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OPTIMAL DECISIONS FOR MARINE TOURISM

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Manado 95115, Indonesia
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West Koha Village, Mandolang
Minahasa 95661, Indonesia

In the spirit to promote decisions based analytics through OR/MS, the theme of the conference is

“Optimal Decisions for Marine Tourism”

The primary objectives of the conference are:

1. to provide OR/MS researchers, academicians and practitioners an appropriate platform for sharing experiences, communication and networking with other experts within the nation and from around the world
2. to promote and disseminate the scientific field of operations research in Indonesia through the Indonesian Operations Research Association (IORA).

Conference Chair:

Dr. Nelson Nainggolan, M.Si, *Sam Ratulangi University*

Operation Research as well as Management Science (OR/MS) are viewed as a body of established mathematical models and techniques to solve complex management problems. It encompasses a growing number of technical areas arising in the direction and management of large systems of men, machines, materials and money in industry, business, government, defense, and other decision-making fields.

This conference can be held in collaboration of Indonesian Operations Research Assosiation (IORA) and Faculty of Mathematics and Natural Sciences, Sam Ratulangi University. The same conference had previously been held twice, initially hosted by Universitas Pakuan Bogor, and followed by Universitas Terbuka Tangerang as second host. This coference is now held at Sam Ratulangi University for the third time, that is why it is known as the 3rd International Conference on Operations Research (ICOR) under a main theme entitled Optimal Decisions for Marine Tourism. The point of this conference is to provide a perfect event for researchers, academics and practitioners of Operations Research, to share experience, build communication and network with experts from all over world. Thank you!

From the President

Indonesian Operations Research Association (IORA)
Prof. Sudradjat Supian

Distinguished Guest, All invited Speakers, Participant, Ladies and Gentlemen,

It is a great pleasure for me On behalf of the Association of the Indonesian Operations Research Association, I would like to welcome you all at this special event International Conference On Operations Research at the Universitas Sam Ratulangi. This event is the third event for IORA-ICOR and congratulations to the Universitas Sam Ratulangi be able to host and also thanks to the minister of maritime affairs and fisheries and Manado Provincial Governor.

The theme of the conference, *Optimal Decisions for Marine Tourism*, reflects our belief that many future challenges in our life need involvement of operations research and typical analytic operations research. Our future and our capacity to reach sustainable development goal such as ensure availability and sustainable management of water and sanitation for all; ensure access to affordable, reliable, sustainable and modern energy for all; take urgent action to combat climate change and its impacts; end poverty in all its forms everywhere; conserve and sustainably use the oceans, seas and marine resources for sustainable development; end hunger, achieve food security and improved nutrition and promote sustainable agriculture, ensure healthy lives and promote well-being for all at all ages, among other challenges require the advances the roles of operations research in collaboration with other disciplines. Operations Research is the application of scientific & mathematical methods to the study & analysis of problems involving complex systems. Analytics is defined as the scientific process of transforming data into insights for making better decisions.

Operations research is a multi-disciplinary field therefore Interaction with other fields of science is indispensable and proven to have given rise to new areas that improve the ability in decision making and techniques used are modeling.

Typically, applications of Operations Research in these and other areas deal with decisions involved in planning the efficient allocation of scarce resources - such as material, skilled workers, machines, money and time - to achieve stated goals and objectives under conditions of uncertainty and over a span of time. Efficient allocation of resources may entail establishing policies, designing processes, or relocating assets. OR analysts solve such management decision problems with an array of mathematical methodologies. Completely of the operations research field can be seen in AMS 2000 or MCS 2010.

And now, I need to clarify that IORA is a new association in Indonesia he is beginning piloted in workshops in Operations Research and Optimization modelling on June 4, 2011 in the Department of Mathematics Faculty of Mathematics and Natural Science, Universitas Padjadjaran, then be disseminated to several universities, government and industry.

IORA is a container that provides a forum for scientists Operational Research and to expand our horizons through the exchange of knowledge and application technology, IORA established on August 25, 2014 by deed of Notary Number 42 and the Minister of Justice and Human Rights Number. AHU-00439.60.10.2014.

IORA members came from a variety of fields, education, Resercher, government, industry, practitioners etc, in 2017 members numbered 130 members and until now IORA members numbered 240 members, and we wait for those who have become members through www.iora.or.id.

Ladies and gentlemen,

We need to inform that at the current conference will also be held meeting IORA board.

Finally, Have a nice International Conference on Operations Research. I hope there are plenty of benefits we can share and empower through this and hopefully your participations and contributions will make this conference a productive and successful one



From the Dean

Faculty of Mathematics and Natural Sciences, Sam Ratulangi University
Prof. Dr. Benny Pinontoan, M.Sc.

Welcome to Universitas Sam Ratulangi, welcome to The 3rd International Conference on Operations Research (ICOR) organized by the Indonesian Operations Research Association (IORA) and the Faculty of Mathematics and Natural Sciences, Universitas Sam Ratulangi.

The theme this year is *Optimal Decisions for Marine Tourism*. This theme is based on the fact that Indonesia is a maritime country as well as tourism is targeted to be the prime mover of the country development and that Operations Research is relevant and essential knowledge to apply to these areas.

We have more than 200 participants registered, which shows a wide range of interests on this topic. Hopefully all papers can be published in the IOP Proceeding indexed in Scopus.

It is a great honor for us to organized this event. We thank IORA for appointed us and for the collaboration which I believe will be a door that open to more collaborations with more partners in the future. We get full support from and therefore we thank the Rector of Universitas Sam Ratulangi and the Governor of North Sulawesi Province.

Finally, we welcome you to Manado, for many of the participants maybe still long destination, but we hope that during your stay you will enjoy and take advantage of the many sights to see in the city and also experience wonderful moments in and on Bunaken Island as well as the many natural wonders in the surrounding areas.

Pakatuan wo Pakalawiden. God bless you.



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Probability-based Structural Assessment of Existing Concrete Buildings using the First Order Reliability Method

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Abstract. The assessment of existing RC structures become more demanding as the number of aging structures increases over time. There can be numerous reasons of conducting structural assessment namely different use of existing structures other than specified from its previous design, the need of higher load application, and degradation indication of the structures. Degradation is by far the main reason for the assessment. The buildings are commonly designed base on the technology progress in their time of construction. Therefore, different buildings could have different degree of safety. The building safety should be increased appropriate to up to date requirements in order to prevent the potential accidents. The method employed in this research is the structural assessment of the existing concrete building using the first order reliability method. The building has already stood for 20 years and has ever been abandoned for several years. Now, the government are trying to reuse the building and gaining information whether the building is still appropriate to function. One of the efforts is by using NDT by means of Schmidt Hammer Test. The probability-based structural assessment concludes it is safe enough, reliability index (β) = 4.5.

1. Introduction

There are several parameters affecting the performance and service life of reinforced concrete (RC) structures among others strength, quality of concrete, concrete cover, age, and environmental exposure. The assessment of existing RC structures become more and more demanding as the number of aging structures increases over time. There can be numerous reasons of conducting structural assessment namely different use of existing structures other than specified from its previous design, the need of higher load application, and degradation indication of the structures. Degradation is by far the main reason for the assessment.

It is hard to simulate degradation process since it relates to various chemical and physical phenomena (1). Probabilistic approach is so far give better and reliable service life prediction model. Monitored field data together with probabilistic evaluation offer reliable results in predicting the probabilities of degradation. Probability function, reliability based models, Monte Carlo simulation, Markov chain method, and fuzzy logic are the promising probability or statistical model based concepts (2).

The building regulation related to safety level become more and more strict recently. There is a rise of requirements that should be fulfilled by the building to be allowed to keep functioning. The buildings are commonly designed base on the technology progress in their time of construction.

Therefore, different buildings could have different degree of safety. The building safety should be increased appropriate to up to date requirements in order to prevent the potential accidents (3).

2. First order reliability method

The structural reliability has elemental purpose which is the analysis of straightforward relation between the action effect (e.g. external load) and the resistance of a structure (e.g. allowable material stress). Taking the action effect as E and structural resistance as R , the requirement of structural reliability can be expressed as the following inequality form (equation 1).

$$E < R \quad (1)$$

The equation 1 confirms that the observed structural component satisfactorily satisfies the desirable safe state. On contrary, the structural failure takes place when this condition is not fulfilled. The critical point between the desirable and undesirable state thus can be formulated as the following equality form (equation 2).

$$E - R = 0 \quad (2)$$

The equation 2, the well-known basic formulation for limit state function, is often called the performance function. Though it is nice to have such a simple formulation, one must realize that this simplification not always work for all kind of structural members and materials.

Many attempts have been done to simplify the theory of reliability for the sake of practical application. There are a lot of standard around the world incorporate a kind of load and material factors that represents the probabilistic principles. Among these standards, we can notice those written in world famous standards such as American Concrete Institute – ACI (4), American Institute of Steel Construction – AISC (5), and European Norms – EN (6). They implement a kind of coefficient so-called partial factor. For the sake of clarity, one can see the illustration of the fundamental probabilistic method like the one pictured in Eurocodes (figure 1).

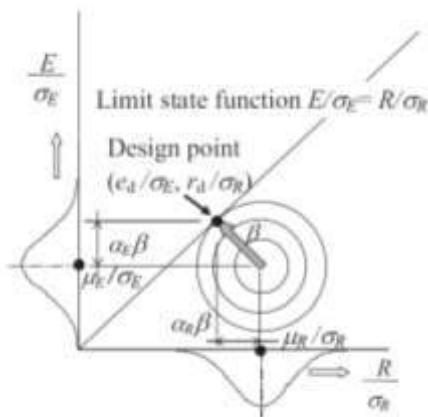


Figure 1. The relation between E and R for the design point.

The two-dimensional graph pictured in figure 1 illustrates the basic variables E and R with the basic limit state function. The fraction of R/σ_R is in the horizontal axis meanwhile the fraction of E/σ_E is in the vertical axis. Both variables, E and R , are assumed to be mutually independent and normally distributed. A concentric circle can be drawn to denote combined probability function related to density of probability of different level. An unrealistic hypothesis will emerge from the normally distributed assumption in some particular cases that will probably give purely an approximation.

The diagonal axis of the two probability functions divides the joint area into two regions. The first region is lying above the diagonal axis and the other one below the diagonal axis. The region below the diagonal axis represents the desirable area (safe state) where equation 1 is fulfilled. The region above the diagonal axis therefore indicates the failure conditions. Any point located on the diagonal line (critical failure boundary) will become the design point (e_d , r_d). Several researches show that the best choice for the limit state function is the closest point to the mean (μ_E , μ_R). Incorporating the findings, the coordinate of the design point read as follows (equation 3 and 4) (7).

$$e_d = \mu_E - \alpha_E \beta \sigma_E \quad (3)$$

$$r_d = \mu_R - \alpha_R \beta \sigma_R \quad (4)$$

The variables of α_E and α_R are sensitivity factor of the variables E and R respectively, which are generally called the first order reliability method (FORM). Considering the cosine of the direction normal to the failure boundary, one will obtain the following two equations (equation 5 and 6).

$$\alpha_E = -\frac{\sigma_E}{\sqrt{\sigma_E^2 + \sigma_R^2}} \quad (5)$$

$$\alpha_R = -\frac{\sigma_R}{\sqrt{\sigma_E^2 + \sigma_R^2}} \quad (6)$$

These two sensitivity factors (equation 4 and 5) are set to have a fix value of -0.7 and 0.8 for α_E and α_R respectively. The validation of this approximation is limited to a range of standard deviation as follows (equation 7) (6).

$$0.16 < \frac{\sigma_E}{\sigma_R} < 7,6 \quad (7)$$

The parameters related to the cube strength of concrete are denoted by y and the parameters related to the strength of concrete in structures are denoted by x. The mean value of concrete strength is jointed to the cube strength of concrete by equation 8 (8).

$$\mu_x = 0.67 \mu_y \quad (8)$$

Another important parameter that should be known during the calculation of the probability-based structural assessment of existing concrete buildings using the first order reliability method is the coefficient of variation of concrete strength. The coefficient of variation of concrete strength for x and y is expressed by equation (9).

$$\delta_x^2 = \delta_y^2 + 0.125 \quad (9)$$

The relation between probability of failure (P_f), allowable stress of concrete (f_a), and coefficient of variance can be formulated as follows (equation 10).

$$\mu_x = 0.67 \mu_y \quad (10)$$

The relation between probability of failure and safety index is then described by equation (11).

$$P_f = 1 \times 10^{-\beta} \quad (11)$$

The safety index b , as defined in accordance with ISO 2394-1998, General Principles on the Reliability for Structures, shall have the following values for a structural element (9).

- > 3.7 for Safety Class 1
- > 4.3 for Safety Class 2
- > 4.8 for Safety Class 3

3. Methodology

The method employed in this research is the structural assessment of the existing concrete building. The building has already stood for 20 years and has ever been abandoned for several years. Now, the government are trying to reuse the building and gaining information whether the building is still appropriate to function. One of the efforts is by using non-destructive test (NDT) by means of Schmidt Hammer Test. The condition of the building and the test results can be seen below.

3.1. The Location and condition of the Existing Building

The building object is one of the government buildings located in Pontianak, West Kalimantan, Indonesia (Coordinate: 00°01'14"S 109°20'29"E). It is a two storey building with the height of 4.5 m for first floor and the height of 4 m for the second floor. The building material is steel reinforced concrete for the main structural systems and structural steel for the roof structural systems. The geometry of the building is rectangular (length: 28.80 m and width: 16.50 m). The section of the building in long and short direction and the first and second floor plan are as follows (figure 2).

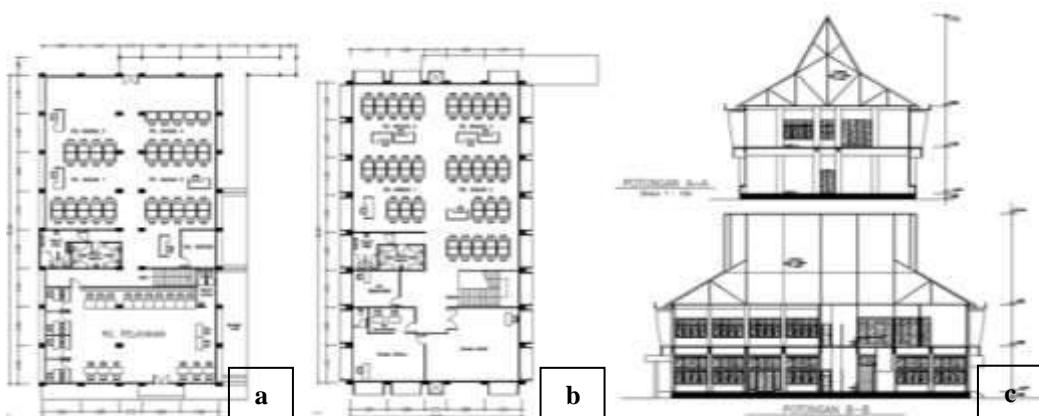


Figure 2. (a) 1st floor plan (b) 2nd floor plan (c) building sections.

3.2. The Schmidt Hammer Test of the Existing Concrete Building

The method used in this test is according to Indonesian Standard, RSNI 03-4803-2010, the testing method of hardened concrete based on rebound number (10). This standard is adopted from ASTM C805 (11). It is a non-destructive test (NDT) on concrete. This method can be used to assess the uniformity of concrete in the field, describe parts of structures that have poor quality or concrete suffered damage, and estimated the development of concrete strength in the field.

The equation 2, the well-known basic formulation for limit state function, is often called the performance function. Though it is nice to have such a simple formulation, one must realize that this simplification not always work for all kind of structural members and materials.

This test method can also be used to estimate the strength of concrete, for that a correlation between the strength of the concrete and the rebound number is needed. This relationship must be established from concrete mixtures and predefined tools. The relation between concrete and rebound numbers is generated from the strength of the commonly used concrete. In order to estimate strength at the moment of construction, specify the relationship by displaying the rebound number on the molded test object and measured the strength of the same or similar test object. For estimate the strength of the existing structure, specify the relationship between the rebound numbers which is measured on the structure with the strength of the concrete core taken from the location concerned. The measurement in this research is performed by using the Schmidt hammer test (Original Schmidt Type N, Proceq, Switzerland) (figure 3).



Figure 3. Schmidt hammer test.

3.3. The Results of Schmidt Hammer Tests

The hammer test is performed by a team of technicians from Laboratory for Construction, Innovative Structures, and Building Physics, Department of Architecture, Politeknik Negeri Pontianak, West Kalimantan, Indonesia (figure 4). There are several locations in the building taken as samples. The locations are focused on different types of structural elements, namely stair slab, second floor slabs, ring beams, second floor beams, first floor columns, and second floor columns. The results of Schmidt Hammer Tests can be seen in table 1.



Figure 4. Technician perform the measurements.

4. Calculations and Discussion

The Schmidt Hammer Tests are conducted in February 2018. The data gained are then statistically analyzed using statistical parametric analysis. In this case, the result of parametric analysis includes: number of data (n); range (R); minimum and maximum value (x_{\max} and x_{\min}); data sum (Σ); mean (μ); standard deviation (σ); and coefficient of variance (δ). The results as shown in table 2.

Table 1. The results of schmidt hammer tests.

Sample Number	Location	Rebound Value (R)		
		1	2	3
1	Stair slab	54	52	44
		47	44	36
		44	44	54
2	Stair slab	42	40	44
		42	48	42
		44	46	32
3	2nd floor slab	32	38	36
		34	32	34
		39	39	36
4	2nd floor slab	42	36	34
		39	32	34
		34	36	36
5	2nd floor ring beam	50	36	45
		50	44	44
		38	36	49
6	2nd floor ring beam	30	40	38
		36	40	42
		35	36	40
7	1st floor column	46	44	45
		45	54	40
		52	42	44
8	2nd floor column	42	39	34
		42	40	38
		40	49	40
9	2nd floor beam	40	40	40
		38	40	38
		38	49	48
10	2nd floor beam	38	38	36
		36	36	42
		40	49	40

Table 2. Descriptive analysis of the measured data.

	N	Descriptive Statistics			Sum	Mean	Std. Deviation	Variance
		Statistic	Statistic	Statistic				
X	90	24.00	30.00	54.00	3673.00	40.8111	.58121	5.51381
Valid N (listwise)	90							30.402

Several statistical parameters can be obtained from table 2, namely mean value (μ_y) = 40.81; standard deviation (σ_y) = 5.51; coefficient of variance (δ_y) = 30.40% = 0.3040. Using previously mentioned equations for reliability analysis, one will obtain the following calculations.

$$\delta_x = \sqrt{\delta_y^2 + 0.125} = \sqrt{0.3040^2 + 0.125} = 0.47$$

$$\mu_x = 0.67 \mu_y = 0.67(40.81) = 27.34$$

$$\sigma_x = 0.67 \sigma_y = 0.67(5.51) = 3.69$$

$$f_a = 0.34 R_{average,min} = 0.34(35.6) = 12.10$$

$$P_f = \varphi\left(\frac{f_a - \mu_x}{\sigma_x}\right) = \varphi\left(\frac{12.10 - 27.34}{3.69}\right) = \varphi(-4.13) = 1 - 0.99997 = 3E-05$$

$$P_f = 1 \times 10^{-\beta} \Leftrightarrow 3E-05 = 1 \times 10^{-\beta} \Leftrightarrow \beta = 4.5$$

The value of β is 4.5. Based on ISO 2394-1998, this value fulfills the target reliability index > 3.7 for Safety Class 1.

5. Conclusion

The probability-based structural assessment of existing concrete buildings using the first order reliability method has been performed. It is proved to be practically easy to use a simple formulation as such. It is obviously quiet demanding method remembering that a quick decision always should be taken during the construction practice.

Based on the obtained results, the following conclusions are attained.

1. The Schmidt Hammer Test is one of the NDT tests that are practically easy to use and quickly give predicted results.
2. The probability-based structural assessment of existing concrete buildings using the first order reliability method gives conclusion that the structure is safe enough. It is shown by the value of reliability index (β) = 4.5.
3. The results gained here are a kind of approximation only. Based on several researches, the strength of the existing concrete building using Schmidt hammer test should be verified with concrete core test from the location concerned.

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Designing a Multifunction Switch for Energy Efficiency

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Abstract. Climate Change caused by the effect of Green House Gas Emissions has become one of the great world impacts nowadays, especially in human life, although scientifically cannot be proved clearly and still become a great discussion and tough debate between scientists in science and environmental field. The primary suggestion is to keep maintaining the nature sustainability by bringing real actions to establish green environment, and increase surroundings care, such as plant trees, use bicycle instead of motor vehicles, promote a healthy green walk, and energy efficiency. Energy efficiency is an act or procedure taken for decreasing energy waste affected by human attitudes and life style, machine failures, or even nature phenomenon and reactions. The important of energy efficiency and a good way to have great care for climate change and environment, generate ideas to optimize switch functions with more leverage, in addition to many products easily found on the market. Switch is a small and essential electronic component of an electric circuit or electronic device, but not very difficult to use in operations. Although in simple and various form, but switch has a specific characteristic and could not be abandoned from its effect on setting time and efficiency use. Through this research, authors try to innovate using standard switch/button to build a multifunction switch which is expected to support the energy saving and its efficiency use. Methods used in conducting research were literature study, observation, analysis, design, and circuit/product testing. Data was analyzed and processed to modify a standard operational switch and design it into a new switch with new functions in controlling electrical equipment. The research outcome gives shape and features to build a multifunctional switch that can be used to perform single machine operation or multiple operations.

1. Introduction

Energy Efficiency is an effort undertaken with the aim of reducing the amount of energy needed, in the use on equipment or even an energy-related system. Switch is one of the electronic components, a simple controller component to turn on and turn off electricity operations that supports energy efficiency. Without switch, it is quite difficult to do controlling and security acts to electronic devices.

Switch is classified as a passive component and has important role in developing world of electricity. Its function is so simple but very essential for human life, made this component used in almost every electronic devices. Basically there are 2 (two) kinds of switch that usually used in human daily life, i.e. toggle switch and push button. These two switches have their unique characteristic with specific function [1,2,4].

Toggle switch or familiar with on-off switch generally consists of two positions, on and off. On position functions to turn on the light or electronic device, while off position functions to turn off those ones. Push button is usually found in digital devices with DC inputs. This switch has a button that can be pushed, to turn on or turn off a light/electronic device [1,5].

Together with technology development in electronic field, toggle switch and push button have been through a different modification and function. Currently we have several models of switch made by manufacture to fulfil the demands on energy and electricity, as shown in figure 1.



Figure 1. Several models of toggle switch and push button

Source: <http://teknikelektronika.com/pengertian-saklar-listrik-cara-kerjanya/>

Mainly, switch component will connect and disconnect electric current. When switch is ON (moved or pushed), the switch contact will be connected each other and form a closed loop, cause the electric current to flow. And if the switch is OFF (moved or pushed again), the switch contact will break and form an open loop, cause no electric current to flow. This is briefly explained in figure 2.

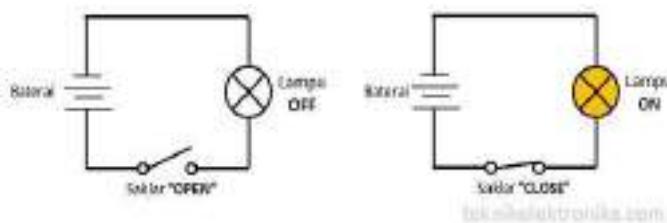


Figure 2. Basic characteristic of a switch

Source: <http://teknikelektronika.com/pengertian-saklar-listrik-cara-kerjanya/>

2. Scope of Problem

This research is focused on “Could a switch being modified and optimized to create a multifunction switch that will be useful for energy efficiency?

3. Literature Review

Based on online survey done by Vision Prize, scientists in climate field are mostly choose renewable energy, energy efficiency, and future generation nuclear power as the most promising one in resolving climate change. Twenty six percents of respondent told that they will focus on using fund for energy efficiency, and specifically 20% respondent on energy efficiency technology. This means that scientists are starting to make priority on other solutions beside carbon emission reduction [6]. Various innovations could be done on a product or technology to create a better outcome to solve recent problems in human life. The success of innovation will depend on the innovator, supporting resources, and ability to deal with frustration and uncertainty, and qualitative and quantitative inputs at decision making process. One part of the innovation scope is related to assemblies, i.e. configure components being connected to become another form of product which shown a specific or set of functions [7].

Switch is classified as one of the passive components that reliable in organizing electric current traffic. Its function, treatment, and characteristic are important parameters in determine input signal good performance and electric current control that drive electric circuit. The activation of a switch also

will trigger spike voltage which can affect circuit or electric device performance, specially the one that need accurate time without a delay [3,4]. Optimization is needed to get the better component performance and energy efficiency, by keep considering the average of current time [8].

4. Results and Discussion

To support energy saving and energy efficiency, authors made innovation on electrical component by creating a new switch from several switches (toggle and push buttons) sold in the market. A selection procedures had been conducted to design a new switch with multifunction specification that need good quality of proved reliability switch besides having a big and wide button surface that easily could add another switch or button at the centre. From voltage and current specifications, those switches meet the requirement for design standard and electric circuit performance. The design concept is given in figure 3.

In this research, a multifunction switch was designed to control a mouse and a flashlight. When toggle switch was set to OFF position, mouse was not active and could not be used. The two push buttons were not functioned although they were pressed, because the main switch (toggle switch) was in OFF condition. But when the toggle switch was set to ON position, those push buttons were functioned well to make the USB outputs came out with 5 DC Volt to turn on digital devices connected to their terminals, the mouse and the flashlight.

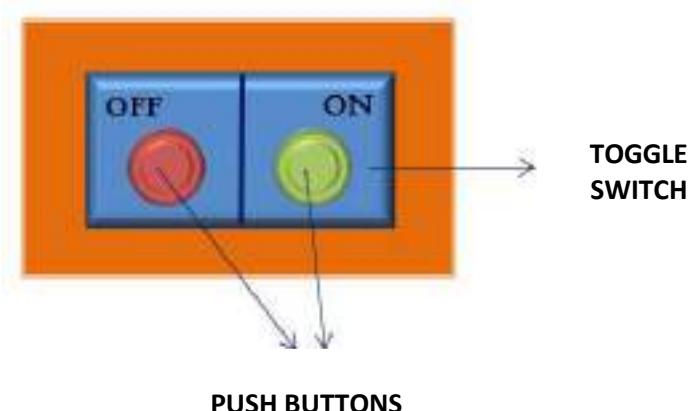


Figure 3. Design concept of a multifunction switch

4.1. Comparison to choose switches for the design concept

From our literature review and observation conducted in several shops/markets that sell electronic components, 5 toggle switches and 5 push buttons were chosen as sample. The comparison for those switches is given in table 1.

Table 1. Comparison made for several switches

Type of Switch	Specification
 Toggle	Small in size, has 3-pin, 2 x 1,5 x 1,5 cm dimension, 6A 250 V~, and 10A 125 V~
 Toggle	Small in size, red lamp will light on when at ON position, 3 x 2,5 x 2 cm dimension, 16A 250V~ and 20A 125V~

Type of Switch	Specification
 Toggle	Big in size, small toggle, 2 position switch, 10A x 250V ~
 Toggle	Big in size, large toggle, 2 position switch, one way two lamps, 10A x 250V ~
 Toggle	Big in size, medium toggle, 2 position switch, 10A x 250V ~
 Push Button	Small in size, has 2-pin, 1,5 x 1,5 x 1 cm dimension, 6A 250 V~
 Push Button	Mini size, 0,5 x 0,5 x 0,5 cm dimension, need another circuit to operate switch, 6A 5-12 DCV
 Push Button	Small in size, has 2-pin, 1,5 x 1,5 x 1 cm dimension, 6A 250 V~
 Push Button	12 mm LED push button, medium in size, DC12V/50 mA, contact resistance less than 100 ohms, has 4-pin
 Push Button	No LED, small push button, 1 x 1 x 1 cm dimension, 250V~ 3A, has 3-pin
 Push Button	No LED, large and long push button, 1 x 1 x 1 cm dimension, 250V~ 3A, has 2-pin

Analysis:

After organized discussions, few general consultations, and also literature study in the library including online survey, a 2 position medium toggle switch was chosen because of its famous proven quality and reliability function. This switch has a large and wide toggle button, so it will be easier to add a push button at the center. A square push button was chosen because it is generally available in the market and its size very suitable to be located at the center of the toggle switch. As another alternative, a medium round push button was chosen because of its flexible size and trending. From their voltage and current specifications, those switches meet the requirement of design standard and electric circuit performance.

4.2. Designing and Testing a multifunction switch

After decided the type of switches that would be used for design, a model of a multifunction circuit was sketched and built which combined both switch functions from toggle and push button, as shown in figure 4, and it was expected that this would help the process of controlling and saving energy. The input and outputs of Multifunction switch was measured with the following result as we can see in table 2.



Figure 4. The prototype of multifunction switch using square and round buttons

Table 2. The measurement of input and outputs

Measurement	Input voltage (volt)	Output voltage USB 1 (volt)	Output voltage USB 2 (volt)
1	5,09	4,97	5,08
2	5,10	4,98	5,08

Analysis:

Measurement outputs showed the expected value, approaching 5 DCV with a tolerant value. The smallest tolerant is $\pm 2\%$. A digital device with input voltage around 5 DC Volt can be connected to the USB terminal of this multifunction switch.

4.3. Testing the transition signal of multifunction switch



Figure 5. The observations of transition signal using oscilloscope

Analysis:

When observations were conducted using oscilloscope to observe the transition signal from ON to OFF, at the beginning it showed no significance changes, but when the oscilloscope being set again at the proper amplitude and frequency value, with a little bit patience in moving or pushing the switch many times, it was observed that there was a little unstable voltage spike when transition happened, as given by figure 5. Almost every circuit that use switch will have this kind of condition, and this problem can be observed more detailed in advance research in order to understand the phenomenon and to design more reliable output.

4.4. Using multifunction switch with a laptop

In this stage, the new designed switch was connected to a laptop and controlled a mouse and a flashlight as shown in figure 6.



Figure 6. Multifunction switch was connected to a laptop

Analysis:

When the main switch was turned OFF, mouse did not work and could not be used. The two buttons at the centre would not functioned although have already set to ON. If the switch was turned ON, the two buttons at the centre would functioned to control and turn on the electronic devices.

4.5. Multifunction switch for a Lamp

Another design is given in figure 7 where we can see that the multifunction switch was built for another prototype, a nice decorating lamp.

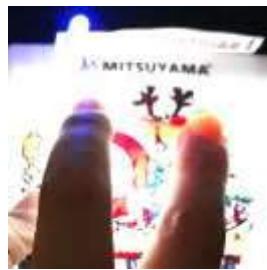


Figure 7. Multifunction switch as a decorating lamp

Analysis:

When the main switch was turned ON, the lamp would light on and when the two buttons were turned on together, the small LED at the top of the switch would light on.

4.6. Multifunction switch and energy efficiency

The multifunction switch design supports energy efficiency in several ways: usability, flexibility, and reliability. One panel has 3 switches (1 toggle and 2 push buttons) where there is a combination of functions in 1 panel with outputs of 5 DCV which can be connected with light and other DC power-saving digital devices. This design is flexible because to turn off all the connected devices or equipment, simply set the position of the main switch to OFF position.

5. Conclusion

From this research we concluded that a multifunction switch can be designed and built to control a mouse, a flashlight, and other USB digital devices. However the transition from OFF to ON position has 'spike' signal that need to be considered in the future for better design, including controlling low voltage wattage and high voltage wattage with proper circuit connections. This research gives a technology innovation product outcome for learning process and supports energy efficiency demand. With a continuous research, availability of electronic components, and support from electronic and electric power industries, it is possible to design this switch in a form of market product for controlling lamps, computers, and machines.

Acknowledgments

Thank you for the university support in funding, and encouragement from our colleagues.

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Respiratory Diseases Expert System Using Dempster-Shafer Theory

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Abstract. Breathing is a vital need for human being because without breathing human could not survive. The process of breathing is related to the respiratory system. Poor environmental and behavioral factors can cause problems with the respiratory tract. In 2013, Indonesia's Ministry of Health reported that the asthma prevalence was about 4.5% while for bronchitis that associated with COPD (Chronic Obstructive Pulmonary Disease) around 3.7%. In Manado particularly, according to the Integrated Disease Surveillance (IDS) 2015-2016 report that collected from government community health clinics across the province, there were 10 prominent diseases where 5 of it were categorized as respiratory disease. These were Influenza (Flu), Asthma, Bronchitis, Pneumonia and Pulmonary TB. In this study, we developed an expert system that can identify the 5 symptoms of the disease in the respiratory system and provide the treatment solutions. There were 25 symptoms defined in this study. Forward chaining method was used for the reasoning, while the uncertainty reasoning was based on Dempster-Shafer theory. Experimental results show that the trust value is up to 87.8%. This results clearly shows that the system can performed well to identify the respiratory disease.

1. Introduction

Breathing is a vital need for human, because without breathing human could not survive. There are several factors that can cause health problems in the respiratory tract, i.e.: environmental factors and behavioral factors of human towards their health. Environmental factors include poor sanitation such as lack of clean water, toilet, garbage disposal, waste management, healthy environments, water and air pollution. Poor behavioral factors include the lack of habit for proper hand washing, throwing trash out of place, and spitting in public places [1], in addition to the factors mentioned above, the health problems in the respiratory tract also can be caused by extreme weather factors. Based on the Basic Health Research (RKD) of the Ministry of Health of the Republic of Indonesia in 2013, the prevalence of asthma in Indonesia was 4.5% while bronchitis that associated with COPD (Chronic Obstructive Pulmonary Disease) was 3.7% [2]. Data from the North Sulawesi Provincial Health Office in 2015-2016, stated that there were 10 prominent diseases based on Disease Integrated Surveillance (STP) of North Sulawesi Province Health Center, the highest ranked disease was Influenza with 63,839 cases, pulmonary tuberculosis 7,223 cases, and Pneumonia 503 cases [3]. In this study, we used five types of respiratory diseases that frequently occur in North Sulawesi. We defined the five types of diseases based on the data from the North Sulawesi Provincial Health Office, where many people suffered from it but usually ignore the symptoms that appear and tend to choose to do their own treatment without consulting a doctor since the disease were considered as common illness. Respiratory health problem that are not treated properly can cause death. Usually, respiratory tract health problems can be solve by visiting a doctor in order to get an appropriate treatment.

An expert system is a computer system that is intended to replicate the aspects of an expert's decision-making ability. Expert systems make maximum use of special knowledge as an expert to solve problems [4]. Expert systems for diagnosis using the Dempster-Shafer theory have been widely used, however, there were only few number of researchers applied it for respiratory track diseases. The Dempster-Shafer theory proves by using Belief Functions (trust functions) and Plausible Reasoning (reasonable thinking), which are used to combine separate pieces of information (evidence) to calculate the probability of an event.

The remainder of the paper is organized as follows: Section 2 presents the literature review. A detailed explanation of the Dempster-Shafer theory is in section 3, while section 4 presents the expert system for the diagnosis of respiratory diseases. Section 5 shows the implementation of the system include the experimental results. Finally, Section 6 concludes the paper.

2. Related Work

Several researchers have studied about Dempster-Shafer method and its application in various fields such as in medical diagnosis, prediction and decision-making applications. Research conducted by [6] produced an expert system that can diagnose tuberculosis disease using the Bayes Theorem combining with Dempster-Shafer method. Likewise, research conducted by [7] was able to produce an expert system that can determine liver fibrosis disease using Dempster-Shafer theory that extended for fuzzy focal elements.

The research conducted by [8] combined the Analytic Hierarchy Process (AHP) with Dempster-Shafer Theory for multi-criteria decision-making (MCDM). The research conducted by [9] proposed a forex trading expert system based on some new technical analysis indicators and a new approach to the rule-base evidential reasoning (RBER) using fuzzy logic and the Dempster-Shafer theory. The first two studies mentioned above have similarities in the research topic while the rest two studies have similarities in the method approach, i.e. Dempster-Shafer.

3. Dempster-Shafer Theory

The Dempster-Shafer method was first introduced by Dempster, that experimented with an uncertainty model with a probability range as a single probability. In 1976 Shafer published the Dempster theory in a book entitled *Mathematical Theory of Evident*. In general, the Dempster-Shafer theory is written with the following formula [10]:

$$Bel(X) = \sum_{X \subseteq Y} m(Y) \quad (1)$$

$$Pls(X) = 1 - Bel(X') = 1 - \sum_{X \subseteq Y'} m(X') \quad (2)$$

Belief (Bel) is a measure of the strength of evidence in supporting a set of propositions. If it is zero then it indicates that there is no evidence, and if the value of 1 indicates that there is certainty. Plausibility is also valued at 0 to 1, if we are sure of X 'we can say $Bel(X') = 1$ so that the formula above values $Pls(X) = 0$. [10]. In an expert system, for a problem there are a number of evidence that will be used as the uncertainty factor for decision making in diagnosing a problem. To deal with a number of such evidence the Dempster-Shafer theory is written with the following formula:

$$\sum_{X \in P(\Theta)} m(X) = 1 \approx \sum_{X \in P(\Theta)} m(X) = 1 \quad (3)$$

$$m1 \oplus m2(Z) = \frac{\sum_{X \cap Y=Z} m1(X)m2(Y)}{1-k} \quad (4)$$

$$k = \sum_{X \cap Y=\emptyset} m1(X)m2(Y) \quad (5)$$

Figure 1 depicts the flowchart of expert systems for diagnosing respiratory diseases using the Dempster-Shafer theory

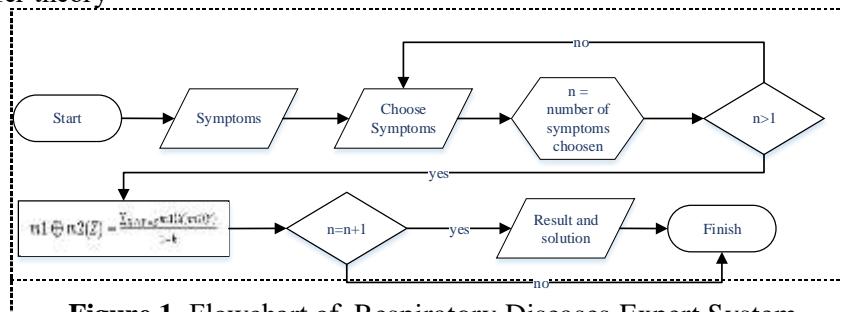


Figure 1. Flowchart of Respiratory Diseases Expert System

4. Respiratory Diseases Expert System

An expert system usually has four main components consisting of knowledge acquisition, knowledge base, inference engine, and system interface [11]. Likewise, the Respiratory Diagnosis System Expert System also has four components. The architecture can be seen in Figure 2.

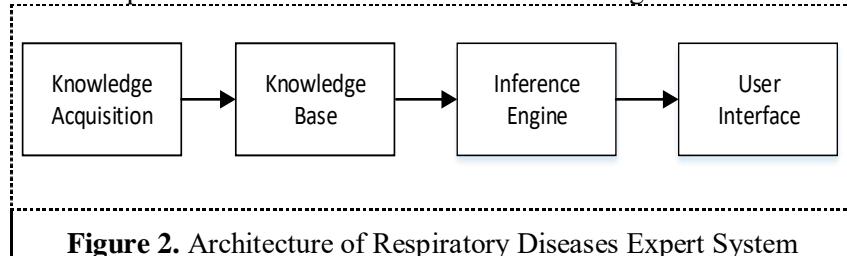


Figure 2. Architecture of Respiratory Diseases Expert System

4.1. Knowledge Acquisition

In this study the source of knowledge was obtained from three sources. Documentary sources of knowledge that complement the data were obtained from books and journals. For the main sources of knowledge obtained through interviews from the experts i.e. respiratory disease doctors (pulmonologist). The explanation of various types of diseases in the respiratory tract along with their symptoms, and the weight to each symptom were also obtained from the experts. Moreover, we also obtained the ways of treatment and prevention of diseases in the respiratory tract from the experts.

4.2. Knowledge Base

Knowledge base plays an important role in the development of expert systems. Through the knowledge base everything related to the symptoms of respiratory tract disease were expressed through facts and rules as the reference for solving problems. In our design there are five types of respiratory diseases with 25 symptoms. The knowledge base for respiratory diseases can be seen in Table 1.

Table 1. Knowledge Base of Respiratory Disease's

Symptoms	D1 ^a	D2 ^b	D3 ^c	D4 ^d	D5 ^e	Trust Value
The body feels pain especially on the back	√					0.6
Chills with fever	√		√	√	√	0.6
Sneeze	√					0.8
Nasal Congestion	√		√			0.8
Runny nose	√					0.6
Sore throat	√		√			0.6
Headache	√		√			0.5
White phlegm cough		√				0.6
Feel tightness in chest		√				0.5
Shortness of breath			√			0.5
Cough with phlegm after 2-3 days			√			0.6
Yellow phlegm cough			√	√	√	0.6
Sudden breathless-ness	√					0.8
Night sweats without any reasons			√	√		0.7
Green phlegm cough			√			0.5
Wheezing	√					0.6
Nausea and vomiting			√			0.5
Coughing up blood			√		√	0.7
Diarrhea			√			0.4

Dry cough	√	√	0.8
Cough for more than a Month		√	0.8
Appetite and weight Loss		√	0.6
Insomnia/ Sleep Disorder		√	0.4
Shortness of breath on Exertion		√	0.8
Chest pain		√	0.4

^aInfluenza.

^bAsthma.

^cBronchitis.

^dPneumonia.

^ePulmonary Tuberculosis.

The list of symptoms along with the trust values shown in Table 1 is the result of knowledge acquisition from a pulmonologist in Manado. If the trust value > 0.5 it means that the symptom is a typical symptom that characterized for the five respiratory tract diseases, while if the trust value is < 0.5 then this just a common symptom of the respiratory tract disease.

4.3. Inference Engine

The inference engine is the brain of the expert system. This component contains the mindset and reasoning mechanism used by experts in solving a problem. In this study the inferiority technique uses forward chaining while the representation of knowledge using rules. Below show an example of the calculation process using the Dempster-Shafer theory that applied in the expert system for diagnosis the respiratory diseases. Five symptoms data from several respiratory diseases along with the weight defined by the expert are shown in Table 2.

Table 2. Symptoms and the trust value

Symptom	Trust Value
Sneeze	0.8
Nasal congestion	0.8
Runny nose	0.6
Coughing up blood	0.7
Insomnia/Sleep Disorder	0.4

1. Define the initial density (m)

Initial density (m) consists of belief and plausibility

1st Symptom: Sneeze

Sneezing is a symptom of Influenza ($P1$) with a weight of 0.8, so we obtained:

$$m1\{P1\} = 0,8$$

$$m2\{\emptyset\} = 1 - 0,8 = 0,2$$

2nd Symptom: Nasal congestion

Nasal congestion is a symptom of Influenza ($P1$) and Bronchitis ($P3$) with a weight of 0.8, then we obtained:

$$m2\{P1, P3\} = 0,8$$

$$m2\{\emptyset\} = 1 - 0,8 = 0,2$$

2. Define the new density (m)

The occurrence of the second symptom i.e. nasal congestion, thus we need to calculate the new density for several combinations ($m3$). The combination of rules between ($m1$) and ($m2$) can be seen in Table 3.

Table 3. Combination rules for $m3$

$m2\{P1, P3\} = 0,8$	$m2\{\theta\} = 0,2$
$m1\{P1\} = 0,8$	$P1 = 0,64$
$m1\{\theta\} = 0,2$	$P1, P3 = 0,16$

$$m3\{P1\} = \frac{0,64+0,16}{1-0} = 0,8 \quad m3\{P1, P3\} = \frac{0,16}{1-0} = 0,16$$

$$m3\{\theta\} = 1 - (0,8 + 0,16) = 0,04$$

3rd Symptoms: Runny nose

Runny nose is a symptom of Influenza ($P1$) with a weight of 0.6, then we obtained:

$$m4\{P1\} = 0,6$$

$$m4\{\theta\} = 1 - 0,6 = 0,4$$

The occurrence of the third symptom i.e. runny nose, thus we need to calculate the new density for several combinations ($m5$). The combination of rules between ($m3$) and ($m4$) can be seen in Table 4.

Table 4. Combination rules for $m5$

$m4\{P1\} = 0,6$	$m4\{\theta\} = 0,4$	
$m3\{P1\} = 0,8$	$P1 = 0,48$	$P1 = 0,32$
$m3\{P1, P3\} = 0,16$	$P1 = 0,096$	$P1, P3 = 0,064$
$m3\{\theta\} = 0,04$	$P1 = 0,024$	$\theta = 0,016$

$$m5\{P1\} = \frac{0,48 + 0,096 + 0,032 + 0,024}{1-0} = 0,92 \quad m5\{P1, P3\} = \frac{0,064}{1-0} = 0,064$$

4th Symptoms: Coughing up blood

Coughing up blood is a symptom of Pneumonia ($P4$) and Pulmonary TB ($P5$) with a weight of 0.7, then we obtained:

$$m6\{P4, P5\} = 0,7$$

$$m6\{\theta\} = 1 - 0,7 = 0,3$$

The occurrence of the fourth symptom i.e. coughing up blood, thus we need to calculate the new density for several combinations ($m7$). The combination of rules between ($m5$) and ($m6$) can be seen in Table 5.

Table 5. Combination rules $m7$

$m6\{P4, P5\} = 0,7$	$m6\{\theta\} = 0,3$	
$m5\{P1\} = 0,92$	$\theta = 0,644$	$P1 = 0,276$
$m5\{P1, P3\} = 0,064$	$\theta = 0,0448$	$P1, P3 = 0,0192$
$m3\{\theta\} = 0,016$	$P4, P5 = 0,0112$	$\theta = 0,0048$

$$m7\{P1\} = \frac{0,276}{1-0,6888} = 0,8868 \quad m7\{P1, P3\} = \frac{0,0192}{1-0,6888} = 0,0616$$

$$m7\{P4, P5\} = \frac{0,0112}{1-0,6888} = 0,0359$$

5th Symptom: Insomnia/Sleep Disorder

Insomnia/Sleep Disorder is a symptom of Pulmonary TB (*P5*) with a weight of 0.4, then we obtained:

$$m8\{P5\} = 0,4$$

$$m8\{\emptyset\} = 1 - 0,6 = 0,6$$

The occurrence of the fifth symptom i.e. insomnia/sleep disorder, thus we need to calculate the new density for several combinations (*m9*). The combination of rules between (*m7*) and (*m8*) can be seen in Table 6.

Table 6. Combination rules *m9*

$m8\{P5\} = 0,4$	$m8\{\emptyset\} = 0,6$
$m7\{P1\} = 0,8868$	$\theta = 0,3547$
$m7\{P1, P3\} = 0,0616$	$P1, P3 = 0,0369$
$m7\{P4, P5\} = 0,0359$	$P4, P5 = 0,0215$
$m7\{\emptyset\} = 0,0048$	$P5 = 0,0064$
	$\theta = 0,0028$

$$m9\{P1\} = \frac{0,532}{1-0,3739} = 0,8497$$

$$m9\{P5\} = \frac{0,0143}{1-0,3739} = 0,0233$$

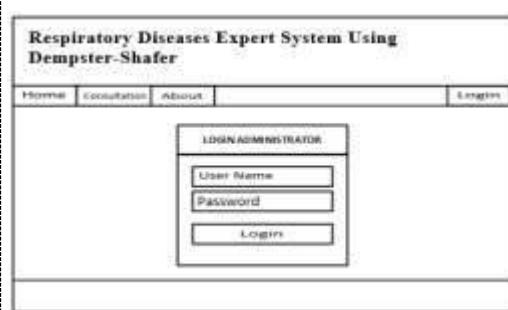
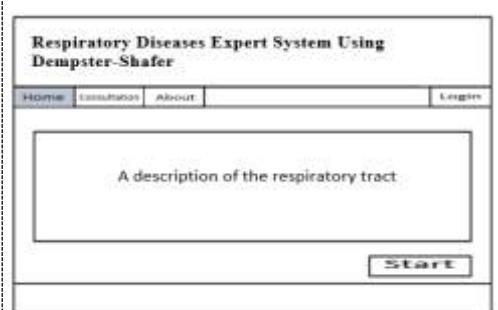
$$m9\{P1, P3\} = \frac{0,0369}{1-0,3739} = 0,0589$$

$$m9\{P4, P5\} = \frac{0,0215}{1-0,3739} = 0,0343$$

Based on the computation from 5 existing symptoms, the results obtained was *P1* disease, i.e. Influenza with a confidence value of 0.8497 or 84.97%.

4.4. User Interface

This component is a medium of interaction between the user and the system. There are three different types of users in the Respiratory Diagnosis System Expert Using the Dempster-Shafer Theory. The user interface on this system were made based on the type of users, i.e. regular user, expert, and administrator. Regular users interact with the system when consulting about respiratory diseases, while the expert users interact with the system in processing symptom, disease and solution data. The administrator user is the user responsible for the system. Expert System for Diagnosing Respiratory Tract Disease Using Dempster-Shafer Theory was build using PHP and MySQL for the database. In Figure 3 is a login page layout for expert users and administrators. Figure 4 depicts the homepage layout for regular user.

