member countries will increase in the next five years. The amount of foreign tourists visiting North Sumatra from Malaysia, Philippines, Singapore and Thailand as a whole have increased by 2,61%, 1,14%, 3,10%, and 5,66%. The amount of foreign tourists who visited North Sumatra from Brunei Darussalam, Vietnam and Myanmar as a whole have decreased by 3,56%, 4,90% and 28,11%. Therefore the number of foreign tourists from Thailand is predicted to be more significant compared to other countries.

5.2 Next Research

For next research of the same type it is recommended to do the simulations with other variables that influence the amount of tourists as well, and simulate more than 10 times iteration so that the results obtained can be more accurate.

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