 <p>Respiratory Diseases Expert System Using Dempster-Shafer</p> <p>Home Consultation About Logout</p> <p>LOGIN ADMINISTRATOR</p> <p>User Name Password Login</p>	 <p>Respiratory Diseases Expert System Using Dempster-Shafer</p> <p>Home Consultation About Logout</p> <p>A description of the respiratory tract</p> <p>Start</p>
<p>Figure 3. Layout of Login page for expert and administrator</p>	<p>Figure 4. Layout of Homepage for regular user</p>

5. Implementation

Below are some of the user interaction with the system. For regular user, the consultation page consists of 3 sections, namely patient data sections, consultation section, and consultation results. The page for patient data is the initial page when user want to do a consultation which containing the input form that must be filled with the patient's personal data. The data that must be filled by the patient are full name, gender, age, and address. After user complete input the data, user will hit the "Start Consultation" button, then a consultation page will appear containing patient data and symptom data. Patient data contains the full name, gender, age, and address of the patient, while the symptom data contain a list of symptoms in the system. Furthermore, the patient must choose the appropriate symptoms. Upon completion selecting the appropriate symptoms, user will press the "View Results" button. Then the consultation result page will appear. The results of the consultation will stated the name of the disease, the value of trust, information about the disease, and possible solutions. The layouts for regular users consultation page and its result can be found in Figures 5 and 6 respectively.

	
Figure 5. Regular user's consultation page	Figure 6. Regular user's consultation result page

The page that can be accessed by expert users consist of patient data, disease data, and symptom data. Patient data contains data from patients who have consulted and the results of the consultation. Disease data display all types of diseases included in the system. The symptom data page containing symptoms data from diseases discussed in the application. Expert user's disease data page and symptoms can be found in Figures 7 and 8 respectively.

	
Figure 7. Expert user's disease data page	Figure 8. Expert user's symptoms data page

Data verification page can only be accessed by admin users and contains data that has been entered or changed by experts. Data verification display can be found in Figure 9.



Figure 9. Data verification page for administrator user

Based on the experimental results, we found that when we used two symptoms for predict the disease, the accuracy achieved is 80% for diseases namely influenza, asthma, pneumonia, and pulmonary tuberculosis. However, for bronchitis only achieved 64% of accuracy. The results keeps shows consistency in achieving higher accuracies when use 3 and 4 symptoms for all the diseases except for bronchitis which is show lower accuracy then other four diseases. Yet, all diseases can achieved high accuracies (>94.2%) when used 5 symptoms for the prediction. The test results can be seen in Table 7.

Table 7. Experimental Results

Disease Name	2 symptoms	3 symptoms	4 symptoms	5 symptoms	Average
Influenza	80%	92%	92%	96.8%	90.2%
Asthma.	80%	90%	92%	96%	89,5%
Bronchitis	64%	73,6%	88,5%	94,2%	80,1%
Pneumonia	80%	90%	94%	97%	90,3%
Pulmonary Tuberculosis	80%	88%	92%	95,2%	88,8%

6. Conclusion

In this paper, we have successfully build an expert system application for diagnosis the respiratory tract disease using the Dempster-Shafer Method. This application can help users to identify respiratory diseases and provide solutions to the diagnosis. The system diagnoses the types of respiratory diseases by including the symptoms experienced by the user through the system's interface.

The experimental results for five types of disease for five runs obtained the highest accuracy of 90.3% for pneumonia and the lowest accuracy of 80.1% for bronchitis. Thus, it can be concluded that the more symptoms given, the system will provide better results. The overall system performance has an accuracy of 87.8%

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Algorithm for Printing a Fold Book

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Abstract. When printing a book, generally page number is one of the important parameter so reader could follow all the content and information from the book. Several books are printed in a form of Fold Book in order to be more environmental friendly. Print a book in form of Fold Book needs more time and a little bit complex because we need to arrange all the page numbers in sequence orders whenever they are folded. To make the printing process faster, it is necessary to know the steps to do page numbering and how to print, to avoid any error and make the process easier. Not many people ever pay attention or have interest in conducting a research related this kind of printing. Considering the importance and usefulness of printing a Fold Book, a research is conducted to derive an algorithm for Fold Book page numbers printing which will be able to be used by human or applied on machines or computers. The methods used for this research were literature study, experience based observation, analysis, programming, and testing. The result is expected to meet the aim of this research, and really helpful for printing booklet, information, and textbook in a form of Folded Book.

1. Introduction

Book is a window of the world that helps us to get all kinds of information, extends our own view on science and technology, and understands daily problems. Although the development of Information Technology slowly starts to shift the existence of book, but book is still considered important and essential so *e-book* is created to change the role of book in human reality world.

However, even though *e-book* is getting easier to get, but some people still prefer print books rather than read *e-books* because printed book has several advantages over *e-book*. For example, it does not make our eyes become quickly tired, and there are also those who consider printed books to have more trading value if collected in printed form.

The publishing industry in Indonesia has an annual net revenue of USD 466 million in 2013 and create important role in educating Indonesian people around more than 17,000 islands. Almost 40,000 new titles are published annually and *e-book* only contribute 2 % [9].

For students, book is something that cannot be negotiable. Unfortunately it is not easy to get English textbooks in Indonesia. In addition, these textbooks are generally much more expensive than local books. Fortunately nowadays is very easy to get textbook in a form of *e-book*. *E-book* can be printed again in a form of book for easier reading and learning.

When printing a book, generally page number is one of the important parameter so reader could follow all the content and information from the book. Several books are printed in a form of Fold Book in order to be more environmental friendly. Print a book in form of Fold Book needs more time and a little bit complex because we need to arrange all the page numbers in sequence orders whenever they are folded. To make the printing process faster, it is necessary to know the steps to do page numbering and how to print, to avoid any error and make the process easier.

People mostly know how to print a booklet, information, or book using single sheet in A4 size and F4 size, but when they are dealing with Fold Book, it is a bit annoying and cause a problem and delay their time for printing. Although some printer already have feature for book printing, but people, especially workers and students, did not pay much attention to that and it happened that they still keep having problems when printing a folded book using A4 and F4 paper sheets.

The methods used for this research were literature study, experience based observation, analysis, programming, and testing. The result is expected to meet the aim of this research, and assist people to print booklet, information, and textbook easier and faster than they usually did. The reason why we conducted this study was also because we considered not many people have done a research related to this problem despite book is still important for human life development and how future digital technology improvement will be very helpful with this algorithm that could be applied in artificial intelligence based computers.

2. Scope of Problem

This research is focused on “How to derive an algorithm for page numbers printing which will be able to be used by human or applied on machines or computers?”

3. Literature Review

Based on online survey done by Vision Prize, scientists in climate field are mostly choose renewable energy, energy efficiency, and future generation nuclear power as the most promising one in resolving climate change. Twenty six percents of respondent told that they will focused on using fund for energy efficiency, and specifically 20% respondent on energy efficiency technology. This means that scientists are starting to make priority on other solutions beside carbon emission reduction [5]. Various innovation could be done on a product or a technology to create a better outcome to solve recent problems in human life. The success of innovation will depend on the innovator, supporting resources, and ability to deal with frustration and uncertainty, and qualitative and quantitative inputs at decision making process. One part of the innovation scope is related to assemblies, i.e. configure components being connected to become another form of product which shown a specific or set of functions [6].

Printing a multipage document in booklet form is a difficult task if we do it manually. We need to calculate page sizes and margins, and worst of all have to reorder the pages so that they come out in the proper order when the sheets are folded and collated. Fortunately, Word can do all the hard work that we want [7,8].

Microsoft Word has a menu for printing fold books that can be found at Page Setup Microsoft Word. There are several steps to do the printing using Microsoft Word Rules, however the procedures will be easier if could be simplify in just few steps using algorithm [7,8].

4. Results and Discussion

Normally when we print a book, page number is the important parameter so readers could follow all the content and information from the book. If the book does not print in a right sequence number, both us and the readers could get confused or do not know where to start reading it, and would be a little mess with the book being printed.

Several books are printed in a form of Fold Book in order to be more environmental friendly. Print a book in form of Fold Book needs more time and a little bit complex because we need to arrange all the page numbers in sequence orders whenever they are folded. To make the printing process faster, it is necessary to know the steps to do page numbering and how to print, to avoid any error and make the process easier. This research is conducted to derive an algorithm for page numbers printing which will be able to be used by human or applied on machines or computers. The methods used for this research were literature study, experience based observation, analysis, programming, and testing.

4.1. Basic Concept

Whenever people want to do a printing job, they usually need to consider certain aspects such as size, margins, and page layout. Some critical items in binding also need to be included as important parameters or requirements [10].

Most booklets are printed with Saddle-Stitch binding method [4] that uses printed sheets which are folded and nested one inside the other and then stapled through the fold line with wire staples. Based on literature study and experience based observation, first we derive the basic concept for doing numbering. It starts from the minimum page that we could have, i.e. 4 pages which need only 1 sheet of A4 paper. If we fold the paper, we could get 4 pages with the sequence as shown in figure 1.

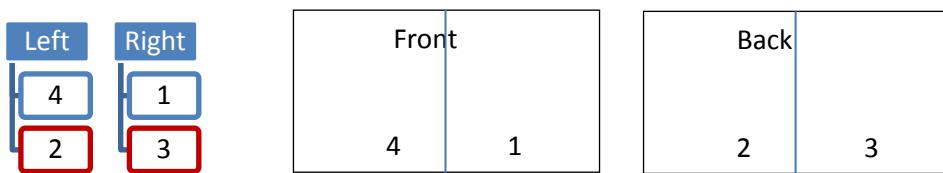


Figure 1. Basic Concept of an Algorithm for Printing Fold Book

The printing selection should be 2 pages per sheet. Do the right sequence, the first printing at the front of the paper will be page 4 and page 1 (4,1), and the other printing on the back of the paper will be page 2 and page 3 (2,3).

4.2. Algorithm

From the basic concept, we can derive an algorithm to help us do page numbering and print the fold book easier:

1. Write the number of page that need to be printed (including cover and all sections). Number of page = n .
2. Round up n to multiplication of 4 (4,8,12,16,20,24,28, and so on).
3. Divided by 4 to know the number of sheet that will be needed for printing.
4. List and write the page number into LEFT and RIGHT cells in a zigzag pattern, started with page 1 on the upper right cell. When arrive at the bottom cell, back again until at the top, ended on the upper left cell. This procedure is explained clearly in figure 2.

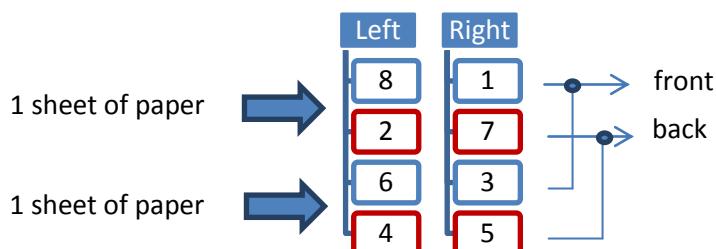


Figure 2. Numbering a Booklet that has 5, 6, 7, or 8 pages

5. Set the print process for 2 pages per sheet.
6. Set the sequence of pages that will be printed in a form of (left,right).
7. Start printing all the front pages, and then idle for 2 or 3 minutes for paper reversing that will continue printing all the back pages.

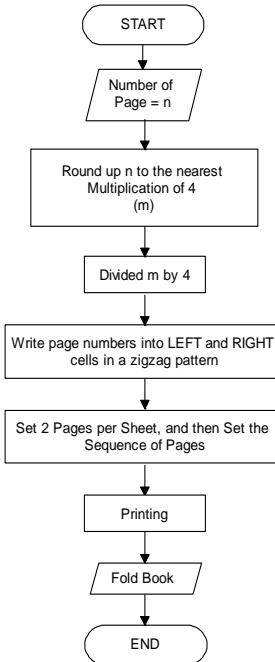


Figure 3. Flowchart of a Fold Book Printing Algorithm

This algorithm can be used manually by human to print a fold book, or applied on machines or computers. To describe more briefly, we simulate the algorithm using C programming to get the desired output logically [1,2,3].

```

Void calculate(int pages)
{
    //Variable Declaration
    int i; //public looping
    int counter = 0; //counter variable
    int pagesL; //pages counter
    int j=0; //sheet pages looping
    int countL; //upper bound sheet pages
    int sheet; //print sets
    //Round up the number of page
    while(pages%4!=0)
        pages++;
    //Defining the number of sheets needed
    int sheets=pages;
    printf("Number of sheets: %d\n",sheet);
    //Defining the left and right cells
    int indexLpage;
    int arrleft[100];
    int arrright[100];
    pages=pages/2;
    //set array value to 0
    for (i=0; i<pages; i++)
        arrleft[i]=0;
    for (i=0; i<pages; i++)
        arrright[i]=0;
    for (j=0; j<sheet; j++)
    {
        for (i=0; i<4; i++)
        {
            if (i==0)
                arrleft[0]=j+1;
            else if (i==1)
                arrright[0]=j+1;
            else if (i==2)
                arrleft[1]=j+1;
            else if (i==3)
                arrright[1]=j+1;
        }
        for (i=2; i<4; i++)
        {
            if (i==2)
                arrleft[2]=j+1;
            else if (i==3)
                arrright[2]=j+1;
        }
        for (i=4; i<6; i++)
        {
            if (i==4)
                arrleft[3]=j+1;
            else if (i==5)
                arrright[3]=j+1;
        }
        for (i=6; i<8; i++)
        {
            if (i==6)
                arrleft[4]=j+1;
            else if (i==7)
                arrright[4]=j+1;
        }
        for (i=8; i<10; i++)
        {
            if (i==8)
                arrleft[5]=j+1;
            else if (i==9)
                arrright[5]=j+1;
        }
        for (i=10; i<12; i++)
        {
            if (i==10)
                arrleft[6]=j+1;
            else if (i==11)
                arrright[6]=j+1;
        }
        for (i=12; i<14; i++)
        {
            if (i==12)
                arrleft[7]=j+1;
            else if (i==13)
                arrright[7]=j+1;
        }
        for (i=14; i<16; i++)
        {
            if (i==14)
                arrleft[8]=j+1;
            else if (i==15)
                arrright[8]=j+1;
        }
        for (i=16; i<18; i++)
        {
            if (i==16)
                arrleft[9]=j+1;
            else if (i==17)
                arrright[9]=j+1;
        }
        for (i=18; i<20; i++)
        {
            if (i==18)
                arrleft[10]=j+1;
            else if (i==19)
                arrright[10]=j+1;
        }
        for (i=20; i<22; i++)
        {
            if (i==20)
                arrleft[11]=j+1;
            else if (i==21)
                arrright[11]=j+1;
        }
        for (i=22; i<24; i++)
        {
            if (i==22)
                arrleft[12]=j+1;
            else if (i==23)
                arrright[12]=j+1;
        }
        for (i=24; i<26; i++)
        {
            if (i==24)
                arrleft[13]=j+1;
            else if (i==25)
                arrright[13]=j+1;
        }
        for (i=26; i<28; i++)
        {
            if (i==26)
                arrleft[14]=j+1;
            else if (i==27)
                arrright[14]=j+1;
        }
        for (i=28; i<30; i++)
        {
            if (i==28)
                arrleft[15]=j+1;
            else if (i==29)
                arrright[15]=j+1;
        }
        for (i=30; i<32; i++)
        {
            if (i==30)
                arrleft[16]=j+1;
            else if (i==31)
                arrright[16]=j+1;
        }
        for (i=32; i<34; i++)
        {
            if (i==32)
                arrleft[17]=j+1;
            else if (i==33)
                arrright[17]=j+1;
        }
        for (i=34; i<36; i++)
        {
            if (i==34)
                arrleft[18]=j+1;
            else if (i==35)
                arrright[18]=j+1;
        }
        for (i=36; i<38; i++)
        {
            if (i==36)
                arrleft[19]=j+1;
            else if (i==37)
                arrright[19]=j+1;
        }
        for (i=38; i<40; i++)
        {
            if (i==38)
                arrleft[20]=j+1;
            else if (i==39)
                arrright[20]=j+1;
        }
        for (i=40; i<42; i++)
        {
            if (i==40)
                arrleft[21]=j+1;
            else if (i==41)
                arrright[21]=j+1;
        }
        for (i=42; i<44; i++)
        {
            if (i==42)
                arrleft[22]=j+1;
            else if (i==43)
                arrright[22]=j+1;
        }
        for (i=44; i<46; i++)
        {
            if (i==44)
                arrleft[23]=j+1;
            else if (i==45)
                arrright[23]=j+1;
        }
        for (i=46; i<48; i++)
        {
            if (i==46)
                arrleft[24]=j+1;
            else if (i==47)
                arrright[24]=j+1;
        }
        for (i=48; i<50; i++)
        {
            if (i==48)
                arrleft[25]=j+1;
            else if (i==49)
                arrright[25]=j+1;
        }
        for (i=50; i<52; i++)
        {
            if (i==50)
                arrleft[26]=j+1;
            else if (i==51)
                arrright[26]=j+1;
        }
        for (i=52; i<54; i++)
        {
            if (i==52)
                arrleft[27]=j+1;
            else if (i==53)
                arrright[27]=j+1;
        }
        for (i=54; i<56; i++)
        {
            if (i==54)
                arrleft[28]=j+1;
            else if (i==55)
                arrright[28]=j+1;
        }
        for (i=56; i<58; i++)
        {
            if (i==56)
                arrleft[29]=j+1;
            else if (i==57)
                arrright[29]=j+1;
        }
        for (i=58; i<60; i++)
        {
            if (i==58)
                arrleft[30]=j+1;
            else if (i==59)
                arrright[30]=j+1;
        }
        for (i=60; i<62; i++)
        {
            if (i==60)
                arrleft[31]=j+1;
            else if (i==61)
                arrright[31]=j+1;
        }
        for (i=62; i<64; i++)
        {
            if (i==62)
                arrleft[32]=j+1;
            else if (i==63)
                arrright[32]=j+1;
        }
        for (i=64; i<66; i++)
        {
            if (i==64)
                arrleft[33]=j+1;
            else if (i==65)
                arrright[33]=j+1;
        }
        for (i=66; i<68; i++)
        {
            if (i==66)
                arrleft[34]=j+1;
            else if (i==67)
                arrright[34]=j+1;
        }
        for (i=68; i<70; i++)
        {
            if (i==68)
                arrleft[35]=j+1;
            else if (i==69)
                arrright[35]=j+1;
        }
        for (i=70; i<72; i++)
        {
            if (i==70)
                arrleft[36]=j+1;
            else if (i==71)
                arrright[36]=j+1;
        }
        for (i=72; i<74; i++)
        {
            if (i==72)
                arrleft[37]=j+1;
            else if (i==73)
                arrright[37]=j+1;
        }
        for (i=74; i<76; i++)
        {
            if (i==74)
                arrleft[38]=j+1;
            else if (i==75)
                arrright[38]=j+1;
        }
        for (i=76; i<78; i++)
        {
            if (i==76)
                arrleft[39]=j+1;
            else if (i==77)
                arrright[39]=j+1;
        }
        for (i=78; i<80; i++)
        {
            if (i==78)
                arrleft[40]=j+1;
            else if (i==79)
                arrright[40]=j+1;
        }
        for (i=80; i<82; i++)
        {
            if (i==80)
                arrleft[41]=j+1;
            else if (i==81)
                arrright[41]=j+1;
        }
        for (i=82; i<84; i++)
        {
            if (i==82)
                arrleft[42]=j+1;
            else if (i==83)
                arrright[42]=j+1;
        }
        for (i=84; i<86; i++)
        {
            if (i==84)
                arrleft[43]=j+1;
            else if (i==85)
                arrright[43]=j+1;
        }
        for (i=86; i<88; i++)
        {
            if (i==86)
                arrleft[44]=j+1;
            else if (i==87)
                arrright[44]=j+1;
        }
        for (i=88; i<90; i++)
        {
            if (i==88)
                arrleft[45]=j+1;
            else if (i==89)
                arrright[45]=j+1;
        }
        for (i=90; i<92; i++)
        {
            if (i==90)
                arrleft[46]=j+1;
            else if (i==91)
                arrright[46]=j+1;
        }
        for (i=92; i<94; i++)
        {
            if (i==92)
                arrleft[47]=j+1;
            else if (i==93)
                arrright[47]=j+1;
        }
        for (i=94; i<96; i++)
        {
            if (i==94)
                arrleft[48]=j+1;
            else if (i==95)
                arrright[48]=j+1;
        }
        for (i=96; i<98; i++)
        {
            if (i==96)
                arrleft[49]=j+1;
            else if (i==97)
                arrright[49]=j+1;
        }
        for (i=98; i<100; i++)
        {
            if (i==98)
                arrleft[50]=j+1;
            else if (i==99)
                arrright[50]=j+1;
        }
        for (i=100; i<102; i++)
        {
            if (i==100)
                arrleft[51]=j+1;
            else if (i==101)
                arrright[51]=j+1;
        }
        for (i=102; i<104; i++)
        {
            if (i==102)
                arrleft[52]=j+1;
            else if (i==103)
                arrright[52]=j+1;
        }
        for (i=104; i<106; i++)
        {
            if (i==104)
                arrleft[53]=j+1;
            else if (i==105)
                arrright[53]=j+1;
        }
        for (i=106; i<108; i++)
        {
            if (i==106)
                arrleft[54]=j+1;
            else if (i==107)
                arrright[54]=j+1;
        }
        for (i=108; i<110; i++)
        {
            if (i==108)
                arrleft[55]=j+1;
            else if (i==109)
                arrright[55]=j+1;
        }
        for (i=110; i<112; i++)
        {
            if (i==110)
                arrleft[56]=j+1;
            else if (i==111)
                arrright[56]=j+1;
        }
        for (i=112; i<114; i++)
        {
            if (i==112)
                arrleft[57]=j+1;
            else if (i==113)
                arrright[57]=j+1;
        }
        for (i=114; i<116; i++)
        {
            if (i==114)
                arrleft[58]=j+1;
            else if (i==115)
                arrright[58]=j+1;
        }
        for (i=116; i<118; i++)
        {
            if (i==116)
                arrleft[59]=j+1;
            else if (i==117)
                arrright[59]=j+1;
        }
        for (i=118; i<120; i++)
        {
            if (i==118)
                arrleft[60]=j+1;
            else if (i==119)
                arrright[60]=j+1;
        }
        for (i=120; i<122; i++)
        {
            if (i==120)
                arrleft[61]=j+1;
            else if (i==121)
                arrright[61]=j+1;
        }
        for (i=122; i<124; i++)
        {
            if (i==122)
                arrleft[62]=j+1;
            else if (i==123)
                arrright[62]=j+1;
        }
        for (i=124; i<126; i++)
        {
            if (i==124)
                arrleft[63]=j+1;
            else if (i==125)
                arrright[63]=j+1;
        }
        for (i=126; i<128; i++)
        {
            if (i==126)
                arrleft[64]=j+1;
            else if (i==127)
                arrright[64]=j+1;
        }
        for (i=128; i<130; i++)
        {
            if (i==128)
                arrleft[65]=j+1;
            else if (i==129)
                arrright[65]=j+1;
        }
        for (i=130; i<132; i++)
        {
            if (i==130)
                arrleft[66]=j+1;
            else if (i==131)
                arrright[66]=j+1;
        }
        for (i=132; i<134; i++)
        {
            if (i==132)
                arrleft[67]=j+1;
            else if (i==133)
                arrright[67]=j+1;
        }
        for (i=134; i<136; i++)
        {
            if (i==134)
                arrleft[68]=j+1;
            else if (i==135)
                arrright[68]=j+1;
        }
        for (i=136; i<138; i++)
        {
            if (i==136)
                arrleft[69]=j+1;
            else if (i==137)
                arrright[69]=j+1;
        }
        for (i=138; i<140; i++)
        {
            if (i==138)
                arrleft[70]=j+1;
            else if (i==139)
                arrright[70]=j+1;
        }
        for (i=140; i<142; i++)
        {
            if (i==140)
                arrleft[71]=j+1;
            else if (i==141)
                arrright[71]=j+1;
        }
        for (i=142; i<144; i++)
        {
            if (i==142)
                arrleft[72]=j+1;
            else if (i==143)
                arrright[72]=j+1;
        }
        for (i=144; i<146; i++)
        {
            if (i==144)
                arrleft[73]=j+1;
            else if (i==145)
                arrright[73]=j+1;
        }
        for (i=146; i<148; i++)
        {
            if (i==146)
                arrleft[74]=j+1;
            else if (i==147)
                arrright[74]=j+1;
        }
        for (i=148; i<150; i++)
        {
            if (i==148)
                arrleft[75]=j+1;
            else if (i==149)
                arrright[75]=j+1;
        }
        for (i=150; i<152; i++)
        {
            if (i==150)
                arrleft[76]=j+1;
            else if (i==151)
                arrright[76]=j+1;
        }
        for (i=152; i<154; i++)
        {
            if (i==152)
                arrleft[77]=j+1;
            else if (i==153)
                arrright[77]=j+1;
        }
        for (i=154; i<156; i++)
        {
            if (i==154)
                arrleft[78]=j+1;
            else if (i==155)
                arrright[78]=j+1;
        }
        for (i=156; i<158; i++)
        {
            if (i==156)
                arrleft[79]=j+1;
            else if (i==157)
                arrright[79]=j+1;
        }
        for (i=158; i<160; i++)
        {
            if (i==158)
                arrleft[80]=j+1;
            else if (i==159)
                arrright[80]=j+1;
        }
        for (i=160; i<162; i++)
        {
            if (i==160)
                arrleft[81]=j+1;
            else if (i==161)
                arrright[81]=j+1;
        }
        for (i=162; i<164; i++)
        {
            if (i==162)
                arrleft[82]=j+1;
            else if (i==163)
                arrright[82]=j+1;
        }
        for (i=164; i<166; i++)
        {
            if (i==164)
                arrleft[83]=j+1;
            else if (i==165)
                arrright[83]=j+1;
        }
        for (i=166; i<168; i++)
        {
            if (i==166)
                arrleft[84]=j+1;
            else if (i==167)
                arrright[84]=j+1;
        }
        for (i=168; i<170; i++)
        {
            if (i==168)
                arrleft[85]=j+1;
            else if (i==169)
                arrright[85]=j+1;
        }
        for (i=170; i<172; i++)
        {
            if (i==170)
                arrleft[86]=j+1;
            else if (i==171)
                arrright[86]=j+1;
        }
        for (i=172; i<174; i++)
        {
            if (i==172)
                arrleft[87]=j+1;
            else if (i==173)
                arrright[87]=j+1;
        }
        for (i=174; i<176; i++)
        {
            if (i==174)
                arrleft[88]=j+1;
            else if (i==175)
                arrright[88]=j+1;
        }
        for (i=176; i<178; i++)
        {
            if (i==176)
                arrleft[89]=j+1;
            else if (i==177)
                arrright[89]=j+1;
        }
        for (i=178; i<180; i++)
        {
            if (i==178)
                arrleft[90]=j+1;
            else if (i==179)
                arrright[90]=j+1;
        }
        for (i=180; i<182; i++)
        {
            if (i==180)
                arrleft[91]=j+1;
            else if (i==181)
                arrright[91]=j+1;
        }
        for (i=182; i<184; i++)
        {
            if (i==182)
                arrleft[92]=j+1;
            else if (i==183)
                arrright[92]=j+1;
        }
        for (i=184; i<186; i++)
        {
            if (i==184)
                arrleft[93]=j+1;
            else if (i==185)
                arrright[93]=j+1;
        }
        for (i=186; i<188; i++)
        {
            if (i==186)
                arrleft[94]=j+1;
            else if (i==187)
                arrright[94]=j+1;
        }
        for (i=188; i<190; i++)
        {
            if (i==188)
                arrleft[95]=j+1;
            else if (i==189)
                arrright[95]=j+1;
        }
        for (i=190; i<192; i++)
        {
            if (i==190)
                arrleft[96]=j+1;
            else if (i==191)
                arrright[96]=j+1;
        }
        for (i=192; i<194; i++)
        {
            if (i==192)
                arrleft[97]=j+1;
            else if (i==193)
                arrright[97]=j+1;
        }
        for (i=194; i<196; i++)
        {
            if (i==194)
                arrleft[98]=j+1;
            else if (i==195)
                arrright[98]=j+1;
        }
        for (i=196; i<198; i++)
        {
            if (i==196)
                arrleft[99]=j+1;
            else if (i==197)
                arrright[99]=j+1;
        }
        for (i=198; i<200; i++)
        {
            if (i==198)
                arrleft[100]=j+1;
            else if (i==199)
                arrright[100]=j+1;
        }
        for (i=199; i<201; i++)
        {
            if (i==199)
                arrleft[101]=j+1;
            else if (i==200)
                arrright[101]=j+1;
        }
        for (i=200; i<202; i++)
        {
            if (i==200)
                arrleft[102]=j+1;
            else if (i==201)
                arrright[102]=j+1;
        }
        for (i=201; i<203; i++)
        {
            if (i==201)
                arrleft[103]=j+1;
            else if (i==202)
                arrright[103]=j+1;
        }
        for (i=202; i<204; i++)
        {
            if (i==202)
                arrleft[104]=j+1;
            else if (i==203)
                arrright[104]=j+1;
        }
        for (i=203; i<205; i++)
        {
            if (i==203)
                arrleft[105]=j+1;
            else if (i==204)
                arrright[105]=j+1;
        }
        for (i=204; i<206; i++)
        {
            if (i==204)
                arrleft[106]=j+1;
            else if (i==205)
                arrright[106]=j+1;
        }
        for (i=205; i<207; i++)
        {
            if (i==205)
                arrleft[107]=j+1;
            else if (i==206)
                arrright[107]=j+1;
        }
        for (i=206; i<208; i++)
        {
            if (i==206)
                arrleft[108]=j+1;
            else if (i==207)
                arrright[108]=j+1;
        }
        for (i=207; i<209; i++)
        {
            if (i==207)
                arrleft[109]=j+1;
            else if (i==208)
                arrright[109]=j+1;
        }
        for (i=208; i<210; i++)
        {
            if (i==208)
                arrleft[110]=j+1;
            else if (i==209)
                arrright[110]=j+1;
        }
        for (i=209; i<211; i++)
        {
            if (i==209)
                arrleft[111]=j+1;
            else if (i==210)
                arrright[111]=j+1;
        }
        for (i=210; i<212; i++)
        {
            if (i==210)
                arrleft[112]=j+1;
            else if (i==211)
                arrright[112]=j+1;
        }
        for (i=211; i<213; i++)
        {
            if (i==211)
                arrleft[113]=j+1;
            else if (i==212)
                arrright[113]=j+1;
        }
        for (i=212; i<214; i++)
        {
            if (i==212)
                arrleft[114]=j+1;
            else if (i==213)
                arrright[114]=j+1;
        }
        for (i=213; i<215; i++)
        {
            if (i==213)
                arrleft[115]=j+1;
            else if (i==214)
                arrright[115]=j+1;
        }
        for (i=214; i<216; i++)
        {
            if (i==214)
                arrleft[116]=j+1;
            else if (i==215)
                arrright[116]=j+1;
        }
        for (i=215; i<217; i++)
        {
            if (i==215)
                arrleft[117]=j+1;
            else if (i==216)
                arrright[117]=j+1;
        }
        for (i=216; i<218; i++)
        {
            if (i==216)
                arrleft[118]=j+1;
            else if (i==217)
                arrright[118]=j+1;
        }
        for (i=217; i<219; i++)
        {
            if (i==217)
                arrleft[119]=j+1;
            else if (i==218)
                arrright[119]=j+1;
        }
        for (i=218; i<220; i++)
        {
            if (i==218)
                arrleft[120]=j+1;
            else if (i==219)
                arrright[120]=j+1;
        }
        for (i=219; i<221; i++)
        {
            if (i==219)
                arrleft[121]=j+1;
            else if (i==220)
                arrright[121]=j+1;
        }
        for (i=220; i<222; i++)
        {
            if (i==220)
                arrleft[122]=j+1;
            else if (i==221)
                arrright[122]=j+1;
        }
        for (i=221; i<223; i++)
        {
            if (i==221)
                arrleft[123]=j+1;
            else if (i==222)
                arrright[123]=j+1;
        }
        for (i=222; i<224; i++)
        {
            if (i==222)
                arrleft[124]=j+1;
            else if (i==223)
                arrright[124]=j+1;
        }
        for (i=223; i<225; i++)
        {
            if (i==223)
                arrleft[125]=j+1;
            else if (i==224)
                arrright[125]=j+1;
        }
        for (i=224; i<226; i++)
        {
            if (i==224)
                arrleft[126]=j+1;
            else if (i==225)
                arrright[126]=j+1;
        }
        for (i=225; i<227; i++)
        {
            if (i==225)
                arrleft[127]=j+1;
            else if (i==226)
                arrright[127]=j+1;
        }
        for (i=226; i<228; i++)
        {
            if (i==226)
                arrleft[128]=j+1;
            else if (i==227)
                arrright[128]=j+1;
        }
        for (i=227; i<229; i++)
        {
            if (i==227)
                arrleft[129]=j+1;
            else if (i==228)
                arrright[129]=j+1;
        }
        for (i=228; i<230; i++)
        {
            if (i==228)
                arrleft[130]=j+1;
            else if (i==229)
                arrright[130]=j+1;
        }
        for (i=229; i<231; i++)
        {
            if (i==229)
                arrleft[131]=j+1;
            else if (i==230)
                arrright[131]=j+1;
        }
        for (i=230; i<232; i++)
        {
            if (i==230)
                arrleft[132]=j+1;
            else if (i==231)
                arrright[132]=j+1;
        }
        for (i=231; i<233; i++)
        {
            if (i==231)
                arrleft[133]=j+1;
            else if (i==232)
                arrright[133]=j+1;
        }
        for (i=232; i<234; i++)
        {
            if (i==232)
                arrleft[134]=j+1;
            else if (i==233)
                arrright[134]=j+1;
        }
        for (i=233; i<235; i++)
        {
            if (i==233)
                arrleft[135]=j+1;
            else if (i==234)
                arrright[135]=j+1;
        }
        for (i=234; i<236; i++)
        {
            if (i==234)
                arrleft[136]=j+1;
            else if (i==235)
                arrright[136]=j+1;
        }
        for (i=235; i<237; i++)
        {
            if (i==235)
                arrleft[137]=j+1;
            else if (i==236)
                arrright[137]=j+1;
        }
        for (i=236; i<238; i++)
        {
            if (i==236)
                arrleft[138]=j+1;
            else if (i==237)
                arrright[138]=j+1;
        }
        for (i=237; i<239; i++)
        {
            if (i==237)
                arrleft[139]=j+1;
            else if (i==238)
                arrright[139]=j+1;
        }
        for (i=238; i<240; i++)
        {
            if (i==238)
                arrleft[140]=j+1;
            else if (i==239)
                arrright[140]=j+1;
        }
        for (i=239; i<241; i++)
        {
            if (i==239)
                arrleft[141]=j+1;
            else if (i==240)
                arrright[141]=j+1;
        }
        for (i=240; i<242; i++)
        {
            if (i==240)
                arrleft[142]=j+1;
            else if (i==241)
                arrright[142]=j+1;
        }
        for (i=241; i<243; i++)
        {
            if (i==241)
                arrleft[143]=j+1;
            else if (i==242)
                arrright[143]=j+1;
        }
        for (i=242; i<244; i++)
        {
            if (i==242)
                arrleft[144]=j+1;
            else if (i==243)
                arrright[144]=j+1;
        }
        for (i=243; i<245; i++)
        {
            if (i==243)
                arrleft[145]=j+1;
            else if (i==244)
                arrright[145]=j+1;
        }
        for (i=244; i<246; i++)
        {
            if (i==244)
                arrleft[146]=j+1;
            else if (i==245)
                arrright[146]=j+1;
        }
        for (i=245; i<247; i++)
        {
            if (i==245)
                arrleft[147]=j+1;
            else if (i==246)
                arrright[147]=j+1;
        }
        for (i=246; i<248; i++)
        {
            if (i==246)
                arrleft[148]=j+1;
            else if (i==247)
                arrright[148]=j+1;
        }
        for (i=247; i<249; i++)
        {
            if (i==247)
                arrleft[149]=j+1;
            else if (i==248)
                arrright[149]=j+1;
        }
        for (i=248; i<250; i++)
        {
            if (i==248)
                arrleft[150]=j+1;
            else if (i==249)
                arrright[150]=j+1;
        }
        for (i=249; i<251; i++)
        {
            if (i==249)
                arrleft[151]=j+1;
            else if (i==250)
                arrright[151]=j+1;
        }
        for (i=250; i<252; i++)
        {
            if (i==250)
                arrleft[152]=j+1;
            else if (i==251)
                arrright[152]=j+1;
        }
        for (i=251; i<253; i++)
        {
            if (i==251)
                arrleft[153]=j+1;
            else if (i==252)
                arrright[153]=j+1;
        }
        for (i=252; i<254; i++)
        {
            if (i==252)
                arrleft[154]=j+1;
            else if (i==253)
                arrright[154]=j+1;
        }
        for (i=253; i<255; i++)
        {
            if (i==253)
                arrleft[155]=j+1;
            else if (i==254)
                arrright[155]=j+1;
        }
        for (i=254; i<256; i++)
        {
            if (i==254)
                arrleft[156]=j+1;
            else if (i==255)
                arrright[156]=j+1;
        }
        for (i=255; i<257; i++)
        {
            if (i==255)
                arrleft[157]=j+1;
            else if (i==256)
                arrright[157]=j+1;
        }
        for (i=256; i<258; i++)
        {
            if (i==256)
                arrleft[158]=j+1;
            else if (i==257)
                arrright[158]=j+1;
        }
        for (i=257; i<259; i++)
        {
            if (i==257)
                arrleft[159]=j+1;
            else if (i==258)
                arrright[159]=j+1;
        }
        for (i=258; i<260; i++)
        {
            if (i==258)
                arrleft[160]=j+1;
            else if (i==259)
                arrright[160]=j+1;
        }
        for (i=259; i<261; i++)
        {
            if (i==259)
                arrleft[161]=j+1;
            else if (i==260)
                arrright[161]=j+1;
        }
        for (i=260; i<262; i++)
        {
            if (i==260)
                arrleft[162]=j+1;
            else if (i==261)
                arrright[162]=j+1;
        }
        for (i=261; i<263; i++)
        {
            if (i==261)
                arrleft[163]=j+1;
            else if (i==262)
                arrright[163]=j+1;
        }
        for (i=262; i<264; i++)
        {
            if (i==262)
                arrleft[164]=j+1;
            else if (i==263)
                arrright[164]=j+1;
        }
        for (i=263; i<265; i++)
        {
            if (i==263)
                arrleft[165]=j+1;
            else if (i==264)
                arrright[165]=j+1;
        }
        for (i=264; i<266; i++)
        {
            if (i==264)
                arrleft[166]=j+1;
            else if (i==265)
                arrright[166]=j+1;
        }
        for (i=265; i<267; i++)
        {
            if (i==265
```

5. Conclusion

Our basic research gives conclusion that an algorithm for printing a fold book could be derived to make booklets printing or textbooks printing easier to be done and can be applied manually or applied automatically on machines and computers, so those digital devices can help people in operating and doing any task related to Fold Book printing.

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Fractional Differential Equation Model for Relaxation Problem of Lubricating Oil

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Abstract. Two of the relaxation problems in fluids are surface tension and viscosity. The surface tension of a fluid is the stretched elastic tendency of the fluid due to the attraction force between the molecules. Meanwhile, viscosity is a measure which represents the magnitude of a moving fluid. Previous studies are interested in the fluid mechanics problem presenting the relationship between the surface tension and viscosity in both linear and exponential models. The aim of this study is to present the the discourse about the fractional relationship in the form of fractional differential equation model based on the empirical data of the measurement of surface tension and viscosity of lubricating oil in the laboratory. Laplace transform and Mittag-Leffler function are used to find solution of fractional differential equation. The output of this research is a proposed fractional model and some graphs showing the relationship between them.

1. Introduction

Two of many problems of relaxation in fluids are surface tension and viscosity. Surface tension is a fluid tendency to stretch, so that the surface of fluids is covered by a membrane caused by cohesion, and surface tension is the surface force of each unit of length with the unit N/m . Viscosity is a measure that states the magnitude of friction between molecules in a fluid.

Based on the empirical calculation of surface tension and viscosity of 25 types of lubricants in laboratory, we design the fractional relationship model that consist of Fractional Derivative Model and Fractional Differential Equation Model.

In liquids, viscosity is caused by the force of cohesion between similar molecules. The coefficient of viscosity denoted by η where the unit is Nsm^{-2} . If there is a moving object in a liquid which has a viscosity η , the object will have a frictional force. In other words, if the object moves with velocity v in the fluid with coefficient of viscosity η , then the frictional force is

$$F_{fr} = k \eta v$$

The surface tension of a liquid corresponds to the stretching line that the liquid surface possesses, and is defined as the force per unit of length. The formula for surface tension is

$$\gamma = \frac{F}{l}$$

where F is force , l stays for length (m), and γ represents surface tension (N/m).

The relationship between surface tension and viscosity has been proposed firstly by Silverman & Roseveare (1932) with the following equation:

$$\gamma^{-1/4} = A \frac{1}{\eta} + B$$

where A and B are constants.

Pelofsky then (1966) proposes an empirical relationship between the natural logarithm of surface tension and the inverse of viscosity in a large variety of liquids with the formula

$$\gamma = A \exp\left(-\frac{B}{\eta}\right)$$

where A and B are constants.

The Pelofsky formula is then challenged by Schonhorn (1967). He extends the formula by introducing the concept of vapour viscosity η_v into the following equation:

$$\gamma = A \exp\left(-\frac{B}{\eta_l - \eta_v}\right).$$

Schonhorn equation, however, is not successful in correlating the temperature where $\eta \rightarrow \infty$ and surface tension at the melting point. Thus, empirical equation has been developed by Ahmari & Amiri (2015):

$$\gamma = A \frac{T_c - T}{T_c - T_m} \left(1 - \frac{B}{\eta}\right).$$

2. Methods

In this research we use the data of 30 types of lubricating oils with various brands and SAE grades. The surface tension and viscosity of each lubricant are measured in laboratories.

The viscosity is measured by Sekonic Viscomate VM-10A-L instrument at Material Physics Laboratory of Universitas Padjadjaran. Meanwhile the surface tension is measured by Digital Tensiometer Lauda TD1 instrument at Pharmacy Instrument Laboratory of Institut Teknologi Bandung.

To find solution of fractional differential equation, Laplace Transformation and Mittag-Leffler function are used as the method.

Laplace Transformation of function $f(t)$ is

$$F(s) = \int_0^\infty e^{-st} f(t) dt,$$

and the Mittag-Leffler function with two parameters α and β is defined as follows

$$E_{\alpha,\beta}(z) = \sum_{k=0}^{\infty} \frac{z^k}{\Gamma(\alpha k + \beta)}, \quad (\alpha > 0, \beta > 0).$$

Another form of Mittag-Leffler function is $\varepsilon_k(t, \lambda; \alpha, \beta)$ is

$$\varepsilon_k(t, \lambda; \alpha, \beta) = t^{\alpha k + \beta - 1} E_{\alpha,\beta}^{(k)}(\lambda t^\alpha), \quad (k = 0, 1, 2, 3, \dots).$$

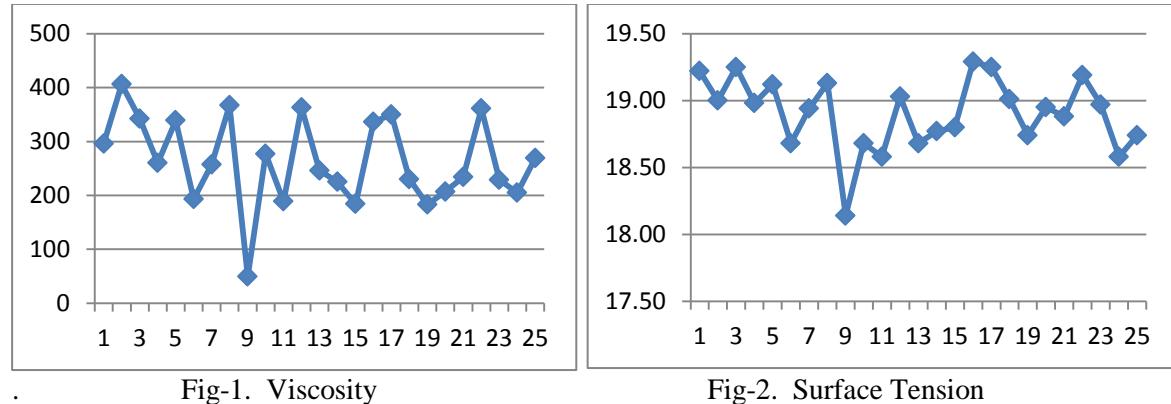
where $E_{\alpha,\beta}^{(k)}(z)$ is k -order derivatives. Laplace transformation of Mittag-Leffler function is

$$L\{\varepsilon_k(t, \pm \lambda; \alpha, \beta)\} = \frac{k! s^{\alpha - \beta}}{(s^\alpha \mp \lambda)^{k+1}} \dots$$

3. Main Result

3.1 Result of Measurement

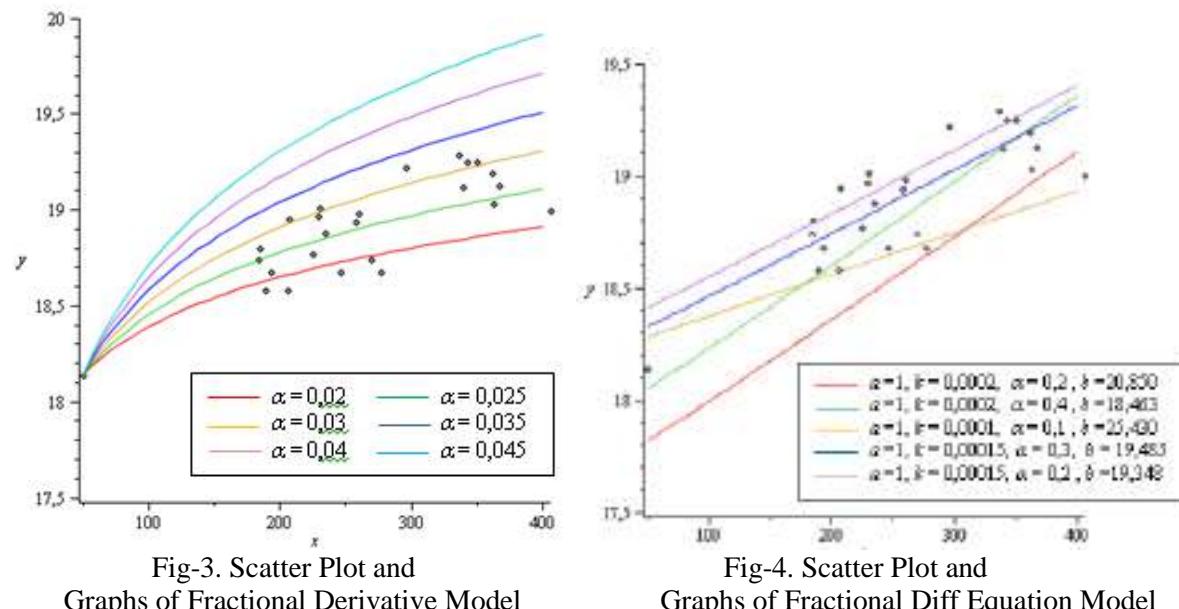
The results measurement of Surface Tension and Viscosity are presented in graph below:



3.2 Result of Models

Based on the data in Fig-1 and Fig-2. and the graphs in Fig-3 below, the fractional derivative model is obtained

$$\gamma = a \cdot D^\alpha \eta + b = 16,223 \cdot D^{(0,975)} \eta.$$



Based on the data in Fig-1 and Fig-2. and the graphs in Fig.4, the Fractional Differential Equation Model is obtained

$$\gamma^{(\alpha)} + a\gamma = b \cdot e^{k\eta}$$

where $a = 1$, $b = 19,485$, $k = 0,00015$, and $\alpha = 0,3$, or explicitly, can be expressed as

$$\gamma^{(0.3)} + \gamma = 19.485 e^{0.00015\eta}$$

4. Conclusion

Based on the research that has been done on the data which is the result of measurement of surface tension and lubricant oil viscosity of various types and brands circulating in Indonesia, there is an empirical relationship between the two. This relationship can be expressed in the regression model or fractional relationship, ie the fractional derivative model or the fractional differential equation model. Regardless of the size of the R^2 value, the existence of the solution of the fractional differential equation model is assured.

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Reserve of Equity-Linked Life Insurance Premium by using the Zillmer Method

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Abstract. Equity link life insurance is insurance that not only provides benefits protection, but also provides investment benefits. If only Indonesia Mortality Table 2011 is used as a tool to calculate premiums, it is not good enough because the data in the life table only reflects historical death information, so the chance of death cannot be calculated accurately to determine the amount of insurance premiums. In addition, the mortality rate for non-integral age cannot be obtained, giving rise to missing data. Alternatively, a combined mortality model will be used, which is formed by several forms of survival functions. The survival function model is divided into three age groups, namely young age will be used Weibull distribution, middle age will be used Inverse-Weibull distribution, and old age will be used Gompertz distribution. the results will also be compared with the results of calculations based on Indonesia Life Table 2011. The model obtained also, besides being used to calculate premiums, will also be used to calculate premium reserves. The method used to calculate premium reserves is the Zillmer Method. Net Single Premium obtained by using a combined mortality model to determine the chance of death, is greater than the premium calculated using TMI 2011. This certainly has a direct impact on the amount of premium reserves obtained.

1. Introduction

Initially life insurance only provides benefits when the insured is at risk. Such insurance is known as traditional life insurance. Traditional life insurance products get less attention for prospective customers because the benefits are only obtained when there is a risk. Along with the development of life insurance products, insurance products appear endowment soul that provides benefits not only when the insured person experiences risk, but when the insured party does not experience the risk also still get a profit. In addition to endowment life insurance, there is also insurance that provides protection and investment benefits known as equity-linked life insurance.

As with other insurance products, equity-linked life insurance uses the Mortality Table as a tool to calculate premiums. But, according to Tsai, et al, (2014) the use of Mortality Tables gives two problems, first the Mortality Table only reflects death information historically so that it cannot predict the rate of security to evaluate insurance. Second, it cannot determine the mortality rate information between two ages because the Mortality Table presents the mortality rate in discrete periods. These things can provide a premium determining the price of the premium, which should be higher than the premium price offered so that it can cause losses to the company.

The solution was used a combined Mortality Model that refers to Carriere, J.F (1992), Tsai, et al, (2014) to estimate the mortality rate. Tsai, et al (2014) made a mortality model by combining the survival functions of Gompertz, Weibull and Inverse-Weibull. In this study, used the Indonesian Mortality Table 2011 issued by AAJI (Indonesian Life Insurance Association) to

determine the Joint Mortality Model suitable for use in Indonesia and its effect on the calculation of equity-linked life insurance premiums.

Calculation of premium reserves is also very important because it can provide losses to the company if it is not suitable in the calculation. Calculation of reserves must be adjusted so as not to cause losses. For example, in the first year the costs required were greater than the costs in the following years, because accounting for new policies was more expensive than keeping a policy book. Therefore, the calculation of life insurance premiums related to the equity in this study used modified premium reserves, namely the Zillmer method. Rohaena, O (2007), uses the Zillmer method to determine premium reserves. The results obtained are expected to be more in line with the actual situation. The modified backup method from Zillmer is widely used in life insurance companies in Indonesia. In this paper the author will try to determine the reserve size of the equity link life insurance premium using the Zillmer Method.

2. Zilmer Method for Premium Reserves

The Combined Mortality Model is a model formed from several survival functions. The combined Mortality Model in this study refers to Tsai, et al, (2014), namely by combining the survival functions of Gompertz, Weibull, and Inverse-Weibull. It is assumed that the rate of death can be categorized into criteria for adults, adolescents, and children. In adulthood, the mortality rate follows the Gompertz distribution, the teenage mortality rate follows the Inverse-Weibull distribution and the mortality rate in children follows the Weibull distribution. The equation for determining the Combined Mortality Model, namely (Tsai, et al, 2014):

$$s(x) = \sum_{k=1}^3 \psi_k s_k(x) \quad 1$$

Where $s(x)$ is a survival function which states the probability of life at age x , ψ_k is the probability of death because k and $\psi_1 + \psi_2 + \psi_3 = 1$, $s(x)_k$ is the specific survival function because $k = 1,2,3$ which represents the Weibull, Inverse-Weibull, and Gompertz survival functions accordingly. Weibull, Inverse-Weibull, and Gompertz survival functions are defined as follows (Tsai, et al, 2014):

$$s_1(x) = \exp\left(-\left(\frac{x}{m_1}\right)^{\frac{m_1}{\sigma_1}}\right) \quad 2$$

$$s_2(x) = 1 - \exp\left(-\left(\frac{x}{m_2}\right)^{\frac{m_2}{\sigma_2}}\right) \quad 3$$

$$s_3(x) = \exp\left(\exp\left(-\frac{m_3}{\sigma_3}\right) - \exp\left(\frac{x - m_3}{\sigma_3}\right)\right) \quad 4$$

Where m_i is the location parameter and σ_i dispersion parameter, $i = 1,2,3$. Then the probability density function can be obtained, namely:

$$f(x) = \frac{\partial(1 - s(x))}{\partial x} = \sum_{k=1}^3 \psi_k f_k(x) \quad 5$$

where:

$$f_1(x) = \frac{1}{\sigma_1} \left(\frac{x}{m_1}\right)^{\frac{m_1}{\sigma_1}-1} \exp\left(-\left(\frac{x}{m_1}\right)^{\frac{m_1}{\sigma_1}}\right) \quad 6$$

$$f_2(x) = \frac{1}{\sigma_2} \left(\frac{x}{m_2}\right)^{\frac{m_2}{\sigma_2}-1} \exp\left(-\left(\frac{x}{m_2}\right)^{\frac{m_2}{\sigma_2}}\right) \quad 7$$

$$f_3(x) = \frac{1}{\sigma_3} \exp\left(\left(\frac{x - m_3}{\sigma_3}\right) + \exp\left(-\frac{m_3}{\sigma_3}\right) - \exp\left(\frac{x - m_3}{\sigma_3}\right)\right) \quad 8$$

The Zillmer method is a calculation of premium reserves method based on gross premiums, so that the calculation is in accordance with the actual situation. A Zillmer argues that loading in the first year is greater than loading standards so that the amount of net premiums for the first year is smaller than the net premium for the following year.

Net premiums in the first year are smaller than the following year then $P_1 < P_2$, therefore the difference from P_1 and P_2 is:

$$P_2 - P_1 = \alpha \quad 9$$

Where α (in %) is the Zillmer level. Total premiums during the coverage period are:

$$\begin{aligned} P_{x:\bar{n}} \ddot{a}_{x:\bar{h}} &= P_1 + P_2 (\ddot{a}_{x:\bar{h}} - 1) \\ &= P_1 - P_2 + P_2 \ddot{a}_{x:\bar{h}} \\ &= -\alpha + P_2 \ddot{a}_{x:\bar{h}} \end{aligned} \quad 10$$

So that from equation (11), P_2 is obtained as follows :

$$P_2 = P_{x:\bar{n}} + \frac{\alpha}{\ddot{a}_{x:\bar{h}}} \quad 12$$

and from equation (10), P_1 is obtained as follows :

$$P_1 = P_{x:\bar{n}} - \alpha \left(1 - \frac{1}{\ddot{a}_{x:\bar{h}}}\right) \quad 13$$

Where h is Zillmer time. When $h < n$ is called short-term Zillmer and when $h = n$ is called the full-term Zillmer. P_1 and P_2 are used for reserve calculations with a prospective method approach. The size of the Zillmer method reserves for age x within the period of n years at time t with the Zillmer time h , i.e.

$${}_t V_{x:\bar{n}}^{(hz)} = {}_t V_{x:\bar{n}} - \alpha \frac{\ddot{a}_{x+t:\bar{h}-t}}{\ddot{a}_{x:\bar{h}}} \quad 14$$

In this study $h = n$ is used so that equation (14) becomes

$${}_t V_{x:\bar{n}}^{(nz)} = {}_t V_{x:\bar{n}} - \alpha \frac{\ddot{a}_{x+t:\bar{n}-t}}{\ddot{a}_{x:\bar{n}}} \quad 15$$

Where ${}_t V_{x:\bar{n}}$ is represents a net premium reserve for age x with a period of n years and $\ddot{a}_{x:\bar{n}}$ the present value of the immediately annuity of 1 IDR, for age x with a period of n years.

3. Results and Discussion

Like the research conducted by Tsai, et al (2014), the basic model used is as in equation (1). To create a Combined Mortality Model, parameter values must be found from $\psi_1, \psi_2, \psi_3, m_1, m_2, m_3, \sigma_1, \sigma_2, \sigma_3$, by minimizing the loss function found in the journal Carriere, J.F (1992) as follows:

$$\sum_{x=0}^{111} \left(1 - \left(\frac{\hat{q}_x}{q_x} \right) \right)^2 \quad 16$$

where q_x is probability of death from *Indonesian Mortlity Table* TMI 2011 for age x , \hat{q}_x probability of death, that will be estimated at age x by equation :

$$\hat{q}_x = 1 - \left(\frac{\hat{s}(x+1)}{\hat{s}(x)} \right) \quad 17$$

$\hat{s}(x)$ is joined mortality model in the equation (1).

First the parameters will be determined for ψ_1 , ψ_2 , and ψ_3 by first calculating the d_x value based on the Indonesian Men and Women Joint Mortalita Table. The equation that is proposed to determine the values of the parameters of ψ_1 , ψ_2 , and ψ_3 , is as follows.

$$\psi_k = \frac{\sum_a^b d_x}{\sum_0^{111} d_x} \quad 18$$

Where a is the lower limit of age and b is the upper limit of age for probability of death due to k . The parameter values of ψ_1 , ψ_2 , and ψ_3 were obtained by using computer programs, whose results are presented in Table 1 as follows.

Table 1. Value ψ_1 , ψ_2 , and ψ_3

ψ_1	0,011480601
ψ_2	0,008890123
ψ_3	0,979629276

Then by using computer software and the results of the parameters ψ_1 , ψ_2 , and ψ_3 in Table 1, the dispersion parameter limits $0 < m_1 \leq 17$, $17 < m_2 \leq 33$, $33 < m_3 \leq 111$, as well as the value of the probability variables that have a range from zero to one by minimizing the loss function obtained the parameter values presented in the table as follows.

Table 2. Values of parameters model of JointMortality

Parameter	Nilai
ψ_1	0.011480601
ψ_2	0.008890123
ψ_3	0.979629276
m_1	0.591570041882516
m_2	25.092977541286100
m_3	68.445354829850400
σ_1	0.850772707015585
σ_2	0.972238863292677
σ_3	10.274641155524000

The parameter results in Table 2 are obtained after iterating 3933 iterations. Substitute the parameter values to equation (1) in order to obtain the Combined Mortality Model based on the Indonesian Mortality Table 2011 made by AAJI (Indonesian Life Insurance Association). The Combined Mortalita Model can estimate life chances and chance of death at an age that will later affect the premium value of the equity-linked life insurance products.

3.1 Simulation of Equity-Linked Life Insurance Premium Calculation

Before calculating the premium, the assumptions that will be used are constant, with the average of the BI rate obtained at 0.067 or 6.7%. The purchase of shares is only 1 lot (100 sheets). Allocated the value for risk-free investment is 750,000.00 IDR. The correlation between portfolio and interest rate is 0. Varians from the portfolio of 20% of the initial value of the portfolio. The growth of premium prices is calculated discretely. The age of entering insurance is 16 years, 20 years, 25 years, 30 years, and 35 years with the insurance period of each policy until 55 years. To determine the premium amount of equity-linked life insurance products, the equation used is as follows (Tsai, et al, 2014):

In the same way and using computer programming is obtained the value of claims and premium prices for each policy are as follows:

Tabel 3. Results of calculation of claim value and premium price

No	Entry age (years)	Claim value (IDR)	Combined Mortality Model Premium (IDR)	Indonesian Mortality Table Premium (IDR)
1	16	2.287.485,703	2.265.286,155	2.288.137,799
2	20	2.304.385,402	2.282.935,584	2.305.134,034
3	25	2.332.991,506	2.317.014,370	2.334.413,708
4	30	2.372.981,135	2.355.639,109	2.374.463,970
5	35	2.428.884,252	2.416.029,306	2.430.705,952

Based on Table 3, the single premium price using the Combined Mortality Model is smaller than using the Indonesian Mortality Table 2011 and the higher the age the greater the premium price, either by using the Joint Mortality Model or using the Indonesian Mortality Table.

3.2 Simulation of Calculation of Premium Reserves with the Zillmer Method

When calculating premium reserves, the calculated premium must be in the form of annual premiums because when the premium is single, there is no need to calculate premium reserves. Therefore, the annuity value is sought first and the annual premium price for the five policyholders whose results are presented in Table 4 and Table 5.

Tabel 4. Annuity values and annual premium prices based on combined mortality models

No	Entry age (years)	Annuity	Annual premium price (IDR)
1	16	14,19870826	159.541,7071
2	20	13,73546838	166.207,3342
3	25	13,02871403	177.839,0687
4	30	12,15652616	193.775,6789
5	35	10,92540464	221.138,6567

Tabel 5. Annual premium price based on Indonesian Mortality Tables 2011

No	Entry age (years)	Annuity	Annual premium price (IDR)
1	16	14,55500214	157.206,2839
2	20	14,16710403	162.710,3203
3	25	13,52798752	172.561,7875
4	30	12,65628556	187.611,4409
5	35	11,45056590	212.278,2379

The following is a simulation of the calculation of first-year premium reserves by the Zillmer method for the age of 16 years of insurance entry with an insurance contract up to the age of 55

$$\begin{aligned}
 \text{years with } \alpha \text{ of } 20\%. \quad & V_{16:39|} = A_{16+1:39-1|} - P_{16:39|} \ddot{a}_{16+1:39-1|} - \frac{\alpha \ddot{a}_{16+1:39-1|}}{\ddot{a}_{16:39|}} \\
 & = 2412356,424 - 159541,7073 \cdot 14,09257257 - \frac{0.2 \cdot 14,09257257}{14,19870826} \\
 & = 164003,1375
 \end{aligned}$$

Reserves for the 2nd years and subsequent years are obtained using Maple 18 software which is presented in the table as a follow.

Table 6. Reserves of premiums for the age of insurance entry 16 years with a period of up to the age of 55 years

t (year)	$tV_{16:\overline{39}}$ Mortality Model (IDR)	$tV_{16:\overline{39}} $ TMI(IDR)
1	164.003,1385	142.469,7942
2	209.020,0091	183.560,6125
3	258.853,0138	229.434,2329
4	314.109,4185	280.689,9643
5	375.478,2604	337.998,0749

In the same way obtained premium reserves for other policies are presented in the table as follows.

Table 7. Reserve insurance premiums for age 20 years with a period of up to 55 years

t (year)	$tV_{20:\overline{35}}$ Mortality Model (IDR)	$tV_{20:\overline{35}} $ TMI(IDR)
1	284.810,0919	260.645,0896
2	354.012,7250	325.394,1723
3	431.055,6612	397.791,9141
4	517.138,0154	478.796,6900
5	611.003,2163	569.548,1840

Table 8. 25-years insurance premium for incoming age with a period of up to 55 years

t (year)	$tV_{25:\overline{30}}$ Mortality Model (IDR)	$tV_{25:\overline{30}} $ TMI(IDR)
1	560.342,4810	539.637,9993
2	675.929,8975	655.690,5587
3	809.423,2432	786.231,2642
4	961.951,8002	933.248,3490
5	1.134.151,060	1.099.014,045

Table 9. 30-years insurance premium for incoming age with a period of up to 55 years

t (year)	$tV_{30:\overline{25}}$ Mortality Model (IDR)	$tV_{30:\overline{25}} $ TMI(IDR)
1	1.132.692,648	1.098.696,401
2	1.348.590,969	1.313.091,843
3	1.595.317,464	1.554.929,194
4	1.873.398,676	1.827.907,193
5	2.187.105,874	2.136.384,235

Table 10. 35-year insurance premium for incoming age with a period of up to 55 years

t (year)	$tV_{35:\overline{20}}$ Mortality Model (IDR)	$tV_{35:\overline{20}} $ TMI(IDR)
1	2.250.314,172	2.210.008,954
2	2.659.101,266	2.612.544,992
3	3.120.999,956	3.067.787,863
4	3.643.439,479	3.582.801,142
5	4.234.936,167	4.166.021,376

4. Conclusion

The combined Mortality model obtained is based on the 2011 Indonesian Mortality Table, whose parameters are obtained numerically by computer programming. The numerical calculation of the

price of the equity-linked insurance premium by using the Combined Mortality Model is smaller than using the Indonesian Mortality Table 2011. However, the annual premium price using the Combined Mortality Model is greater when compared to using the Indonesian Mortality Table 2011. The results of this calculation simulation further improvement is needed, so that it becomes more perfect.

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A Pilot Study of Finding the Factors that Influence the Absence of Native Kupang be a Leader in Industrial Position at Kupang, East Nusa Tenggara, Indonesia

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Abstract. Kupang, the capital city of East Nusa Tenggara province, is a strategic region for economic growth that become primary foundation to the development of the industrial and other business sector. This industrial and business sector growth has put Kupang as a developing region and become investment destination. Investors from all over Indonesia and even from overseas has open their business and representative offices at Kupang. It is noticed that from various type of organizations at Kupang, a common phenomenon that leaders of business and industrial sectors are coming from outside Kupang that drives the absence of native Kupang in certain strategic position. This research aims to find the factors that influence this phenomenon. The survey' sample involved are: college students, employed and unemployed people in Kupang and companies leaders. This research focused on demography, moral, and work culture variables that have many components. Through the survey result, a comparation of these components of the three variables' answers from respondents and from the organization leaders in Kupang. The survey results shown that the factors that influence the absence of native Kupang be leaders in Kupang mostly are level of: emotional management, empathy, loyalty, creativity, fighting spirit and willingness to improve.

1. Introduction

Kupang, the capital city of East Nusa Tenggara province, in the beginning was a 2nd Layer District has gone through several territorial expansion[1] has a 180,27 km² area of which 735,57 hectare are industrial area or industrial region. With it's total population of 335.585 inhabitants, the city of Kupang has reached the highest position of population growth that is 3,56%[2]. As the capital city of a province, Kupang also become the top achievers in the percentage of results of graduation at almost all level of education, ranging from Secondary School (JH) up to University level. Align with that fact, there are at least 6.980 bachelors spreaded across various courses in 2010. Therefore, the existence of intellectuals with sufficient knowledge and skills are expected to be able to fill those strategic positions in multiple company either public or government institution and private sector.

An observation to the 34 companies of various lines and types of organizations, giving a positive feedback that indeed mostly the chairman at those companies in Kupang are not a native Kupang while mostly the intellectuals works as second or third layer in those companies, even they do willing to be paid below the province minimum wage limit (UMP)[3]. Having a highest contribution to the Gross Regional Domestic Product of East Nusa Tenggara province[4], doesn't necessarily lift

the Kupang native people to fill strategic positions of industrial fields. On the contrary most of the chosen leaders in industrial fields are coming from outside Kupang, far away from the hope that if native Kupang become the leader, they will contribute more because they do understand both character and culture of native Kupang. In other words, there are equality of quality between native Kupang and non native Kupang leaders.

For this phenomenon, a comprehensive treatment, metered and targeted are required to deal with this situation here in Kupang, which is why mostly non native Kupang fills strategic positions compared to the native Kupang people.

The research objectives of this paper is to find the factors that influence the absence of native Kupang appointed as a leader in industrial positions at Kupang city, the East Nusa Tenggara, Indonesia.

2. Research Variables

The following variables are included in this study: gender, education, job/occupation, job function (if employed), income, parent's job, marital status, parent's marital status, religion, siblings, child birth order, skills, organizational experience, have a dream to lead a company and reason to start a job.

The level of pride, desire to steal, level of telling lie, revenge level, emotion control, empathy level, loyalty level, preserverance level, level of creativity, leadership level, desire to work, fighting spirit, ability to use the internet and the advanced desire level are measured using Likert 1 – 5 scale.

Those variables, such as: pride level, desire to steal, level of lie, revenge level, emotion control, empathy level, loyalty, perseverance, creativity, leadership, work desire, fighting spirit, internet, and advanced desire, will be grouped as categorical variables with the following rules: Low, if the score is less than or equal 20; High, if the score is more than 20.

3. Method

This research accomplished through an observation in Kupang, conducting surveys to at least 34 companies across all type of organization, and also some resident of Kupang city. The population taken as a sample respondent of this research mostly are Kupang resident on the productive age. The population sample size in this research are 655 respondents, the population of leaders in Kupang at most 101 chairmans were all taken with purposive sampling technique[5]–[7] that has a point of view that the authors wants every sample of the population choosen are aligned with the goal of the research.

The data analysis method used is Descriptive Statistic to get the overview of respondent characteristics and the will of companies leader. Furthermore, the Mann Whitney test [8], [9] were used to see if there are score different of the respondents and the score expected by the leaders for some variables involved in this research. The conclusion or hypothesis as the test result shown that some condition are true happening at the population being observed.

Suppose the data consist of two random samples $X_1, X_2 \dots X_n$ denote the random sample of size n from population 1 and $Y_1, Y_2 \dots Y_m$ denote the random sample of size m from population 2. Assign the rank 1 to $n + m$. Let $R(X_i)$ and $R(Y_j)$ denote assigned to X_i and Y_j for all i and j . $N = n + m$

Mann Whitney Test is used to determine whether there is a difference between mean of X and Y or not.

H_0 : there is no difference between mean of X and Y

H_1 : there is a difference between mean of X and Y

Test Statistic = $T = \sum_{i=1}^n R(X_i)$

Decision rule is made by compare T with quantile W_p from Appendix 1

H_0 is rejected if $T < W_{\alpha/2}$ or $T > W_{1-\alpha/2}$

4. Result And Discussion

The following table shows the questioner result from the respondent, which includes some observation variables namely: level of arrogant, desire to steal, desire to lie, revenge level, emotion control, level

of empathy, level of loyalty, perseverance, creativity level, leadership level, work desires level, fighting power, ability to use the internet and lastly, advanced desire.

Table 1. Results of Research Variable Description (Non Leader Group)

Variables	Categories	%	Descriptions
Level of Arrogant	Low	98.9%	Mostly the level of arrogant of the respondents are low.
	High	1.1%	
Desire to Steal	Low	96.9%	Mostly the desire to steal of the respondents are low.
	High	3.1%	
Desire to Lie	Low	95.4%	Mostly the desire to lie of the respondents are low.
	High	4.6%	
Revenge Level	Low	73.1%	Mostly the revenge level of the respondents are low.
	High	26.9%	
Emotion Control	Low	75.6%	Mostly the emotion control of the respondents are low.
	High	24.4%	
Level of Empathy	Low	44.6%	Mostly the level of empathy of the respondents are high.
	High	55.4%	
Level of Loyalty	Low	59.8%	Mostly the level of loyalty of the respondents are low.
	High	40.2%	
Perseverance	Low	83.4%	Mostly the perseverance of the respondents are low.
	High	16.6%	
Creativity Level	Low	82.1%	Mostly the creativity level of the respondents are low.
	High	17.9%	
Leadership Level	Low	87.5%	Mostly the leadership level of the respondents are low.
	High	12.5%	
Work Desires Level	Low	46.9%	Mostly the work desires level of the respondents are high.
	High	53.1%	
Fighting Spirit	Low	29.5%	Mostly the fighting spirit of the respondents are high.
	High	70.5%	
Ability to use the Internet	Low	63.7%	Mostly the ability to use the internet of the respondents are low.
	High	36.3%	
Advanced Desires	Low	45%	Mostly the advanced desires of the respondents are high.
	High	55%	

The results shows that all respondents involved have several good thing namely: low level of arrogant, low desire to lie, low desire to steal, low revenge level; high level of empathy, high work desires, high fighting spirit and high advanced desires. There are also things that are not good enough found on most respondents, namely: low level of emotional control, low level of loyalty, low perseverance level, low creativity level, low leadership level, low ability to use the internet. These weaknesses needs extra attention by the respondents, because those are related to the desired demands of most companies leaders in Kupang, as described by the survey's results, are presented on the following table:

Table 2. Results of Research Variable Description (Leader Group)

Variables	Categories	%	Descriptions
Level of Arrogant	Low	94.1%	Mostly companies leader demanding a low level of arrogant of the respondents.
	High	5.9%	
Desire to Steal	Low	95%	Mostly companies leader demanding a low desire to steal of the respondents.
	High	5%	
Desire to Lie	Low	95%	Mostly companies leader demanding a low desire to lie of the respondents.
	High	5%	
Revenge Level	Low	75.2%	Mostly companies leader demanding a low revenge level of the respondents.
	High	24.8%	
Emotion Control	Low	24.4%	Mostly companies leader demanding a high emotion control of the respondents.
	High	75.6%	
Level of Empathy	Low	52.5%	Mostly companies leader demanding a low level of empathy of the respondents.
	High	44.6%	
Level of Loyalty	Low	40.6%	Mostly companies leader demanding a high level of loyalty of the respondents.
	High	59.4%	
Perseverance	Low	94.1%	Mostly companies leader demanding a low level of perseverance of the respondents.
	High	5.9%	
Creativity Level	Low	76.2%	Mostly companies leader demanding a low creativity level of the respondents.
	High	23.8%	
Leadership Level	Low	76.2%	Mostly companies leader demanding a low leadership level of the respondents.
	High	23.8%	
Work Desires Level	Low	96%	Mostly companies leader demanding a low work desires level of the respondents.
	High	4%	
Fighting Spirit	Low	27.7%	Mostly companies leader demanding a high fighting spirit of the respondents.
	High	72.3%	
Ability to use the Internet	Low	61.4%	Mostly companies leader demanding a low ability to use the internet of the respondents.
	High	38.6%	
Advanced Desires	Low	32.7%	Mostly companies leader demanding a high advanced desires of the respondents.
	High	67.3%	

The results given by those companies leaders in Kupang regarding the respondents who are eligible to work at their company, as a summary they are mostly don't care about level of arrogant, desire to steal, desire to lie, revenge level, perseverance level, leadership level, work desires and the ability to use the internet. Despite mostly they do demanding high score on the following variables: level of emotion control, empathy level, loyalty level, creativity level, fighting spirit, and advanced desire of those respondents.

If we compare the results of Table 1 and Table 2, we could draw conclusion that to be eligible to work and become a leader in the companies in Kupang, a native Kupang must lift up their skills, namely: level of emotion control, level of loyalty, and level of creativity, those are scored low from the non leader respondents in Kupang.

Furthermore in this research, having put the results from both group of respondents to those variables involved into Likert scale, the authors want to know whether similarities exists between them. To get into this summary, a Mann Whitney test method is used with significant level of 0,10[8], [9].

The data analysis shows that factors that differentiate between the average score of those two group of respondents as follows: Level of emotion control, the respondent's scores are lower than scores demanded by companies leader in Kupang. Level of loyalty, the respondent's scores are lower than scores demanded by companies leader in Kupang. Level of creativity, the respondent's scores are lower than scores demanded by companies leader in Kupang. Leadership level, the respondent's scores are lower than scores demanded by companies leader in Kupang. Mostly the companies leader in

Kupang sets lower threshold value of leadership level. In contrary, most respondent scores is much lower than the threshold values. Due to mostly companies leader in Kupang wants lower score of leadership level, the authors has decided to set aside this variable in this research. The advanced desires level, the respondent's scores are lower than scores demanded by companies leader in Kupang. Mostly the companies leader in Kupang sets higher threshold value of the advanced desires level. Even though mostly respondent scores are high, but those scores lower than the demanded score.

The above results shows that native Kupang need to enhance the following variables in order to full fill the work demands of companies in Kupang, and later be a leader them selves; namely: level of emotion control, level of loyalty, level of creativity, and the advanced desires level.

The following discussion will emphasize on those variables on which the native Kupang people needed, so that they have the opportunity to be a leader in companies or organizations in Kupang. Those variables are: level of emotion control, level of loyalty, creativity level and the advanced desires level.

A. Human Behavior

Human behavior is an essential thing that is uniquely differentiate one person to another in the world. Behavior is a personal soul expressions[10]. Something that initially abstract or intangible become real and visible through one's words and actions. This behavior formed as a result of the long journey that a person been through in their live that create a person and his/her characters. Another factors that also have role to form a human behavior are their surrounding, family in small scale. A Local custom has also play roles in forming a human behavior. This character building process intensively starts from physical development, intellectual, personality and social skills[11]. At least there are 3 factors to observe and measure human behavior: individual factor, social factor and external factor.

B. Behavior Formation

To form a personal behavior, especially one that close related to someone performance or someone occupation, be attained with these two factors. First, motivation[12]. With developing motivation within, someone can move toward the goals they want to achieve. Secondly, acknowledgement. Someone behavior may move toward a positive direction or negative direction related to the acknowledgement received.[13]. These two factors become main stimulant of personal behavior formation. In business organization, the employee positive behaviors formation achieved through several phase of requirements. Starts with psychological need, security need, need to be loved, self confidence, and self actualization[14]. As a worker, someone will be motivated to give their best if the company also give a proper acknowledgement to their employees. This strategic can be done in many ways, namely: word of affirmation, quality time, acts of service, tangible gifts and physical touch[15]. By acknowledging one achieved performance, spare time to discuss with the employee, helping each other, giving present, and celebration; are some approaches that tend and have positive impact that significantly resulting a responsible behavior.

C. Human Resource Development

Employees in organization or company are their assets. The economic growth of an organization depends on the growth of human as an organizational capital. Human capital [16], [17] related to the skills and knowledge of the employee[18]. As an asset of them, company expecting an employee with sufficient skill and knowledge to be used as maximum as possible. Some strategic steps can be done to achieve a productive and innovative employee in accordance with their field of expertise, namely: provision of educational programs, the company or organization has a personal development policy for their employees. Secondly, company maximize the benefit programs for their employees. Both employees and company should work hand in hand to achieved the company's goal. The absence of this will lead to failure to achieve company's goal, and soon near the future it will happen.

D. Productive Employee

Productive[12], [19] is aligned with the style or the behavior of work that produce a sustainable output. Productive is related to behavior. A productive employee has a healthy work behaviors for their organization. To form a productive work behaviours at least developed in several ways. First, standard organization system is a powerful tool to grow a productive performance for their employees. Standard Operational Procedure (SOP) is a solid example in organization system that may forms a productive behavior of the employees. It has to be clearly written and understood by all organization members, so that same perspective across the organization members while running the operational of the organization. Secondly, an example. A sophisticated organization system is not sufficient enough without an example, role models or personal who voluntarily doing their works according to the rules. A productive employee will benefits them selves in micro scope, and in widen scope they will contribute a significant contributions to the growth and development of human development index.

5. Conclusions

This research results has shown that at least there are four reasons why mostly companies leader in Kupang refuse to accept native Kupang people as a leader. The reason are: most native Kupang people has a low emotion control, low loyalty level, low creativity level, and lastly their advanced desires doesn't match to the standard of companies leader in Kupang. For this reason, those four factors needs more attentions so that they can be improved by most native Kupang educated people, that in the end they may equally capable to those who are not native Kupang to lead an organization or company in Kupang.

To cope with these lacknesses of native Kupang people, the coaching to school-age children, college students, and to Kupang resident in general in order to expunge their limitations and improve their competence. For the next stage, a survey needs to be conducted about factors that affect the loyalty level of native Kupang people so that it may get improved accordingly.

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Appendix 1. Critical Values of the Mann-Whitney U Test

$n_1 \setminus n_2$	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2		0	0	0	1	1	1	1	2	2	2	3	3	3	3	4	4	4	
3	0	3	1	2	2	3	4	4	4	5	5	6	7	7	8	9	9	10	
4	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
5	0	1	2	4	5	6	8	9	11	12	13	15	16	18	19	20	22	25	
6	0	2	1	3	7	8	10	12	14	16	17	19	21	23	25	26	28	30	
7	0	3	4	6	8	11	13	15	17	18	21	24	26	28	30	33	35	37	
8	1	3	5	8	10	13	15	18	20	23	26	28	31	33	36	39	41	44	
9	1	4	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	
10	1	4	7	11	14	17	20	24	27	31	34	37	41	44	48	51	55	62	
11	1	5	8	12	16	19	23	27	31	34	38	42	46	50	54	57	61	65	
12	2	3	9	13	17	21	26	30	34	38	42	47	51	55	60	64	68	72	
13	2	6	10	15	19	24	28	33	37	41	47	51	56	61	65	70	75	84	
14	3	7	11	16	21	26	31	36	41	46	51	56	61	66	71	77	82	92	
15	3	7	12	18	23	28	33	39	44	50	55	61	66	72	77	81	88	100	
16	3	8	14	19	25	30	36	42	48	54	60	65	71	77	83	89	95	107	
17	3	9	15	20	26	33	39	45	51	57	64	70	77	83	89	96	102	115	
18	4	9	18	22	28	35	41	48	55	61	68	75	82	88	95	102	109	123	
19	4	10	17	23	30	37	44	51	58	65	72	80	87	94	101	108	115	130	
20	4	11	18	25	33	39	47	54	62	69	77	84	92	100	107	115	123	130	

The Relationship between Internet Use for Information Search and Academic Performance of Civil Engineering Students in Sariputra Indonesia University

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Abstract. The purpose of this research is to determine to what extent is the relationship between internet use and the academic performance of civil engineering students in Sariputra Indonesia University. This is a qualitative descriptive research with 25 civil engineering students as the population. The data were collected using questionnaire about internet use for information search to civil engineering students in Sariputra Indonesia University. The questionnaire used has passed validity and reliability test. The collected data were then analyzed using SPSS to test for the normality which resulted in Asymp. Sig. of 0,409 for internet use variable and 0,965 for academic performance variable. Both significance values are larger than 0,05. Test of linearity shown a value of 0,249 which is larger than 0,05. Pearson correlation has been used to test the hypothesis where the value of r was $0,265 \leq$ tabulated r value of 0,396. Therefore, H_0 is accepted and H_a is rejected. Based on the results, it can be concluded that there is no significant relationship between internet use for information search and academic performance of civil engineering students in Sariputra Indonesia University.

Keywords : Academic performance, internet use, qualitative descriptive research

1. Introduction

In order to improve the education quality in Sariputra Indonesia University in Tomohon which then can improve the quality of its graduates, therefore, the university provides various facilities to support the lecturing process. One of the facilities provided by the university is internet in form of Wireless Fidelity (WiFi) which can be accessed by the students from their devices or from the computer provided in computer laboratory on campus. In this modern era, internet use holds an important role to the lecturing process in the university in which it is expected that internet can improve the academic performance of the students, especially UNSRIT civil engineering students who are the object of this research.

In general, civil engineering students who use internet access on campus are in good condition. They use the internet to do a lot of things. However, do they optimize the use of the internet for academic purposes or not? This question needs to be answered in order to ensure that the internet provided by the university meets its intentional purpose.

Internet provided by Sariputra Indonesia University can be used by students to access any sites to find any information. However, the university has no control to what sites the students can visit. Therefore, it is within their confidence whether they use the internet for academic purposes or not. Even though, the provided internet is supposed to be used mainly for academic purposes in order to support the learning process of the students.

Internet use by civil engineering students is vary, depending on the needs of each students [1]. Indeed, the use of technology especially computer and internet has a lot of advantages. Students can obtain learning materials such as books, modules, journals, magazines, and newspapers from electronic library (e-library) and electronic book (e-book) websites. The existence of the internet also enables the long-distance lecturing in which there is no need for students to attend classes in order to get education or degree. The learning materials can be accessed from their personal computers at home that has been connected to the internet or from any internet café that provides internet service [2].

Employees and students are connected to internet through the network provided by their company or institution. Some individuals or small institutions use dial-up access such as modem and standard cable telephone to connect to the internet. Other people or institutions choose to use faster connections such as DSL, cable television, radio signal, and satellite [3].

Academic performance is the most important part of students' learning process. It is defined as the change in behavior as the result of a set of educative activities include cognitive, affective, and psychometric aspects [4]. This is also applied to university students in which academic performance has a significant influence on the end result of the students' learning process. Successful students are those who can show a significant change in terms of their way of thinking, skills, and behavior toward an object [5].

The effect of internet use is massive. It can be either positive or negative. One of the positive impacts of internet use in terms of education is internet can ease students in looking for information and improve their knowledge. While the negative impact is students can access materials outside the academic purposes which may lead to a misuse of the internet provided by the university.

The purpose of this research is to determine to what extent is the relationship between internet use for information search and the academic performance of civil engineering students in Sariputra Indonesia University. The existence of internet in form of WiFi provided by Sariputra Indonesia University is expected to support its lecturing process which then can increase the quality of its education and graduates. This is a qualitative descriptive research with 25 civil engineering students as the sample. The data were collected using questionnaires about internet use for information search to civil engineering students. This research consists of two variables, which are independent and dependent variables. The independent variable is internet use and the dependent variable is academic performance of civil engineering students in form of students' Grade Point Average.

The data analysis method used in this research was descriptive method, in which it can give a clear description to the researcher about the observed variables. It can also picture the analysis test required in order to know the data distribution and the variables of the population itself. The analysis tests used were normality and linearity test. Hypothesis test was also used to find out the relationship between internet use variable and students' academic performance variable. The results were then used to determine whether the hypothesis was rejected or accepted.

2. Research Methodology

Research method used in this research was descriptive method with quantitative approach. According to (Sugiyono, 2010), "quantitative method is one type of research methods that use numbers and statistic."

Population of this research is all civil engineering students of Sariputra Indonesia University in Tomohon. Sampling technique used in this research was proportional cluster random sampling in which the samples are chosen randomly and formed into a proportional group. This research has two variables which are independent and dependent variables. The independent variable is the internet use and the dependent variable is the academic performance of the civil engineering students in form of students' Grade Point Average.

3. Data Analysis Method

The data analysis method used in this research was descriptive analysis method. It gives a clear description to the researcher about the research variables and the analysis tests required in determining the data distribution and the population variable. The analysis tests used were normality and linearity

tests. In addition, hypothesis test was also conducted in order to figure out whether the hypotheses were rejected or accepted.

The data obtained through questionnaires to the students were then analyzed in order to know the results of this research. There are several steps of the data analysis process, such as:

2.1 Normality test

Normality test was used to figure out whether the samples were from normally distributed population or not. The basic of the decision making of this test is if the significance value $\geq 0,05$, it means that the data are not distributed normally.

3.2 Linearity test

Linearity test is a test to figure out whether the data of the internet use variable make a linear line towards the civil engineering students' academic performance variable. The basic of the decision making of this test is if the significance value is $< 0,05$, it means that the data make a linear line or the other way around.

3.3 Hypothesis test

Hypothesis test was conducted in this research in order to find out whether the hypotheses were accepted or rejected. The hypotheses of this research are:

H_a = there is a relationship between internet use and academic performance of UNSRIT civil engineering students

H_0 = there is no relationship between internet use and academic performance of UNSRIT civil engineering students

4. Results and Discussion

The questionnaires used in this research has passed the validity and reliability tests with result of cronbach's alpha value of 0,689 with 18 instruments, which was larger than the table value of 0,368. It meant that the questionnaires were valid and reliable to be used in this research. The data obtained from the questionnaires were then analyzed. The analysis process started with normality test, then linearity test, and the last was hypothesis test.

Normality test table shown Asymp. Sig. value of 0,409 for internet use variable and 0,965 for academic performance variable. Both significance values were larger than 0,05 which meant that the distribution of the data of both variables formed a normal distribution. See table (1).

Table 1. Normality Test

	Internet Use	Academic Performance
N	25	25
Asymp. Sig. (2-tailed)	.409	.965

Linearity test aimed to determine whether the relationship between internet use variable and academic performance variable is linear or not. The decision making process in the linearity test is if the significance value (linearity) $< 0,05$, then the relationship between the independent and dependent variables is linear, while if the significance value (linearity) $> 0,05$, then the relationship is not linear. The linearity test of this research shown a significance value (linearity) of 0,249 which was larger than 0,05. Therefore, it can be concluded that the relationship is not linear. See table (2).

Table 2. Linearity Test

			Sum of Square	Df	Mean Square	F	Sig
Academic Perfromace * Internet Use	Between groups	Linearity	27.991	1	27.991	1.580	.249

The hypothesis test conducted in this research aimed to determine whether the proposed hypotheses were accepted or rejected. Based on the normality and linearity tests, it was known that the samples were distributed normally but the relationship between variables are not linear. Therefore, researcher conducted the correlation test between internet use variable and academic performance variable to test the hypotheses. It resulted in Pearson correlation (r value) of $0,265 \leq r$ table of 0,396. Thus, H_0 was accepted and H_a was rejected. Based on that result, it can be concluded that there is no relationship between the internet use and the academic performance of UNSRIT civil engineering students.

Based on those results, it can be concluded that there is no significant relationship between the internet use for information search and the academic performance of civil engineering students in Sariputra Indonesia University. Even though the students access on-campus internet mainly for other purposes instead of academic purposes, their academic performance are still satisfied. Students utilize the technology improvement especially internet to support them during the learning process and other on-campus activity.

5. Conclusion

Based on this conducted research, researcher concludes that there is no significant relationship between the internet use and the academic performance of UNSRIT civil engineering students since they mainly use internet for accessing social media instead of academic purposes.

Based on the above conclusion, researcher suggests that students need to use internet as a media search for academic purposes. Furthermore, the university needs to improve the internet networking system in order to support students in accessing information in regards with their academic.

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Extract Leaves Carambola as Antibacterial on Smoked Skipjack (*Katsuwonus pelamis*) in Gorontalo

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Abstract. Handling and processing fisheries reference the decision minister for fishery and maritime number 52A / KEPMEN-KP / 2013 about the requirements quality assurance and security fisheries to the process production processing and distribution, and decision head of national standardization no: 76 / KEP / BSN / 8 / 2009 on Standard National Of Indonesia 2725.3: 2009 handling and processing products fish smoke. The purpose of this research is restricting the growth of bacteria and prevent a fall in the quality of smoked skipjack (*Katsuwonus pelamis*) in the province of Gorontalo. Research methodology is the method his experiments with treatment extract leaves carambola as a preservative on smoked skipjack and long storage. Design used is a random complete. The research indicated that fish smoke who were given extract leaves carambola able to press the growth of bacteria to storage 4 days (4.2×10^4 colonies /gr).

1. Introduction

Processing of smoke in Gorontalo are smoking by some means, namely by means of fish clamped bamboo, pierced using iron next fish in smoke in their entirety not eviscerate and the two sides. To improve the quality of smoked skipjack (*Katsuwonus pelamis*) safe for consumed and guaranteed necessary testing TVB, histamine, and the number of microbes. Testing is very important made to the fish smoke because of the three types of testing had an important role in determining product quality of smoked skipjack (*Katsuwonus pelamis*). For that one conservation efforts industrial products of smoked skipjack (*Katsuwonus pelamis*) is by using extract leaves carambola. The purpose of this research is to find influence extract leaves carambola to the total volatile bases and the number of bacteria in smoked skipjack (*Katsuwonus pelamis*).

2. Research Methodology

2.1. Time and Place

Research is done in March till May 2018, housed in the Agriculture Laboratorium University and testing sample Gorontalo implemented in the laboratory Nutrition and Fodder Hasanuddin University and testing hall and Control Fisheries Product Quality, Makassar.

2.2. Tools and Materials

Tool used for the extraction carambola leaves: a separating funnel or evaporator, a measuring glass, erlenmeyer, stems stirrer, cotton and pipet. Material used the research is smoked skipjack (*Katsuwonus pelamis*), leaves carambola (*Averhoa billimbi*), ethanol, resin exchanger ion (dowex 1-x800-100-mesh), aquades, HCL, NAOH, H₃PO₄, ortoptalatdikarboksilaldehyde (pest), TCA solution, boric acid, K₂CO₃, as vaseline, indicators conway, butterfield solutions phosphate buffered, niven media, NH₄OH, H₂SO₄ and CHCl₃.

2.3. Research Procedure

2.3.1. Extract material. Extract material that is used is the carambola leaves (*Averrhoa bilimbi*) derived from limboto. This leaves separated from its stalk and dried with an oven at a temperature of 40 - 50⁰C or by drying in the sun for the next 2 days, then milled or pounded until smooth and sifted with 25 - 35 mesh. The process of grinding leaves can be affecting the extraction of. According to Ketaren et.al (1994), the extraction of resources is increasing from the fact sizing material, because contact between the materials and a solvent is a process of osmosis that runs slow.

2.3.2. The extraction of leaves (*Averrhoa bilimbi*). The extraction of is the process of separation, the withdrawal or spending a component of a mixture of a cup .Usually use a solvent that in accordance with components of that which is desirable, a liquid separated and volatilized it is time for the forests of the appointed manan has stated, 2008 in Mukhliso , 2010). The leaves extracted uses the method maceration by comparison the materials and a solvent (Alcohol 70 %) 1: 7. Then it is put for 48 hours. To get better results, a solvent redeemable after 24 hours ago was done filtering. Filtrat volatilized filtered by the reduction of produced extract a viscous. The leaves wuluh 2.5 kg and a solvent (alcohol 70 %) as many as 15 liters so as to produce 1.5 litter extract. The manufacture of this extract take a long time .This is because equipment used is very simple.

2.4. The sample testing

2.4.1. An analysis of the total microbes (Total Plate Count) (SNI 01-2332.3-2006). The principle of TPC analysis is growth mikrorganisme after an example inkubasi in media to 35⁰C temperature for 48 hours, so these microorganisms will grow reproduce by form colonies can was counted. The procedure work tpc analysis is as follows sample: weighed in aseptic as much as 25 grams and added 225 ml solution butterfields phosphate buffered, then di homogenat for 2 minutes. Homogeneous is dilution 10-1 solution. As many as 1 ml homogenat taken using pipette sterile put into bottles 9 ml solution butterfields phosphate buffered to achieve examples with dilution 10-2. On each dilution done homogenat at least 25 times. We do the same for dilution 10-3, 10-4, 10-5, and so on according to the conditions sample. Next to the method to pour cup (pour plate method),In pipette as many as 1 of any dilution and put into a petri dish sterile in duplo using pipette sterile. Into Are each a sample already containing, added 12-15 ml media plate count agar that (PCA) already cooled up to the temperature 45⁰C. After to be solid, a petri dish which contains in order solution samples put into of incubator with reversed position for 48 hours on the temperature 35⁰C. Then done observations with by counting the number of bacteria colonies that is in a counter the use cup colonies. The number of colony calculated is a petri dish have bacteria colonies between 25-250 colonies.

2.4.2. The level of Volatile Analysis Total Bases (SNI 2354.8: 2009). This analysis aimed at to determine the quantity of a compound a base that is formed due to volatile protein degradation. Work procedure is divided into 3 the stage.

a.) The Ekstraktion

As well as the first of all the extraction of sample are weighed as much as 10 g cup to that of a glass, and added 90 ml perchloric acid (PCA) 6 %. The sample use homogenizer for two minutes. Sample next filtered by the use of paper filter rough and produce filtrat that can be used on next phase

b.) The distillation

As many as 50 ml filtrat sample put a tube distillation, it is a few drops phenolphthalein indicators and added a few drops foaming silicon anti. A tube distillation mounted on destilator and added 10 ml NAOH 20 % until a marked with red. Then prepared about erlenmeyer containing 100 ml H₃BO₄ 3 % and 3-5 drops indicators tashiro purple. Then didestilasi steam sample less than 10 minutes

to obtain destilat 100 ml so in volume end reached \pm 200 ml solution green. Solution 17 applications prepared by replacing sample extract with 50 ml perchloric acid (PCA) 6 % and worked with the equal to sample.

c.) The titration

Solution destilat samples and then cesium applications using solution HCL 0.02 N. The final point titration characterized by the establishment of back color purple. The calculation TVB can be done by the formulation.

$$\text{Content TVB (mgN/100 g)} = \frac{(Vc - Vb) \times NHCL \times Fp \times 100 g}{\text{weight of the sample (g)}}$$

Information:

VC = Volume HCL titration solution to sample,

N = Normality HCL

VB = Solution in volume HCL titration applications,

FP = Dilution

3. Result And Discussion

3.1. Analisis of bacterial

The research indicated that fish smoke who were given extract leaves carambola able to press the growth of bacteria to storage 4 days (4.2×10^4 colonies / gr). This thing to see Figure 1.

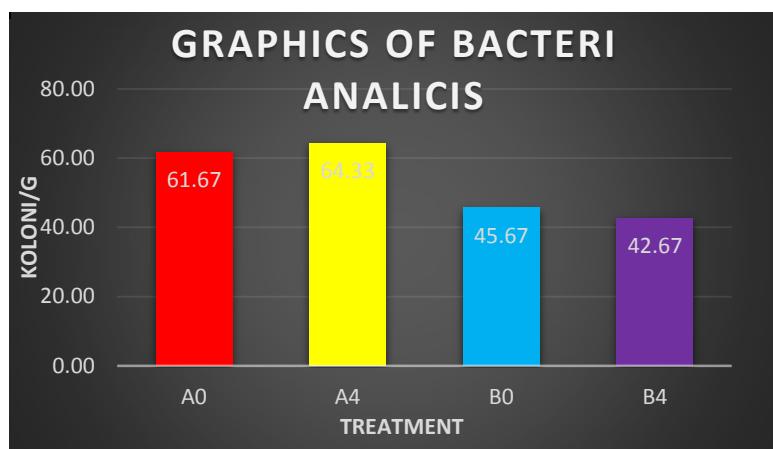


Figure 1. Graphics of Bacteri Analicis

Figure 1. The fruits of their testing ALT in treatment A0 (6×10^4 kol / g), A4 (6×10^4 kol / g), B0 (4×10^4 Kol / g) and treatment B4 (4×10^4 kol / g). The result of this research menjelskan A0 that treatment with the highest number of bacteria colonies with the highest proportion of B0 treatment. This is allegedly affected by extract leaves the carambola capable of bacteria on treatment B0 suppress the development. Did also the treatmen on A4 and B4.

This is allegedly affected by extract leaves the carambola capable of bacteria on treatment B0 suppress the development. The high number of bacteria colonies on treatment A0 influenced by packaging costs fish of the test of the state of high temperatures. Ilyas (1983) stated the growth of bacteria on fish is strongly influenced by the temperature at, the lower the temperature then it would be more slow the growth of bacteria. Storage during came the decomposition of either by flora bacteria or by a proteolytic enzyme. To tersediaan oxygen is the limited growth microbes will be stunted. Many at least the womb bacteria on the material depends on good food handling and poor quality of these foods are to process it further

The high number of bacteria colonies on treatment A4 expected at stir by time storage for 4 days. Septian *et al.*, (2017) stated that the longer storage has been an increase in the value of bacteria colonies, it is used in the are caused by bacteria and mildew started to grow and breed. It is used in the pertegas by buckle *et al.*, (1985), that in the early stages of growth microorganisms has not yet occurred cell division. Following a new fits the surroundings perfectly capable of adapting, bacterial cells will grow and divide in eksponsil maximum of. B4 treatment having value that is lower than treatment A4. This is allegedly affected by extract leaves the carambola wuluh able to reduce the number of bacteria colonies on smoked skipjack (*Katsuwonus pelamis*) that is stored in four days. The number of bacteria colonies on treatment B4 4 x104 colonies/g. The results of the Astuti *et.al* (2015) stated that extracts leaves the carambola can be inhibiting the growth of bacteria .Tannin extract leaves to fall from the carambola is inhibitor to execute so that many microorganisms that growth could slow down its growth. An enzyme secreted by microbes is a protein and protein and by tannin so that the enzyme will not active (Winarno, 1981).

Contamination bacteria in fish smoke can be through handling of a less well, through the air and ground. The presence of microorganisms this could happen because elevated levels of water for storage and the increasing temperature support, for example the growth of bacteria *S. aureus* can grow well on the temperature 30 - 37⁰c (Suseno *et al.*,2016). The analysis variety of the total number plates seen in table 1.

Table 1. The variety of fingerprint analysis test total plates

Source of diversity	JK	DB	KT	F _{Count}	F _{Table} 0.05
Treatment	138904583333.33	3	463015277777.78		
Error	-134197666666.67	8	-16774708333.33	-2.76	4.07
Total	4706916666.67	11			

Sources: Data primary 2018

The table 1. The f count = -2,76 less than f table in standard (5 %) 4,07. It was decided to refuse H1 and receive H0, which means that the differences between similar real treatment.

3.2. Analycis Of TVB

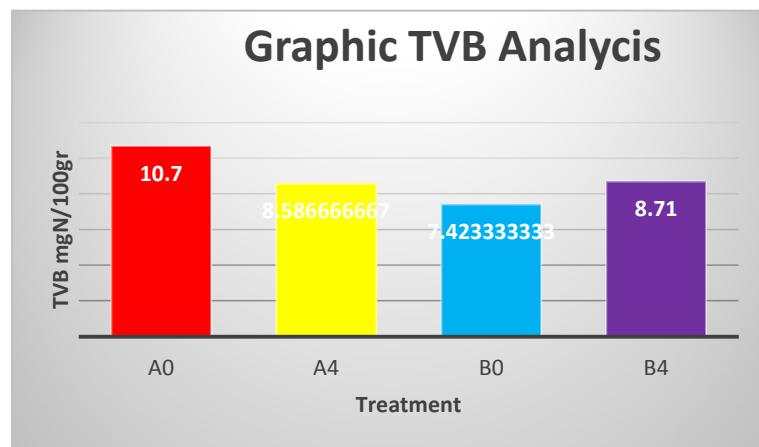


Figure 2. Graphic TVB Analycis

Figure 2. Shows that total bases in volatile content of smoked skipjack is still below the threshold namely & it is; 30 mgN/ 100 g (Zaitsev *et.al.* 2009). It looks on a chart to 4 treatment. The highest value is added to its treatment of 10.7 A0 (control of) mg N /gr, with the lowest in B0 treatment with an extract and without storage. In treatment A4 and B4 did not appear to be a significant difference.

The results of the analysis variety of shows that treatment extract the carambola leaves and long storage influence clear ($p<0.05$) of TVB of smoked skipjack. The low level of the womb total bases in volatile treatment B0 is strongly influenced by extract leaves the carambola used. Astuti (2018) stated that the low level of TVB on fish skipjack that is stored for 18 of the clock denote that extracts leaves the carambola who in use to reduce the growth of bacteria. This is supported by the Genisa (2000), who explained that to the stunting bacteria can causing the production of an enzyme decline. An enzyme that declining activity it can slow down the process of the splitting of proteins that will increase the nitrogen which were easily boiled into a compound that simpler TVB building blocks. This is a causing thing low levels of TVB on smoked skipjack.

The state of and the number of TVB levels also depends on level freshness fish , the worse the quality of fish then it would be more high levels of TVB. Elevated levels of activity TVB especially caused by bacteria, as the presence of the proven conformability in the increased number of bacteria so that it can be used to follow degrees decay fish. In fishes that fresh, TVB levels very small even consists almost entirely of ammonia. But the fish that was decomposing, now a lot change in nature and the quantity of fish which at TVB in the flesh of sports.

A compound anti microbes that is in in smoke is also a cause of the low TVB on smoked skipjack. A great variety of aldehyde, alcohol, the ketone, an acid and so on that causes the growth of bacteria is obstructed. Fogging can also repair an apparition of fish because the surface of fish to glossy. Fish quality smoke different golden yellow or yellow colored tanned like copper whose glossy, typical fish fresh smelling smoke, his flesh hard or springy, and the skin taut. While fish smoke low only show the characteristics of his flesh pulpy, the skin dull, broken, slimy, or pays a fungi, smelling as regards not fresh, there are a crystalline salt, blood, stain black or other impurities (Sulistijowati *et.al* , 2011)

The results of the analysis variety of shows that treatment extract the carambola wuluh leaves and long storage influence clear ($p < 0.05$) of TVB of smoked skipjack. Can be seen in table 2.

Table 2. The variety of fingerprint analysis test TVB

Source of diversity	JK	KT	F Count	F table
				0,05
Treatman	-905.512	-301.837	-2.66633	4,07
Error	905.6252	113.2032		
Total	0.112931			

Sources: Data primary 2018

4. Conclusions And Recommendations

4.1. Conclusion

1. The extract leaves carambola capable of inhibiting increased TVB smoked skipjack (*Katsuwonus pelamis*) for storage 4 day, with value TVB on all the treatment 8,59 mgN / g until 10,7 mgN / g. The number of TVB on all treatment is still below threshold that it is required &; 30mgN / 100 g.
2. The total every testing bacteria treatment berkiasar between 4×10^4 coloni/g until 6×10^4 coloni/g is standard SNI quality 2725.1:2009, the quality of smoke requirements fish s total is number plates $\pm 5,0 \times 10^5$ colonies /g.

4.2. Recommendation

Needs Further research on influence smoking skipjack (*Katsuwonus pelamis*) before smoking with extract leaves carambola on the growth of bacteria and the storage of smoked skipjack (*Katsuwonus pelamis*).

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The Size Variation of Rotifer *Brachionus rotundiformis* Cultivated with Different Feed at 4 Ppt Salinity

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Abstract. Rotifer *Brachionus rotundiformis* is a group of zooplankton which is utilized by fish larvae for feeding to initiate their growth. Rotifer *B. rotundiformis* is widely favored by marine fauna larvae because of its small size and can fits well with various larval mouth. Thus, it is easily preyed by larvae. The purpose of this study was to determine the variation of rotifer *B. rotundiformis* morphometry if cultured with different feed at 4 ppt. The use of 4 ppt salinity is expected to provide a variable morphometric size because *B. rotundiformis* has a polymorphism property. Polymorphism is a symptom of alteration in shape and size of lorica when the environmental conditions changes. Micro algae used as feed for rotifer *B. rotundiformis* were *Nanochloropsis oculata* and *Prochloron* sp. Micro algae *N. oculata* is one of the most popular feed for rotifer culture, while *Prochloron* sp. is a feed that has not been widely used. Micro algae are cultured with Hirata medium. In the early stages *B. rotundiformis* was cultured at optimum temperature (28 °C) and salinity 20 ppt, then *B. rotundiformis* is cultured at salinity 4 ppt. Salinity adaptation is done by lowering the salinity of the medium by 2 ppt every two days in a 10 mL reaction tube containing 10 individuals. After adaptation, *B. rotundiformis* was transferred in a 1000 ml container with a density of 50 individuals. For the morphometric aspect, the total length, the length of the lorica, the width of the lorica and the anterior width was measured. The results showed that the total length of rotifer *B. rotundiformis* fed with micro algae *Prochloron* sp. were smaller than of rotifer fed with *N. oculata*. Based on the morphometry of *B. rotundiformis* feeding with *Prochloron* sp. at a salinity of 4 ppt has the potential to be developed as feed for fish larvae.

1. Introduction

The ocean hidden enormous natural resources that can be exploited with responsibility for human welfare. Marine potency resides not only on macro organism but also on micbiological potential is not only a macroorganism, but also a microorganism. Plankton has two function in the marine food chain as a primary and secondary producer. Some zooplankton have been widely used as live feed for larvae, namely rotifer *Brachionus rotundiformis*. Rotifer *B. rotundiformis* has the potential to be developed for the feeding of fish larvae in its early stage (Fieder and Purser 2000; Assavaaree et al., 2001). Rotifer *B. rotundiformis* is favored by a variety of marine fauna larvae because it is a relatively small in size and suitable for larvae mouth. Due to the rotifer characteristics, it is suggested that rotifer could be cultivated as natural food for fish larvae. In an attempt to identify the possibility of cultivating rotifer in a laboratory, this study aimed to determine the variation of rotifer morphometric size cultured with different feed and low salinity at 4 ppt.

In this study, micro algae used as feed for rotifer *B. rotundiformis* were *N. oculata* and *Prochloron* sp. Micro algae *N. oculata* is one of the most popular feed for culture rotifer in Japan (Maruyama and Hirayama 1993) while *Prochloron* sp. is a newly tested feed. Recent study from Ogello et al. (2017) discovered that dried microorganisms of *N. oculata* and *Chlorella vulgaris* can accelerate the growth of rotifer *B. rotundiformis*. Rimper et al. (2008) successfully showed *B. rotundiformis* can be cultured with micro algae *N. oculata* and *Prochloron* sp. at 20 ppt salinity. This finding reveal that micro algae *Prochloron* sp. has smaller morphometry than *N. oculata*. Therefore, the objective of this study was to determine the variation of rotifer morphometric size cultured with different feed at lower salinity (4 ppt). The hypothesis is that higher salinity treatment will result in a different morphometry. It is expected that 4 ppt salinity treatment could provide a various morphometric size because *B. rotundiformis* has a polymorphism property. Polymorphism is a symptom when an organism changes in shape and size of lorica if the environmental conditions alter (Nogrady et al., 1993).

2. Materials and Methods

The study was conducted in Marine Biotechnology and Marine Biology and Chemical Laboratory, Faculty of Fisheries and Marine Sciences, Sam Ratulangi University of Manado. Micro algae used for feeding rotifers were *N. oculata* and *Prochloron* sp. with a density of 3×10^6 cells/mL. Micro algae were cultured in Hirata medium. The culture container was equipped with an aerator to promote algal growth. The algae incubator had 20 watt lamps as source of light for algae. The room was set at 25°C. The micro algae used for feeding *B. rotundiformis* was centrifuged and the precipitate was stored in the refrigerator as feed stock. *B. rotundiformis* was cultured in a 1000 mL container. In the early stages, *B. rotundiformis* was cultured at optimum temperature (28 °C) and salinity (20 ppt). Furthermore, *B. rotundiformis* was adapted at 4 ppt salinity. The seawater was diluted with water to decrease the salinity. The water was measured with a refractometer until a salinity of 4 ppt was obtained. The adaptation of *B. rotundiformis* in different salinity was done by decreasing the salinity of the medium 2 ppt every two days in a 10 mL reaction tube containing 10 individuals. After adaptation, *B. rotundiformis* was transferred into a 1000 mL container with a density of 50 individuals and cultured at 4 ppt salinity with two different feed types (*N. oculata* and *Prochloron* sp.).

The morphometric measurements were based on three parts, namely the length of the lorica (LL), the width of the lorica (WL) and the anterior width (AW) (Hagiwara et al., 1995).

3. Results

The study demonstrated that there are higher variation of rotifer *B. rotundiformis* morphometry with different feed treatment and cultivated at 4 ppt salinity. The mean value based on morphometry measurement on rotifer fed with *N. oculata* was: Total length (TL) = 221 µm; Length of Lorica (LL) = 137.98; Anterior width (AW) = 68.85; Lorica's width (LW) = 109.65 µm. Meanwhile, the morphometry of rotifer fed with *Prochloron* sp. were: Total Length (TL) = 157.70 µm; Length of Lorica (LL) = 120.63; Anterior Wide (AW) = 56.16; Lorica's width (LW) = 96.83 µm (Table 1).

4. Discussion

The study showed that the smallest rotifer *B. rotundiformis* morphometry was found in rotifer fed with *Prochloron* sp. This phenomenon was likely due to the polymorphism of rotifer *B. rotundiformis*. Polymorphism was the condition where shape and size of the lorika undergoing changes to a kind of plasticity if the environmental conditions transformed (Nogrady et al., 1993). This polymorphism can lead to a considerable difference of 15% morphometric (Fukusho, 1989).

The results showed that feeding *Prochloron* sp. to *B. rotundiformis* resulting in a smaller morphometric size when compared to *N. oculata* feed. This result was expected. Moreover, this results demonstrated this situation could be beneficial since marine biologist could manipulate the development of *B. rotundiformis* as a natural feed that fits different sizes of fish larval mouth.

5. Conclusion

The morphometric of rotifer *B. rotundiformis* fed with micro algae *Prochloron* sp. at 4 ppt salinity was smaller than that of the rotifer fed with *N. oculata*. Further investigations on how to accelerate the cultivation of micro algae *Prochloron* sp. as feeding for *B. rotundiformis*.

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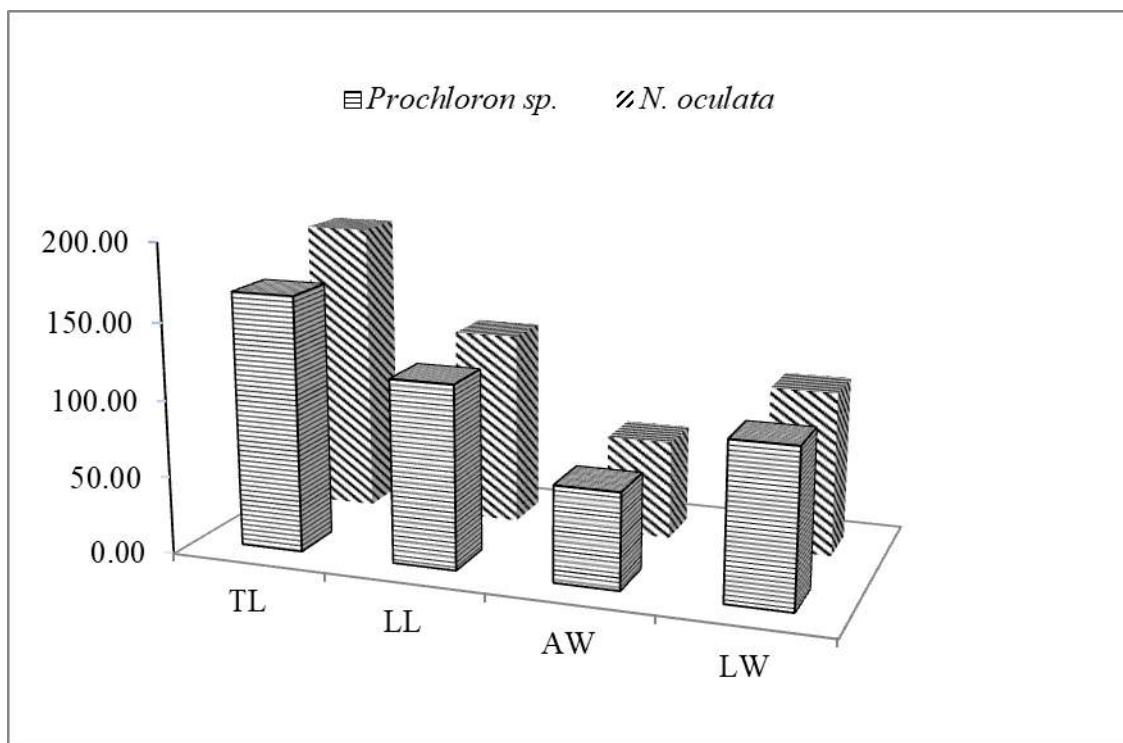
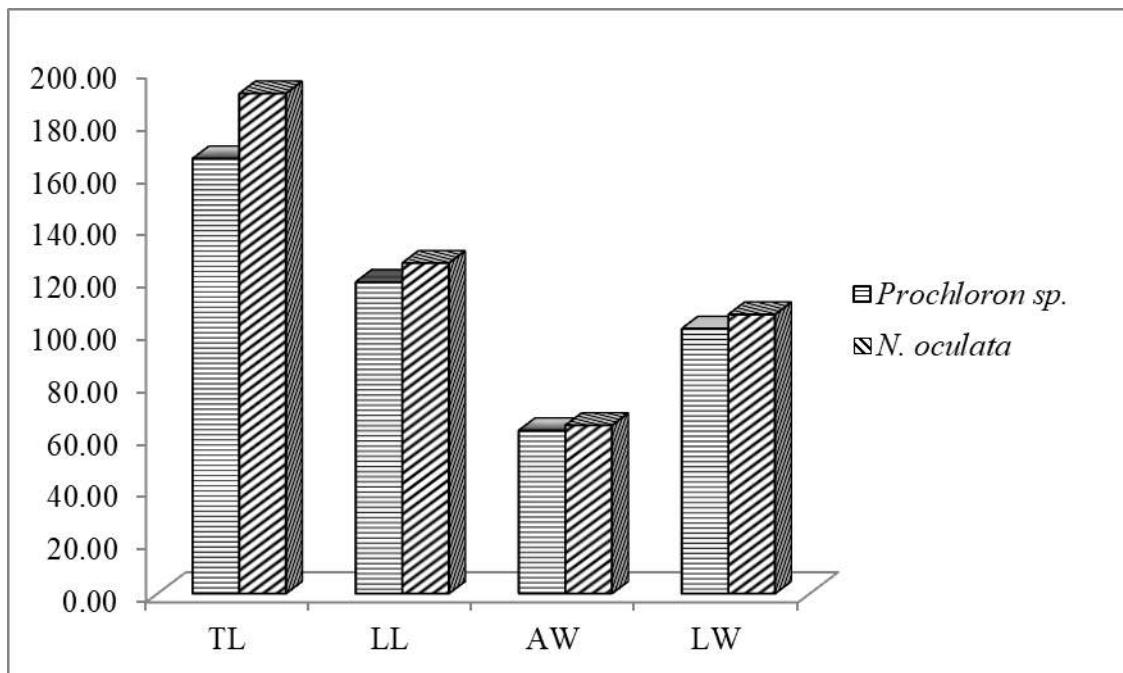


Figure 1. Morphometry (μm) B. rotundiformis with assorted feed
TL= Total Length, LL= Lorica Length, LW= Lorica Width, AW= Anterior Width

Size Identification of the Adult Sea Cucumber, *Holothuria scabra*, in the Coastal of Labetawi Village, Tual Town of Maluku Province

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Abstract. Sea cucumber, *Holothuria scabra* is elongated round with mouth and anus lying on both sides of the opposite body. High protein content and contain anti-bacterial compounds because sandfish are widely caught and used as food and medicine. To maintain the availability of sandfish in a sustainable manner, it is necessary to do the breeding activities. This research aims to determine the spawning time and body weight of sandfish, *H. scabra* which can be used as the adult. The research took place from March to April 2018 where the adult sample was collected from the coastal of the Labetawi village and breaded in the Hatchery laboratory. Spawning stimulation was done by temperature fluctuation method. Results show that Sea Cucumber, *Holothuria scabra*, in the village of Labetawi matured and spawned in March and April. In addition, it is also known that sandfish, *Holothuria scabra* matured and spawned when it had a weight of 80 gram, where it can be identified as adult.

1. Introduction

Sea Cucumber (Phylum Echinodermata; Class Holothuroidea) is well known as a marine benthic organisms, which has an economic value. Generally, some species of sea cucumber are often catching by local fisherman, where the species of *Holothuria scabra* is the most exploration. A high protein and anti-bacteria compound content cause this species is more exploited and be used as food and medicines sources (Padang *et al*, 2014). Sea cucumber forms elongate and roundabout, where mouth and anus situate in both opposites of body.

Based on an observation to fisherman of collecting sea cucumber, it was found that the population of sea cucumber, *H. scabra*, in the coastal of Tual decreased both in number and sizes. The species has a great value in the market, thus, there has been continuing exploited without concerning of its conservation. The value in the market is about 400.000 – 1.200.000 rupiah/kg dry sea cucumber. Other thing is that it is a sessile species, where it moves very slowly, and it has become a target of catching since many-many years ago (Tomatala, *et al*, 2018).

To maintain sea cucumber available in natural population, it must be required a certain specific effort in management, where a Mari culture of sea cucumber will be one of the solution. A nursery is a part of Mari culture where it has a goal of producing sea cucumber seed. By producing seed of sea cucumber, the number of production can be maintained as well as sea cucumber availability in nature. Here, adult available is required to produce seeds both of continuities and number. Decreasing number of sea cucumber population in field give an affect to have an appropriate adult sizes to an adults. Some characteristic of having the sea cucumber adult is a gonad maturation, where it is not like grouper fish, pearl oyster (*Pinctada* sp), and abalone (*Haliotis* sp), the gonad maturation of sea

cucumber can be only observed by killing the organism. Spawning can be a methods to know a sea cucumber maturation level. This research was applied to know a time of spawning and size of body weight of sea cucumber (*H. Scabra*), when they will be identified as an adult.

2. Research Method

This research was applied in the hatchery of Polytechnic Tual during March until April 2018. 30 Adults were collected in the night time when low tide in Labetawi Village, Tual Town. Samples were placed into 100 liter chamber (Figure 1a). Then Adults were brought and arrived in spawning placed 2 hours after collected. Weight of adults were measured before transforming into fiber chamber, then it was stimulated to spawn (Figure 1b). Sea water temperature was rose into 3°C, then reduced back to natural sea water temperature. The Spawning stimulation was applied in dark condition, where a small lighter sometimes used. When spawning occurred, adults were removed from spawning chamber, then weight of adults were measured. Eggs of every adult were measured. All sea cucumbers that are spawned, are stocking on Pen-culture and given additional feed by ablibitum. Mortality was accounted a week after placing the sea cucumber into Pen-culture. Sea waters qualities such as salinity, temperature, oxygen content, and turbidity were measured every day during a week.



Figure 1. Adult collection (a) and adult stimulation (b)

3. Data Analysis

Sea Cucumber mortality was counted based on bellow formula, as follow:

$$M = \frac{N_t}{N_o} \times 100$$

Where :

- M : Mortality (%)
- N_t : Number of dead individuals
- N_o : Number of individuals at stocking
- .

4. Results And Discussions

4.1. Adults Sizes

Data on measurements of body weight of samples sea cucumbers and sea cucumbers which spawn are requested in the following Table 1:

Table 1. Data on sea cucumber body weight

Adults	Adults		Spawning adults	
	March	April	March	April
weight (g)	79,5 - 205	78,4 - 215	103 - 184	80 - 205
Average (g)	129,06	127,78	143,5	142,5

The size in weight and average of collecting adults in this research is still unexpected comparing to sea cucumber adults generally used in sea cucumber nursery (Table 1). Sea cucumber adults has range of > 200 g (Meñez *et al*, 2012). The sizes of Sea Cucumber adults ranged from 80 – 205 g in this study. The range of male spawning was 80 – 205 g, while females were 103 – 128 g. This study indicates that there is no ideal size of sea cucumber adult in the waters of Labetawi village. Over exploited of sea cucumber in the field was one reason. The exploited of sea cucumber was high, as the result, small size comparing to some years before leafed in this sea waters (Sembiring *et al*, 2016). Where it was below an ideal size of sea cucumber adults for hatchery.

4.2. Spawning

Number of Sea cucumber adults spawning is shown in below table 2.

Table 2. Number of adults spawning during observation times

Month	Spawning (Individu)		
	Male	Female	Total
March	2	2	4
April	5	2	7

Adults spawning after stimulating in the hatchery occurred in March and April. It might also indicated that the adults of sea cucumber spawn in the field during March and April. Spawning might occur as a result of various endogenous, such as the maturation time, and exogenous factors, such as environmental pressure as a result of stimulation by sea waters temperatures. The time of spawning of sea cucumber is supporting the spawning time that was reported by Rahantoknam and Kelabora (2017). *H. scabra* spawns during January until July in Southeast Maluku sea waters.

Both male and female spawned at the same time during March and April indicated both male and female have a synchrony reproduction pattern. This pattern were concerned by Sembiring *et al* (2017), both occurring of synchrony and un-synchrony spawning might recognize from the number of adults treated.

A female spawned had 1.230.000 – 1.435.000 eggs in this study. This number of eggs per female might low comparing to number of eggs per female reported by Agudo (2006). A female collected directly from field spawned 9.000.000 – 12.000.000 eggs (Agudo, 2006). Like others marine invertebrates, such as marine mussels, maturation time and adult sizes might be implied in number variation of eggs production (Ompi and Svane, 2018; Ompi, 2010), where this pattern was also concerned by Sembiring *et al* (2017) and Agudo (2016), when sea cucumber adults spawned.

In this study, male spawned first and then followed by female. There was 20 – 30 minutes differences of spawning activities among both male and female. This spawning behaviors was also reported by Eekhaut *et al* (2012). Sea cucumber released sand particles out of the body at the same time, when sea cucumber spawned in this study. This condition indicated that sea cucumber had stress time when spawning took placed (Sembiring *et al*, 2016).

4.3. Mortality

The mortality of sea cucumber adults during a week in this study was 0 %. No mortality might be caused by both of a short time culture and an adults sizes of culture. An adult might have more ability of adjusting environment condition comparing to juvenile stage (Dualantus and Djauhari, 2010). The mortality of sea cucumbers culturing in the field might vary such as 15 – 60 % (Agudo, 2012; Purcell, 2012), 6.4 % (Serang *et al*, 2016), and 0% in this study. Null mortality might indicate that sea cucumber might not be easy to be dead as a resulted of stress in this culture condition. Sea cucumber

needs a health environment condition to support its activities (Sulardiono *et al*, 2017). In this study, seawaters qualities were in ideal condition to support sea cucumber activities as it is shown in Table 3.

Table 3. Seawater quality parameters measured during research.

Parameters	Ranged of water qualities		References
	Observation	Optimum	
Temperatures (°C)	29 - 31	26 - 32	Andriyon <i>et al</i> , 2016
Salinities (ppt)	33 - 35	28 – 35	Indriana <i>et al</i> , 2017
pH (mg/l)	7,2 - 7,9	6 - 8,5	Giraspy and Walsalam, 2010
DO (ppm)	6,2 - 7,9	6 - 8,4	Serang <i>et al</i> , 2016
Water particles (cm)	104-140	> 40	Komala, 2015
Currents (cm/sec)	19 - 24	< 40	Tomatala <i>et al</i> , 2018

5. Conclusion

Sea Cucumber can reach maturation stage and spawn in Labetawi Village in March and April, It is called as an adult when it has 80 gram of weight, where it can have a mature stage and spawning.

Acknowledgements

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Classification System Determining Stress Level Using K-Nearest Neighbors Method

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Abstract. Stress is generally viewed as condition in which a person experiences a psychic disorder in response to the stresses it faces. Unlike adult who can recognize the stress they face and manage it, junior high student are often unaware of the stress they are experiencing, which usually happen around them. This study aims to design a classification system to determine the level of stress experienced by student by applying the K-Nearest Neighbors method. The data of this study came from 254 respondents of SMP Katolik Don Bosco Bitung. The determination criteria were taken from age, class, sex, number of siblings including the student himself, the child to which he or she and the 20 questionnaire questions parameter K, we take K = 5 value for the nearest neighbors of the data test against the train data. The training data for this system itself was taken from a questionnaire distributed to 254 students of SMP Katolik Don Bosco Bitung. The result of this study suggest that the classification system is successfully implemented and can determine the stress level of junior high school level in SMP Katolik Don Bosco Bitung.

1. Introduction

Stress is a feeling or thought that arises in response to a threat or challenge known as a stressor [1]. Positive stress can encourage and spur someone to get things done, but negatively stress can cause health problems such as sleep and digestive disorders [2], especially for junior high school students so determining stress levels needs to get serious attention to get treatment immediately.

Research conducted by Kanchana et al. [3] compared the analysis of the artificial neural network method and the classification method for measuring stress levels indicating that the classification method gave better results. Encouraged by this, in this study a classification system will be created to determine the level of stress experienced by junior high school students using the K-Nearest Neighbors classification method. Classification of stress levels based on research by Warno et al [4], divides stress into three categories, namely mild stress, middle stress and severe stress.

The purpose of this study is to create a classification system using KNN to determine the stress level of junior high school students. The data needed for this study were 254 questionnaire data distributed to junior high school students with personal identity and questions.

2. Literature review

The K-Nearest Neighbors method is an algorithm that is often used in addition to predictions and estimates [5]. Larose and Larose [5] explain if classification has similarities with estimates, but the

target variables are more categorical rather than numerical. Based on this, KNN is included as an instance-based learning, in which training data from test data has been stored first. The classification of new data can be determined by comparing it with the majority of training data that are similar when tested [5], the majority of these are taken based on voting from K's constituency [6].

The K value itself determines how many closest neighbours influence the classification process [5] with the closest point of the new data given based on its distance, but avoids the use of even values because it can give confusing results [6]. In general, the distance function that is often used is the Euclidean distance:

$$d_{Euclidean} = \sqrt{\sum_i (x_i - y_i)^2} \quad (1)$$

Dimana :

d = distance Euclidean

x_i = data test

y_i = data training

Using voting as the basis for determining classification, Banjarsari et al. [7] in their study concluded that the value of $K = 5$ has a high accuracy of classification. On the other hand in the research Rahmawati and Adnan [8] explained that letters cannot be calculated so they must be converted into decimals using ASCII rules. Therefore the gender of the answer is a letter and must be changed for L worth 76 and P is worth 80. The criteria that become an assessment in this classification are students' personal identities namely gender, age, class, number of siblings and children in what order in siblings .

3. Methodology

3.1. Sample and Data Collection

The first phase of this study was to collect data from students, which consisted of 254 students as a sample of a total of 699 students taken based on the Solvin formula. Data were collected using a questionnaire that has been tested for validity and reliability with a confidence level of 5%. Validity test itself is done twice.

The first test was conducted with 30 questions for 30 students for the results of 18 valid questions and 12 invalid questions. The second test was 50 students with 20 questions for 20 questions with 18 questions taken from the results of the first valid test, then added 2 new questions, the results obtained stated that the 20 questions were declared valid. The final stage is to calculate the reliability of 20 questionnaire questions with the results declared valid for the value of $r = 0.857$, to test the validity and reliability using SPSS 24.

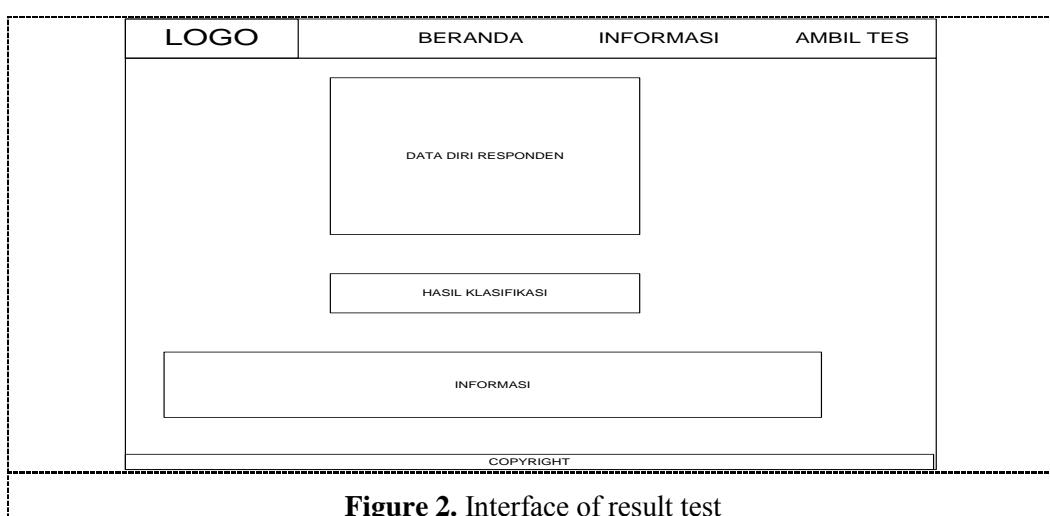
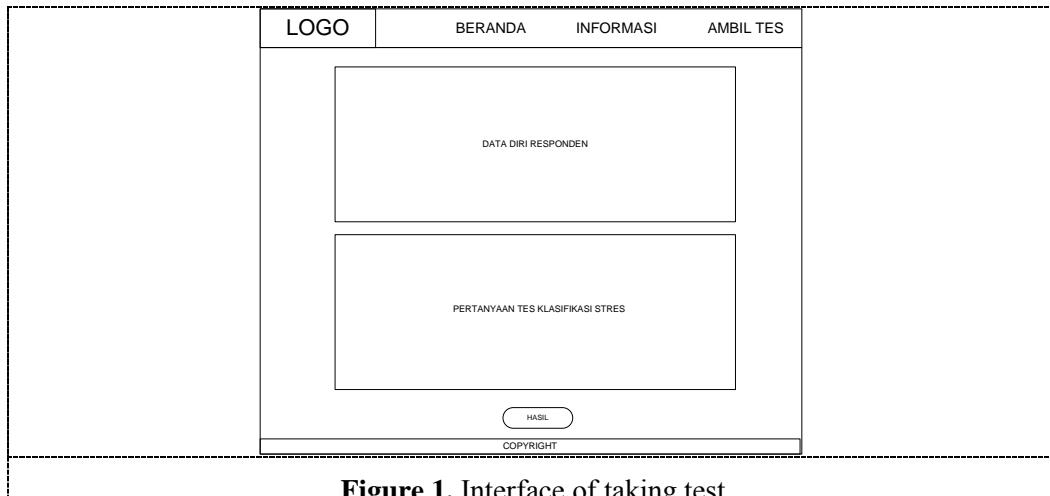
3.2. Analysis and System Design

Data collected from the questionnaire will be used as training data for the system built, with contents containing personal identities and answers from 20 questions. The first step is to share data, what is needed and not. In the personal identity, only the name of the student is deleted and the remainder remains, and for all the answers are taken. Then, for the student's birthday is changed to age. However, based on the research by Rahmawati and Adnan the letter changed to L is 76 and P is 80 [8]. Table 1 contains the results of the questionnaire that has been distributed, consisting of personal identity and answers that have been changed first. The following is the training data used.

Table 1. Data latih

Num	Gender	Age	Class	Number of Siblings	Order	Question										Stress Classification
						1	2	3	4	5	...	20				
1	76	13	2	2	1	2	2	2	4	2	...	4	Mild Stress			
2	80	12	2	2	1	4	4	3	3	3	...	5	Middle Stress			
3	80	14	2	2	3	3	2	5	5	2	...	4	Middle Stress			
4	80	13	3	3	3	3	1	1	2	1	...	4	Mild Stress			
5	76	14	3	2	1	3	3	5	5	3	...	5	Severe Stress			
...
254	80	14	2	5	2	5	2	3	4	3	...	4	Severe Stress			

From the training data in Table 1, the software model of the KNN method will be designed. The first step is to create an interface from the software. Figure 1 shows the interface design of test retrieval. Figure 2 shows the interface design of the test results.



The test results shown in Figure 2 are based on the KNN method used in this study after going through the classification process. The classification process of the KNN method itself can be seen in the pseudocode below.

START

```
SET arrayIdentity, arrayKuesioner
SET mergerArray(arrayIdentity, arrayKuesioner)
SET arraySlice(mergerArray, 1)
SELECT db
SET db INTO arrayDb

SET Function euclidean(arrayDb, mergerArray)
    SET arrayDistances
        FOREACH arrayDb as arrayKey to arrayRow
            FOREACH arrayRow as arrayIndex to arrayValue
                FOREACH mergerArray as mergerRow to mergerValue
                    IF arrayIndex == mergerRow
                        continue
                    ENDIF
                    SET arrayDistance[arrayRow] = square( power(mergerArray-arrayIndex, 2))
                    SET classify
                    SET arrayDistances = array (arrayDistance, classify)
                ENDFOREACH
            ENDFOREACH
        ENDFOREACH
    SORT arrayDistances
    RETURN arrayDistances

END
```

3.3. Implementation and Testing

The results of the analysis and design will then be applied to programming. Figure 3 shows the implementation of the test-taking interface design that contains the student's identity, in the form of the name, date of birth, gender, class, number of siblings, and children to what he is.



Figure 3. Implementation of test taking

Figure 4 shows the implementation of the test interface design that contains the name, age and results of stress classification using the KNN method.



Figure 4. Implementation of result test

Based on the implementation that has been carried out, the KNN method is tested if it can run as the results of the analysis. With data not yet classified as in Table 2, the results obtained state that if the data is classified as medium stress.

Table 2. Data test

Jenis Kelamin	Usia	Kelas	Jumlah Saudara	Anak Ke	Pertanyaan						
					1	2	3	4	5	...	20
76	13	2	2	1	3	3	4	4	2	...	5

4. Conclusion

Based on the results of the research that has been presented, it can be concluded that :

1. The K-Nearest Neighbors method for $K = 5$ can be applied in determining the stress level of junior high school students.
2. The amount of data that used can affect the classification results.

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Dipole-dipole Configurations of Resistivity Geoelectric Methods Exploration to Detect Landslide Slip Surface in Tomohon City

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Abstract. Landslides are a source of many disasters, usually in hilly areas, especially the Tinoor area of Tomohon Subdistrict. The slip surface on hills is one of the main factors in the occurrence of landslides. Identification of the slip surface existences in the study area is important as an effort to mitigate natural disasters. Exploration using the resistivity geoelectric method of dipole-dipole configurations. Data acquisition uses multichannel and multielectrode resistivity and IP meter MAE X612EM, data is processed using Res2Dinv software. Exploration is carried out on 3 lines, each line is 62 m long, spacing is 2 m. The slip surface is interpreted as a sandy clay layer with resistivity (30 - 215) Ω m. Identified slip surface on line 1 along the line with a depth of (2 - 10) m, On line 2, the slip surface is identified at 3 locations, varying to a depth of 15 m. On line 3 there are 2 locations of slip surface that reach depths of up to 11m.

1. Introduction

Tinoor 1 Village, North Tomohon Subdistrict, Tomohon City, is passed by the main road from Manado City to Minahasa Regency, this village is a hilly area. The main road is located on the slopes of the hills with steep slopes, in some locations there have been avalanches. Landslide is one of the most aggressive natural disasters that causes loss of lives and billions of dollars worth of damages annually worldwide. However, there are different factors such as geological, topographical, and human causes (disregard for sustainable developments) contribute towards landslide occurrences [1]. Landslides are one of the most common natural as well as man-made hazards in mountainous terrain [4].

Landslides are one of the critical geological processes, which cause not only enormous damage to civil engineering structures i.e. roads, railways, bridges, dams, bio-engineering structures, and houses but also lead to loss of life. Hence, there is a need for landslide susceptibility mapping for identification of potential landslide areas. Interaction between local geology and the long-term climatic conditions result in significantly different landforms with varying degree of susceptibility to land sliding. Although landslides are local phenomenon, but the total loss of life and property due to landslides is far greater than any other hazard [2]. The relationship between the landslide and slope is correlated with the geological environments within the certain area closely. Comprehensively, the different landslides often correspond to different critical slope [3].

Landslides can manifest themselves in many different forms, including rock falls, rockslides, debris flows, soil slips, rock avalanches, and mud-flows. Some infrequent landslides may lead to catastrophes. Considering the scale of these events, they are basically unpreventable. The most reliable way to prevent landslide-induced casualties and economic losses is to avoid building towns or cities in the vicinity of steep terrains. But, this is considered impracticable or impossible in many countries due to the rapid growth of human population or due to the expensive cost in relocating of ancient or historical cities. Thus, regional landslide hazard analysis and management is becoming an important task for city planners and officials [4]. Landslide disasters including debris flows are the one of the most frequent natural disasters in Korea, and losses of lives and property damages due to these catastrophic events have been increased every year. Various mitigation programs and related policies have been conducted in order to respond and prepare landslide disasters [5].

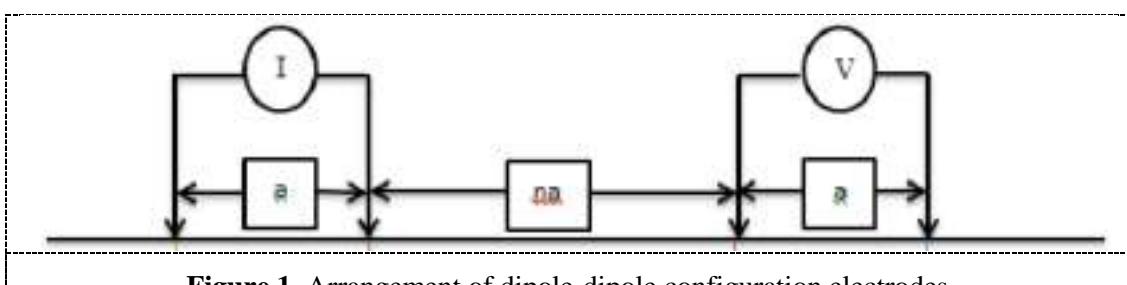
Jongmans and Garambois presented an interesting diagnosis of the relatively limited use of geophysical methods in identifying landslide hazards. They found that *geophysical methods provide images in terms of physical parameters, which are not directly linked to the geological and mechanical properties required by geologists and engineers. Another reason comes from a tendency among some geophysicists to overestimate the quality and reliability of the results.* Undoubtedly, these statements are relevant to much geophysical work, so it is important to continually emphasise the principles behind proper identification of hazards using geophysical means. It specifies the geophysical methods which are of greatest importance in the study of landslides. Their advantages and limitations are presented. The principles of the geophysical methods applied at the stage of designing and carrying out measurements, processing and interpreting data, analysis of results and their documentation are described [6]. The geophysical data were successfully used for the interpretation of the spatial structure of the Havuzlu Landslide [8]. It was shown that geophysical methods are valuable tools for the extraction of information about the subsurface. Although the extent of the landslide investigated herein could not be determined fully. The suitability and limitations certain resistivity methods could be demonstrated [9].

One of the geophysical methods commonly used to detect the presence of slip fields is the resistivity geoelectric method. This method is environmentally friendly, it can give a subsurface picture to a certain depth according to the length of the stretch of the measurement path. The resistivity geoelectric method is carried out by injecting electric current I into the ground and then measuring the potential difference ΔV .

The resistivity geoelectric method has several types of configurations, including: Wenner Alpha configuration, Wenner Beta configuration, Schlumberger configuration, Wenner Schlumberger configuration, Dipol-dipole configuration, Pole Dipole configuration. Each configuration determines the measured resistance value based on the geometry of the electrode configuration, which is termed the "K" geometry factor. In this study, Dipole dipole configuration, electrode current and potential electrode arrangement are shown in Figure 1. The Dipole dipole Configuration has a geometry factor,

$$K = (n+2)(n+1)(n)(\pi a)$$

With a is the distance between two electrodes, $n = 1, 2, 3, \dots$



Amount of the K value determines the apparent resistivity value (ρ) according to the equation:

$$\rho = K \frac{\Delta V}{I}$$

2. Study Area

The study area is located in Tinoor 1 Village, Tomohon District, Minahasa Regency, North Sulawesi Province (Figure 2). Topographic conditions in the form of mountainous areas, the area of study in latitude and longitude coordinates ($1^{\circ}23'8.57'' - 1^{\circ}23'11.28''$) N dan ($124^{\circ}49'52.92'' - 124^{\circ}49'54.84''$) E. Vegetation conditions in the form of plantations, shrubs and forests. There are several residential houses, and houses are built to sell on the side of the road. Geological conditions in the study area are volcanic breccia rocks, tuffs, tuffs, alluvium, limestone, coral reefs, sand, silt, conglomerates and clays.

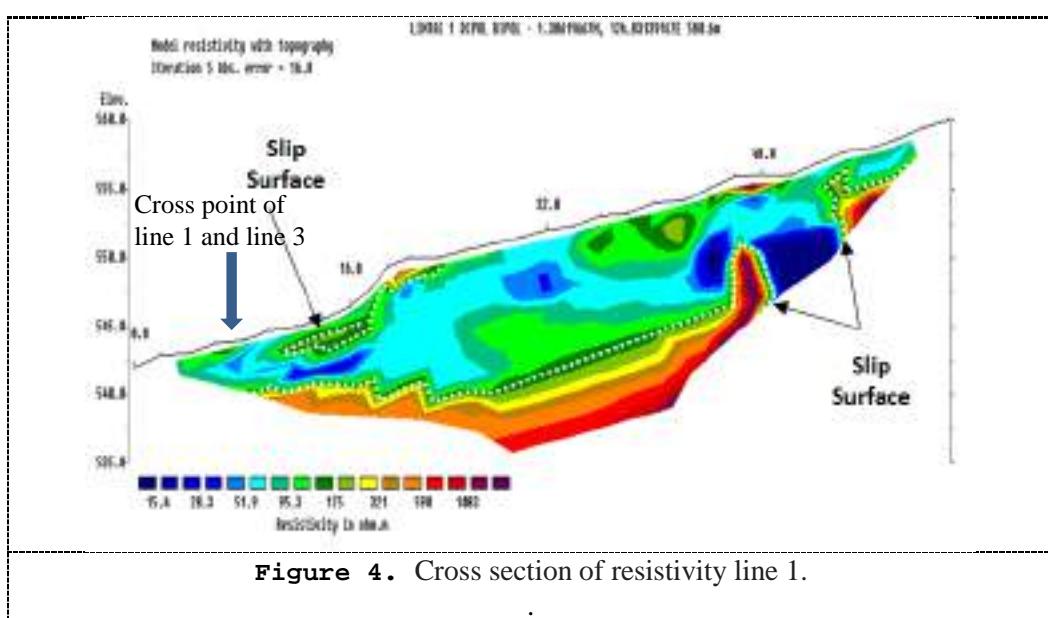


3. Results and Discussion

Exploration using geoelectric resistivity method of dipole-dipole configuration is carried out on 3 lines (Figure 3), each path is 62 m long, spacing is 2 m. The data was processed using Res2Dinv software and generated 2-dimensional resistivity crosssection. The slip surface is interpreted as a sandy clay layer with resistivity (30 - 215) Ωm .



Exploration results on line 1 can be seen in Figure 4,



The layer identified as a slip surface in two places. Layer 1 is located on the 8th - 18th meter with a depth of ≤ 2 m. The second layer in the image looks to consist of two parts which are thought to be the same layer, layer 2 is located along the path with a depth of 2 - 10 m.

The slip surface on line 2 can be seen in Figure 5

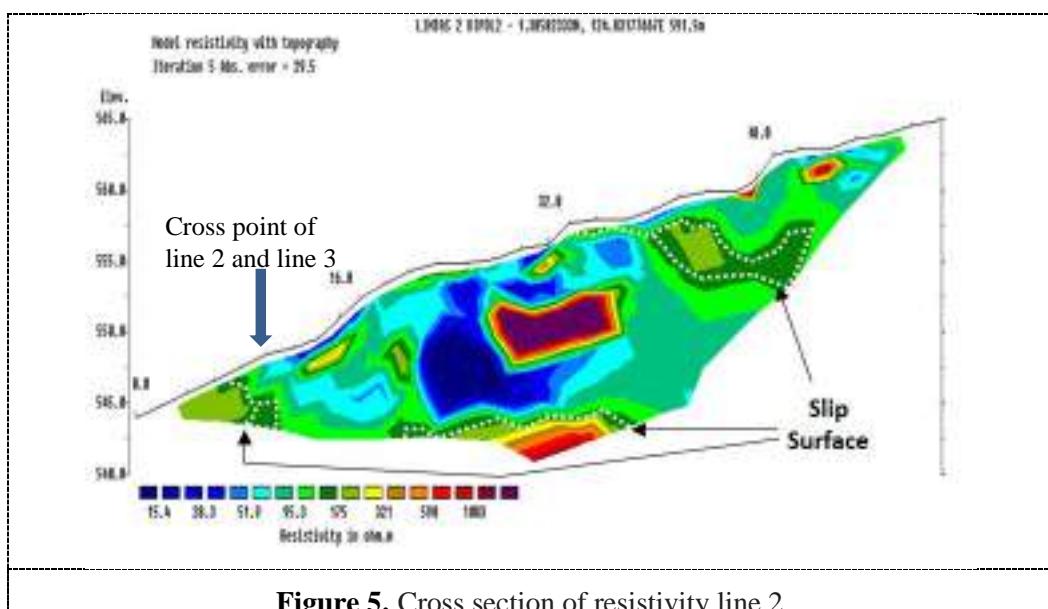


Figure 5. Cross section of resistivity line 2.

On line 2, the slip surface was identified in 3 locations. Location 1 on the 6th to 10th meter with a depth of ≤ 5 m, the second location at 20th to 38th meter with a depth of 12-15 m, location 3 at 34th to 53th with a depth of ≤ 7 m. The slip surface at location 1 and location 2 is thought to be interconnected and continuous.

Line 3 is done by crossing the 1st line and line 2. As long as line 3 intersects line 1 and line 2. The cross-section of the resistivity of line 3 is shown in Figure 6,

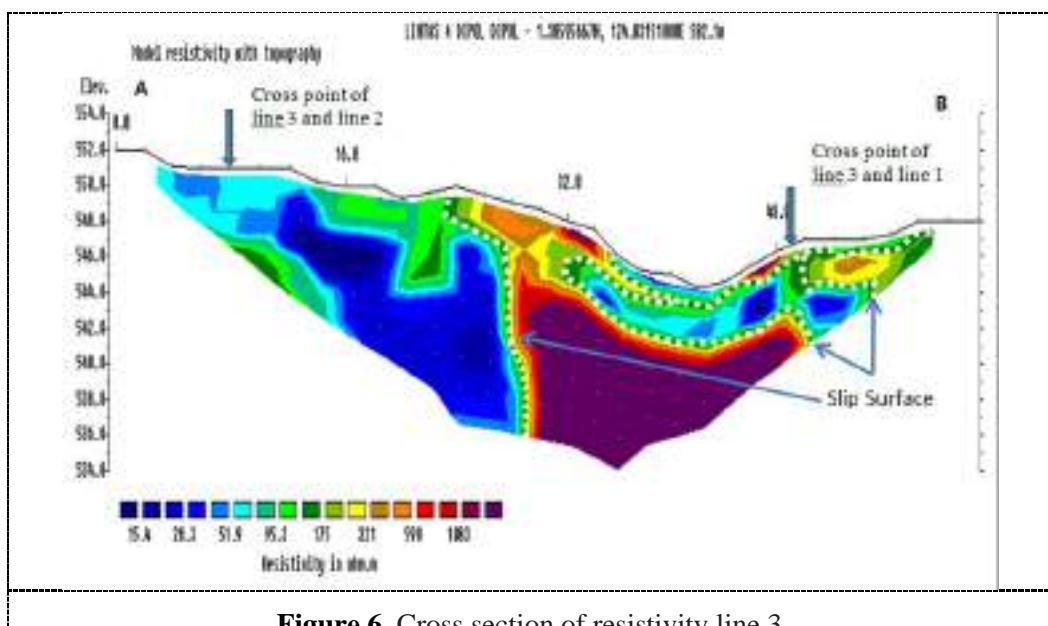


Figure 6. Cross section of resistivity line 3.

On line 3, 3 locations were obtained, namely the the first locatian at 8-12 meter with a depth of 4-7 m, the second location at the 24-26 meter with a depth of 14 m and the 32-59 meter with a depth of 6 m. The layer below the intersection between lines 3 and 2 (Figure 6), a slip surface layer is detected with a depth of ≥ 4 m, this corresponds to the condition of the subsoil under the intersection of line 2 and line 3 (Figure 5) where the depth of the slip surface is ≤ 5 m. so that if the slip surface at locations 1 and 2 is estimated to be continuous, then at the research location there is a significant potential for landslides. The soil layer below the intersection between line 3 and line 1 (Figure 5) identified the slip surface with a depth of ≤ 6 m, according to the condition of the subsoil below the intersection between line 1 and line 3 (Figure 4) where the depth of the slip surface was identified 4 m.

The identification of the interconnected layers of slip surfaces in the research area indicates that there is a potential for landslides. The vegetation that is meeting at the research site is considered to be one of the anchoring factors so that the soil mass does not slide down. So that the existence of the existing vegetation needs to be maintained and increased in number and quality. The vegetation functions to control rainwater that seeps into the soil. Geoelectrical data showed a zone of low resistivity values identified as a clayey sand-filled aquifer. This aquifer played an impor- tant role in the triggering process of the landslide [10]. When effects of clearcutting were superimposed on natural site conditions, several factors appeared to contribute to the enhancement or suppression of landslide and debris flow impacts. These factors included an increase in triggering mechanisms associated with loss of forest When canopy and loss of soil strength due to root cohesion [11]

4. Conclusion

Identified landslide slip surface, the slip surface is interpreted as a sandy clay layer with resistivity (30 - 215) Ω m. Slip surface on line 1 along the line with a depth of (2 - 10) m, on line 2 there are three locations of the slip surface, namely: location 1 is located on the 6th to 10th meter with a depth of ≤ 5 m, location 2 at 20th - 38th meter with depth of (12 - 15) meter location 3 at 34th to 53th meter with a depth of ≤ 7 m. on line 3 there are two locations, namely the 7th - 16th meters with a depth of (5 - 11) m and the 33th to 59th meters with a depth of ≤ 4 m.

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The Potential Use of *Catharanthus roseus*) as a Beach Tourism Jewelry and as an Herbal Medicine for Tourists

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Abstract. The studied potential use of tapak dara (*Catharanthus roseus* L. G Don) as a beach tourism jewelry and as an herbal medicine for tourists has been done. In Indonesia, *C. roseus* although not native to Indonesia but from the results of a survey along the coast of Bolevard Manado, the Bololosian Bolot shows that this plant grows wild and some have been cultivated as ornamental plants. But it is still not well organized. This plant has been studied a lot and has been used as a medicinal plant. The content of vincristine and vinblastine, which has been known recently as a cure for cancer, has opened up opportunities for farmers to cultivate these plants. One of the potensial use were this flower plants well growth at the poor vetiver and the lack of knowledge of the community. Good plant quality is characterized by good flower growth, resistant to pests and diseases. Efforts to cultivate tapak dara with good growth are fulfilling the desired growth requirements, one of which is the height of the best place for the growth of this plant. The potential utilization of *C. roseus* as a jewelry or garden ornament in coastal marine tourism around the coast of North Sulawesi is very possible and very good to be used in the development of local, national and international tourism creative industries. The uniform and fast production of *C. roseus* seeds is very possible by utilizing plant tissue culture techniques. Another creative tourism industry with the use of *C. roseus* is using dried leaf powder into healthy drinks in the form of teabags for visitors in coastal marine tourism that has been known as a cure for various diseases and supporting public health.

1. Introduction

Marine tourism is one of the leading programs and priorities in national tourism development with the direction of development consisting of: introduction of tourist destinations, support for environmental conservation campaigns, and enhancement of marine cultural tourism. Indonesia has around 17,508 islands, of which 10,000 are small islands, with a coastline of 81,000 km, sea area of about 3.1 million km², and coral reefs of around 50,875 km², Indonesia has great potential for the development of marine tourism. Indonesian coral reefs contribute as much as 21% of the world's coral reef wealth and 75% of the world's coral species can be found in Indonesia (1).

Utilization of the results of science and technology research such as tapak dará plant can also be very potential to be developed into creative industries. The tapak dara plant (*C. roseus*) is one of the plants that is widespread in the tropics. This plant originally came from Madagascar so it was also known as Madagascar Periwinkle. At this time this plant has spread in almost all tropical regions such as China,

India, Indonesia, Australia, North and South America. In Indonesia, these plants are often found as ornamental plants that are planted in the front yard of the house. This plant is a chronic shrub with a plant height of less than 1m.

Tread plants have beautiful flower colors such as light purple, pink or white. The widespread distribution of tapak dara in various regions, causes these plants to have local names. In Indonesia, this garden ornamental plant is known by various names, such as called sindapor atau tapak dará (Sulawesi), bunga tembaga (Sundanese), and kembang tapak dara (Javanese). Malaysians know him as a kemunting cina, pokok rumput jalang, pokok kembang sari cina, or pokok ros pantai. In the Philippines it is known as tsitsirika, in Vietnam as hoa hi dang, in China it is known as chang chunhua, in England as rose periwinkle, and in the Netherlands as soldaten bloem. Tread plants can grow in the lowlands to the highlands with an altitude of 800 m above sea level (asl.). This plant likes open places, but can also grow in shaded places. This plant can be grown with seeds, stem cuttings, or roots.

2. Methods

The data collection method used in writing this article is by searching online related libraries. Then the real potential continued, followed by a survey to the beach beaches around Manado. The beaches that have been traveled are Likupang, Kianari Beach, Lumintang beach, Bentenan Beach in the North part of North Sulawesi. The southern coast of northern Sulawesi is also traced directly from Malalayang, Kalasea, Taleli, Koha, Mokupa, Tombariri, Tana Wangko, Pondang, Bitung, Benteng portugal, Kapitu, Majaan, Boyonpante, Aergale, Tanamon, Nanasi, Mariri Baru, Pantai lolan, Ambang I, Inobonto, Bolaang Uki, Pantai Sondana, Tabila, Pantai Linawan, Pinolosian until to Kombot, it was concluded that the breeding site grew around the beach well (Figure 1 A).

3. Results and Discussion

In Indonesia, *C. roseus* although not native to Indonesia but from the results of a survey along the coast of Bolevard Manado, the Bololosian Bolot shows that this plant grows wild and some have been cultivated as ornamental plants (Fig. 1 and 2). But it is still not well organized. This plant has been studied a lot and has been used as a medicinal plant (Fig. 1, 2 and 3). The content of vincristine and vinblastine, which has been known recently as a cure for cancer (, has opened up opportunities for farmers to cultivate these plants. One of the causes of the poor growth of vetiver plants is the lack of knowledge of the community about the growing requirements for good growth of virgin plants. Good plant quality is characterized by good flower growth, resistant to pests and diseases. Efforts to cultivate tapak dara with good growth are fulfilling the desired growth requirements, one of which is the height of the best place for the growth of this plant (Fig. 2).



Figure 1. The appearance of *C. roseus* grows thriving and Good (A), Still growing and flowering even though the soil is barren, dry and rocky (B).



Figure 2. The variation of the type of ornamental plant *C. roseus* in North Sulawesi (3)

The altitude factor will show the difference in climate on certain terrain which will affect plants such as temperature. Temperature is an environmental factor that affects plant growth and development. High and low temperatures around the plant are determined by solar radiation, plant density, light distribution in the plant canopy (14, 15, 16). This *C. roseus* can be known as the flower appearing from the armpit. The color of the flower is white, some are pink petal, small shaped petals (Fig. 2). Flower crowns are trumpet shaped, and the ends are wide (17, 18). A flat flower edge, consisting of an ovoid-shaped flower, and a pointed end close to the left. The *C. roseus* has a cylindrical shaped house hanging from the stem. The fruit is cylindrical, pointed, stony (14, 15, 16, 17, 18).



Figure 3. The appearance of the *C. roseus* surveyed at the Malalayang beach that grows wild or without planting in coastal areas with watery and nutrient-free soils and dry and hot temperatures during the day.

Catharanthus roseus, commonly known as the Madagascar periwinkle, rose periwinkle, or rosy periwinkle, is a species of flowering plant in the dogbane family Apocynaceae (15, 16). It is native and endemic to Madagascar, but grown elsewhere as an ornamental and medicinal plant, a source of the drugs vincristine and vinblastine, used to treat cancer. Other English names include "Cape periwinkle" and old-maid (17, 18). It was formerly included in the genus *Vinca* as *Vinca rosea*. It is an evergreen subshrub or herbaceous plant growing 1 m tall. The leaves are oval to oblong, 2.5–9 cm long and 1–3.5 cm broad, glossy green, hairless, with a pale midrib and a short petiole 1–1.8 cm long; they are arranged in opposite pairs (14, 17). The flowers are white to dark pink with a darker red centre, with a basal tube 2.5–3 cm long and a corolla 2–5 cm diameter with five petal-like lobes. The fruit is a pair of follicles 2–4 cm long and 3 mm broad (14, 17, 18).

The result of surveying the observations of *C. roseus* growth along the beach road starting from Manado Boulevard, Malalayang, Kalasea, Taleli, Koha, Mokupa, Tombariri, Tana Wangko, Pondang, Bitung, Benteng portugal, Kapitu, Majaan, Boyonpante, Aergale, Tanamon, Nanasi, Mariri Baru, Pantai lolan, Ambang I, Inobonto, Bolaang Uki, Pantai Sondana, Tabila, Pantai Linawan, Pinolosian until to Kombot, it was concluded that the breeding site grew around the beach well (Figure 1A). The growth of *C. roseus* depends on environmental conditions and physical disturbances that occur because these plants just grow on the roadside without being cultivated. The growth of *C. roseus* is very easy and able to withstand infertile soil conditions or lack of nutrients. Very limited conditions of nutrients can be seen in Fig. 1, 2 and 3.

The results of research by Canadian experts - Ely Lilly, Svoboda, and Noble - and reports of H. Sutarno and Radjiman showed that there are four substances in the virgin field that can be used: Vinblasine, it can be used in the treatment of leukemia. Vincristine, besides being used in the treatment of leukemia, also breast cancer, and other malignant tumors (26, 27, 28). Vindesine, used in the treatment of leukemia in children, and people with tumor pigment. Vinorelbine, often used as a treatment ingredient to prevent glandular division (25, 26). The recipes are as follows: - Provide 22 tapak dara leaves, pulasari bark (*Alyxia reinwardtii*), and fennel fruit (*Foeniculum vulgare*). - Wash thoroughly, then boil in 3 cups of clean water. - Add enough brown sugar, and let it boil, until later it is only half. - After cold, strain, then drink. Do it 3 times a day, every time you drink half a glass. Drink for a month (3). But Pandiangan (4) have reported the teabag herbal powder of *C. roseus* decreased of sugar and triglyceride and cholesterol in blood of rats after 13 day treatment (4).

Morphology and Taxonomy of *C. roseus* plants the virgin can grow well from low land to an altitude of 800 meters above sea level (15). The tree is an upright bush and can reach 1 meter in height. The stem contains a milky white, round-shaped sap with a small, woody, segmented, branched, and very dense hair. The leaves are ovoid, green, and are single leaf clarified (18). The leaves are about 2-6 cm long, 1-3 cm thick, and the leaves are very short (14). The virgin tread flower from the leaf armpit. Flowers are violet, rosa red, white, white with red, purple, yellow, pale spots (Fig 2 and 4). Small, petal shaped petals. Flower crowns are trumpet shaped, and the ends are wide. But the flower is flat, consisting of an oval-shaped flower canopy, and the pointed end closes to the left. The treads are cylindrical, pointed, hairy, the pangjang is about 1.5-2.5 cm long, and has many sedes (16, 17).

The tapak dará site contains more than 70 kinds of alkaloids. Two types of alkaloids found in the leaves, vinblastine and vincristine, are active anti-cancer that can be used in chemotherapy. Vinblastine is used for patients with Hodgkin's disease and vincristine is used for children with leukemia. Vincristine, besides being used in the treatment of leukemia, also breast cancer, and other malignant tumors, besides that there is also Vindesine content used in the treatment of leukemia in children, and patients with tumor pigments, and Vinorelbine which is often used as a treatment ingredient to prevent division gland. Vinblastine (VLS) and vincristine (VCR), other anti-cancer alkaloids are leurosine (VLR), vincadioline, leurosidine, catharanthine, and lochnerine. While alkaloids with hypoglycemic effects (lowering blood sugar levels) are leurosine, catharanthine, lochnerine, tetrahydroalstonine, vindoline.

Growing requirements for *C. roseus*. The habitat of the tread plant is growing in sandy places (Fig.2) but can also grow on the banks of the river, savanna vegetation and dry places, and in the forest (Fig. The virgin is a plant that has a high tolerance to salt so that most are found near the sea but are often found up to 1500 m above sea level (Fig. 2). The virgin can live in an environment that is not too hot. The air temperature at night is 18-20°C while during the day is 24-30°C. The desired pH is 5.4-5.8. The height of a place is an environmental factor that has an influence on plant growth and development. Each plant has the growth requirements it wants, one of the growing requirements is the height of the place of planting.



Figure 4. The ornamental view of tapak dará (*Catharanthus roseus*) that is very potential to be used as an ornamental plant for marine beach parks (14-18).



Figure 5. Potential beauty of the beach by utilizing *C. roseus* as a well-organized ornamental plant



Figure 7. The ornamental view of tapak dará (*Catharanthus roseus*) that is very beauty used as an ornamental plant for Nongnooch Pattaya Parks at Thailand (7th October 2018)

In the wild, it is an endangered plant; the main cause of decline is habitat destruction by slash and burn agriculture. It is also however widely cultivated and is naturalised in subtropical and tropical areas of the world. It is so well adapted to growth in Australia, that it is listed as a noxious weed in Western Australia and the Australian Capital Territory, and also in parts of eastern Queensland. In Ayurveda (Indian traditional medicine) the extracts of its roots and shoots, though poisonous, are used against several diseases. In traditional Chinese medicine, extracts from it have been used against numerous diseases, including diabetes, malaria, and Hodgkin's lymphoma.^[11] Many of the *vinca* alkaloids were first isolated from *Catharanthus roseus*, including vinblastine and vincristine used in the treatment of leukemia and Hodgkin's lymphoma (5).

4. Conclusions

1. The potential utilization of *C. roseus* as a jewelry or garden ornament in coastal marine tourism around the coast of North Sulawesi is very possible and very good to be used in the development of local, national and international tourism creative industries
2. The uniform and fast production of *C. roseus* seeds is very possible by utilizing plant tissue culture techniques by somatic embryogenesis and regeneration plant.
3. Another creative tourism industry with the use of *C. roseus* is using dried leaf powder into healthy drinks in the form of teabags for visitors in coastal marine tourism that has been known as a cure for various diseases and supporting public health.

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Behavior of Hypertension Patients at the Community Health Center in Manado City

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Abstract. Hypertension is a disease that cannot be cured but can be controlled. According to WHO data, 7.9 million people die each year because of non-communicable diseases. About 1.5 million people die from complications of hypertension each year. In Indonesia, the prevalence of hypertension at >18 years of age is 26.5% with the number of patients diagnosed by health workers as much as 9.4%. There were 9.5% of patients taking medication, including 0.1% who took their own medication without being diagnosed by health workers. Adherence to treatment of hypertensive patients is important since it must always be controlled to prevent complications that can lead to death. Method; this study uses a qualitative descriptive research method and was conducted at the Manado City Community Health Center. The aim of this study is to gain a deeper understanding of the principles underlying observed symptoms and facts to apply them practically in improving health services to improve health promotion related to hypertension. Conclusion: The knowledge, attitude and action of informants seeking treatment for hypertension is lacking basic health promotion of hypertension disease. Diet that is not in accordance with a healthy way of life after knowing that the sufferer has hypertension, even though on a daily basis still eating unhealthy foods but eating patterns on holidays or during events in Manado City show a risky pattern against hypertension.

1. Introduction

Hypertension is a disease that cannot be cured but can be controlled. According to WHO (2013) data, 7.9 million people die each year because of non-communicable diseases. Adults over 25 years in the world of hypertension are 36%. About 1.5 million people die from complications of hypertension each year. 1 in 3 people in Southeast Asia suffer from hypertension. In Indonesia, the prevalence of hypertension at > 18 years of age is 25.8% with the number of patients diagnosed by health workers as much as 9.4%. There were 9.5% of patients who were taking hypertension medication, including people who took their own medication without being diagnosed by health workers by 0.1% (Risikesdas, 2013). In North Sulawesi, 27.1% hypertension cases were reported from community health center. The prevalence of hypertension increases with increasing age. Hypertension has the greatest impact on global mortality compared to other risk factors. Adherence to treatment of hypertensive patients is important because it must always be controlled so there are no complications that can lead to death. With treatment behavior, researchers can find out the description of hypertensive patients who seek treatment in their health.

2. Aims and Method

The research was conducted at the Manado City Community Health Center. The aim of this study is to gain a deeper understanding of the principles underlying observed symptoms and facts that are not driven by the intention to apply them practically where the practical benefits to be gained are as input in improving health services to improve health promotion related to hypertension. This study uses a qualitative descriptive research method. The informants were patients who came to outpatient care for hypertension in 10-community health center in Manado City.

3. Result and Discussion

In accordance with the aim of deepening qualitative research to gain a deeper understanding of the behavior of hypertensive patients, namely knowledge, attitudes, and actions, who seek treatment at the community health center that underlies observed symptoms and facts to apply them practically so as to achieve the ultimate goal of improvement health status in the city of Manado, we get the following results.

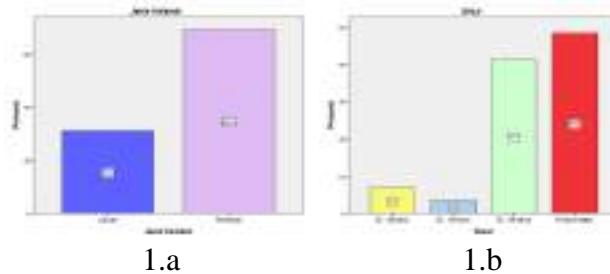


Figure 1. Distribution of informants based on gender (1.a) and age (1.b)

From figure 1.a, seen as many as 69% of informants were women, while the rest were male informants. From Tarigan et all, shows that female gender are more likely to seek treatment than male. Based on figure 1.b, most of the informants were over 50 years of age where 41.4% were between 50 - <60 years and 48.3% were more than 60 years old respectively. Research results from Waas et all, shows that the age group above 40 years old were higher than below 40 years old.

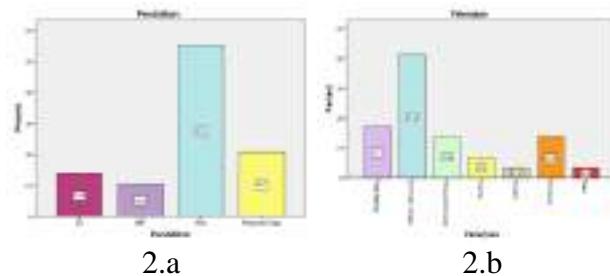


Figure 2. Distribution of informants based on education (2.b) and work (2.b)

Most of the informants interviewed had high school education and the equivalent of 55.2% followed by informants with tertiary graduates as much as 20.7% (figure 2.a). This results is in-line with Waas research, whereas, the education level was higher in low and middle rank of education that undergoes hypertension. From figure 2.b, it can be seen that most of the informants based on work are mostly household members as much as 41.4%, while those who do not work occupy the following rank as much as 17.2%.

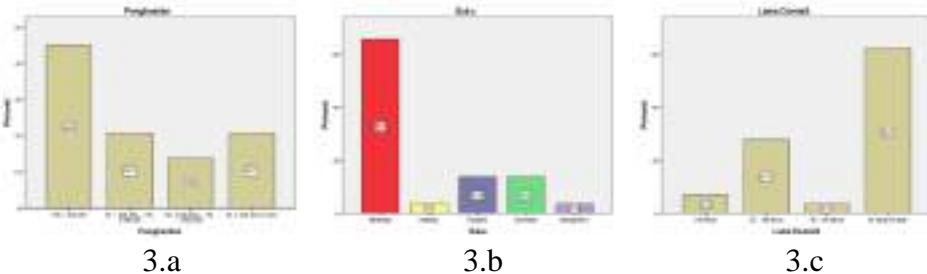


Figure 3. Distribution of informants based on income (3.a), ethnicity 3.b) and length of stay (3.c)

Based on figure 3.a, as much as 44.8% have income below Rp. 1,000,000, - while the informant's income is between Rp. 2,000,000 - <Rp. 3,000,000, as much as 13.8%. Although the income of informants on research by Waas et all was higher for low income, we found that informants with hypertension has lower income. Figure 3.b shows a total of 65.5% of informants came from the Minahasa tribe, while the Sangihe and Gorontalo tribes were respectively 13.8% and the Manado and Mongondow tribes were 3.4% respectively. As many as 62.1% have lived in the city of Manado for more than 40 years and over, while 6.9% of new informants have settled in the city of Manado for less than 10 years (figure 3.c).

Result from the interview transcript conducted by informants who had hypertension.

Question: What do you know about hypertension?

Informant: we only know high blood but people just say high blood pressure

Question: do you know the symptoms of hypertension?

Informant: all this time I just know that if the blood pressure rises, I will suffer a stiff neck, and headache. And usually, when I am angry at my students, I think that that is where I am suffering high blood pressure. I got angry because of their behavior of these kids...

Question: Then do you know the risk factors for hypertension?

Informant: What is the risk factor doc?

Question: It is like what causes your hypertension?

Informant: Last time, the doctor told me maybe because of the cigarette. The doctor had told me to stop but I said that the cigarette could stop my stressed after I teach. Especially when the students are naughty. Is it because of smoking?

Question: besides smoking do you know what other risk factors are?

Informant: emotional maybe doc, also food and stress

Question: what impact did you know from hypertension?

Informant: what do you mean doc?

Question: What is your experience from high blood pressure impact with yourself?

Informant: my experienced was, doc, headache, my neck usually stiffed, but the neck is ok. But, anyone can get a stroke if you have high blood pressure maybe?

Question: Yes, that's right; stroke can happen if you have high blood pressure

Informant: keep away from that thing, who will take care of my wife and children?

Question: when did you have high blood pressure for the first time?

Informant: oh the first time I knew is from the dentist at the community health center here. Then by reading from the Internet, and also with someone who has the same sign for high blood pressure.

Question: how do you find knowledge about hypertension?

The informant: a lot of asking the doctors, but a high blood pressure must be reduce this and that, the doctor said for the things causes high blood pressure

Question: So when did you know you suffer this high blood pressure?

Informant: So long time, around 10 years ago.

The knowledge of informants from the interviews showed that the answers were not complete, even though most of them mentioned definitions and symptoms. From this, the informant shows how they came to know about the disease and they know how to come to find the right place for treatment. Nevertheless, the risk of the disease is unclear.

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Question: Do you need treatment after you were diagnosed with hypertension? Did you immediately get treatment?

Informant: oh yes doc, I directly go to the doctor. I am afraid when my blood pressure will go up then doctor also say the hazard things about high blood

For their attitude shown by the informant's shows the need for treatment if you have hypertension and feel worried about the treatment obtained. They would come to find doctors and seek their medicine in community health center to have consultation with doctors or health practitioners.

Question: Do you feel worried?

Informant: well, I make it enjoy, doc, I don't want to think because it makes more stressful, then my blood pressure will rise.

Question: how do you feel first and foremost about hypertension?

Informant: I don't feel like how to do it if I go along with taking medication and keep good eating activities so that you stay healthy

Question: what do you do when you know you got this hypertension like you said before?

Informant: I take medicine and continue to exercise. I am reducing smoking nowadays.

Question: what is the effect of your daily activities?

Informant: if we have high blood pressure affect it's just that I feel that my head is aching, I would take medicine and a little rest

Question: what is important is that you are diligent in taking medicine. Who do you think is responsible for the disease you are experiencing?

Informant: I, myself doc, I smoke and get angry, it's actually my fault.

Question: Since when did you check your blood pressure to the doctor or community health center?

Informant: it's the day because I feel like my head and neck, the neck is like stiffing, so I went to the doctor, about 10 years ago

Question: then what is the motivation of you immediately examine yourself to the doctor?

Informant: Motivation, is how you want to get rid with this complaint

Question: What is your view of high blood pressure? Do you realize that this has affected you?

Informant: Yes, I am aware that I have my hypertension. Alert, and subtracts things that can trigger more than this.

Question: how do you take care of your health before you have high blood pressure?

Informant: oh it doesn't work that way because I know we have high blood pressure, I just eat anything doc and that time I am not doing exercise just eat and sleep.

Question: What do you do for this hypertension?

Informant: Just like this, you take the medicine, which we said earlier

Question: Then after you know the hypertension, how do you try to find a cure?

Informant: Like I said earlier doc, I came to the doctor, why is the doctor check and give prescription for medicine, we obey the doctor, saying that he is taking medication regularly

Question: then how do you use existing facilities such as community health centers?

Informant: we use the community health center to help people know about health; especially we have the insurance that we are covered

Question: how often you come to check out your blood pressure to the doctor or community health center?

Informant: well, yeah, doc, if there is a complaint, I immediately control it, and come here to the community health center by taking the chronic drugs every month

Question: what is your encouragement to come back here to control your blood pressure?

Informant: if you feel bad you are not so fit, I come to the community health center and the doctor will give me vitamin

Question: Are you taking regular medication according to the doctor's advice?

Informant: Yes, regularly so I don't want to have a stroke

Question: how do you obey the advice of the doctor?

Informant: Following, the doctor's advice to take the medicine

Question: after consultation with the doctor how do you take care of your health?

Informant: Exercise, I run early in the morning before teach or in the afternoon

Question: Do you have any changes before you got high blood pressure and now?

Informant: there is a doc; I keep my blood pressure controlled now, so not like the old days

Question: last question. Is there a special action that you do for health care so you don't have high blood pressure?

Informant: special action, is exercise and only a healthy lifestyle is what doctors say

At the end of the action they were seen actively seeking treatment and trying to obey doctor's recommendations even though they were still lacking in taking anti-hypertensive drugs. Health seeking behavior is always expected even though most of the informants will start doing it when the signs or symptoms they feel lead to hypertension according to their knowledge. Informant habits is always trying to avoid the risk of hypertension even though it will be violated because of certain circumstances that make them have to temporarily ignore the risk of disease.

In the interview, it is clear that a diet that is not in accordance with a healthy way of life after knowing that the sufferer has hypertension, even though on a daily basis still eating unhealthy foods but eating patterns on holidays or during events in Manado City show a risky pattern against hypertension.

Our conclusion is that the patients need basic health promotion about this disease. They also need to obtain a deeper understanding of the behavior of hypertension that seek treatment at the Manado City community health center which underlies observed symptoms and facts to apply it practically to achieve the goal of improving health status in the people of Manado City. Diet that is not in accordance with a healthy way of life after knowing that the sufferer has hypertension, even though on a daily basis still eating unhealthy foods but eating patterns on holidays or during events in Manado City show a risky pattern against hypertension

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The Effect of Difenoconazole Fungicide on the Viability of Fungi *Phytophthora infestans* de bary Causing Leaf Rot Disease of Tomato (*Solanum lycopersicum*)

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Abstract. Modoinding is one of the sub-districts in South Minahasa Regency which has a large area with ten villages and has a cold climate, which is a potential area for the development of tomato as highland horticultural crops. Efforts to increase tomato production often face obstacles in the form of pests and diseases attacking. There are several pests and diseases that attack tomato, one of which is tomato leaf rot caused by the fungus *Phytophthora infestans* de bary. The use of pesticides, especially fungicide difenoconazole in tomato plants left residues that can result negative impacts on the environment and humans. There is no scientific information about the influence of fungicidal difenoconazole residues on the viability of fungi associated with tomato leaf rot. The purpose of this study was to determine the effect of fungicide difenoconazole on the viability of *P. infestans* de bary. Fungus *P. infestans* de bary. were isolated from the leaves of tomato plants that attacked by leaf rot disease, referring to the method carried out by Haniah [1]. Measurement of the viability of fungus *P. infestans* de bary. carried out using a center-curved glass object, then soil fungus isolates left for 3 days, 5 days and 7 days. Observations were made under a microscope by looking at the ability of spores, conidia, and growing hyphae. Fungus *P. infestans* de bary. including species that have relatively low viability, where the fungus is only able to grow on giving of fungicides Difenoconazole to treatment C (50 ppm) and is unable to grow on giving Difenoconazole fungicides as much as 75 ppm (treatment D) to 100 ppm (treatment E), characterized by inhibition of the growth of zoospores, sporangium, and hyphae.

1. Introduction

Tomatoes are fruit vegetables belonging to annual shrubs and belong to the Solanacea family. Tomatoes are a source of vitamins and minerals. Its use is increasingly widespread, because in addition to being consumed as fresh tomatoes and for cooking ingredients, it can also be further processed as a raw material for food industries such as fruit juice and tomato sauce [1]. Potential tomato plants and deserve to be developed intensively in agribusiness scale, especially in Modoinding District and Indonesia in general. Tomatoes are one of the horticultural commodities with high economic value and still require serious handling, especially in terms of increasing the yield and quality of tomatoes [2].

Modoinding is one of the sub-districts in South Minahasa Regency which has a large area with ten villages and has a cold climate, which is a potential area for the development of tomato plants as highland horticultural crops. Efforts to increase the production of tomato plants often face obstacles in the form of pests and diseases that cause crop failure or a minimum of reduced yields. There are several pests and diseases that attack tomato plants, but the most damaging and hitherto very

disturbing horticultural farmers in Modoinding District are tomato leaf rot caused by the *Phytophthora infestans* de bary fungus.

Until now the damage caused by tomato leaf rot on tomato plantations has become a serious problem among farmers in Modoinding Subdistrict. Various attempts have been made to control this disease, one of which is by using pesticides. Surveys conducted in North Sulawesi in 1990 showed that almost all farmers used pesticides to control agricultural pests and diseases [3]. Compared to other pest and disease control techniques, the use of pesticides by most farmers is considered more effective, its use is more practical, and brings great economic benefits [4]. Various types of pesticides have been used since this compound is known as a powerful weapon for eradicating plant pests and diseases [5].

The results of interviews with horticultural farmers in Modoinding District in controlling tomato plant diseases, they use a lot of pesticides. They said that during the cultivation of tomato plants, the use of pesticides to control the disease continues to be carried out as well as the use of agricultural land has long been carried out by tomato plant farmers. They also said that when the tomato cultivation land was not fertile, the clearing of the forest around the agricultural area was done by farmers to be used as new land as agricultural land. Seeing this fact, it can be expected that there is a possibility of soil contamination because of the continuous use of pesticides, this can be a cause of the increasing extent of agricultural land contaminated with pesticides.

Land as a growing medium for plants does not only consist of abiotic components but also contains a large number of living things (soil microbes). Various types of microbial activity in the soil greatly affect soil fertility. The side effect of the use of pesticide applications in controlling diseases in tomato plantations is the presence of residues left in the soil for a long time that can endanger soil biota and microorganisms. The more tomato plants sprayed with pesticides will affect the accumulation of residues on the soil. Rao [6], pesticides that cannot be broken down by soil biota if they are used continuously, the residue will accumulate and can pollute the soil. Many types of soil biota and microbes are useful for soil. If the presence of pesticides disrupts the life or activity of soil biota, soil fertility will be disrupted.

From the survey conducted by researchers, there were several farmers at the survey site who had carried out control with various fungicide mixtures. One of the fungicides used is Difenoconazole fungicide. The continuous use of fungicides, especially those made from active Diphenonconazole, can lead to changes in the conditions of the soil fungus and *Phytophthora infestans* de bary. which can cause a reduction in the viability of these fungi to the fungicides Difenoconazole in the tomato planting area, so this needs to be studied and examined.

2. Materials And Methods

2.1 Time and Place of Research

Sampling was carried out on tomato plantations in Modoinding District, South Minahasa Regency. Isolation, identification and testing of the viability of *P. infestans* de bary fungi. held in the Laboratory of Microbiology, Department of Biology, Faculty of Mathematics and Natural Sciences, Sam Ratulangi University, Manado.

2.2 Prosedur Penelitian

Fungus *P. infestans* de bary. isolated from the leaves of tomato plants that experienced late blight (referring to the method performed by Haniah [7]. The tomato leaves are washed with running water for 5 minutes. After washing, surface sterilization is carried out by placing it in Alcohol 70% solution for 5 minutes, then proceed to 1% NaOCL solution for 5 minutes, then dry with sterile tissue. After that it was rinsed with sterile Aquadesh \pm 1 minute repeated twice, then the tomato leaf pieces were dried on sterile tissue paper and planted on a petri dish containing PDA medium.

Observations were made after 7 days until the fungus filled the petri dish, then isolated and purified on the new PDA media. The fungus used for research is a fungus that grows on the inner hemisphere

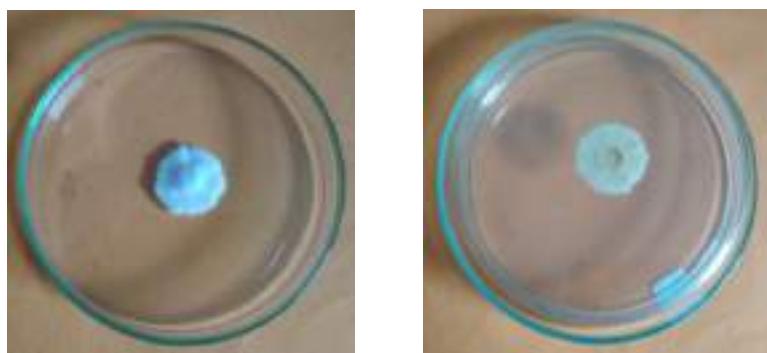
[8]. Furthermore, pure culture of the fungus was tested for viability.

To measure the viability of the fungus *P. infestans* de bary, done by taking a small amount of *P. infestans* de bary fungus isolates that already exists. Approximately 1 drop of fungicide Difenoconazole is mixed with *P. infestans* de bary fungus as much as 1 gram or as many as 1 needle and placed on a glass object whose center is curved, then left for 3 days, 5 days and 7 days. Observations were made by looking at the form of spores, conidia, and hyphae that grew.

3. Results And Discussion

After it has been isolated and identified, based on observational data that matched with the identification book of Compendium of Soil Fungi (Domsch *et al.*, 1980 *in Ilyas* [9] and Introduction to General Tropical Fungi by Gandjar *et al.* [10] and Introduction to Food – Borne Fungi (Samson *et al.*, 1981 *in Subowo* [11], fungus isolates obtained were *P. infestans* de bary. *Pythiaceae* family according to macroscopic (Figure 1) and microscopic observations (Figure 2).

P. infestans de bary fungi is included to species that has a fairly low viability, where this fungus is only able to grow at 25 ppm of Difenoconazole fungicide (treatment B) to treatment C (50 ppm) and is unable to grow when exposed to Difenoconazole fungicide 75 ppm (treatment D) to 100 ppm (treatment E), this was characterized by the inhibition of the growth of their zoospores, sporangium, and hyphae (Table 1).



A

B

Figure 1. Macroscopic Forms of Mushroom Morphology *P. infestans* de bary. (3 days) (A. front view, B. colony reverse)

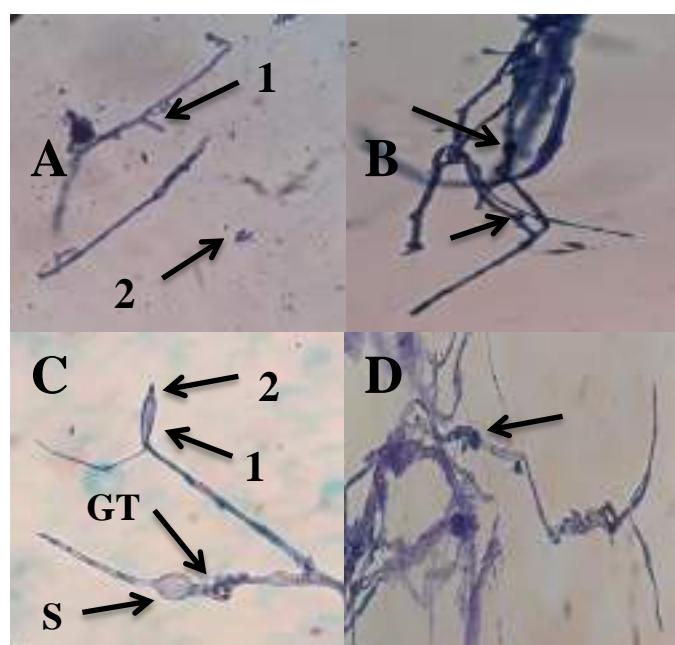


Figure 2. Microscopic Form of Mushroom Morphology P. infestans de bary.: (A: phialide without conidia (arrow 1), scattered zoospores (arrow 2); B: seen some sporangium along the hyphae (arrow); C: sporangium (S) is formed at the end of a gem tube (GT), phialide pumpkin shape (arrow 1), conidia at the tip of the phialide (arrow 2); D: sporangium grows in the main hyphae (arrow)

Growth of P. infestans de bary. in the treatment of difenoconazole 75 ppm to 100 ppm, showed a difference with the control, namely conidia with slow growth with hyphae that were irregular in shape, unclear, and short. This is because Difenoconazole is a systemic fungicide that causes hypha shortening and decreasing of haustoria function. Vyas (1984) *in* Situmorang [12], stated that difenoconazole causes hyphae shortening and decreasing of haustoria function as food absorbers in each infected part. Hyphae will swell and bend, even 36 hours after infection will cause death. The decreasing in hyphae growth is not always followed by the decreasing of conidial growth, although the growth is remaining to continue, the decreasing of the conidia numbers is remain taken place. Difenoconazole is a broad-spectrum fungicide, belongs to the triazole fungicide class which works systemically and has preventive and curative power. Difenoconazole works to inhibit demethylation during ergosterol synthesis, so that stopping fungal development.

Priadi (2009) *in* Sari [13] stated that the higher the concentration of active ingredients of fungicides used causes spore germination to be inhibited, because high fungicide concentrations cause the least amount of water that can enter by osmosis into spore cells. To germinate spores requires sufficient amount of water as a medium for chemical reactions in cells, activating enzymes, circulating nutrients to all parts of the spore cells that are actively doing cell division to germinate. Fungicides control or kill fungi in several ways, including by damaging cell walls, disrupting cell division, affecting the permeability of cell membranes, and inhibiting the action of certain enzymes that inhibit the metabolic process of fungi (Djojosumarto, 2000 *in* Situmorang [14]).

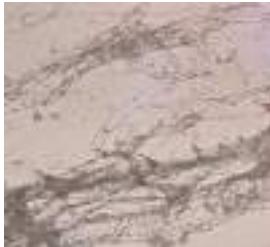
Fungus P. infestans de bary. does not show resistance to fungicides Difenoconazole which is characterized by its low viability. The decreasing of fungal viability due to application of fungicide has also been reported by Mulyati *et al.* (2004) *in* Situmorang [14]. Toxic properties of fungicides will neutralize toxic enzymes, affect membrane permeability, cell wall synthesis and cell division, conduct chelation and precipitation of chemicals, and affect the synthesis of proteins and nucleic acids which result in reducing the fungal viability.

Systemic fungicides also interfere with the synthesis of fungal cell walls, synthesis and function of cell membranes, also affect the energy income in cells and metabolic intermediaries, interfere with lipid synthesis and cell nucleus function (Sijpesteijn, 1970 *in* Situmorang [12]. Vyas (1984) *in* Situmorang [12], systemic fungicides control pathogenic fungi by forming various chemical inhibitors that spread as fungal toxins and inhibit fungal growth through more specific mechanisms than non-systemic fungicides.

Chloride-containing fungicides also cause changes in the size of bacterial and fungal communities that can be caused by inhibition or destruction of components that play a role in the soil microbial community (Sigler and Turco 2002 *in* Hindersah *et al.* [15]. Tiansang *et al.* (2008) *in* Situmorang [14], stated that propineb at certain doses showed inhibition of conidia germination and dispersion and inhibition of acervuli formation in the mycelium. Inhibition of conidia germination will reduce the amount of conidia produced.

The ability of fungicides Difenoconazole in inhibiting the growth of soil fungi is thought to be caused by the compounds contained in the fungicide. In general, agricultural land in the Modoinding District is suspected to have been contaminated by pesticides. Excessive use of pesticides leaves chemical residues in the soil. Microbes that can grow in fungicides Difenoconazole may be able to use the fungicide for its metabolic process or the fungicide has no effect on the growth process.

Table 1. The viability of fungi *P. infestans* de bary. at Glass Object for 3 days.

TREATMENT	FORM OF SPORE, CONIDIA, AND HYPHAE		
	DAY 3	5	7
A (0 ppm)			
B (25 ppm)			
C (50 ppm)			
D (75 ppm)			
E (100 ppm)			

4. Conclusion

Based on testing with 5 treatments, Fungus *P. infestans* de bary. including species that have relatively low viability, where the fungus is only able to grow on giving of fungicides Diphenoconazole to treatment C (50 ppm) and is unable to grow on giving Diphenoconazole fungicides as much as 75 ppm (treatment D) to 100 ppm (treatment E), characterized by inhibition of the growth of zoospores, sporangium, and hyphae.

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Distribution of Butterfly Habitat *Troides helena* L. In in Forest Park of Mount Tumpa, Manado, North Sulawesi

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Abstract. Forest damage will cause habitat fragmentation. Habitat fragmentation will threaten the diversity of butterflies. Several studies have shown that the occurrence of forest destruction in the tropics caused by illegal logging, timber extraction from forests and the conversion of forests to agricultural land will affect the distribution, structure and composition of the community, species richness and biodiversity. Butterflies (Lepidoptera) are among the insects that live in the northern Sulawesi protected forest area. The insect has a very important role as a pollinator that encourages pollination of plants. Butterflies can also be used as bioindicators for changes in environmental quality. This is because butterflies are very sensitive to changes in ecosystems. This study aims to examine the spread of *Troides helena* species as a basis for the conservation of endangered and protected butterflies. The research method is a survey method with a line transect sampling to determine the habitat of the *Troides helena* butterfly population. The research location is divided into 3 transect lines, namely settlement, plantation and secondary forest with a length of 1000 m and an observation area of 100 m

1. Introduction

Butterflies (Lepidoptera) are among the insects that live in the protected forest area of the northern part of Sulawesi. The insect has a very important role as a pollinator that encourages pollination of plants [1]. Butterflies can also be used as bioindicators for changes in environmental quality [2]. This is because butterflies are very sensitive to changes in ecosystems, relatively easy to collect, and very popular. Butterflies also have economic value, especially in adult forms as collections, and as patterns and art [3]. Like other animals, butterflies also face the threat of scarcity and extinction, mainly due to the conversion of forests. Native forests on the northern Sulawesi peninsula have experienced 21% loss of forest over the past 15 years due to commercial logging, mining, fire, agriculture and development projects [4]. The existence of this forest area is increasingly pushed and converted into residential and agricultural lands. Most types of butterflies are very dependent on one or two types of host plants, so the threat to these types of plants is tantamount to threatening the existence of butterflies. Depreciation and changes in forest ecosystems that occur due to rapid exploitation is a threat to the existence of butterflies in North Sulawesi. For example, an area rich with my life is sufficient to be cleaned and processed for agriculture and plantations. Although there are those who can move to new habitats, the food sources of the larvae have perished which may be food that is specific to the larvae of the butterfly.

Forest damage will cause habitat fragmentation. Habitat fragmentation will threaten the diversity of butterflies. Several studies have shown that the occurrence of forest destruction in the tropics caused by illegal logging, timber extraction from forests and the conversion of forests to

agricultural land will affect the distribution, structure and composition of the community, species richness and biodiversity [5]

So far, how the distribution and conservation of protected and endangered butterflies in the Forest Park of mount Tumpa, which is an area of distribution in North Sulawesi, has never been studied and published. Even though this information is very important considering the current forest destruction and hunting of butterflies occur on a large scale. For that, before we lose biodiversity, especially butterflies, the distribution of protected and endangered butterflies in Manado's mountain mountain forest park is very important as a basis for biodiversity and as a basis for conservation of protected and endangered butterflies in Sulawesi North.

2. Research method

2.1. Time and Place of Research

Sampling in the Forest Park of mount Tumpa Area and Analysis in the Biology Department of UNSRAT F-MIPA Conservation Laboratory

2.2. Ways of working

Research methods are as follows:

1. The discovery of the Triodes species in the field

The research method used in finding Triodes butterflies in the field is by using literature and direct observation in the field.

2. Distribution of butterflies.

The research method used in forming the distribution of butterflies is by determining the coordinates of the Triodes butterfly, with a purposive survey method. Point determination is carried out following a randomly defined transect line along 1000 m. Sampling is carried out from 8 to 15 pm [6]

3. Results and Discussion

Based on the results of the study Transect 1 is located at the coordinates N = 01034'0638 " E = 124050'04.88 ". Transect 1 is a settlement area where this area is a trajectory area and a place to find nectar because there is a *Spatodea campanulata* tree which is a tree producing nectar for T helena butterflies. On transect 2, the plantation area is located at coordinates 01034'21,53 'and' E = 124050, '3,25', namely the plantation area, is a trajectory area and a place to look for nectar because in this region there are several plants which are plants that produce nectar for T helena butterflies such as *Spatodea campanulata* plants and *lantana camara* plants. Transect 3 is a secondary forest transect located at the coordinates N = 010 33'50,84 and E = 124050'05.72. This area is a place to play, land, mate and fly and look for nectar with the availability of *Spatodes* and *Lantana camara* plants as nectar-producing plants and also the availability of host plants where eggs are laid, *Aristolochia tagala*.



Figure 1. *Spatodea caspanulata* plant as a nectar-producing plant.



Figure 2. *Aristolochia tagala* plant as a host plant



Figure 3. *T. helena* butterfly that is perched

Based on observations from the three research transects, transect 3 which is a conservation area of the Gunung Tumpa Forest Park area is higher because of the secondary forest vegetation structure where there are nectar-producing host plants such as *Spatodea campanulata* [6], states that the butterfly *Spatodea campanulata* is a nectar-producing plant for *T. helena* butterflies. Butterfly *T. helena* likes bright and red flowers,[7]. [6] stated that in the Gunung Tumpa Forest Park, the host plant *Aristolochia tagala* was found. *A. tagala* plant is a food plant for *T. helena* larvae. *T. helena* larvae eat the *Aristolochia tagala* forest betel leaf [8].

4. Conclusion

Based on the results of the study, *T. helena* butterflies can be found in three research transects, in which all three transects become flight paths, where nectar is sought, filling nectar and where to lay eggs and fly and play activities

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Number of Species and Number of Individual Bats in Mount Duasudara Sanctuary, Sulawesi Utara, Indonesia

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Abstract. Sulawesi Island has a level of endemic fauna, and supports the life of the most unique bat in Indonesia[9]. Of the 21 species of bats recorded in Sulawesi, eight species (38%) were endemic species and of the eight species, two (sometimes three) species were classified as endemic to the level of genera[2,3]. Mount Duasudara Sanctuary is one of the most important conservation areas found on the island of Sulawesi. This means that North Sulawesi has enormous potential as a tourism object because it has biodiversity and fauna endemic levels compared to other regions in Indonesia. In this region there are many endemic animals such as: black monkeys (*Macaca nigra*), tangkasi (*Tarsius spectrum*), kuskus (*Ailurops ursinus*), maleo birds (*Macrocephalon maleo*), hornbills (*Rhyticeros cassidix*), king prawns and several species bat[5,6]. This nature reserve area is also not spared from various habitat disturbances, such as: forest fires, agricultural land clearing and hunting. Bats as a tourist attraction have not been utilized especially when the bat population exits at dusk from the mouth of the cave giving an interesting attraction. The purpose of this study was to identify the number of species and the number of individual bats in the Mount Duasudara Sanctuary. The study site consisted of seven main vegetation zones at altitudes ranging from 0 to 1351 m above sea level. All habitat types were observed using the Mist-net method at altitudes of 1 and 3 m.

1. Introduction

Sulawesi is an island with unique conditions and forms, the largest and most geologically complex in the Wallacea region. This area consists of thousands of Pulau Samudra, is a transition zone between plants and animals from the Oriental (Asia) and Austrolo-Papuan (Australia) regions. Sulawesi Island has endemic fauna levels, and is reported to support the most important bat life in Indonesia[9]. Among the twenty-one types of bats recorded in Sulawesi, eight of them (38%) are endemic and eight of them, two (sometimes counted three) among these species are classified as endemic to the level of genera[3].

Conservation efforts on the island of Sulawesi began in the early 1900s, when the Dutch colonial government established several nature reserves and continued to date with the establishment of new areas by the Government of Indonesia[4]. Sulawesi Island has 54 conservation areas out of 373 conservation areas in Indonesia[9]. Furthermore, North Sulawesi has important conservation areas, namely: Mount Duasudara Sanctuary, Ambang Sanctuary, Lokon Mountain Sanctuary, Bogani Nani Wartabone National Park, Bunaken National Park and Manembo-nembo Wildlife Sanctuary representing various ecosystems from valleys and mountain peaks to the bottom of the waters[4]. This means that North Sulawesi has enormous potential in the number of species and individuals compared to other regions in Indonesia.

Mount Duasudara Sanctuary is one of the most important conservation possessions found in North Sulawesi today. Geographically, this area is also located on 124° 8' - 125° 8' East Longitude and 134° 8' North Latitude[5] has an area of about 8,867 ha and includes three volcanoes, namely: Mount Tangkoko with an altitude of 1,109 meters above sea level having a caldera with a diameter of 1 km, Gunung Batuangus with an altitude of 450 meters above sea level and Mount Duasudara with an altitude of 1,351 meters above sea level. Geologically, this area is a young volcano, the soil is sandy because of the high volcanic ash deposits on the upper layer and has a rather loose soil with a rough and sandy texture that is classified as Regosol soil with young volcanic parent material. The topography of this area has slopes from the slope to the maximum elevation of 1,351 m above sea level, extending from south to north of Mount Duasudara and Batuangus. Mount Batuangus, which is an ash hill, has rare wooded hills with *Casuarina equisetifolia* trees as exotic trees and mostly bare hills. The climate shows the typical patterns of the Minahasa region from November to April, the wind comes from the southeast with high rainfall, but the southern part of the region is protected by mountains and during the rainy season in this area gets less rainfall compared to the slopes the north side and the air become hot and dry [5]. In August and September, it is generally the driest in a year, sometimes for five weeks there is absolutely no rain so the forest looks brown, dry and forest fires often occur [4].

From the coast, lowlands to mountains in the Mount Duasudara Sanctuary there are seven vegetations, namely: alang-alang grassland, secondary bushes, Casuarina forest, coastal forest, lowland rain forest, subMontana rainforest and moss forest. In this region there are also many endemic animals such as: black monkeys (*Macaca nigra*), Tangkasi (*Tarsius spectrum*), cuscus (*Ailurops ursinus*), Maleo birds (*Macrocephalon maleo*), hornbills (*Rhyticeros cassidix*), Raja Udang birds (*Halcyon chloris*, *Cittura cyanotis*) and several species of bats[5]. A survey conducted by the Wildlife Conservation Society in 1999-2003, reported the existence of ten species of bats in six vegetation in the Tangkoko-Duasudara Sanctuary, namely: *Rousettus celebensis*, *Rousettus amplexicaudatus*, *Cynopterus brachyotis*, *Thoopterus nigrescens*, *Nyctimene cephalotes*, *Macroglossus minimus*, *Megaderma spasma*, *Rhinolopus* sp., *Myotis* sp., *Taphozous* sp. In the next four years, Lengkong (2009) reported nine species of bats in four vegetation in September - November at an altitude of 250 masl, 500 masl, 750 masl and 1000 masl in the Tangkoko-Duasudara Sanctuary, namely: *Acerodon celebensis*, *Boneia bidens*, *Cynopterus brachyotis*, *Dobsonia exoleta*, *Macroglossus minimus*, *Nyctimene cephalotes*, *Rousettus celebensis*, *Thoopterus nigrescens* and *Myotis muricola*.

Furthermore, the presence of bats is also increasingly threatened in the Mount Duasudara Sanctuary due to habitat loss and hunting[6]. People hunting bats are used for commercial purposes and consumed by themselves. According to a research report from Lengkong in 2009 at the Tangkoko-Duasudara Sanctuary, some bat species that were successfully hunted by the community for three months were *Acerodon celebensis* (9 individuals), *Cynopterus brachyotis* (3 birds), *Dobsonia exoleta* (13 birds), *Rousettus celebensis* (21 tails) and *Thoopterus nigrescens* (25 tails). The bat species that have been caught are then marketed at the Winenet Market, Girian Market and even in the Tomohon Market. In addition, based on orders from the community and certain ethnic descent. Bats breed very slowly, in addition to a long period of pregnancy (3-6 months) also the number of children only 1-2 births so that if the number of deaths and hunting is greater than breeding, the bat population will decrease[8]. Thus, the diversity of bats in the Mount Duasudara Sanctuary is highly threatened by these pressures.

Bats are very important for people's lives because they act as dispersers of fruit seeds (guava, guava, walnuts, sapodilla and sandalwood); as an economical plant pollinator (petai, durian, mangrove and kapok); as a pest control insect; as a producer of guano and phosphate mines in caves; and as an object of ecotourism[8]. Furthermore, bats from the suborder Megachiroptera (fruit-eating and nectar bats) such as codots and bats, despite eating fruit and are often considered pests on plantations but have a large share in the process of pollinating plants. As many as 186 species of medicinal plants, wood producers, and food sources depend on the Megachiroptera bats,

if the fruit-eating bats are lost then a number of plants will be difficult to pollinate[1]. Bats as a tourist attraction have not been utilized especially when the bat population exits at dusk from the mouth of the cave giving an interesting attraction[4,10]. If the management of conservation of bats is not considered, then the decline in population will have an impact on economic losses, disruption of ecological functions and natural balance[8].

2. Research Methodology

2.1. Time and Place of Research

This research was conducted from May to August 2018 in the Mount Duasudara Sanctuary, Bitung City, North Sulawesi Province. This study includes seven main vegetation with a height of 0-1351 m above sea level. Data analysis was carried out in the Laboratory of Ecology, Faculty of Mathematics and Natural Sciences, Sam Ratulangi University.

2.2. Research Procedures

Sampling is carried out in each zone in the Mount Duasudara Sanctuary. Overall sampling is done for 4 months, where many are 21 every night. Furthermore, sampling is carried out to determine the location of net installation in each zone, as well as making a mistnet test accompanied by the installation of ropes. The installation of a net measuring 12 x 3.6 m is two nets, namely: the first net with a height of one meter from the ground, and the second net with a height of three meters from the ground. The net is placed in an open area in the forest based on the zone and placed using a rope that is suspended from a tall tree up to a maximum height of 15 meters.

Each net was surveyed only once for 7 days a month in an effort to reduce the impact of net shyness (bats avoid nets because they are accustomed to their position). The net is opened in the afternoon at 6:00 p.m. and closed at 6:00 o'clock in the morning, except when it is raining, strong winds or other problems will be added time. At the time of observation, it was carried out in the dark months to avoid bat predators. All are examined at the most every hour and every caught bat is examined. The netted bats are put in a calico cloth bag, weighed, measured, examined for their sex and reproductive conditions, and identified the number and species before being released again. Bats can be identified using keys in[8]. Bats in the Gunung Duasudara Sanctuary are well studied compared to other parts of Sulawesi and no problems arise. In addition, in determining the location of each zone, GPS is used. All observation and analysis data are recorded in a data sheet.

3. Results And Discussion

After measurement and identification of bat species caught in the GunungDuasudaraSanctuary, 15 research species and 475 individuals were discovered during the research activities. Based on the catch, it is known that the number of bat species from various zones in the GunungDuasudaraSanctuary varies greatly (Table 1).

Based on the table, it can be seen that there are more species in the submontana forest zone (13 species), and lower in the grasses zone (4 species). More numbers of individuals in the moss forest zone (121 individuals), and lower in the *Casuarina* forest zone (16 individuals). The greater number of bat species in each zone varies depending on vegetation. *T. nigrescens* in the moss forest zone is a larger species of individuals from various zones.

The more number of species in the submontana forest zone shows that almost all the netted bats in the GunungDuasudaraSanctuary are found in this zone, except *R. tangkokoensis*. This means that it is a habitat that is suitable for almost all bats because there are kongkoriang tres (*A. dumosa vidal*) and langsat (*Ficus* sp.) which are fruits that are preferred by bats. In addition, it is suspected that bats are abundant in the area because they are close to the caves in the moss forest zone. The low number of species in the grasses zone is due to the absence of fruit trees favored by bats. There is a bat species in the reed zone because there are two caves on the beach which are inhabited by

bats. Furthermore, in the moss forest zone with more individuals because there are nine caves which are dwellings for bats like *T. nigrescens*. In the *Casuarina* forest zone with the lowest number of individuals thought to be caused by frequent high winds, bats are easily carried by the wind up to the zone. In addition, there is also one green snake (*Tropidolaemus wagleri celebensis*) which is one of the predators for bats.

Table 1. The number of species and individual bats in the Mount Duasudara Sanctuary

N u	Species	Moss	Sub Monta na	Number of individuals					Tota l
				Lowla nd	Casuar ina	Coasta l	Shrub	Grasse s	
1	<i>Acerodon celebensis</i>	0	6	0	0	0	0	0	6
2	<i>Boneia bidens</i>	0	1	0	0	0	0	0	1
3	<i>Cynopterus brachyotis</i>	0	2	2	3	9	11	5	32
4	<i>Cynopterus luzoniensis</i>	2	8	9	1	6	9	3	38
5	<i>Cynopterus minutus</i>	0	5	8	0	25	8	5	51
6	<i>Dobsonia viridis</i>	0	2	2	0	0	1	0	5
7	<i>Macroglossus minimus</i>	4	5	8	2	2	0	0	21
8	<i>Macroglossus tailiniensis</i>	0	0	0	1	0	0	0	1
9	<i>Megaderma spasma</i>	0	1	0	0	0	0	0	1
1	<i>Nyctimene cephalotes</i>	2	1	3	0	0	0	0	6
0	<i>Rousettus amplexicaudatus</i>	42	54	17	2	24	5	33	177
1	<i>Rousettus celebensis</i>	4	4	15	5	4	0	0	32
2	<i>Rousettus tangkokoensis</i>	0	0	7	0	1	0	0	8
1	<i>Thoopterus nigrescens</i>	52	2	0	1	1	0	0	56
4	<i>Thoopterus tailiniensis</i>	15	13	8	1	3	0	0	40
5	Number of individuals	121	104	79	16	75	34	46	475

4. Conclusion

Bats in the Gunung Duasudara Sanctuary were found in 15 species and 475 individuals. The number of species is more abundant in the SubMontana forest zone, and almost all bats are found in this zone except *R. tangkokoensis*. More individuals are found in the moss forest zone. More number of species and number of individuals is caused by the presence of kongkoriang fruit (*A. dumosa vidal*) and langsat (*Ficus* sp.) Which are preferred by bats, and the existence of caves as bat habitat.

Acknowledgment

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Prevention of Nutrition Problems in the Development Stage of the First Thousand Days of Life in the City of Manado

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Abstract. In dealing with demographic conditions in the second and third decades of this millennium, Indonesia should intensively prepare its next generation. For this reason, one of the preparations is to provide good nutrition to produce a bright future and the quality of human resources that will be able to compete against the era of globalization. Primary prevention can be adopted with two intervention modes, namely Promotion of Health and special protection. This is also the main level of prevention of this disease, but refers to non-communicable diseases, such as obesity, hypertension, diabetes, cancer, coronary artery disease, and others. Consists of elimination of "risk factor" modification of the disease. In such chronic and non-communicable diseases, etiologic agents (causes) are unknown (or not well established) and etiologies are discussed in terms of risk factors. They may act as contributing factors. This research is expected to add and provide scientific information about the description of the implementation of the concept reducing malnutrition on cadres of Integrated Service Posts and at the Community Health Center. Where practical benefits to be gained include input in improving health services in health promotion efforts related to malnutrition. This study uses a qualitative descriptive research method. Assessment through interviews using the mixed method adopted and expanded through Problem Structure Analysis, consists of 16 areas and carried out in 10 places in the community health centers in Manado City and uses a three-step model: 1: detection of problems and concerns; 2: explain the characteristics and seriousness of problems and concerns in dialogue with cadres and doctors; 3: analysis and decisions about what to do next. After passing through the interview stage, problem detection using a three-step model provides results where most mothers who have babies under two years rarely get complaints for the overall assessment of the baby. In the health of "growth and development" and the interaction of children with given parents, mothers who were interviewed experienced a few problems. As for questions in terms of family and environment, they stated that in general they never experienced problems at all. This research is a community approach that needs to be applied by doctors who work in primary services by applying one of the concepts of family doctors as community leaders. Here the role of Community Health Center, community, doctors and their networks as institutions that provide health services at the first level that are directly involved with the community is very important. The Community Health Center is responsible for organizing health development in its working area, namely increasing the awareness, willingness and ability to live healthy for everyone who lives in its working area so that the highest degree of health can be realized. This research is expected to be used as a reference in medical education and further education by doctors. Thus, access to quality health services can be improved through improving the performance of Community Health Center by involving

the community in overcoming nutritional problems in the first thousand days of developmental stages of life in the city of Manado.

1. Introduction

The causes of malnutrition vary widely and are related to complications that can occur later on, therefore prevention and management of malnutrition by empowering the community by recognizing and handling malnutrition quickly and accurately to reduce the risk or long-term complications. Primary prevention can be adopted with two intervention modes, namely Promotion of Health and specific protection. This is also the main level of prevention of this disease, but refers to non-communicable diseases, such as obesity, hypertension, diabetes, cancer, coronary artery disease, and others, it has to be deal specifically. Consists of elimination of "risk factor" modification of the disease. In such chronic and non-communicable diseases, etiologic agents (causes) are unknown (or not well established) and etiologies are discussed in terms of risk factors. They may act as contributing factors.

In dealing with demographic conditions in the second and third decades of this millennium, Indonesia should intensively prepare its next generation. For this reason, one of the preparations is to provide good nutrition to produce a bright future and the quality of human resources that will be able to compete against the era of globalization.

2. Aims and Methods

This research is expected to add and provide scientific information about the description of the implementation of the concept of family doctors on cadres of Integrated Service Posts at the Manado City Community Health Center. Where practical benefits to be gained include input in improving health services in health promotion efforts related to malnutrition.

This study uses a qualitative descriptive research method. Assessment through interviews using the method adopted and expanded through Problem Structure Analysis, consists of 16 areas and carried out in 10 places in the community health centers in Manado City and uses a three-step model: 1: detection of problems and concerns; 2: explain the characteristics and seriousness of problems and concerns in dialogue with cadres and doctors; 3: analysis and decisions about what to do next.

3. Results And Discussion

After passing through the interview stage, problem detection using a three-step model provides results where most mothers who have babies under two years rarely get complaints for the overall assessment of the baby.

In the health of "growth and development" and the interaction of children with given parents, mothers who were interviewed experienced a few problems. As for questions in terms of family and environment, they stated that in general they never experienced problems at all.

This research is a community approach that needs to be applied by doctors who work in primary services by applying one of the concepts of family doctors as community leaders. Here the role of Community Health Center, community, doctors and their networks as institutions that provide health services at the first level that are directly involved with the community is very important. The Community Health Center is responsible for organizing health development in its working area, namely increasing the awareness, willingness and ability to live healthy for everyone who lives in its working area so that the highest degree of health can be realized. This research is expected to be used as a reference in medical education and further education by doctors. Thus, access to quality health services can be improved through improving the performance of Community Health Center by involving the community in overcoming nutritional problems in the first thousand days of developmental stages of life in the city of Manado.

After initial preparation, field surveys and research settings, we interviewed informants who were in accordance with this research method. The informants we obtained for this result were participants attend integrated service post activities that had babies under two years old.

The results we get for this stage are

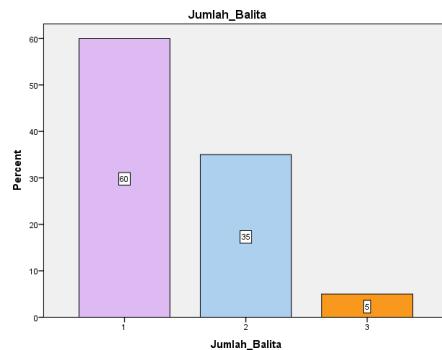
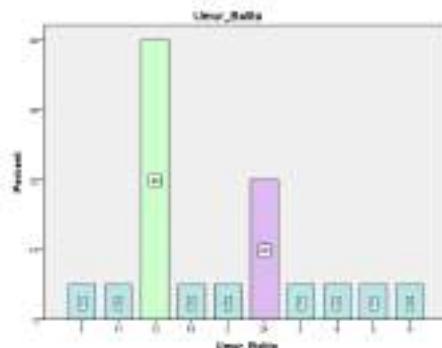


Figure 5.1. Number of Toddlers in the Family

From Figure 5.1, the highest number of children under five in the family interviewed was 1 baby under two years in one family.



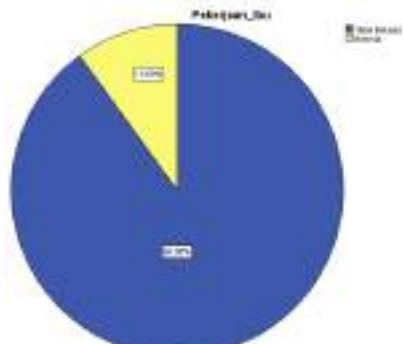


Figure 5.4. Mother's Job

The results of the question of the variable of work undertaken by the mother, only 10% stated that they worked. Meanwhile, 90% of mothers interviewed is not working.

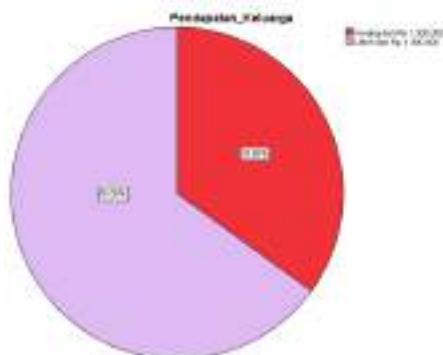


Figure 5.5. Total Income in Family

From the data obtained about family income, 65% stated that family income is less than Rp. 1.300.000, - per month.

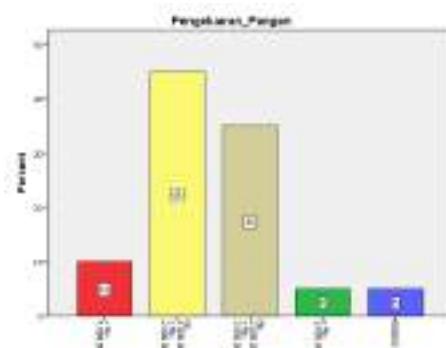


Figure 5.6. Family Food Expenditures

While the expenditure on food in the family, the informants stated that the average expenditure was around Rp. 1,000,000, - less than Rp. 2,000,000, - (40%) every month followed by 35% ranging from Rp. 2,000,000, - up to less than Rp. 3,000,000 per month.

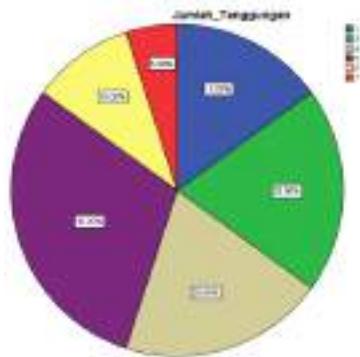


Figure 5.7. Number of Dependents in Family

For family dependents, most are 30% for 5 dependents and 5% for dependents 7.

One of the results of interviews with respondents;

Informant Identity; Name (Initial): MS, Female; Number of Toddler: 1; Toddler Age: 9 Months; Mother's Education: Graduated from high school; Mother's Job: Not Working; Family Income: \geq Rp. 1,300,000 / month

- *With this amount of income, is it enough to meet the daily needs of the family? Enough*
- *What amount of expenditure do you use for family food consumption for one month? Rp. 1,000,000*
- *How many family members are covered? One*

Question: "So if you are evaluating, are there difficulties with your baby, do you have a problem raising your baby?"

Informant: "There is none"

Question: "Do you experience problems for baby's overall health?"

Informant: "Nope"

Question: "Is there a motor development problem for your baby, how about his movements? Is it good? "

Informant: "Good, his development is good"

Question: "How about the baby's language, can the baby start talking?"

Informant: "The baby can laugh and starting sounding"

Question: "Do you have a problem for this by your judging?"

Informant: "No, there is none"

Question: "If you're using the language, do you experience problems, mother tongue is there a problem?"

Informant: "No, I do not have a problem"

Question: "If there is an emotional development, for example, when the mother try to make the baby's laugh is there a problem for you?"

Informant: "No, there is no problem for his emotional. He likes to laugh."

Question: "If the baby is contact with other people, for example, when mother gave the baby to someone just to hug, is that a problem you have?"

Informant: "Yes, the baby just want her grandma to hug, nobody else."

Question: "If there are behaviors for example someone else wants to make the baby laugh is there a problem?"

Informant: "Oh, yes, the baby just want to laugh when someone will make him laugh"

Question: "If there is stimulation that you're giving, for example, you as a mother's giving a stimulation, is there a problem?"

Informant: "What do you mean?"

Question: "For example, this is for the baby's development of first thousand days until the age of 2 years, it is important to work on the development of the brain so it must be stimulated, there is a problem if you are stimulating, like giving him a toy, how is it?"

Informant: "Just a little"

Question: "Does that mean you have the most time with the baby, are you having a problem that means you are using time?"

Informant: "No, there is not"

Question: "If the environment lives outside the house for example, you bring the baby in the neighborhood, do you have a problem or do you just put it inside the house?"

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Informant: "I don't have a problem, I go with neighbor there to find fresh air and hang out."

Question: "If you say, for example, is there a place that you let your baby in a nursery?"

Informant: "No I have never"

Question: "But, for example, if there is an activity for you to go out, so you would leave the baby in the daycare center, it becomes a problem?"

Informant: "It's going to be a problem for me."

Question: "In the family, do you often experience problems in the family?"

Informant: "No"

Question: "Do you feel that for mothers knowledge in assessing the growth and development there are certain topics that you feel there are miss, there are mothers who don't know, for example, the development on how to stimulate children or how to teach children in order to train in the development of motoric movements so that there is a quick stand, the mother still feels lacking, or stimulates how to stimulate adolescents to talk, that you feel there is a topic that you still don't know?"

Informant: "Little, there are somethings that we as mother shod gain more knowledge. Because we need it for our baby's."

This research is a community approach that needs to be applied by doctors who work in primary services, in this case the Community Health Center, by applying one of the concepts of family doctors as community leaders. In addition, with community empowerment through Integrated Service Post cadres, this applied research is an activity held primarily to gain a deeper understanding of the Prevention of Nutrition Problems in the First Thousand Day Developmental Stages of Life at community health centers through family doctors that underlie the symptoms and facts. It was observed to apply it practically so as to achieve the ultimate goal of increasing health status in the people of Manado City.

The role of Community Health Center, community, doctors and their networks as institutions that provide health services at the first level that are directly involved with the community is very important. The Community Health Center is responsible for organizing health development in its working area, namely increasing awareness, willingness and ability to live healthy for everyone who lives in its working area as part of empowering the community to achieve the highest level of health. This research is expected to be used as a reference in medical education and further education by doctors. Thus, access to quality health services can be improved through improving the performance of Community Health Center by involving the community in overcoming nutritional problems in the first thousand days of developmental stages of life in the city of Manado.

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Assessment through interviews using the method adopted and expanded through Problem Structure Analysis, consists of 16 areas and carried out in 10 places in the community health centers in Manado City and uses a three-step model: 1: detection of problems and concerns; 2: explain the characteristics and seriousness of problems and concerns in dialogue with cadres and doctors; 3: analysis and decisions about what to do next.

From almost every interview with informants, we have minimal problems for each area that we ask. the problem that we found a lot was in the question: *Do you feel that for mothers knowledge in assessing the growth and development there are certain topics that you feel there are miss, there are mothers who don't know, for example, the development on how to stimulate children or how to teach children in order to train in the development of motoric movements so that there is a quick stand, the mother still feels lacking, or stimulates how to stimulate adolescents to talk, that you feel there is a topic that you still don't know?"* The answers that we got is only a short list things. To explain ore, informants will need more time and also to explore the standards of knowledge by every informants.

The detection of problems with this interview is less for problem structure analysis. By that, explaining the characteristic and seriousness of problems will be less and concerns in dialogue with cadres and doctors is needed for the next step. After gaining the result, analysis and decisions about what to do next will be concluded in making the model expected for Prevention of Nutrition Problems in the Development Stage of the First Thousand Days of Life.

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The Effectiveness of Ethanol Extract of Sidaguri (*Sida rhombifolia L.*) Leaf to Reduce Total Cholesterol Levels on White Male Rats of Sprague Dawley

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Abstract. The purpose of research is to find out the effect of the extract given in order to analyze the effectiveness and the effectual dosage of ethanol extract of sidaguri leaf against the decreasing of cholesterol levels of a male *galur* white mouse *Sprague Dawley* that has been induced by PTU. For the research, 20 white mice are used. The mice are divided into 5 groups, and each group consists of 4 mice. The treatment consists of dosage I (22,8 mg/200 g weight), dosage II (45 mg/200 g weight), dosage III (91 mg/200 g weight), positive control is (Simvastatin 0,252 mg/200 g weight) and negative control is (CMCNa 0,5 %). Research result show that all treatment dosage used are effective to lower the cholesterol levels of the white mice in 15 days period of medication. Dosage II (45 mg/200 g weight) is the most effective dosage to lower the cholesterol levels of male white mice *Sprague Dawley*.

1. Introduction

Cholesterol is an important element in the body that is needed to regulate the chemical processes in the body, but high amounts of cholesterol can cause atherosclerosis, namely narrowing and hardening of the arteries (Rahayu 2005). Cholesterol is a part of fat called plasma lipids, together with triglycerides, phospholipids and free fatty acids. Cholesterol is obtained from foods derived from animals such as the brain, egg yolks, chicken skin and innards. Triglycerides from foods that contain carbohydrates and saturated fats such as meat, margarine, butter, cheese, palm oil and coconut oil.

The function of cholesterol is to synthesize (make) cell membranes, change cell fluidity and synthesize steroid hormones and bile acids, while triglycerides are the main energy source in the human body (Dalimarta, 2007 and Tapan, 2005). The type of cholesterol that can be harmful is often referred to as LDL (Low Density Lipoprotein), which is the biggest cholesterol carrier lipoprotein to be distributed throughout the peripheral and peripheral tissue endothelium. LDL is also a VLDL metabolite called bad cholesterol because of its atherogenic effects (Dalimarta, 2007). Plants that can be used as herbal remedies to treat cholesterol are sidaguri plants, which are found in Indonesia. The content contained in the leaves of sidaguri are alkaloids, calcium oxalates, tannins, saponins, phenols, amino acids and flying oils, (Ismawan, 2012). The results of research conducted by Indah (2015) showed that sidaguri leaves contain alkaloid compounds, flavonoids, saponins and tannins.

The results of previous studies revealed that ethanol extract of sidaguri leaves can inhibit xanthine oxidase activity so that it can reduce uric acid levels (Siti, 2012) and inhibit the growth of *Klebsiella pneumonia* bacteria (Agasta and Sri, 2012). Sidaguri leaves are

empirically widely used as cholesterol-lowering by the community combined with other plants, because there has been no scientific research so it is still necessary to test the effectiveness of the ethanol extract of sidaguri leaves as cholesterol-lowering in male white rats in Sprague Dawley strain. Society empirically consumes 20 grams of dried sidaguri leaves (Winarto, 2004). Sidaguri leaves are expected to reduce cholesterol levels as an alternative medicine.

2. Research Methods

2.1. Material Collection

The materials used in this study were young sidaguri leaves picked from the 4th leaf from the shoots, which were obtained from the Indonesian Medicinal and Aromatic Plant of Research Institute (BALITTRO), Cimanggu, Bogor.

2.2. Sidaguri Leaves Simplicia Powder Making

Sidaguri fresh leaves were washed with running water until clean, then the leaves were drained so that the water content decreases, after that it was dried using an oven at a temperature of $\pm 45^{\circ}\text{C}$ to dry. The dried leaves were brownish and brittle, then smoothed using a grinder so that they become powder. The powder was sieved with a 30 mesh sieve, then the powder is weighed and placed in a tightly closed container.

2.3. Sidaguri Leaves Ethanol Extract Making

The powder was inserted into the container for maceration with 70% ethanol until it is completely submerged in a well-closed container and protected from light rays. Maceration is done 2x with 500 grams of sidaguri leaves powder and 5L of 70% ethanol, then macerated for 3x24 hours in a brown glass bottle. The bottle was stirred or shaken once every 6 hours for 15 minutes, after being soaked for 24 hours, then filtered with batis cloth. The filtrate was stored in another brown glass bottle, while the residue is re-macerated with 70% ethanol solvent, after maceration was filtered with a batis cloth. The residue is added back with the remaining solvent, then filtered again with a batis cloth. The filtrate was combined, then it is poured. Macerate was evaporated by using evaporator to get a thickened extract.

2.4. Characteristic Analysis of Simplicia Powder and Thickened Extract

2.4.1. Determination of Water Content. Determination of the simplicia powder water content was done by using a moisture balance tool; first, turn on the on / off button, then placing the dish in the middle and holding the punch on top, last, adjust the program accuracy and temperature according to the simplicia to be tested and then set. Weighed as much as 5 grams of simplicia (medium accuracy), put on the punch with the amount of powder that has been adjusted, flattened to cover the surface of the punch and then close it, after the completion of the water content percent of simplicia will be recorded automatically in the moisture balance.

Determination of thickened extract water content was carried out using the gravimetric method, weighed 10 grams of thickened extract and then put into a porcelain cup that was previously put, then put into the oven with a temperature of 105°C for 5 hours and weighed, then continued drying and weighed at a distance 1 hour to constant weight (MOH RI, 2000).

2.4.2. Determination of Ash Content. The determination of the simplicia ash content was carried out by approximately 2-3 grams of simplicia powder carefully weighed, put into the silicate crucible that had been discharged and set in place, the incandescent leveled slowly

until the charcoal was finished, cooled and weighed. Ash content is calculated for the material that has been dried in the air (Indonesian Ministry of Health, 2000). The requirement of ash content extract according to Herbal Pharmacopoeia (2008) is not more than 5.9%.

2.5. *Simplicia* Powder Phytochemical Analysis and Thickened Extract

2.5.1. Alkaloid Test. A total of 500 mg of simplicia powder and thick extract were weighed, then added 1 ml of 2 N hydrochloric acid and 9 ml of water, heated on a water bath for 2 minutes then cooled and filtered, then the filtrate was used as an experimental solution in the following tests:

- a. The filtrate on the watch glass, added 2 drops of Bouchardat LP. Positive results are addressed by the presence of brown to black deposits.
- b. Filtrate on watch glass, added 2 drops of Mayer LP. Positive results are addressed by the presence of white or yellow deposit dissolved in methanol P.
- c. The filtrate on the watch glass, added 2 drops of Dragendorff LP. Positive results are addressed by the presence of brown orange deposit (Health Agency, 1995).

2.5.2. Flavonoids Test. A total of 500 mg of simplicia powder and thickened extract were weighed, then dissolved in 5 ml of 95% ethanol, as much as 2 ml and added 0.1 grams of Magnesium powder, then added 10 drops of concentrated hydrochloric acid, gently shaken. The red orange to red purple color formed positively showed the presence of flavonoids (Health Agency, 1995).

2.5.3. Saponin test. A total of 500 mg of simplicia powder and thickened extract were weighed, then put into a test tube, added 10 ml of hot distilled water, cooled and then shaken vigorously for 10 seconds. Positive results were indicated by the formation of a solid foam for not less than 10 minutes, as high as 1 cm to 10 cm. On the addition of 1 drop of hydrochloric acid 2 N the foam does not disappear (Health Agency, 1995).

2.5.4. Tanin Test. A total of 2 grams of simplicia powder and thickened extracts were added with 80% ethanol as much as 30 ml whipped constantly for 15 minutes, then filtered. The obtained filtrate was evaporated on a water bath. On the remaining evaporation added hot distilled water, then stirred. After cold then centrifuged. The above liquid was separated by decantation, and the solution was used as a test solution. The test solution was carried out as follows:

- a. Adding 10% gelatin solution, white precipitate will appear.
- b. Plus NaCl-gelatin (1% solution of gelatin in a 10% NaCl solution with a ratio of 1: 1). Deposits arose and compared with the results in a point.
- c. Plus a solution of 3% iron (III) chloride, occurs in blue green to blackish color (Hanani, 2015).

2.6. Experimental Animal Caring (Acclimatization)

The experimental animals used in this study were male white rats with Sprague Dawley strain as many as 20 tails aged 3-4 months with a weight of about 200-300 grams. Divided into 5 treatment groups, each group consisted of 4 heads. Previous male white rats were acclimatized first in the animal cage room for approximately 1 week. Acclimatization aimed to familiarize mice with their new environment and observed general conditions such as

weight and animal health. The cage was in the form of a plastic box with a wire cap measuring 30 cm x 20 cm x 12 cm which was covered with rice husks and cleaned regularly every three times in a week so that the condition of the cage remains dry and healthy. During the study all groups of mice were fed a standard B-512 pellet feed, and drank by ad libitum.

2.7. PTU Induction (Propiltiouracil)

Rats induced by PTU 100 mg as much as 12.5 mg/day in 2 doses for 10 days. Propylthiouracil was made in the form of 0.5% cmc suspension solution by dissolving 100 mg of PTU (1 tablet) in 8 ml of solvent, so that in 1 ml of solution containing 12.5 mg of PTU (Allo, et al., 2013). The calculated dose volume was induced orally.

2.8. Administration of Sidaguri Leaves Ethanol Extract on Experimental Animals

A total of 20 male white rats Sprague Dawley strain were divided into 5 groups where each group consisted of 4 male white rats with group distribution, namely:

1. Dosage I Ethanol extract of sidaguri leaves 22.8 mg / 200 g BB as much as 2 ml orally.
2. Dosage II Ethanol extract of sidaguri leaves 45 mg / 200 g BB as much as 2 ml orally.
3. Dosage III Ethanol extract of Sidaguri leaves 91 mg / 200 g BB as much as 2 ml orally.
4. Positive control given Simvastatin 0.252 mg / 200 g BB as much as 2 ml orally.
5. Negative control given 2 ml CMC Na solution as much as 2 ml orally.

2.9. Procedure for measuring total cholesterol

The tail of the rats was cleaned from the dirt. Blood was taken from the rat's tail by wounding it, the blood was placed on a strip taken using the oxidase-peroxidase reactive strips which were then installed on the Accu check active glucometer device to check for cholesterol levels expressed in mg / dL.

2.10. Research design

To obtain a conclusion about anticholesterol from sidaguri leaves ethanol extract in male white rats, the data obtained were analyzed using variance analysis for Factorial Complete Random Design.

3. Result and Discussion



Picture 1. Powder and Thickened of Sidaguri leaf.

Rendemen serbuk yang diperoleh sebesar 31, 11 %. Rendemen ekstrak etanol daun sidaguri adalah 29, 21 %.

Powder rendement obtained was 31.11%. The rendement of sidaguri leaves ethanol extract was 29.21%.

Tabel 1. Result of Powder and Thickened Extract Water Content Analysis

Redo	Water Content	
	Powder	Extract
1	2,62 %	15,09 %
2	2,50 %	14,31 %
Average	2,56 %	14,7 %

Tabel 2. Result of Powder and Thickened Extract Ash Content Analysis

Redo	Ash Content	
	Powder	Extract
1	7,42 %	5,33 %
2	7,96 %	5,39 %
Average	7,69 %	5,36 %

Tabel 3. Results of Phytochemical Analysis

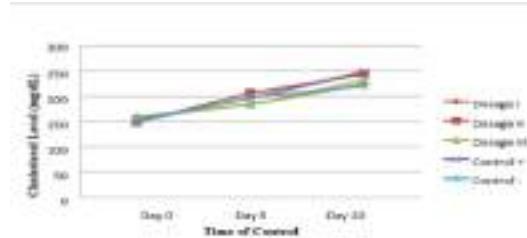
Compound Class	Analysis result	
	Powder	Extract
Alkaloi	+	+
Flavonoid	+	+
Saponin	+	+
Tanin	+	+

3.1. Enhancement Rat Cholesterol Levels after PTU Induction

Mice were conditioned to become hypercholesterolemic by administering PTU tablets in 0.5% CMC Na given orally (the calculation of PTU's dose in PTU (propylthiouracil) served to increase cholesterol levels by inhibiting thyroid hormone synthesis. If the thyroid hormone is inhibited it will also slow down LDL receptors in the body, so that cholesterol excretion through feces is inhibited, there is accumulation in the blood which causes blood cholesterol

levels to rise (Guyton and Hall, 1997). Propylthiouracil will cause hypothyroidism which is associated with increased plasma LDL concentrations due to decreased LDL catabolism. The cause is that in the hypothyroid condition there is a decrease in receptor synthesis and LDL excretion in the liver, so that LDL circulates in the plasma and causes hypercholesterolemia (Allo, et al., 2013).

Cholesterol enhancement



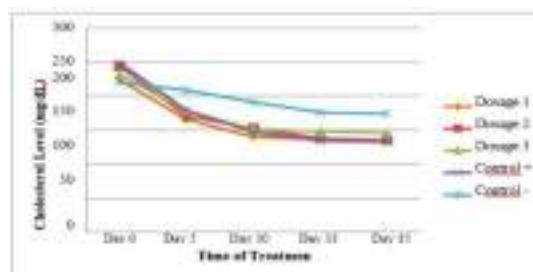
Picture 2. Graphic of Cholesterol Level Enhancement Average

The average results where cholesterol levels before induction with PTU were 153.8 mg / dL, after induction on the 5th day there was an increase to 193.7 mg / dL, then induction again on the 10th day there was an increase to 233.65 mg / dL. These results indicate that the administration of PTU can significantly increase cholesterol levels, according to the research of Allo, et al (2013).

3.2. Results of Treatment of Sidaguri Leaf Extract to Decrease Cholesterol Levels

The treatment was carried out on rats that had been induced by PTU. The rat treatment group consisted of: ethanol extract of sidaguri leaves at dose I which was 22.8 mg / 200 g BB, ethanol extract of second dose sidaguri leaves were 45 mg / 200 g BB, ethanol extract of sidaguri dose III leaf which was 91 mg / 200 g BB, Positive control with Simvastatin 0.252 mg / 200 g BW and negative control with 0.5% CMC solution.

The extract was carried out orally every day for 15 days and cholesterol levels were measured on the 5th, 10th, 13th and 15th days after treatment. The treatment dose is based on an empirical dose for humans, namely 20 grams of dried simplicia (Winarto, 2004) which is converted to experimental animal doses as the initial dose. The dose is then raised twice and reduced twice.



Picture 3. Graphic of Cholesterol Level Reduction Average

Measurements were made using the Easy Touch® tool, the parameters measured were cholesterol levels of rats after administering sidaguri leaves ethanol extract.

The cause of the decrease in cholesterol levels is the content of flavonoid compounds which can reduce blood cholesterol levels in mice that experience hyperlipidemia and reduce the oxidation of LDL cholesterol which has an important role in the process of atherogenesis namely inflammation that occurs in the blood vessel walls due to fat accumulation. Flavonoids work to reduce cholesterol synthesis by inhibiting the activity of the enzyme acyl-CoA cholesterol acyl transferase (ACAT) in HepG2 cells which plays a role in decreasing cholesterol esterification in the intestine and liver, and inhibits the activity of the 3-hydroxy-3-methyl-glutaryl-CoA enzyme (Metwally, 2009 and Arief, 2012).

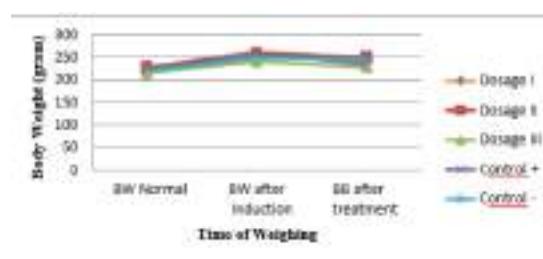
All treatment groups showed a decrease in rat blood cholesterol. Sidaguri extract dosage is the best to reduce cholesterol levels in the treatment of dose II (45 mg / 200 grams BB), followed by dose III (91 mg / 200 grams BB) and dose I (22.8 mg / 200 grams BB), whereas the negative control still shows a large number. Simvastatin as a positive control is indeed much better able to reduce cholesterol levels, this is because Simvastatin works to reduce lipids by inhibiting 3-hydroxy-3-methyl-glutaryl coenzyme A (HMG-CoA) reductase in releasing mevalonic acid cholesterol precursors from coenzyme A. Competitive inhibition by simvastatin results in cellular compensatory responses such as an increase in the HMG-CoA reductase enzyme and Low Density Lipoprotein (LDL) receptors due to an increase in HMG-CoA reductase (Adesta, 2010).

3.3. Pengaruh Perlakuan terhadap Bobot Badan Tikus Putih Jantan

Berat badan tikus menunjukkan adanya perubahan selama perlakuan. Bobot badan tikus yang ditimbang yaitu bobot badan normal sebelum induksi, bobot badan sesudah induksi dan bobot badan setelah pengobatan.

3.4. Effect of Treatment on Male White Body Weight

Rat body weight shows changes during treatment. The body weight of mice that were weighed were normal body weight before induction, body weight after induction and body weight after treatment.



Picture 4. Graphic of Rats Body Weight Change

Changes in rat body weight can be seen in Picture 7. Body weight had increased after induced by PTU because of the accumulation of LDL which was inhibited by its excretion. Changes in body weight gain were higher in the dose I group accompanied by dose II, positive control, negative control and dose III, then decreased for 15 days of treatment and the highest concentration of decrease occurred in the dose II group accompanied by dose I and dose III. Physiological factors and dietary patterns of rats affect changes in body weight that vary during induction and during treatment, so that the increase and decrease in body weight of each rat varies.

3.5. Data analysis

Based on the results of the factorial statistical test, the relationship between the treatment dose and the time of administration gave a significantly different effect on the decrease in cholesterol levels because the sig dose was <0.05 and there was no interaction between dose and time because the sig value > 0.05 so Duncan continued the test, then obtained data that at dose I, dose II, dose III and positive control had the same effect on decreasing cholesterol levels in rats, while in negative controls had a significant different effect on cholesterol levels in rats. Duncan's test results show that dose I, dose II and dose III are in a subset with positive control, which means that the three doses can reduce cholesterol levels well, but dose II (45 mg / 200 grams BB) is the most effective dose for reducing cholesterol levels in rats, because the results on Duncan's test are 168.15 very different slightly compared to positive control, which is 168.40.

Duncan's follow-up test based on the treatment time on days 10, 13 and 15 had the same effect on decreasing cholesterol levels, while on day 0 and day 5 it had a significantly different effect on cholesterol levels in rats.

4. Conclusions and Suggestions

4.1. Conclusion

- a. The administration of sidaguri leaves extract on the 10th, 13th and 15th days had the same effect on decreasing cholesterol levels.
- b. Sidaguri leaves extract at dose II (45 mg / gram BB) was effective in reducing cholesterol levels in male white rats Sprague-Dawley strain induced by PTU.

4.2. Suggestion

- a. Induction comparison between PTU and high-fat feed was needed to increase cholesterol in male Sprague Dawley white rats.
- b. Research was needed to check LDL cholesterol and triglyceride levels in male white rats of Sprague dawley strain.

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Robust Lagrange Multiplier (RLM) Test in Determining Spatial Regression Model

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Abstract. In modeling data that includes spatial elements in it is called a spatial econometrics model. This spatial effect is also called a spatial effect, which consists of two types, namely the effect of spatial dependence and the effect of spatial heterogeneity. Spatial dependence means that an observation in a location is interdependent with observations in other locations. Spatial heterogeneity is a condition where the occurrence of diversity between locations results in each location having different relationship structures and parameters. Testing the effect of spatial dependencies in the model is very important because if ignored will cause the conclusions that are right. There are several models that are formed in data modeling that contain the effects of spatial dependencies, namely Spatial Autoregressive (SAR), and Spatial Error Model (SEM). Tests to determine the model can use the Lagrange Multiplier (LM) Test, but these tests often experience discrepancies in concluding the type of model, especially if there is a misspecification model. Therefore in the study using the Robust Lagrange Multiplier (RLM) test to determine the model used. The results of this study, when using the Lagrange Multiplier (LM) test, significant results were obtained in the Spatial Autoregressive (SAR) and Spatial Error Model (SEM) models, whereas if using the Robust Lagrange Multiplier (RLM) test, only Spatial Autoregressive (SAR) models were obtained. significant, so the model used is the SAR model. The results of this model show that from the case study the Infant Mortality Rate (IMR) in West Java Province in 2015 had significant explanatory variables as the mean length of exclusive breastfeeding (X_1), the mean length of schooling (X_2), and number of medical personnel (midwifery) (X_4).

1. Introduction

To determine the relationship of a variable with the variables that cause it can be made a modeling. The model which is a structural equation built on the relationship between variables based on economic theory can be called an econometric model. But often econometrics research does not involve location or spatial elements in the model, so modeling that includes spatial elements in the model is called the spatial econometrics model.

This spatial effect is called a spatial effect. Spatial effects consist of two types, namely the effect of spatial dependence and the effect of spatial heterogeneity (Anselin, 1988). Spatial dependence means that an observation in a location is interdependent with observations in other locations. The influence of spatial dependencies is illustrated by the similarity of characteristics of locations that are close together, and the characteristics will be increasingly different from the distance of observation. While spatial heterogeneity is a condition where the occurrence of diversity between locations results in each location having different relationship structures and parameters.

Testing the effect of spatial dependencies in the model is very important because if ignored will cause the conclusions that are right. There are several models that are formed in data modeling that contain the effects of spatial dependencies, namely Spatial Autoregressive (SAR), and Spatial Error Model (SEM). Tests to determine the model can use the Lagrange Multiplier (LM) Test, but these tests often experience discrepancies in concluding the type of model, especially if there is a misspecification model. Therefore in the study using the Robust Lagrange Multiplier (RLM) test to determine the model used.

In this research, the Robust Lagrange Multiplier (RLM) test statistic will be used to model the infant mortality rate in West Java Province with the variables included in the model are the average length of schooling, the number of medical personnel (midwifery), the average length of breastfeeding exclusive and percentage of complete basic immunization in West Java in 2015.

2. Literature Review

Spatial matrix is a matrix that describes the proximity between an area with other areas/regions. Regression analysis is a statistical analysis that aims to model the relationship between independent variables with dependent variables. In general, the model can be expressed as follows,

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \quad (1)$$

where \mathbf{y} is the dependent variable observation vector, \mathbf{X} is the predictor variable matrix, $\boldsymbol{\beta}$ is the parameter vector and $\boldsymbol{\varepsilon}$ is the error vector. Augmenting the model (1) with spatial information, results in spatial regression model. The general spatial regression model developed by Anselin is as follows,

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \lambda \mathbf{W}\mathbf{y} + \mathbf{u} \quad (2)$$

$$\mathbf{u} = \rho \mathbf{M}\mathbf{u} + \boldsymbol{\varepsilon}$$

with: $\boldsymbol{\varepsilon} \sim N(\mathbf{0}, \sigma^2 \mathbf{I})$

where

\mathbf{y} = response variable vector of size $n \times 1$

\mathbf{X} = predictor variable matrix of size $n \times k$

$\boldsymbol{\beta}$ = vector of regression coefficient parameter of $k \times 1$

λ = spatial coefficient parameter lag

ρ = parameter of spatial coefficient in error

$\mathbf{u}, \boldsymbol{\varepsilon}$ = error vector (error) of size $n \times 1$

\mathbf{W}, \mathbf{M} = weighted matrix (weighing) of size $n \times n$

\mathbf{I} = identity matrix of size $n \times n$

If we take $\rho = 0$ and $\lambda = 0$, then equation (2) becomes the classical linear regression equation (1), i.e. the model without spatial influence. Some models can be derived from the general model of spatial regression (2), such as Spatial Autoregressive (SAR) or spatial lag model, Spatial Error (SEM) model, and the combination of both models.

Spatial Autoregressive (SAR) model occurs because of the dependence of response values at a location with those at other locations that are interconnected. The SAR model can be derived from equation (2) as follows,

$$\begin{aligned} \mathbf{y} &= \mathbf{X}\boldsymbol{\beta} + \lambda \mathbf{W}\mathbf{y} + \mathbf{u} \\ \mathbf{y} - \lambda \mathbf{W}\mathbf{y} &= \mathbf{X}\boldsymbol{\beta} + \mathbf{u} \\ (\mathbf{I} - \lambda \mathbf{W})\mathbf{y} &= \mathbf{X}\boldsymbol{\beta} + \mathbf{u} \\ \mathbf{y} &= (\mathbf{I} - \lambda \mathbf{W})^{-1}\mathbf{X}\boldsymbol{\beta} + (\mathbf{I} - \lambda \mathbf{W})^{-1}\mathbf{u} \end{aligned} \quad (3)$$

where $\mathbf{u} \sim N(\mathbf{0}, \sigma^2 \mathbf{I})$ is the residual of the autoregressive spatial model with $\mathbf{u} = (\mathbf{I} - \lambda \mathbf{W})\mathbf{y} - \mathbf{X}\boldsymbol{\beta}$.

Spatial error occurs due to the dependency of the error value of a location with errors in other interconnected locations. This occurs when there are variables that affect the value of the dependent

variable but are not included in the model having a correlation between locations. The Spatial Error Model (SEM) can be derived from equation (2) as follows

$$\begin{aligned}
 \mathbf{y} &= \mathbf{X}\boldsymbol{\beta} + \mathbf{u} \\
 \mathbf{u} &= \rho \mathbf{M}\mathbf{u} + \boldsymbol{\varepsilon} \\
 \mathbf{u} &= (\mathbf{I} - \rho \mathbf{M})^{-1} \boldsymbol{\varepsilon} \\
 \text{Then, } \mathbf{y} &= \mathbf{X}\boldsymbol{\beta} + (\mathbf{I} - \rho \mathbf{M})^{-1} \boldsymbol{\varepsilon} \\
 \boldsymbol{\varepsilon} &= (\mathbf{y} - \mathbf{X}\boldsymbol{\beta})(\mathbf{I} - \rho \mathbf{M}) \\
 \text{with: } \boldsymbol{\varepsilon} &\sim \mathbf{N}(\mathbf{0}, \sigma^2 \mathbf{I}_n).
 \end{aligned} \tag{4}$$

Spatial effect testing generally uses Moran's I Test and Lagrange Multiplier (LM) Test. Cliff and Ord used Moran's I statistical test for an observation vector $\mathbf{Y}_n = (Y_{n1}, \dots, Y_{nn})$ at n locations. The calculation of Moran's I test of response variable data is as follows:

Hypothesis:

$H_0 : I = 0$ (no autocorrelation between locations)

$H_1 : I \neq 0$ (there is autocorrelation between locations)

Calculation of Moran's I statistical score:

$$I_{Mo} = \frac{N \sum_{i=1}^n \sum_{j=1}^n w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\left(\sum_{i=1}^n \sum_{j=1}^n w_{ij} \right) \sum_{i=1}^n (y_i - \bar{y})^2} \tag{5}$$

with N being the number of observations, y_i is the observed value at a location i, y_j is the observed value at a location j, \bar{y} is the average of the response variable, and w_{ij} is the weighing between the locations of one another.

The Lagrange Multiplier (LM) test is used to test the effect of spatial dependencies on cross section data. Anselin developed the Lagrange Multiplier (LM) test for spatial lag models and spatial error models.

The former, Lagrange Multiplier Test for spatial lag model, is as follows

Hypothesis:

$H_0: \lambda = 0$ (no spatial effect lag)

$H_1: \lambda \neq 0$ (there is a lag spatial effect)

Test statistics used are:

$$LM_{LAG} = \left(\frac{1}{\sigma^2} \mathbf{e}' \mathbf{W} \mathbf{y} \right)^2 (\mathbf{A} + \mathbf{T})^{-1} \sim \chi^2_{(1)} \tag{6}$$

with:

$$\mathbf{S} = \mathbf{I} - \mathbf{X}(\mathbf{X}'\mathbf{X})^{-1}$$

$$\mathbf{X}'\mathbf{A} = \sigma^{-2} (\mathbf{W}\mathbf{X}\boldsymbol{\beta})' \mathbf{S} (\mathbf{M}\mathbf{X}\boldsymbol{\beta})$$

$$\mathbf{T} = \mathbf{tr}[(\mathbf{W} + \mathbf{W}')\mathbf{M}]$$

Whereas the latter, Lagrange Multiplier Test for spatial error model, is as follows,

Hypothesis:

$H_0: \rho = 0$ (no spatial error effect)

$H_1: \rho \neq 0$ (there is spatial effect error)

Test statistics used are:

$$LM_{SEM} = \left(\frac{1}{\sigma^2} \mathbf{e}' \mathbf{M} \mathbf{e} \right)^2 \mathbf{T}^{-1} \sim \chi^2_{(1)} \tag{7}$$

where \mathbf{e} is the residual of the linear regression model with OLS (Ordinary Least Square) or $\mathbf{e} = \mathbf{y} - \bar{\mathbf{y}}$, \mathbf{W} and \mathbf{M} are the spatial weighing matrix, and $\boldsymbol{\beta}$ is the coefficient vector of the regression parameter

and \mathbf{X} is the independent variable matrix. Rejection criteria H_0 will be rejected if $LM > \chi^2_{(1)}$ or $p-value < \alpha$ which means there is spatial influence.

According to Arbia (2014), in the calculation of LM_{lag} test and LM_{sem} test, the two test statistics are not mutually independent from one another, so when testing an alternative test hypothesis for example testing the spatial error effect for the SEM model it is assumed that there is no spatial lag component in it, vice versa. Therefore, Anselin (1999) proposed a robust version for the two test statistics above.

Bera and Yoon (1993) also suggest using modifications to LM_{lag} and LM_{sem} test statistics, namely by using robust where when testing hypotheses against $\rho = 0$ and $\lambda \neq 0$, vice versa. Modifications to the Lagrange Multiplier (LM) test statistics into the Robust Lagrange Multiplier (RLM) test for the two models are as follows:

$$RLM_{LAG} = \left(\frac{\mathbf{e}' \mathbf{W} \mathbf{y}}{\sigma^2} - \frac{\mathbf{e}' \mathbf{W} \mathbf{e}}{\sigma^2} \right)^2 \left(\frac{1}{\sigma^2} \mathbf{D} \cdot \mathbf{T} \right)^{-1} \sim \chi^2_{(1)} \quad (8)$$

$$RLM_{SEM} = \left(\frac{\mathbf{e}' \mathbf{M} \mathbf{e}}{\sigma^2} - \mathbf{T} \sigma^2 \mathbf{D}^{-1} \frac{\mathbf{e}' \mathbf{W} \mathbf{y}}{\sigma^2} \right)^2 \left(\mathbf{T} - \mathbf{T}^2 \sigma^2 \frac{1}{\mathbf{D}} \right) \sim \chi^2_{(1)} \quad (9)$$

Where $\mathbf{D} = (\mathbf{W} \mathbf{X} \boldsymbol{\beta})' \mathbf{M} (\mathbf{W} \mathbf{X} \boldsymbol{\beta}) + \mathbf{T} \sigma^2$

Hypothesis testing on spatial influence using Robust Lagrange Multiplier (RLM) test statistic is an important step, because if it is ignored it will cause the parameter estimator obtained to be inefficient so that the conclusions are inaccurate (Anselin, 2005).

3. Research Methodology

The data used in this study is secondary data obtained from the National Socioeconomic Survey (Susenas) in 2015, the National Work Force Survey (Sakernas) in 2015 and the Village Potential Data Collection (PODES) activities in 2014 conducted by BPS in 27 districts / City in West Java.

The data taken were the Infant Mortality Rate (IMR) for the response variable, and for the explanatory variables the average duration of exclusive breastfeeding, the average length of schooling, the percentage of complete basic immunization, and the number of medical personnel (midwifery) in West Java in 2015.

Stages of research conducted in this study are:

- Establish a spatial weight matrix (W). In this research we use matrix weighing rook contiguity (sideways touch). Map data processing used ArcGIS software and then calculated by R software.
- Identify the beginning of spatial influence by using Moran's I. Test.
- Conduct testing for model selection by using Robust Lagrange Multiplier (RLM)
- Create spatial regression model based on the conclusion of Robust Lagrange Multiplier (RLM) test.
- Make a Conclusion

4. Results and Discussion

4.1 Linear Regression Model

The linear regression model obtained by using the OLS (Ordinary Least Square) method of Infant Mortality Rate (IMR) in West Java 2015 is as follows:

$$\hat{y} = 18,49 + 0,038X_1 - 1,257X_2 - 0,013 - 0,006X_4 \quad (10)$$

4.2 Spatial Effect Test Results

The results of spatial effect testing can be seen in the table below:

Table 1. Results of Spatial Dependency Analysis

Test Statistic	Value	p-value
<i>Moran's I</i>	0,533	0,0194
LM SAR	1,8402	0,1749
LM SEM	0,1341	0,7141
RLM SAR	3,588	0,0508
RLM SEM	1,8819	0,1701

From Table 1, it can be seen that for spatial effect test using moran's value I for Infant Mortality Rate (IMR) value we obtain p-value of 0,0194. This shows that there is spatial effect or spatial autocorrelation. Then from the Lagrange Multiplier (LM) test obtained the p-value value for the SAR test is 1.8402 and for the LM SEM test is 0.1314 with the p-value of 0.1749 and 0.7141, respectively, stating H_0 accepted meaning that by using the Lagrange Multiplier (LM) test no model is formed. Then, for the RLM SAR test results of 3.588 with a p-value of 0.0500, stating H_0 rejected and RLM SEM is 1.8819 with a p-value of 0.1701 stating H_0 accepted. Hence, it can be concluded that the model resulted based on Robust Lagrange Multiplier (RLM) test is Spatial Autoregressive model (SAR).

4.3 Spatial Regression Model

The test results of Robust Lagrange Multiplier (RLM) model is a model of Spatial Autoregressive (SAR). The results of parameter estimation of Spatial Autoregressive model (SAR) can be seen in table below:

Table 2. Parameter Estimation Results of Spatial Autoregressive Model

	Estimate	p-value
<i>Lamda</i>	0.3418	0.1197
<i>Intercept</i>	13.3051	0.0015
X_1	-0.0324	0.0421
X_2	-0.8695	0.0055
X_3	-0.0165	0.3770
X_4	0.0051	0.0012

From Table 2 it can be seen that with a significant level of 5% explanatory variable X_1 (the mean length of exclusive breastfeeding), X_2 (the mean length of schooling), and X_4 (number of medical personnel (midwifery)) is significant on SAR model with rook/queen contiguity matrix.

The SAR model resulted is:

$$\hat{y}_i = 13,3051 + 0,3418 \sum_{j=1, j \neq i}^{27} W_{ij} \hat{y}_j - 0,0324 X_{i1} - 0,8695 X_{i2} - 0,0051 X_{i4} \quad (11)$$

$$i = 1, 2, \dots, 27$$

The resulted model (11) has significant explanatory variables as the mean length of exclusive breastfeeding (X_1), the mean length of schooling (X_2), and number of medical personnel (midwifery) (X_4). This variable negatively affects the Infant Mortality Rate (IMR). This means that if there is an increase in each variable by one unit there will be a decrease in the Infant Mortality Rate (IMR).

5. Conclusion

Spatial dependency test by using Moran's I test resulted in spatial dependence on Infant Mortality Rate (IMR) of regency / city in West Java 2015. Based on Robust Lagrange Multiplier (RLM) test, we obtained is a Spatial Autoregressive (SAR). The obtained SAR model has significant explanatory variables as the mean length of exclusive breastfeeding (X_1), the mean length of schooling (X_2), and number of medical personnel (midwifery) (X_4). This variable negatively affects the Infant Mortality Rate (IMR). This means that if there is an increase in each variable by one unit there will be a decrease in the Infant Mortality Rate (IMR).

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Quality analysis of chips products using multivariate statistical process control (MSPC)

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Abstract. PT Indorama Synthetics Tbk. is Manufacture Company that engaged in textile field with one of its production that is chips. Chips quality characteristics is measured using 6 variables where on that product experienced downgrade because of chips quality product that is not suitable with quality that has been determined by company. Analytical tool used is Multivariate Statistical Process Control (MSPC) with Free Distribution T^2 Hotelling Control Chart because the used is not fulfill Multivariat Normality assumption. If there is a point that out of control, search for its cause using T^2 Hotelling decomposition method. The purpose of the Multivariate Statistical Process is to monitor the production process with control charts. The results showed that the quality of chips still uncontrollable statistically because there are still 5 different points out of control limits caused by variables *Intrinsic Viscosity* (X_1), COOH (X_2), color b (X_3), and chips/gram (X_5) variables. Some data that is out of control is caused by electrical factor that give the influence of machine used in production process. Because there is a point that is out of control then formed a revision control chart. The second revision control chart shows that the quality of the chips is in control so that it can be calculated the process capability. Based on capability process shows that there are 1 variables that is not suitable with company specification.

1. Introduction

PT. Indorama Synthetics Tbk is a manufacturing company with a continuous patterned production process. To supervise the production process, PT Indorama Synthetics Tbk formed the Department of IPC (Integrated Process Control) in every part of production. One part of the production that utilizes the IPC Department is the CP-3 polymerization process which produces polyester chips and melts. Chips are raw materials used by a company to make plastic beverage bottles [1]. The better the quality of chips, the better the quality of other products that use raw materials in the form of chips. The quality of chips produced by PT Indorama Synthetics Tbk is controlled based on several characteristics, namely Intrinsic Viscosity (IV), Carboxyl Acid (COOH), Color b, In Ethelyne Glycol (DEG), Chips / gram, and oblong, where the six characteristics are measured using a measuring device. To monitor product quality, the company refers to the limit of quality specifications that become the company's standard in determining the quality of chips. If indicated to exceed the quality specification limit, the company immediately takes action. In ensuring quality quality, PT Indorama Synthetics Tbk measures the six characteristics using a control diagram \bar{x} with the limits set by the

company. The control chart is formed for each variable separately. This shows that the analysis conducted by PT Indorama Synthetics Tbk is univariate [2].

The problem that occurs is when the chips produced are not in accordance with the specifications desired by the company, resulting in as much as 1% of products experiencing a downgrade. Losses caused by products that are downgraded when viewed from a financial standpoint, with the same production costs, but the selling price obtained becomes lower. Losses suffered by the company from January 2017 to June 2017 due to downgrade products amounting to IDR760,000,000.00 with a production cost of IDR104,975,000,000.00. The measurement results of several characteristics simultaneously, where the inter-characteristics have a relationship or dependence will produce a multivariate data structure. To find out the quality of a chip, it is measured simultaneously through six characteristics. Based on the statement, it is necessary to analyze according to the data structure on the quality of chips to make a decision in evaluating [1; 2]. According to Akeem et al. [3], multivariate statistical process control (MSPC) is the most suitable monitoring tool for analyzing several variables, and this is advantageous when compared to the use of simultaneous univariate schemes. Decomposition diagnosis is one approach that is generally used to identify influential variables. This approach helps break down, the overall T^2 value and shows the contribution of individual variables, while the combined contribution is also identified. Rogalewicz [4; 5], do a comparison between the use of univariate and multivariate schemes, taking into account the number of variables and their relationships, in the statistical process control. The advantages and disadvantages of both approaches are shown as advocating the application of multivariate statistical control processes (MSPC), which are based on the use of the Hotelling control chart and the multivariate ability index. Similar research has also been carried out by Ferrer [6], Lim et al. [7], and Yahaya et al. [8].

Therefore, by referring to the existing problems, as well as previous research studies, in this paper Quality Analysis of chips products using multivariate statistical process control (MSPC) was conducted at PT Indorama Syenthetics Tbk. The aim of this research is to analyze the stability of the process of quality chips and to know the process capabilities of the chips product. This research was carried out, with the hope that we could obtain benefits as inputs or suggestions to PT Indorama Syenthetics Tbk regarding suitable methods to analyze the characteristics of chips quality in the polymerization process.

2. Material and Methodology

This section discusses the material under study and the stages of controlling chips quality and process capability analysis.

2.1. Material

The data used in this study is secondary data, which is data from the quality of chips produced at the polymerization stage at PT Indorama Synthetics Tbk. The data consists of 178 observations of production data in the period January 2017 to June 2017. Data collection was carried out in two ways, the first by conducting direct interviews with field supervisors and employees at the IPC Department at PT Indorama Synthetics Tbk to obtain the required information such as problems which will be reviewed and data needed. The second method is to take secondary data about observations of the characteristics of chips quality.

2.2. Methodology

In this part of the methodology discussed include: defining research variables, testing correlation between variables, multivariate normal distribution test, distribution free Hotelling T^2 control chart, uncontrolled decomposition process, and process capability analysis.

2.2.1. Research variables

The variables used in this study are six characteristics that determine the quality of chips, the six variables are:

- X_1 : Intrinsic Viscosity (Melt viscosity) (dl/g)
 X_2 : COOH (Polymer chain in 1 chip) (meg/kg)
 X_3 : Color b (Chips color) (%)
 X_4 : DEG (Raw material stability) (%)
 X_5 : Chips/gram(Number of chips) (gram)
 X_6 : Oblong (Chips structure) (%)

2.2.2. Correlation testing between variables

Between variables in each factor must be correlated (dependent), for this reason, the independence test is conducted. Variables x_1, x_2, \dots, x_p said to be mutually independent if the correlation matrix between variables forms an identity matrix [9]. Independent variables show that there is no correlation between variables. To test the freedom between these variables, Bartlett sphericity test can be done. This test is conducted to determine whether the characteristics of chips are mutually dependent, so the use of multivariate methods is feasible to use. According to Aurangzaib and Khan [9], the hypothesis used to test Bartlett sphericity is as follows.

Hypothesis:

$H_0: R = I$ (Between variable characteristics of independent products)

$H_1: R \neq I$ (Between variable characteristics of dependent products)

The test statistic used is:

$$\chi^2_{\text{hitung}} = -\left\{m - 1 - \frac{2p+5}{6}\right\} \ln |R| \quad (1)$$

Where m is the number of observations or the number of observations and R is the correlation matrix of x with variables as much as p obtained using the equation below:

$$R = \begin{bmatrix} 1 & r_{12} & \dots & r_{1p} \\ r_{21} & 1 & \dots & r_{2p} \\ \vdots & \ddots & \ddots & \dots \\ r_{p1} & r_{p2} & \dots & 1 \end{bmatrix} \quad (2)$$

with:

$$r_{jk} = \frac{1}{m-1} \sum_{i=1}^m \left(\frac{x_{ij} - \bar{x}_j}{\sqrt{s_{jj}}} \right) \left(\frac{x_{ik} - \bar{x}_k}{\sqrt{s_{kk}}} \right) \quad (3)$$

Description r_{jk} : Correlation value between variables j and variable k ; x_{ij} : Observation value to-i on variables j ; \bar{x}_j : Average value of observations on variables j ; s_{jj} : Standard deviation of observation values on variables j ; x_{ik} : Observation value to-i on variables k ; \bar{x}_k : Average value of observations on variable k ; and s_{kk} : Standard deviation of observation values on variables k . Where $i = 1, 2, 3, \dots, m$; $j = 1, 2, 3, \dots, p$; $k = 1, 2, 3, \dots, p$; p : Number of variables; and m : Number of observations.

After obtaining the results of the calculation with formula (1), the results are compared with the chi-square table. The test criteria are reject H_0 if the value of $\chi^2_{\text{hitung}} \geq \chi^2_{[\alpha/2, p(p-1)]}$ or value of $p\text{-value} \leq \alpha = 0.05$, that means the characteristics of the chips are interdependent. If the correlation matrix obtained is not an identity matrix, then the use of the multivariate method is feasible to be used [9; 10].

2.2.3. Multivariate normal distribution test

Almost all multivariate data analysis techniques, especially with variable data require normal multivariate assumptions [11; 12]. The basis of the multivariate normal density function is the univariate normal density function. The following is the normal univariate density function with the average μ and variance σ^2 .

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} \text{ for } -\infty < x < \infty \quad (4)$$

Based on equation (4) can be done multivariate normal distribution approach. Given the variable x as much as p arranged in vector form $x' = [x_1, x_2, \dots, x_p]$ and $\mu' = [\mu_1, \mu_2, \dots, \mu_p]$ is the average vector of x , and the matrix Σ (covariance variance matrix of x) is the size of $p \times p$. So that the square of the distance from x to μ can now be written as follows:

$$(\mathbf{x} - \boldsymbol{\mu})' \boldsymbol{\Sigma}^{-1} (\mathbf{x} - \boldsymbol{\mu}) \quad (5)$$

The next step to obtain the multivariate density function is to replace the distance equation in equation (4) with equation (5) and replace the constant $\frac{1}{\sigma\sqrt{2\pi}}$ with a more general form to create an area under the density function united regardless of p value. So that the normal multivariate density function can be written as follows:

$$f(\mathbf{x}) = \frac{1}{(2\pi)^{p/2} |\boldsymbol{\Sigma}|^{1/2}} e^{-\frac{1}{2}(\mathbf{x} - \boldsymbol{\mu})' \boldsymbol{\Sigma}^{-1} (\mathbf{x} - \boldsymbol{\mu})} \quad (6)$$

Where $-\infty < x_j < \infty$ and $j = 1, 2, \dots, p$. Multivariate normal density with p-dimensions is denoted by $N_p(\boldsymbol{\mu}, \boldsymbol{\Sigma})$ [5; 8].

One method used to check whether a data is multivariate normally distributed or cannot use Q-Q plots of distance values using the mahalanobis approach. The following are the steps that will be used to test the multivariate normal distribution with mahalanobis distance approach:

- Calculates the average vector value $\bar{\mathbf{x}}$

$$\bar{\mathbf{x}} = \frac{1}{m} \sum_{i=1}^m \mathbf{x}_i \quad (7)$$

- Finding the value of the variance-covariance matrix \mathbf{S}

$$S_{jj}^2 = \frac{1}{m-1} \sum_{i=1}^m (\mathbf{x}_{ij} - \bar{\mathbf{x}}_j)^2 \quad (8)$$

$$S = \frac{1}{m-1} \sum_{i=1}^m (\mathbf{x}_i - \bar{\mathbf{x}})(\mathbf{x}_i - \bar{\mathbf{x}})' \quad (9)$$

- Calculating the Mahalanobis distance value for each observation point with the average vector using the following equation

$$d_i^2 = (\mathbf{x}_i - \bar{\mathbf{x}})' \boldsymbol{\Sigma}^{-1} (\mathbf{x}_i - \bar{\mathbf{x}}), \text{ where } i = 1, 2, 3, \dots, n \quad (10)$$

Description \mathbf{x}_i : object of observation to-i; m: number of observations; $\boldsymbol{\Sigma}^{-1}$: inverse covariance variant matrix of size p x p; and p: number of variables.

- After obtaining the mahalanobis distance value then the value is sorted from the smallest to the largest

$$(d_{(1)}^2 \leq d_{(2)}^2 \dots \leq d_{(n)}^2) \quad (11)$$

- Determine the value of q_i obtained from the chi-square table

$$\chi^2 \left(p, \frac{i-0.5}{n} \right) = q_i \quad (12)$$

- Make a scatter plot with coordinates between pairs (d_i^2, q_i) .
- If scatter plots tend to form a straight line, then the observational data can be said to be multivariate normally distributed.

In addition to using the Q-Q test plot for normal multivariate can be done by testing the hypothesis through the value of skewness and kurtosis. If the frequency curve of a distribution has a tail that extends to the right (seen from the mean), then it is said to be right (positive), and if vice versa it is left to the left (negative). Curvature or kurtosis is the height of the peak or the friction of a distribution that is usually taken relative to a normal distribution. Skewness and kurtosis values for normal multivariate are defined as follows [11; 13]:

$$\beta_1 = \beta_{1,p} = E[(\mathbf{x} - \boldsymbol{\mu})' \boldsymbol{\Sigma}^{-1} (\mathbf{x} - \boldsymbol{\mu})]^3 \quad (13)$$

$$\beta_2 = \beta_{2,p} = E[(\mathbf{x} - \boldsymbol{\mu})' \boldsymbol{\Sigma}^{-1} (\mathbf{x} - \boldsymbol{\mu})]^2 \quad (14)$$

When $\mathbf{x} \sim N(\boldsymbol{\mu}, \boldsymbol{\Sigma})$ and the central moment value in the third order for multivariate normal distribution is zero, so it is obtained $\beta_{1,p} = 0$ and $\beta_{2,p} = p(p+2)$. On $\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_p$ then the estimated value for $\beta_{1,p}$ and $\beta_{2,p}$ obtained from the following equation:

$$b_{1,p} = \frac{1}{m^2} \sum_{i=1}^m g_i^3 \quad (15)$$

$$b_{2,p} = \frac{1}{m} \sum_{i=1}^m g_i^2 \quad (16)$$

The values of g_i in the equation above using mahalanobis distance obtained by equation (10). The hypothesis used in testing multivariate normality for the value of skewness is as follows:

$H_0: \beta_{1,p} = 0$ (Data is normally distributed)

$H_1: \beta_{1,p} \neq 0$ (Data is not normally distributed)

$\alpha = 5\%$

Test Statistic:

$$z_{skew} = \frac{(p+1)(m+1)(m+3)}{6[(m+1)(p+1)-6]} b_{1,p} \quad (17)$$

The test criteria used are rejecting the null hypothesis if the value $z_{skew} \geq \chi_{\frac{1}{2}p(p+1)(p+2)}^2$, or reject the null hypothesis if the value $p\text{-value} \leq \alpha$ (0.05), which means the data is not normally distributed.

To test hypotheses on the value of kurtosis are as follows:

$H_0: \beta_{2,p} = 0$ (Data is normally distributed)

$H_1: \beta_{2,p} \neq 0$ (Data is not normally distributed)

$\alpha = 5\%$

Test Statistic:

$$z_{kurtosis} = \frac{b_{2,p}-p(p+2)}{\sqrt{8p(p+2)/m}} \quad (18)$$

The test criteria used in the kurtosis value is reject the null hypothesis if the value is greater than the upper limit of 2.5% or less than the lower limit value of 2.5% of the z distribution or reject the null hypothesis if the value $p\text{-value} \leq \alpha=0.05$ [1; 2].

2.2.4. Control chart T^2 Hotelling free distribution

If the normal multivariate assumptions are met then use the control chart T^2 Hotelling, but if it is not fulfilled then the control diagram that is formed, is a control chart T^2 Hotelling free distribution. Steps for creating a control chart T^2 Hotelling free distribution is the same as the steps in creating a control chart T^2 Hotelling, namely as follows [14; 15]:

- Calculate the average of each characteristic observed.

$$\bar{x} = \frac{1}{m} \sum_{i=1}^m x_i \quad (19)$$

- Calculates the variance-covariance matrix of the observed characteristics.

- Calculate statistical values T^2 Hotelling use the following equation:

$$T_i^2 = (x_i - \bar{x})' S^{-1} (x_i - \bar{x}) \quad , i=1,2,\dots,m \quad (20)$$

- For each observation $i = 1,2,3, \dots$, compare values T^2 with the control limits specified using the following equation:

$$UCL = T^2 + ks_{T^2} \quad (21)$$

$$LCL = 0 \quad (22)$$

Description T^2 : average value T^2 Hotelling; and s_{T^2} : standard deviation of value T^2 Hotelling.

The value of k is the control boundary interval coefficient obtained in accordance with the selection of values α with the equation [16; 17]:

$$k = \sqrt{\frac{1}{\alpha}} \quad (23)$$

The upper control limit value (UCL) was obtained from the use of Chebyshev's theorem which without regard to the distribution of the value of x was formulated as follows:

$$P = (\mu - k\sigma < X < \mu + k\sigma) \geq 1 - \frac{1}{k^2} \quad (24)$$

- Make a control chart by making a plot between values T_i^2 with observations $i = 1, 2, 3, \dots, m$.
- If the value T_i^2 outside the control limit, the observation is declared uncontrolled.

2.2.5. Decomposition process for uncontrolled points

In process control both univariate and multivariate sometimes experience uncontrolled processes. If at the time of the control process there are points that are outside the control limits, the cause is sought. There are two things that cause data to occur outside the control limit (out of control), namely assignable cause and common cause [14; 16].

The method used to identify the variables that cause uncontrolled processes in a multivariate manner is to describe the values T^2 on a control chart T^2 Hotelling into the component of the contribution of each variable quality characteristics. If the statistical value is represented T^2 , then the statistical value for all processes without using a variable to-j denoted T_j^2 so the indicator of the variable contribution relationship to-j the process can be formulated in the following equation [16]:

$$d_j = T^2 - T_j^2 \quad (25)$$

Description T^2 : statistical value T^2 Hotelling; and $T_{(j)}^2$: statistical value for the variable to-j. The greater the value of d_j , the greater the contribution of the jth variable to the uncontrolled point [17].

2.2.6. Process capability analysis

Process capability is the ability of a process to produce and produce output in accordance with the needs and characteristics of the company, so that the results are obtained whether the process is able to produce products that are in accordance with the characteristics set by the company. According to Hidayat et al. [1], analysis of process capability used for data that is not normally distributed using the following equation:

$$C_{pc} = \frac{USL - LSL}{6 \sqrt{\frac{\pi}{2} E|X - T|}} \quad (26)$$

The values of USL and LSL are the specification limits set by the company. Based on the above equation for $E|X - T|$ is the expectation value of the average process and company target where the T value is formulated in the equation below:

$$T = \frac{1}{2} (USL + LSL) \quad (27)$$

According to Hidayat et al. [1], constants $6 \sqrt{\frac{\pi}{2}}$ the value is the same or equal to the value 6σ when data is normally distributed. Value σ is an estimated standard deviation in the process when the data used is within the control limit.

According to Lee et al. [9], the value of X in equation (26) is a random variable which is a quality characteristic. Process capability index can be estimated by estimating $E|X - T|$ use equation:

$$\bar{c} = \sum_{i=1}^n \frac{|x_i - T|}{n} \quad (28)$$

Where X_1, X_2, \dots, X_n is a sample of process data. So the estimates of the process capability index are formulated as follows:

$$\hat{C}_{pc} = \frac{USL - LSL}{6 \sqrt{\frac{\pi}{2} \bar{c}}} \quad (29)$$

Constant $6 \sqrt{\frac{\pi}{2} \bar{c}}$ is a natural tolerance measurement that is more robust when compared to 6σ when the quality characteristic data is not normally distributed [16; 17]. A process will be said to be capable or the production process has the ability to produce accurate products, when the capability index values meet the criteria $C_{pc} > 1.33$.

3. Result and discussion

The analysis carried out in this study uses alpha (α) as big as 5%. The software used in this study is Microsoft Office Excel software and R. software.

3.1. Correlation testing between variables

The first stage carried out in this study is testing the correlation between variables, because these variables must be non-dependent (dependent). Variable characteristics of chips quality are said to be dependent if the correlation matrix between variables does not form an identity matrix so that a correlation matrix is formed, using the formula in equation (3). Based on calculations using R software, obtained a correlation matrix of these variables:

$$\mathbf{R} = \begin{bmatrix} 1 & -0.117 & -0.428 & -0.168 & -0.026 & 0.160 \\ -0.117 & 1 & 0.053 & -0.435 & -0.146 & -0.308 \\ -0.428 & 0.053 & 1 & 0.237 & -0.083 & -0.115 \\ -0.168 & -0.435 & 0.237 & 1 & -0.028 & 0.054 \\ -0.026 & -0.146 & -0.083 & -0.028 & 1 & 0.163 \\ 0.161 & -0.308 & -0.115 & 0.053 & 0.163 & 1 \end{bmatrix}$$

Test statistics used in correlation testing use Bartlett sphericity test with equation (1) and hypothesis as follows.

Hypothesis:

$H_0 : \mathbf{R} = \mathbf{I}$ (Inter independent variable quality chips)

$H_1 : \mathbf{R} \neq \mathbf{I}$ (Inter dependent chips quality variables)

$\alpha = 5\%$

The following results are obtained:

$$\chi^2_{\text{hitung}} = - \left\{ 178 - 1 - \frac{2(6) + 5}{6} \right\} (-0.71701906) = 124.8808$$

Based on the results of the above calculations it can be seen that the value χ^2_{hitung} (124.8808) $\geq \chi^2_{\text{tabel}}$ (24.99579), then H_0 rejected. So it can be concluded that the variable quality of the chips is dependent. This shows that the use of multivariate methods is suitable for use.

3.2. Examination of multivariate normality

In this study to find out whether the data quality chips are multivariate normally distributed or cannot be seen visually by mapping the mahalanobis distance quadratic value points according to equation (10) and in accordance with the steps. This analysis is carried out using 178 data observations consisting of 6 variables, using the average data formula in equation (7), obtained by the average data vector value that is:

$$\bar{\mathbf{x}} = \begin{bmatrix} 0.6362 \\ 34.8264 \\ 1.1982 \\ 1.2061 \\ 28.3103 \\ 2.4103 \end{bmatrix}$$

These results indicate that the average value for the Intrinsic Viscosity variable is 178 observations 0.6362, the average value for the COOH variable is 34.8264, the average value for color b variable is equal to 1.1982, average value for DEG variable is 1.2061, the average value for the chips / gram variable is equal to 28.3103, and the average value for the oblong variable is equal to 2.4103.

Equation (9) is used to obtain the covariance variance matrix. The data is processed with the help of Microsoft Office Excel software, so that the results obtained for the variance covariance matrix are as follows:

$$S = \begin{bmatrix} 7.8281 \times 10^{-6} & -0.0009 & -0.0006 & -8.7883 \times 10^{-6} & -3.5722 \times 10^{-5} & 0.0017 \\ -0.0009 & 6.6445 & 0.0721 & -0.0209 & -0.1865 & -3.0863 \\ -0.0006 & 0.0721 & 0.2760 & 0.0023 & -0.0216 & -0.2348 \\ -8.7883 \times 10^{-6} & -0.0209 & 0.0023 & 0.0003 & -0.0003 & 0.0039 \\ -3.5722 \times 10^{-5} & -0.1865 & -0.0216 & -0.0002 & 0.2451 & 0.3134 \\ 0.0017 & -3.0863 & -0.2348 & 0.0039 & 0.3134 & 15.1141 \end{bmatrix}$$

The result of the covariance variance matrix shows that the variance value of the Intrinsic Viscosity variable is equal to 7.8281×10^{-6} with the covariance value formed by the Intrinsic variable Viscosity with the COOH variable is equal to -0.0009 , and so on.

Then the distance value of the mahalanobis approach is calculated using equation (10), for the first observation. The value of the first mahalanobis approach is obtained as follows:

$$x_i - \bar{x} = \begin{bmatrix} 0.636 - 0.6362 \\ 32.827 - 34.8264 \\ 1.31 - 1.1982 \\ 1.1967 - 1.2061 \\ 27.9 - 28.3103 \\ 0.067 - 2.4103 \end{bmatrix} = \begin{bmatrix} -0.00019 \\ -1.99975 \\ 0.11186 \\ -0.00947 \\ -0.41028 \\ -2.34365 \end{bmatrix}$$

$$S^{-1} = \begin{bmatrix} 164675.874 & 26.304 & 335.491 & 3698.673 & 91.955 & -11.295 \\ 26.304 & 0.218 & -0.076 & 14.043 & 0.135 & 0.034 \\ 335.491 & -0.076 & 4.682 & -27.300 & 0.352 & 0.018 \\ 3698.673 & 14.043 & -27.300 & 3997.793 & 12.099 & 0.740 \\ 91.955 & 0.135 & 0.352 & 12.099 & 4.330 & -0.070 \\ -11.295 & 0.034 & 0.018 & 0.739 & -0.070 & 0.076 \end{bmatrix}$$

$$d_i^2 = [-0.00019 - 1.99975 - 0.00947 - 0.41028 - 2.34365]$$

$$\begin{bmatrix} 164675.874 & 26.304 & 335.491 & 3698.673 & 91.955 & -11.295 \\ 26.304 & 0.218 & -0.076 & 14.043 & 0.135 & 0.034 \\ 335.491 & -0.076 & 4.682 & -27.300 & 0.352 & 0.018 \\ 3698.673 & 14.043 & -27.300 & 3997.793 & 12.099 & 0.740 \\ 91.955 & 0.135 & 0.352 & 12.099 & 4.330 & -0.070 \\ -11.295 & 0.034 & 0.018 & 0.739 & -0.070 & 0.076 \end{bmatrix} \begin{bmatrix} -0.00019 \\ -1.99975 \\ 0.11186 \\ -0.00947 \\ -0.41028 \\ -2.34365 \end{bmatrix}$$

$$d_i^2 = 3.57954$$

Based on the calculations above it can be seen that the distance value of the mahalanobis approach at the first observation is 3.57954. By using the same method, calculated the distance value of the mahalanobis approach for all observations so as to produce as many as 178 values which are then sorted from the smallest to the largest values according to equation (11). After that the value is calculated q_i using equation (12) for all observations.

After knowing the value d_i^2 and q_i then the results are formed into a plot (Q-Q plot) between values d_i^2 and q_i so that the results obtained in Figure 1.

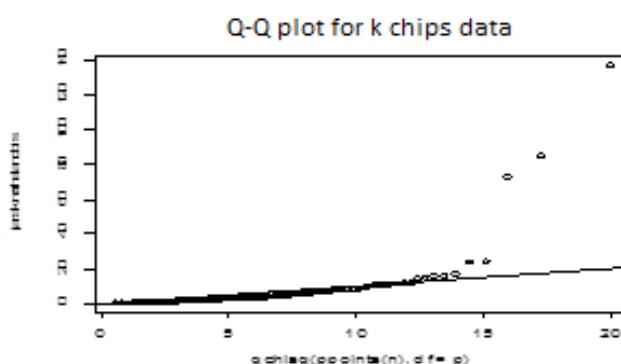


Figure 1. Q-Q plot quality chips

Based on the Q-Q plot it can be seen that the chips quality data is not multivariate normally distributed. This can be seen with several observations spread far from the line. In addition to visual, to see the multivariate normal distribution patterns can be tested by looking at the value of skewness and kurtosis:

The hypothesis used in testing skewness and kurtosis:

- a. Skewness

$$H_0: \beta_{1,p} = 0 \text{ (Data is normally distributed)}$$

$$H_1: \beta_{1,p} \neq 0 \text{ (Data is not normally distributed)}$$

$$\alpha = 5\%$$

- b. Kurtosis

$$H_0: \beta_{1,p} = 0 \text{ (Data is normally distributed)}$$

$$H_1: \beta_{1,p} \neq 0 \text{ (Data is not normally distributed)}$$

$$\alpha = 5\%$$

This test is done by using the help of R software. Using equations (15) and (16) values are obtained $b_{1,p}$ and $b_{2,p}$ on the calculation result of 123.498 for $b_{1,p}$ and 213.6311 for $b_{2,p}$. Based on the calculation using R software can be seen that the value *p-value* for skewness and kurtosis < 0.05 , then the null hypothesis is rejected. This means that data is not normally distributed for both skewness and kurtosis.

3.3. Control chart T^2 Hotelling of free distribution

Based on the assumption test, it can be seen that the data chips do not meet the multivariate normality distribution, so in the control chart formation phase in this study used control charts T^2 Hotelling of free distribution with Chebyshev theorem to determine the control limits on the control chart.

Using 178 data and six observed quality characteristic variables, statistical values will be formed

T^2 Hotelling individually for each observation point using equation (20). After getting the value from T_i^2 for each observation then the value is compared with the upper control limit value (UCL) and lower control limit (LCL). For the UCL value is obtained from equation (21), where the value of k is obtained from equation (23). The upper control limit for this study is obtained from the value of k using $\alpha = 0.05$ as follows:

$$k = \sqrt{\frac{1}{\alpha}} = 4.472136$$

Control chart formation is done by determining the upper control limit using equation (21) and obtaining the following results:

$$UCL = 5.966292 + (4.472136 \times 13.27629) = 65.33968$$

$$LCL = 0$$

Based on the elaboration described in the previous chapter, the process of creating a control diagram is done by calculating the average vector of the six quality characteristics variables:

$$\bar{x} = \begin{bmatrix} 0.6362 \\ 34.8264 \\ 1.1982 \\ 1.2061 \\ 28.3103 \\ 2.4103 \end{bmatrix}$$

and the value of the covariance variance matrix is as follows:

$$S = \begin{bmatrix} 7.8281 \times 10^{-6} & -0.0009 & -0.0006 & -8.7883 \times 10^{-6} & -3.5722 \times 10^{-6} & 0.0017 \\ -0.0009 & 6.6445 & 0.0721 & -0.0209 & -0.1865 & -3.0863 \\ -0.0006 & 0.0721 & 0.2760 & 0.0023 & -0.0216 & -0.2348 \\ -8.7883 \times 10^{-6} & -0.0209 & 0.0023 & 0.0003 & -0.0003 & 0.0039 \\ -3.5722 \times 10^{-6} & -0.1865 & -0.0216 & -0.0002 & 0.2451 & 0.3134 \\ 0.0017 & -3.0863 & -0.2348 & 0.0039 & 0.3134 & 15.1141 \end{bmatrix}$$

Using equation (20) obtained value T^2 Hotelling for 178 chips quality data and the upper control limit value of the lower control limit = 0, so the control diagram is formed as follows:

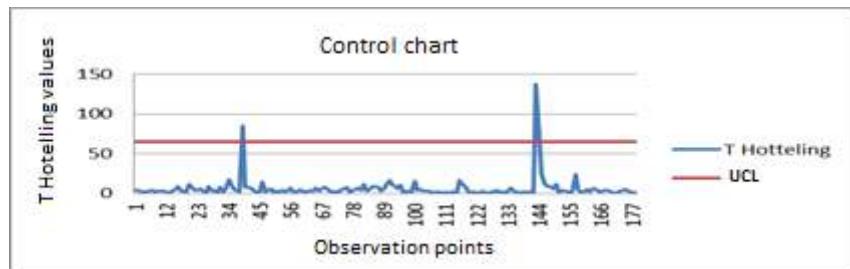


Figure 2. Control chart T^2 Hotelling chips quality

The control chart above shows the points within the control limit as much as 175 chips quality points with the number of points outside the control limit as many as 3 observation points, namely at the 39th, 143rd, and 144th observation points. Each point is out of control it must be tracked what causes it. If you have a clear cause or an assignable cause, such as damage to the machine, changes to the machine settings, operator error, or problems related to the material, then it must be repaired before the process starts again. The variables that contribute the most to making a point outside the control will be tracked using the decomposition control diagram.

3.4. Control chart T^2 Hotelling revision

This stage is carried out if there is a point that is outside the control limit or out of control. Control chart T^2 Hotelling revision is done by not using the three points that were previously out of control. Same as the steps in the calculation in making a control chart T^2 Hotelling, on the control chart T^2 The first revision obtained the upper control limit value of 22.46915 and the lower limit of 0, so the chart T^2 Hotelling the revisions that were formed were:

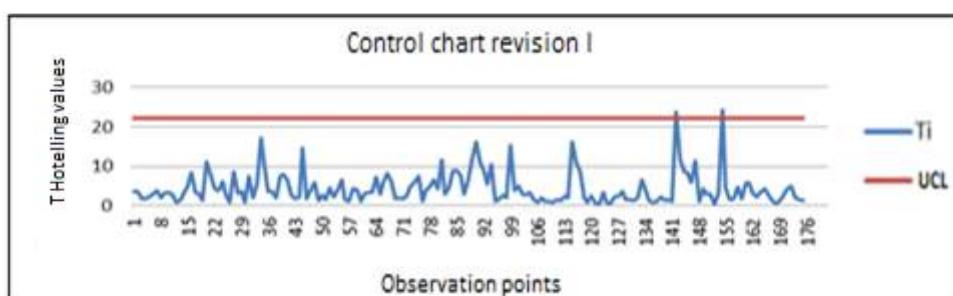


Figure 3. Revision I of control chart T^2 Hotelling

In the first revision control chart there are two points that are outside the control limit, namely the 145th observation point and 157th observation point while the remaining 176 points are in control. Because there are still observation points that are outside the control, it is necessary to do the second revision diagram by not including the data out of control before. Using the same stage, the upper control limit value in the second revision control chart is 19.59114 with the lower control limit value 0. Control chart T^2 Hotelling the second revision formed is as follows:

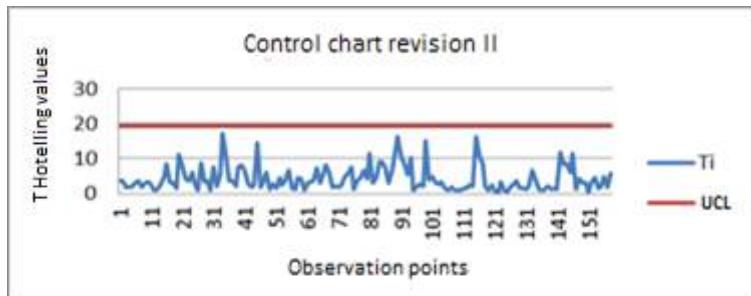


Figure 4. Revision II control chart T^2 Hotelling

In the second control diagram it can be seen that the whole point is in the control so there is no need to re-do the revision control diagram. Based on this calculation, it can be seen that there are 173 points in control (in control) and the remaining 5 points are out of control. To find out what variables contribute most to data that is out of control, decomposition is carried out.

3.5. Decomposition process for uncontrolled points

Based on the results of calculations in the previous stage, the results showed that there were 5 uncontrolled observations, namely observations to 39, 143, 144, 145, and observation data to 157. So that at this stage a further analysis was carried out to find out which variables had the greatest influence on observation uncontrolled. To find out about this, analysis using the method is used T^2 Hotelling decomposition with equation (25). The analysis was carried out with the help of Microsoft Office Excel software, so that the results obtained in Table 1.

Table 1. Analysis of uncontrolled observation Decomposition

Observation	T2 Main	T1	T2	T3	T4	T5	T6	Maximum
39	1.85544278	-1.57431	-3.01387	-1.47086	-1.38189	-1.28321	-1.31902	Variable X5
143	3.3100374	0.249433	0.685435	-0.02043	0.023536	0.242888	0.148315	Variable X2
144	2.63305758	-0.52907	-1.27832	-0.53137	-0.55994	-0.61993	-0.55436	Variable X1
145	3.03902149	-0.22831	-0.07641	-0.21509	-0.19549	-0.09331	-0.19119	Variable X2
157	3.09594173	-0.14617	-1.95127	-0.07174	-0.12971	0.027015	-0.09647	Variable X3

Source: Processed data

From Table 1, it can be explained as follows:

- In the 39th observation, statistical values were obtained T^2 Hotelling which was formed at 1.85544278 with a maximum decomposition value of -1.28321 found in the chips / gram variable (x_5). This shows that the variable that gives the largest contribution to uncontrolled observation is the variable chips / gram (x_5). This is due to the greater value d_j then the greater the variable contribution to-j against the uncontrolled point.
- In the 143rd observation, statistical values were obtained T^2 Hotelling which is formed at 3.3100374 with a maximum decomposition value of 0.685435 contained in the COOH variable (x_2). This shows that the variable that gives the greatest contribution to the uncontrolled observation is the COOH variable (x_2).
- In the 144th observation, statistical values were obtained T^2 Hotelling formed at 2.63305758 with a maximum decomposition value of -0.52907 contained in the Intrinsic Viscosity variable (x_1). This shows that the variable that gives the biggest contribution to the uncontrolled observation is the Intrinsic Viscosity variable (x_1).
- In the 145th observation, statistical values were obtained T^2 Hotelling formed by 3.03902149 with a maximum decomposition value of -0.07641 found in the COOH variable (x_2). This shows

that the variable that gives the greatest contribution to the uncontrolled observation is the COOH variable (x_2).

- e. In the 157th observation, statistical values were obtained T^2 Hotelling formed by 3.09594173 with a maximum decomposition value of -0.07174 found in the variable color b (x_3). This shows that the variable that gives the biggest contribution to the uncontrolled observation is the variable color b (x_3).
- f. Based on the results of the above calculations it can be concluded that the variable that contributes to uncontrolled observation is the Intrinsic Viscosity variable (x_1), COOH (x_2), color b (x_3), and variable chips/gram (x_5).

3.6. Process capability analysis

At this stage an analysis of the capability of the process that has been carried out by the company is carried out, so that the results are obtained whether the process is able to produce products that are in accordance with the characteristics set by the company. From the normality test it is known that the data is not normally distributed, so the analysis of process capability uses equation (26). Using the control limit determined by the company, the T value of equation (27) is obtained for each variable as follows:

$$\begin{array}{ll} T_1 = 0.635 & T_4 = 1.05 \\ T_2 = 35 & T_5 = 28 \\ T_3 = 1.25 & T_6 = 10 \end{array}$$

Based on equation (26) obtained values C_{pc} formed for each variable that can be seen in Table 2.

Table 2. Process capability analysis

Variables	C_{pc} Value	Description
X_1	0.319913	$C_{pc} < 1.33$
X_2	9.68164	$C_{pc} > 1.33$
X_3	4.42255	$C_{pc} > 1.33$
X_4	2.970699	$C_{pc} > 1.33$
X_5	5.064888	$C_{pc} > 1.33$
X_6	21.42168	$C_{pc} > 1.33$

Source: Processed data

Based on the calculation above it can be seen that from the six variables observed as characteristics of the quality of the chips, the results for the Intrinsic Viscosity variable have a value $C_{pc} < 1.33$, so it can be stated that the company's production process is not in accordance with the specifications for the variable. For COOH variables, color b, chips / gram, DEG, and oblong have values $C_{pc} > 1.33$, so that the production process is said to be capable or has the ability to produce accurate products.

4. Conclusion

In this paper a research on quality analysis of chips products using multivariate statistical process control (MSPC) has been conducted at PT Indorama Syenthetics Tbk. Based on the analysis using control charts T^2 Hotelling free of distribution there are five observation points that are outside the control limits caused by the electricity factor that influences the machine used in the assignable cause. The process is said to be stable with an average process of 4.155957 and the upper control limit value of 19.40599. For analysis of process capability shows that the COOH, color b, DEG, chips / gram and

oblong quality characteristics are capable in the sense that these characteristics are able to produce products that are accurate or in accordance with company specifications. As for the quality characteristics of Intrinsic Viscosity, it cannot be said to be capable, meaning that the quality characteristics are not in accordance with company specifications.

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Negative binomial regression to overcome overdispersion in Poisson regression

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Abstract. Partially Oriented Yarn (POY) or semi-finished yarn is a kind of yarn that is produced in the POY Department in PT. Indorama Synthetics Tbk. Prior to running the production activities; the company needs to do the planning and controlling of the production process on the POY yarn properly, and considering that the production process is continuous. If at the time of production process defective POY yarn products are found, it can lead to losses for PT. Indorama Synthetics Tbk. Product defect or break is a discrete response variable in the form of data count. The model that can be used when the response is the data count is Poisson regression model. In exploration of data it is known that discrete data overdispersion means the variance of discrete data is greater than average so to handle the problem Negative Binomial Regression can be used. In this study, there are three predictor variables that are suspected to have effect on the product defect, which are carboxyl acid (COOH), intrinsic viscosity (IV) and beam temperature. Based on AIC value, the suitable model to be used is the Negative Binomial regression model because it has smaller AIC value Poisson regression model so that in this case the use of Negative Binomial regression can be applied. From the Negative Binomial regression model it is known that carboxylic acid (COOH) has an effect on product defect on POY yarn.

1. Introduction

PT. Indorama Synthetics Tbk is a manufacturing company in Indonesia that produces various types of polyester yarn, with a continuous patterned production process, meaning that the production process takes place continuously from the machine to the next machine. POY yarn or semi-finished yarn is one of the products manufactured at PT Indorama. Continuous patterned production process, some POY yarn products are used as raw material for DTY (Draw Texture Yarn) yarn manufacturing process. So that in maintaining the quality of the product in order to remain good the company monitors the process for 24 hours [1; 2]. In the process of product processing that is carried out continuously, it is often unavoidable for the occurrence of imperfect products (defective products). The existence of defective POY yarn products found during the production process can cause a lot of downgraded production goods, meaning that the item has sales criteria below the price expected by PT. Indorama Synthetics Tbk. Defective product data during the period of 1 April 2017 to 30 June 2017. During this period, PT. Indorama has suffered a loss of IDR 496,372,500.00 [1; 2].

Many break products in this study are discrete response variables in the form of frequency / count data and the event is rare [3; 4; 5]. Therefore, the response variable is assumed to be Poisson distributed so that the regression analysis that can be used is Poisson regression analysis. Poisson regression analysis has equidispersion assumptions where the average discrete data is the same as the variance [6; 7]. But in fact discrete data often overdisperses in the Poisson Regression model which causes the model deviance to be very large. The occurrence of overdispersion is due to discrete data variance greater than the average. In the stage of data exploration, POY yarn defective product data overdispersed so that the use of Negative Binomial Regression is more appropriate to overcome it. According to Klakattawi et al. [8], regression to analyze data widely can be done by models such as binomial negative Poisson (NB) and zero-inverted regression. But analysts are often faced with the selection of the right model to take into account dispersion, which usually occurs in analyzing a set of data. According to Melliana et al. [7], the characteristics of the mean Poisson regression and variance must be the same, whereas the data count often becomes greater variance than the mean, which is often called over dispersion. To overcome the dispersion problem, modeling can be done with Generalized Poisson Regression (GPR) and Negative Binomial Regression because it does not require an average value equal to the variance value. Similar studies have also been carried out by Hardin and Hilbe [9], and Ferrer [10].

Referring to the problems and some previous studies, in this paper a study of Negative Binomial regression to overcome overdispersion in Poisson regression is carried out, in the formation of regression models based on factors that influence the level of product defects in PT. Indorama Synthetics Tbk. The aim of this research is to get the factors that influence the defective product during the process of producing POY yarn. In this study the variables included in the model included: carboxyl acid (COOH), Intrinsic Viscosity (IV) and Temperature Beam. These three variables have a control value of the lower limit and upper limit set by the company.

2. Material and Methodology

This section describes the Negative Binomial regression model along with the steps in modeling, and determining which factors affect the POY yarn break product.

2.1. Materials

The data used in this study is in the form of secondary data, namely the characteristics of COOH, IV characteristics, beam temperature, and the number of break products in POY-CP1 obtained from PT. Indorama Synthetics Tbk. The data amounted to 90 observations in the period April 1, 2017 until July 30, 2017. The variables used in this study were the number of POY thread defective products in bobbin units as the response variable (Y), and the predictor variable (X) includes:

- a. Carboxyl / COOH (X_1) measured in meq per kilogram.
- b. Intrinsic Viscosity (X_2) measured in units of dl per gram.
- c. Beam Temperature (X_3) is measured in degrees Celsius.

2.2. Methodology

The following is explained about the steps in the Negative Binomial regression modeling conducted in this study.

2.2.1. Distribution suitability test

Distribution suitability testing is something that needs to be done to see whether the POY yarn defect product meets the assumption of Poisson distribution. One test that can be used is to use the Kolmogorov-Simonov test, where the testing hypothesis is as follows [11; 12]

H_0 : $F(x)=F_0(x)$, that means the defective product POY thread follows the Poisson distribution.

H_1 : $F(x) \neq F_0(x)$, this means that the POY yarn defective product does not follow the Poisson distribution.

The test statistic used is:

$$D = \max|F_n(x) - F_0(x)| \quad (1)$$

where $F_n(x)$ = empirical distribution function; and $F_0(x)$ = certain distribution function.

The testing criteria in the Kolmogorov-Simonov test is to reject the null hypothesis if the values of $D_{hitung} > D_{tabel(n,\alpha)}$ or value of $p-value < \alpha$.

2.2.2 Poisson regression model building

The next step is to form a Poisson regression model. Poisson regression models can be written as follow:

$$\lambda_i = \exp(x_i^T \beta), \quad (2)$$

with x_i is a covariate vector, and β as a regression parameter coefficient whose value is obtained from the estimated results.

Parameter estimation on Poisson regression is done using the Maximum Likelihood Estimation (MLE) method. The likelihood function of the Poisson regression model is as follows:

$$L(\beta) = \prod_{i=1}^n \frac{\exp(-\lambda_i) \lambda_i^{y_i}}{y_i!} \quad (3)$$

While the likelihood log function can be written as:

$$\ln L(\beta) = \sum_{i=1}^n (-\exp(x_i^T \beta)) + \sum_{i=1}^n y_i x_i^T \beta - \sum_{i=1}^n \ln(y_i!) \quad (4)$$

Then parameter estimation β had done by differentiating the results of the log-likelihood from equation (4) on the parameters β . In the parameter estimation step β obtained the results of the equation which is implicit in form so that it needs to do an iteration approach.

According to Emmanuel [6], the iteration approach can use a Fisher Scoring Method algorithm, using a score vector $U(\beta)$ and information matrix $I^{(m)}(\beta)$, that is:

$$U(\beta) = \frac{\partial \ln[L(\beta)]}{\partial \beta}, \quad (5)$$

$$I^{(m)}(\beta) = -E\left(\frac{\partial^2 \ln[L(\beta)]}{\partial \beta^2}\right). \quad (6)$$

The iteration process in the Fisher Scoring Method will fulfill the equation:

$$\beta^{(m+1)} = \beta^{(m)} + I(\beta^{(m)})^{-1} U(\beta^{(m)}), \quad (7)$$

the initial stage determines the initial value $\beta^{(0)}$. The iterative procedure stops when achieving convergent results, namely $|\beta^{(m+1)} - \beta^{(m)}| < \varepsilon$ with $\varepsilon = 10^{-4}$. If not, then go back to the first step with $\beta^{(m+1)}$ is value $\beta^{(m+1)}$ the new one. The iteration calculation in the process is done by using software package R 3.3.3 [13].

2.2.3 Detection of overdispersion

After obtaining the Poisson regression model, the next step is the examination of overdispersion. According to Melliana et al. [7] to determine whether the POY yarn defect product data meets equidispersion assumptions on Poisson regression, can be done by looking at the deviance value divided by the value of the degree of freedom.

Testing hypothesis:

$H_0 : \phi = 1$ (POY yarn defective products do not experience overdispersion problems)

$H_1 : \phi > 1$ (POY yarn defective products experience overdispersion problems)

Test statistics:

$$D = 2 \sum_{i=1}^n \left\{ y_i \ln \left(\frac{y_i}{\hat{\lambda}_i} \right) - (y_i - \hat{\lambda}_i) \right\}, \quad (8)$$

with

$$\phi = \frac{D}{db},$$

where y_i : actual value of observations to- i from POY yarn defective products, and $\hat{\lambda}_i$: estimated value of POY yarn defective products for observation to- i . The testing criteria are to reject the null hypothesis if $\phi > 1$, and db stated degrees of freedom [9; 14].

2.2.4. Negative Binomial regression model

One of the objectives of regression analysis is to determine the pattern of relationships between the dependent variables and the independent variables. Refer Emmanuel [6] and Klakattawi et al. [8], in the Negative Binomial regression model, the response variable Y_i assumed to be a Negative Binomial distribution with the following distribution opportunity functions:

$$P(Y = y_i | \lambda_i, k) = \frac{\Gamma(y_i + \frac{1}{k})}{\Gamma(\frac{1}{k})y_i!} \left(\frac{1}{1+k\lambda_i}\right)^{1/k} \left(\frac{k\lambda_i}{1+k\lambda_i}\right)^{y_i} \quad (9)$$

Where $\lambda_i = t_i \lambda$, λ is the average incidence rate y per observation unit. Observations can be in the form of time, space, distance, area, area, volume, or population size. Because observation is often time, it can be symbolized by t_i . Therefore, in the Negative Binomial model can be written in the form of:

$$\lambda_i = \exp(\ln(t_i) + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip}), \quad (10)$$

or can be stated as follows:

$$\lambda_i = e^{x_i^T \beta}. \quad (11)$$

with λ_i : the average number of POY yarn defective products; x_i : predictor variables or factors that affect defective products like POY; β : regression parameters; and e : the base of the natural logarithm ($e = 2.71828$).

To estimate the parameters of the Negative Binomial regression model can be expected to use Maximum Likelihood Estimator (MLE). Given the Negative Binomial distribution opportunity function as in equation (9). Whereas the likelihood function for the Negative Binomial regression model based on its opportunity function can be written:

$$L(\lambda, \beta, k) = \prod_{i=1}^n \frac{\Gamma(y_i + \frac{1}{k})}{\Gamma(\frac{1}{k})y_i!} \left(\frac{k\lambda_i}{1+k\lambda_i}\right)^{y_i} \left(\frac{1}{1+k\lambda_i}\right)^{\frac{1}{k}}. \quad (12)$$

It is known that $\frac{\Gamma(y+k)}{\Gamma(k)} = k(k+1)(k+2)\dots(k+y-1)$ for y integers. So that

$$\frac{\Gamma(y_i + \frac{1}{k})}{\Gamma(\frac{1}{k})} = \left(\frac{1}{k}\right) \left(\frac{1}{k} + 1\right) \left(\frac{1}{k} + 2\right) \dots \left(\frac{1}{k} + y_i - 1\right)$$

Therefore, $\log L(\beta, k)$ can be written without Gamma function with:

$$\begin{aligned} \ln \left(\frac{\Gamma(y_i + \frac{1}{k})}{\Gamma(\frac{1}{k})} \right) &= \left(\frac{1}{k} \right) \left(\frac{1}{k} + 1 \right) \left(\frac{1}{k} + 2 \right) \dots \left(\frac{1}{k} + y_i - 1 \right) \\ &= \sum_{r=0}^{y-1} \ln \left(\frac{1+kr}{k} \right). \end{aligned}$$

So that the log-likelihood function is obtained from equation (12) as follows:

$$\ln L(\lambda, \beta, k) = \sum_{i=1}^n \left[\left(\sum_{r=0}^{y_i-1} \ln \left(\frac{1+kr}{k} \right) \right) - \ln(y_i!) + y_i \ln(k\lambda_i) - \left(\frac{1}{k} + y_i \right) \ln(1 + k\lambda_i) \right] \quad (13)$$

The above log-likelihood function is differentiated against each parameter $\beta_0, \beta_1, \beta_2, \dots, \beta_p$ and k the value is equal to zero.

The first derivative of the likelihood function with respect to the regression coefficient β is:

$$\begin{aligned} \frac{\partial L(\beta, k)}{\partial \beta_0} &= \sum_{i=1}^n \left[y_i - (y_i + k^{-1}) \left(\frac{k\lambda_i}{1+k\lambda_i} \right) \right] = \sum_{i=1}^n \left[\frac{y_i - \lambda_i}{1+k\lambda_i} \right] = 0. \\ &\vdots \end{aligned}$$

$$\begin{aligned}
 \frac{\partial L(\beta, k)}{\partial \beta_p} &= \sum_{i=1}^n \left[y_i x_{ip} - (y_i + k^{-1}) \left(\frac{k \lambda_i x_{ip}}{1+k \lambda_i} \right) \right] \\
 &= \sum_{i=1}^n \left[\frac{(y_i - \lambda_i) x_{ip}}{1+k \lambda_i} \right] = 0 \\
 &= \sum_{i=1}^n \left[\frac{\lambda_i}{1+k \lambda_i} \frac{(y_i - \lambda_i) x_{ip}}{\lambda_i} \right] = 0.
 \end{aligned} \tag{14}$$

The form of the matrix equation from the first derivative of the likelihood functions to the parameter β that is:

$$\mathbf{U} = \mathbf{X}^T \mathbf{W} \mathbf{z}, \tag{15}$$

with \mathbf{X} is a matrix ($n \times c$) from predictor variables, \mathbf{W} is a diagonal weight matrix to- i and \mathbf{z} is a matrix vector with row to- i , with each element is:

$$w_i = \frac{\lambda_i}{1+k\lambda_i} \text{ dan } z_i = \frac{(y_i - \lambda_i)}{\lambda_i}.$$

The first derivative of the log-likelihood function against the dispersion parameter k is:

$$\frac{\partial L(\beta, k)}{\partial k} = \sum_{i=1}^n \left[\sum_{r=0}^{\infty} \left(\frac{r}{1+kr} \right) + \frac{1}{k^2} \ln(1 + k\lambda_i) - \left(\frac{\frac{1}{k} + y_i}{1+k\lambda_i} \right) \right] = 0. \tag{16}$$

Because equations (14) and (16) are not linear in each of the parameters, a special algorithm is needed to obtain the estimated parameter values. One algorithm that can be used is the Fisher Scoring algorithm.

According to Emmanuel [6] and Klakattawi et al. [8], the Fisher Scoring algorithm is one form of development of the Newton-Raphson method by replacing $H(\beta)$ or the Hessian matrix with $I(\beta)$. The Fisher Scoring iteration equation is as follows:

$$\hat{\beta}_{i+1} = \hat{\beta}_i + I(\hat{\beta}_i)^{-1} U(\hat{\beta}_i), \tag{17}$$

with $I(\beta) = -E[H(\beta)]$ and $I(\beta)$ is Fisher's information matrix, where $H(\beta) = \left[\frac{\partial^2 L(\beta)}{\partial \beta_j \partial \beta_k} \right]$

whereas $U(\beta) = \left(\frac{\partial L(\beta)}{\partial \beta_j}, \dots, \frac{\partial L(\beta)}{\partial \beta_j} \right)^T$ and $j, k = 0, 1, 2, \dots, p$. Thus, the second partial derivative of the likelihood function is the regression coefficient parameter β is:

$$\begin{aligned}
 \frac{\partial^2 L(\beta, k)}{\partial \beta_0} &= - \sum_{i=1}^n \left[\frac{(1+ky_i)\lambda_i}{(1+k\lambda_i)^2} \right] \\
 \frac{\partial^2 L(\beta, k)}{\partial \beta_0 \partial \beta_j} &= - \sum_{i=1}^n \left[\frac{(1+ky_i)x_{ij}\lambda_i}{(1+k\lambda_i)^2} \right].
 \end{aligned} \tag{18}$$

Suppose the first partial derivative of $L(\beta, k)$ against $\beta_j, j \leq p$ is:

$$\frac{\partial L(\beta, k)}{\partial \beta_p} = \sum_{i=1}^n \left[\frac{(y_i - \lambda_i)x_{ip}}{1+k\lambda_i} \right] = 0.$$

The second partial derivative towards $\beta_u, u \leq p$ is:

$$\frac{\partial^2 L(\beta, k)}{\partial \beta_u \partial \beta_j} = - \sum_{i=1}^n \left[\frac{(1+ky_i)x_{iu}x_{ij}\lambda_i}{(1+k\lambda_i)^2} \right]. \tag{19}$$

The expectation of the second derivative of log-likelihood is:

$$E \left(- \frac{\partial^2 L(\beta, k)}{\partial \beta_u \partial \beta_j} \right) = \sum_{i=1}^n \left[\frac{(1+ky_i)x_{iu}x_{ij}\lambda_i}{(1+k\lambda_i)^2} \right]. \tag{20}$$

If equation (20) is expressed in a matrix \mathbf{I} , then:

$$\mathbf{I} = \mathbf{X}^T \mathbf{W} \mathbf{X}.$$

The second derivative of the likelihood function against the dispersion parameter k is:

$$\begin{aligned}
 f''(k) &= \frac{\partial L(\beta, k)}{\partial k^2} \\
 &= \sum_{i=1}^n \left[k^{-3} \sum_{r=0}^{\infty} \frac{y_i - 1}{(r+k^{-1})^2} - 2k^{-3} \ln(1 + k\lambda_i) + \frac{k^{-2}\lambda_i}{1+k\lambda_i} - \left(\frac{(y_i - \lambda_i)(1+2k\lambda_i)}{(k+\lambda_i k^2)^2} \right) \right].
 \end{aligned} \tag{21}$$

The estimation of Negative Binomial regression parameters is done by the following steps:

- Determine the initial estimate of $\beta_i^{(0)}$ and k for example $\hat{k}_1 = 0$.
- Determine the maximum likelihood estimate of the parameters β using Fisher Scoring iteration procedures with assumptions $k = \hat{k}_1$.

$$\hat{\beta}_{i+1} = \hat{\beta}_i + (X^T W_i X)^{-1} X^T W_i z_i. \quad (22)$$

Iteration ends when obtained $\hat{\beta}_{i+1} \cong \hat{\beta}_i$

- c. Use $\hat{\beta}$ to produce an estimate of parameter k using Newton Rapson's iteration procedure.

$$\hat{k}_{i+1} = \hat{k}_i - \frac{f'(k_i)}{f''(k_i)}. \quad (23)$$

Iteration ends when obtained $\hat{k}_{i+1} \cong \hat{k}_i$.

- d. If $|\hat{k}_{i+1} - \hat{k}_i| < \varepsilon$, finished. If not, use the parameter $k = \hat{k}_{i+1}$ and return to step 2. Value ε is a very small positive number value, for example $\varepsilon = 0.001$.

The iteration calculation in the process is carried out using the help of the R 3.3.3 software program package [13].

2.2.5. Hypothesis testing of Negative Binomial regression models

Testing the Negative Binomial regression hypothesis is done to test the suitability of the model simultaneously, and partial to see the significance level of the parameters of the model that is formed.

- Test the significance of the model parameters simultaneously (overall)

According to Emmanuel [6] and Klakattawi et al. [8], after the model is formed, the next step is to examine the meaning of the model simultaneously (overall). This test serves to determine whether the Negative Binomial regression model that is formed there are variables that affect many defective products or not. Simultaneous parameter test (overall) is done using Likelihood Ratio Test (LRT). The test hypothesis can be formulated as follows:

$H_0: \beta_1 = \beta_2 = \dots = \beta_k = 0$ (all predictor variables in the model do not affect many POY yarn defective products),

$H_1: \text{there is at least one } \beta_i \neq 0; (i=1,2,\dots,k)$ (there is at least one predictor variable in the model that affects many POY yarn defective products)

Test statistic on the LRT is test G^2 which is formulated as follows:

$$G^2 = -2 \ln \left(\frac{L_0}{L_1} \right) = -2 [\ln L_0 - \ln L_1] = -2(L_0 - L_1), \quad (24)$$

where L_0 is the likelihood function in the model below H_0 and L_1 is the likelihood function in the full model. The test criteria for LRT are reject H_0 when $G^2 \geq \chi^2_{\alpha, db}$, and accept in other cases, where db is the difference in the free degree of the full model and the model below H_0 .

- Partial model parameter test significance

According to Emmanuel [6] and Klakattawi et al. [8], parameter testing is partially conducted to determine whether the predictor variables affect the individual response variables generated. The test statistic used is the Wald test.

Testing hypothesis:

$H_0: \beta_j = 0$ (predictor variable to- j does not affect many POY yarn defective products)

$H_1: \beta_j \neq 0; j = 1, 2, \dots, k$ (predictor variable to- j affects many POY yarn defective products)

Wald test statistic:

$$W_j = \left(\frac{\hat{\beta}_j}{SE(\hat{\beta}_j)} \right)^2. \quad (25)$$

Where W_j : Wald statistical values for predictor variables to- j ; $\hat{\beta}_j$: estimated coefficient on the predictor variable to- j ; and $SE(\hat{\beta}_j)$: standard error of estimated coefficient on the predictor variable to- j .

Testing criteria, reject the null hypothesis if $W_j > \chi^2_{\alpha, 1}$, or reject the null hypothesis if $p - \text{value} \leq \alpha$ [15].

- Determine the best model

Selection of the best regression model needs to be done to obtain optimal regression analysis results. One measure of the goodness of the model used to compare several models, for example the model produced by Poisson and Negative Binomial can be done by looking at each value of Akaike's Information Criteria (AIC) and Bayesian Information Criterion (BIC) in each model. Akaike defines the calculation of AIC as follows.

$$\begin{aligned} AIC &= -2(\mathcal{L} - p) \\ &= -2\mathcal{L} + 2p. \end{aligned} \quad (26)$$

While the calculation of BIC can be defined in the equation:

$$BIC = -2\log(L) + p \log(n). \quad (27)$$

with p are many parameters. Among Poisson models and Negative Binomial models which have smaller AIC and BIC values indicate that the model is better to use [15; 6; 8].

3. Result and discussion

In this chapter will be presented the results and discussion of the model formation and selection of the best model for the data on the number of POY yarn defect products based on the factors that influence it, namely Carboxylic Acid (COOH), Intrinsic Viscosity (IV), and Beam Temperature. The model that will be used is the Negative Binomial regression model. The calculation process at the stage of the model analysis is done by using software package R 3.3.3.

3.1. Distribution suitability test results

In order to fulfill the Poisson distribution assumption for data on POY flawed product, Kolmogorov-Smirnov test was used. Based on the tests that have been carried out, the Kolmogorov-Smirnov test statistic value is $D = 0.041969141$, and the value $D_{table} = 0.141$. Obviously the value of $D < D_{table}$, so that the null hypothesis is accepted meaning that the defective product data of the POY thread follows the Poisson distribution.

3.2. Poisson regression modeling results

Estimation of parameters in the Poisson regression model is done using the Maximum Likelihood Estimation (MLE) method, and completed using the Fisher Scoring iteration method. The estimated value obtained by four iterations is as follows:

Table 1. Estimation and significance of parameters of the Poisson regression model

Parameters	Estimated Values	Standard Error	p-value
(Intersep)	-200.05749	92.59284	0.0307
Carboxyl Acid (X1)	-0.03095	0.00785	0.000081
Intrinsic Viscosity (X2)	9.15091	15.81464	0.5628
Beam Temperature (X3)	0.69770	0.32538	0.0320

Source: Processed data

So that the Poisson regression model that is formed based on Table 1, is as follows:

$$\ln(\lambda) = -200.05749 - 0.03095X_1 + 9.15091X_2 + 0.69770X_3$$

While the AIC and BIC values obtained from Poisson regression modeling were 708.0574 and 718.0566. Poisson regression model will be used compared to the Negative Binomial model, in order to choose the best model based on the AIC and BIC values.

3.3. Examination of overdispersion

After the Poisson regression model is obtained, then the equidispersion assumption is tested to find out whether the equidispersion assumptions are met or not. Equidispersion examination is done using Deviance Statistics divided by the degree of freedom. If the result is equal to one ($\phi = 1$), then the equidispersion assumption is fulfilled. If $\phi > 1$ then overdispersion occurs, and if $\phi < 1$ then underdispersion occurs. The results of overdispersion testing based on equation (8) can be seen that

the Deviance value is 172.95 divided by the degree of freedom of 86 so that the value $\phi = 2.011047$. Value ϕ is greater than 1, so that it can be concluded that overdispersion occurs in the model so that Poisson regression is not appropriate to be used in this case.

3.4. Negative Binomial regression modeling results

Negative Binomial regression model is a regression model used to overcome the problem of overdispersion in Poisson regression. Following is the Negative Binomial analysis.

- Estimating model parameters

Estimation of the parameters of the Negative Binomial regression model is done using the Maximum Likelihood Estimation (MLE) method, and completed using the Fisher Scoring iteration. The estimated parameter values obtained by one iteration are given in Table 2, as follows.

Table 2. Estimated parameters of the Negative Binomial regression model

Parameters	Estimated Values	Standard Error	p-value
(Intersep)	-198.54341	128.09791	0.12116
Carboxyl Acid (X1)	-0.03103	0.01092	0.00448
Intrinsic Viscosity (X2)	8.50869	21.81517	0.69651
Beam Temperature (X3)	0.69384	0.45005	0.12315

Source: Processed data

So that the Negative Binomial regression models that are formed based on Table 2, are as follows:

$$\ln(\hat{\lambda}) = -198.54341 - 0.03103X_1 + 8.50869X_2 + 0.69384X_3$$

While the AIC and BIC values obtained from the Negative Binomial regression modeling are 685,903 and 698,402.

- Test the meaning of parameters simultaneously

Based on equation (24), a complete model log likelihood value of -337.95 with a free degree of 5 is obtained and a constant model log likelihood value of -343.58 with a degree of freedom 2. Based on equation (24) the value $G^2 = 11.262$ with *p-value* less than 0.01039. Because of the value *p-value* smaller than $\alpha = 5\%$, then the null hypothesis is rejected so that it can be concluded that there is at least one predictor variable in the model that affects the number of POY yarn defective products.

- Partially test the significance of parameters

After getting the estimated parameter values, the parameters are tested simultaneously from the Negative Binomial regression model. Furthermore, to find out what factors significantly influence the number of POY yarn defects, partial testing needs to be done. Based on the test statistics listed in equation (25) the results in Table 3 are obtained.

Table 3. The partial significance of the BN Regression Model

Parameters	Wald	p-value	Description
(Intersep)	2.402500	0.121141516	Not significant
Carboxyl Acid (X1)	8.076964	0.004483149	Significant
Intrinsic Viscosity (X2)	0.152100	0.696536547	Not significant
Temperature Beam (X3)	2.377764	0.123073594	Not significant

Source: Processed data

Based on Table 3, it can be concluded that the independent variable that significantly affects the high defect product of POY yarn is carboxyl acid where the value is *p-value* is 0.004483149 (<0.05). While the other two independent variables are intrinsic viscosity (X_2), and beam temperature (X_3) does not significantly influence the high defect product POY yarn because it has value *p-value* (>0.05).

3.5. Selection of the best model

For selecting the best model generated by Poisson regression and Negative Binomial regression, it can be done by looking at the AIC and BIC values. In Table 4, shows the AIC and BIC values of Poisson regression models and Negative Binomial regression.

Table 4. Comparison of Models Based on AIC and BIC

Model Regresi	AIC Value	BIC Value
Poisson	708.95	718.0566
Negative Binomial	685.903	698.402

Source: Processed data

When viewed from the AIC and BIC values in Table 4, it can be seen that the Negative Binomial regression model gives a smaller AIC and BIC values of 685.903 and 698.402, compared with Poisson regression models which have AIC and BIC values of 708.95 and 718.0566.

Based on the AIC and BIC values it appears that the best model for modeling data on the number of POY thread defective products based on the three predictors is the Negative Binomial regression model.

3.6. Model interpretation

The model produced in the Negative Binomial Regression based on Table 2, can be written as follows:

$$\ln(\lambda) = -198.54341 - 0.03103X_1 + 8.50869X_2 + 0.69384X_3$$

The resulting model does not all significantly affect POY yarn defect products.

Model $\ln(\lambda)$ (at BN) shows that the coefficient is variable X_1 (carboxyl acid) negative value, meaning that if all other variables are in a constant state, adding 1 meq / kg of carboxylic acid in the process of producing POY yarn will reduce the average defective product of POY yarn up to $\exp(-0.03103) = 0.969446$ bobbin. Suppose that in one production yield as many as 1000 bobbins will reduce the average defective product by 0.09%. Meanwhile, variable coefficient X_2 (intrinsic viscosity) positive value, meaning that if all other variables are constant, adding 1 dl / gram intrinsic viscosity during the process of producing POY yarns, will add the average defective product of POY yarn up to $\exp(8.50869) = 4957.664$ bobbin. For example, once a production produces 1000 bobbins, the average defective product will be 495.76%. Positive values are also indicated by the coefficient of the variable beam temperature (X_3), that is, if other variables are constant, the addition of a temperature of 10C during the POY yarn production process will add an average of POY yarn defective products up to $\exp(0.69384) = 2.001386$ bobbin. For example, once a production produces 1000 bobbins, it will add an average defective product of 0.20%.

4. Conclusion

Referring to the results of the discussion, there are several conclusions that can be taken. Based on the AIC and BIC values, the Negative Binomial model is better applied in the case of POY thread defective products, because it has a smaller AIC and BIC value compared to the Poisson model. These results support that the Negative Binomial model can be applied to cases of overdispersion. The Negative Binomial regression model obtained can be written as follows:

$$\ln(\lambda) = -198.54341 - 0.03103X_1 + 8.50869X_2 + 0.69384X_3$$

Using overall Likelihood Ratio Test statistics, there is at least one of the carboxyl acid variables, intrinsic viscosity, and beam temperature which affect the POY yarn defect product. While the partial test results using Wald statistics show that carboxyl acid has a significant effect. So it can be concluded that carboxyl acids are the most influential on the number of POY yarn defective products.

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Prediction of international tourist arrival to West Java Indonesia using decomposition method

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Abstract. The potential of West Java in tourism sector is undeniable considering its natural and human resources, making tourists feel comfortable to stay longer in West Java. Every year, international tourist arrival to West Java increases, forcing the government to work harder to facilitate accommodation for these international tourists. Data of international tourist arrival prediction facilitate in planning the development of West Java tourism. Based on calculation using decomposition method, it is predicted that international tourist arrival to West Java in December 2017 was 21,920 people with Mean Absolute Percentage Error (MAPE) of 14.18%.

1. Introduction

West Java province has a geographical land area of 3,710,061.32 hectares with population of 43,053,732. West Java is a favorite tourist destination besides Special Capital Region of Jakarta and Bali. The potential of West Java in tourism sector is due to strategic location and its accessibility, wide variety of tourist attractions (e.g. natural, cultural and arts attractions, museum, etc.) and the hospitality of its people, making West Java a very comfortable for tourists. Based on the data from Statistics Indonesia, tourist arrival, especially international tourists to West Java is increasing annually. Hence, the government should pay more attention for their accommodation to facilitate them. Data of international tourist arrival prediction is also needed for more effective and efficient development planning of tourist attractions in West Java [1; 2].

According to the data from *Badan Pusat Statistik* (BPS) West Java, incoming international tourists to West Java are known to arrive through two main entries, i.e. Husein Sastranegara Airport and Muarajati Seaport in Cirebon. International tourists arrival through Husein Sastranegara Airport in December 2017 are recorded as many as 17766 tourists which increased 17.11% compared to November 2017 which was 15170 tourists. Meanwhile, international tourist arriving in Muarajati Seaport Cirebon is all 73 ship crews, which decreased 52.60% compared to November 2017 which was 154 tourists [1; 2].

The international tourists arriving to West Java are mostly Malaysian and Singaporean. On December 2017, there are 11,213 international tourists arriving from Malaysia (including crew) through Husein Sastranegara Airport. This number increased by 6.55% compared to November 2017 which was 10,524 tourists. Meanwhile, the arriving international tourists from Singapore (including crew) are increasing 67.13%, from 2,963 tourists in November 2017 to 4,952 tourists in December 2017 [1; 2].

The overall international tourist arrival count to West Java in December 2017 is 17,839 tourists, which increased by 16.41 percent compared to November 2017 which was 15,324 tourists. Beside international tourist from Singapore and Malaysia, the arriving tourist whose number is increasing comes from India and Australia [3]. Meanwhile the number of international tourists arriving from Philippines, Thailand, Japan, South Korea, China, United States of America, United Kingdom, Germany, France and Kingdom of Saudi Arabia are decreasing [4; 5].

The international tourists arrival through Husein Sastranegara Airport in December 2017 is 17,766 tourists, which increased by 17.11% compared to November 2017 which was 15,170 tourists. The number of international tourists arriving through Muarajati Seaport Cirebon is 73 tourists, whom are all shipmen; this number decreased by 52.60% compared to that in November 2017 which was recorded 154 tourist arrivals. Meanwhile, it is known that **Disparbud Jabar** targeted the number of tourists arrival in 2018 is 49.75 million tourists, with 1.75 million of them are international tourists. Various places of interests in districts/cities in West Java provides tourism alternatives which are more diverse for tourists. This helped provides abundant income for national gross domestic product (GDP) [2].

According to the member of Financial Service Authority Commissary Board, West Java Province is one of the biggest national GDP provider after Special Capital Region of Jakarta Province and East Java Province. The portion of gross regional domestic product of West Java towards national GDP reached 13.30% on the third trimester of 2015, or approximately IDR 307.37 trillion (constant price). From this number, the tourism sector provided 4%, with obtained foreign exchange of IDR 155 trillion and provided 11.3 job vacancies. This interesting tourism potential might attract tourists and might change the economy in West Java. Tourists, either domestic or international, who visited West Java surely might need food, beverages, accommodation and souvenirs which enhances processing industries. The continual tourism sector might affect other sectors as well. Extra efforts by all parties in district and city level might attract more international tourist's interest into attending tourist destinations [1; 2].

This paper will present process in predicting international tourist arrival using decomposition method. This study aims to determine the appropriate forecasting method which could be utilized as a guide in predicting international tourist arrival especially in West Java. Tourism planning is very necessary since there are many changes in tourism industry nowadays. Tourism includes multiple aspects and includes various parties, hence, certain strategies are compulsory in tourism activity planning to ensure these activities run well [6; 7]. A well designed tourism planning will surely provide benefits and reduce all negative impacts. Thus, planning in tourism development as an industry is very necessary to achieve the expected tourism industry development plan and achieve the desired goals, either in economy, socio-cultural or environment aspect. **This research is expected to provide knowledge and information for relevant parties for the preparation of tourism planning in the future.**

2. Methodology

In this section a discussion is carried out which includes: multiplicative decomposition forecast accuracy measures method, which will be used to analyze data on the arrival of foreign tourists in West Java.

2.1. Multiplicative decomposition method

One of the methods to predict time series data is using multiplicative decomposition method. Multiplicative decomposition method is one of the oldest prediction methods. By assuming that data consisted of:

$$\text{data} = \text{pattern} + \text{error}$$

Referring to Petrevska [8] and Fortin et al. [9], multiplicative decomposition model is a forecasting which consisted of four components to predict the future. Those four components are: trend,

seasonality, cycle and error. The multiplicative decomposition method is based on the assumption that the actual data is a combination of several components which functionally written as:

$$X_t = f(T_t, S_t, C_t, I_t).$$

The data moving average value using multiplicative decomposition (classic decomposition) is assumed mathematically as follows:

$$Y_t = T_t \times S_t \times C_t \times E_t, \quad (1)$$

Where X_t represents periodic sequence value (actual data) during period of t ; T_t is the trend component value on period of t ; S_t is the seasonality component value on period of t ; C_t is the cycle component value on period of t ; E_t is the random (irregular) error component value on the period of t ; \hat{Y}_t is the forecast value on period of t [3; 10; 11].

To determine the value of \hat{Y}_t on equation (1), the following steps should be done:

- On data actual X_t , moving average is determined with length of p equals to the length of the seasonality (e.g.: 12 months, 4 quarters or 7 days). This is done to obtain the predicted effect of trend and cycle. Hence, a moving average equation is obtained as below:
- $$M_t = T_t \times C_t. \quad (2)$$
- To determine the effect of seasonality S_t , equation (1) is divided by (2); hence a new equation is obtained as follows:

$$\frac{Y_t}{M_t} = S_t \times E_t. \quad (3)$$

- To identify the effect of trend following the actual data pattern, regression and smallest quadrate is used, hence a new trend equation is obtained as shown below:

$$\hat{T}_t = a + bt. \quad (4)$$

Where a represents intercept constant, and b represent slope coefficient, which values could be determined using the equation below:

$$b = \frac{n \sum t X_t - \sum t \sum X_t}{n \sum t^2 - (\sum t)^2} \quad \text{and} \quad a = \frac{\sum X_t}{n} - \frac{\sum t}{n}, \quad (5)$$

where n represents number of data [12; 13].

- To determine the effect of cycle C_t , equation (2) is divided by trend T_t ; hence, a new equation is obtained as shown below:

$$\frac{M_t}{T_t} = C_t. \quad (6)$$

- Next, the forecasting value could be determined using the equation below:

$$\hat{Y}_t = T_t \times S_t \times C_t. \quad (7)$$

The residual value obtained by subtracting actual data and forecasting result on the period of t is then used to determine error level and accuracy of the forecast model [14; 15].

2.2. Forecast accuracy measures

Forecasting (prediction) is conducted due to the presence of complexity and uncertainty in the future which the forecaster must face. A forecast model is said to have a high accuracy if the said model has a very low error level [16; 17; 18]. There are several methods existed to measure the accuracy level of a forecast model, one of which is mean absolute percentage error (MAPE). The MAPE value is determined by using the equation below:

$$MAPE = \left(\frac{1}{n} \sum_{t=1}^n \frac{|X_t - \hat{Y}_t|}{X_t} \right) \times 100\%, \quad (8)$$

Where X_t represents periodic sequence value (actual data) for the period of t , \hat{Y}_t represents forecast value (data prediction values) on the period of t and n represents the number of analyzed forecast data [19; 20; 21].

3. Result and analysis

This section will discuss from data pattern identification to the forecast calculation, which was conducted using multiplicative decomposition method alongside its accuracy measures. The obtained forecast method which was believed to express actual data pattern was used to predict the number of international tourist arrival to West Java.

3.1. Study Object Data

The object of this study was international tourists arriving to West Java. The analysed data was a data comprising international tourist arrival during January 2012-December 2016. This international tourist arrival data was a secondary data obtained from *Biro Pusat Statistik* (Statistics Indonesia) West Java Province. The international tourist arrival data was presented on Table 1 and charted on Figure 1. The forecast method being applied on this study was multiplicative decomposition method. The data was analysed using Microsoft® Excel 2010 and Minitab® 16.

Table 1. The number of international tourist arrival to West Java

Month	Actual Data	Month	Actual Data	Month	Actual Data
Jan-12	9,737	Sep-13	14,742	May-15	18,902
Feb-12	10,771	Oct-13	12,292	Jun-15	15,423
Mar-12	13,366	Nov-13	18,243	Jul-15	6,688
Apr-12	12,711	Dec-13	24,401	Aug-15	10,387
May-12	12,829	Jan-14	16,397	Sep-15	10,652
Jun-12	15,533	Feb-14	14,618	Oct-15	10,755
Jul-12	11,736	Mar-14	21,538	Nov-15	14,981
Aug-12	7,194	Apr-14	13,631	Dec-15	17,067
Sep-12	13,749	May-14	14,725	Jan-16	11,065
Oct-12	7,537	Jun-14	16,942	Feb-16	8,497
Nov-12	15,917	Jul-14	6,241	Mar-16	15,964
Dec-12	18,285	Aug-14	10,648	Apr-16	50,922
Jan-13	14,077	Sep-14	14,132	May-16	16,841
Feb-13	12,088	Oct-14	15,086	Jun-16	9,055
Mar-13	16,815	Nov-14	16,644	Jul-16	9,299
Apr-13	14,008	Dec-14	20,840	Aug-16	12,003
May-13	18,023	Jan-15	10,453	Sep-16	15,141
Jun-13	16,640	Feb-15	13,158	Oct-16	17,444
Jul-13	7,803	Mar-15	15,224	Nov-16	12,876
Aug-13	8,808	Apr-15	16,978	Dec-16	22,510

The data presented in Table 1 can be presented in graphical form as given in Figure 1.

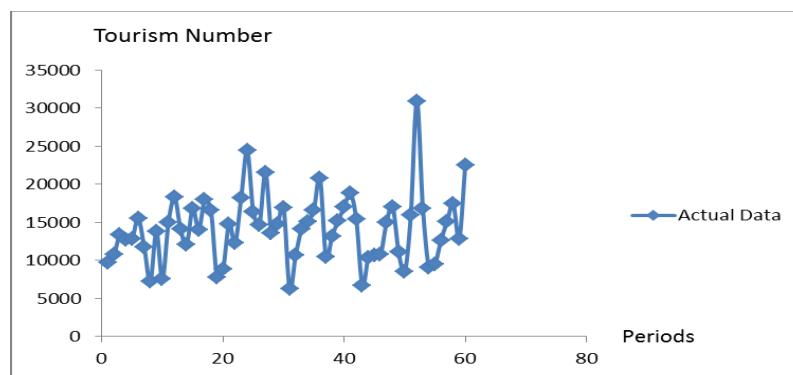


Figure 1. Graph representing the number of international tourist arrival to West Java

3.2. Forecasting using multiplicative decomposition method

By using the data on Table 1 and by referring to the discussion about multiplicative decomposition method, it was known that the prediction of the number of international tourist arrival was conducted by following these steps: to determine the assumed effect of trend and cycle using equation (2); determining the seasonality effect S_t , which was conducted by using equation (3); determining the effect of appropriate trend referring to equation (4) and (5); hence, a linear trend equation was obtained as shown below:

$$\hat{T}_t = 12933.605 + 40.97t ; \quad (9)$$

Next, the effect of cycle C_t was determined by using equation (6). Thus, the forecast values were determined by using equation (7). The result of forecast values determined using multiplicative decomposition method was presented on Table 2.

Table 2. Forecast result of in sample data on the number of international tourists arrival to West Java

Period	Forecasting Result	Period	Forecasting Result	Period	Forecasting Result
Jan-12	11,460	Jan-14	14,216	Jan-16	12,734
Feb-12	11,232	Feb-14	13,900	Feb-16	12,635
Mar-12	14,770	Mar-14	18,262	Mar-16	16,896
Apr-12	13,973	Apr-14	17,343	Apr-16	16,459
May-12	15,144	May-14	18,798	May-16	18,016
Jun-12	14,201	Jun-14	17,329	Jun-16	17,001
Jul-12	6,471	Jul-14	7,667	Jul-16	7,743
Aug-12	8,476	Aug-14	9,653	Aug-16	9,983
Sep-12	12,766	Sep-14	13,998	Sep-16	14,846
Oct-12	10,468	Oct-14	11,206	Oct-16	12,021
Nov-12	15,417	Nov-14	16,527	Nov-16	17,391
Dec-12	19,147	Dec-14	20,288	Dec-16	21,242
Jan-13	12,656	Jan-15	13,485	Jan-17	14,201
Feb-13	12,378	Feb-15	13,183	Feb-17	13,911
Mar-13	16,224	Mar-15	17,095	Mar-17	18,284
Apr-13	15,569	Apr-15	15,756	Apr-17	17,288
May-13	17,225	May-15	16,717	May-17	18,727
Jun-13	16,545	Jun-15	15,370	Jun-17	17,553
Jul-13	7,697	Jul-15	6,914	Jul-17	7,994
Aug-13	10,031	Aug-15	8,778	Aug-17	10,305
Sep-13	15,174	Sep-15	12,859	Sep-17	13,524
Oct-13	12,395	Oct-15	10,870	Oct-17	12,407
Nov-13	17,706	Nov-15	16,251	Nov-17	17,948
Dec-13	21,395	Dec-15	19,307	Dec-17	21,920

The result of the determined forecast values as shown on Table 2 could also be expressed in forms of graph as shown of Figure 2. Forecasting using multiplicative decomposition method yielded MAPE error level of 14.18%; hence, gave the forecast accuracy of 85.82%.

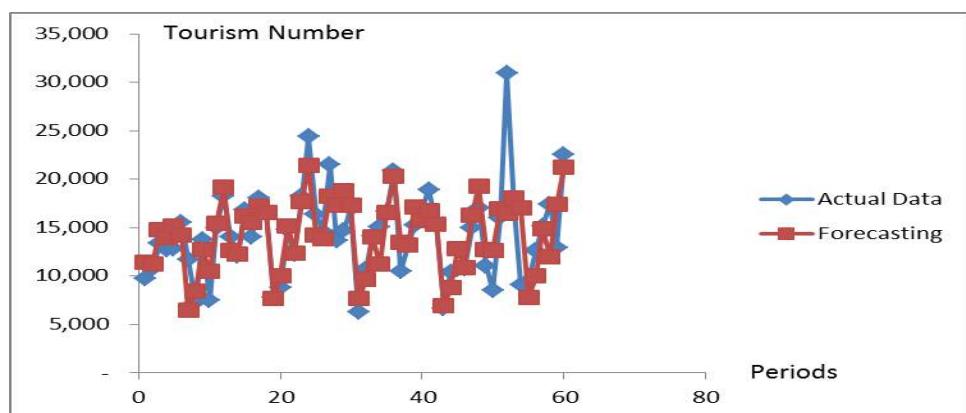


Figure 2. Forecast result and actual data on the number of international tourists arrival to West Java

3.3. Discussion

Referring to the data presented on Table 1 and the graph on Figure 1, it was known that the international tourist's arrival to West Java Province during January 2012-December 2016 was fluctuating monthly; occasionally increased on certain month and decreased on the other. However, after paying a closer attention, Figure 1 showed that during the period of January 2012-December 2016, the tourist arrival trend had a tendency to increase. This showed that the tourist arrival to West Java Province was gradually increasing. Since tourism sector was a prime sector in economic growth in West Java Province, the tourism sector should be managed carefully. To be managed well, the tourism sector in West Java should be supported with proper planning and policies as well. Forecasting the international tourist arrival to West Java Province was one of the basic ways to plan and make certain policies in the tourism sector. The forecasting on this study was conducted using multiplicative decomposition method.

The forecasting using multiplicative decomposition method was based on in sample data, with the result being presented on Table 2 and graph being presented on Figure 2. Referring to Figure 2, it was known that the forecast data graph plot almost overlaps the actual data. This forecast result using multiplicative decomposition method yields MAPE error of 14.18%, hence the forecast accuracy was 85.82%. This simply meant that the multiplicative decomposition method yields a relatively high accuracy result given that the result was able to express actual data with an accuracy of 85.82%. Thus, in the future, this multiplicative decomposition method was proposed to be applied as a basis in planning and policy making in tourism sector of West Java Province. The forecasting using out sample data for the period of January 2017-December 2017 was presented on Table 3.

Tabel 3. Out sample forecast result on the number of international tourists arrival to West Java

Month	Tourism Number	Month	Tourism Number
Jan-17	14,201	Jul-17	7,994
Feb-17	13,911	Aug-17	10,305
Mar-17	18,284	Sep-17	15,324
Apr-17	17,288	Oct-17	12,407
May-17	18,727	Nov-17	17,948
Jun-17	17,553	Dec-17	21,920
Total	99,964	Total	85,898

Based on the forecast result on Table 3, it could be concluded that the international tourists arrival to West Java Province during the first semester (January 2017-June 2017) was predicted 99,964 tourists and during the second semester (July 2017-December 2017) was predicted 85,898 tourists. Thus, the predicted total number of tourists arriving in 2017 was 185,862 tourists.

4. Conclusion

Within this paper, forecast analysis using multiplicative decomposition method and its application in predicting the number of international tourists arriving to West Java Province has been done. The analyzed data was the data comprising international tourist arrival during January 2012 – December 2016. Data analysis revealed that the forecasting using the multiplicative yielded MAPE error of 14.18% or accuracy level of 85.82%. Thus, forecasting using multiplicative decomposition method is better and recommended to be used in data analysis on the existing international tourist arrival data. The out sample forecast result using multiplicative decomposition method showed that the international tourist arrival during January 2017-December 2017 was predicted to be 185,862 tourists. **The weakness of this study is that it produces an accuracy rate of 85.82%. So that in the next study a method is needed to find which results in even greater accuracy.**

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Factors Affecting the Efficiency of Indonesian Public Listed Firms: The Effect of Size and Global Financial Crisis

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Abstract. This study aims to analyze the technical efficiency of Indonesian publicly listed firms, and the effect of firm's size and global financial crisis period on the technical efficiency score. Using the *data envelopment analysis* (DEA) method, this study employs data of 91 listed firms from 10 industrial sectors during 2004-2016 periods, except for banks and other financial institutions. This study uses the Cobb-Douglas production function, where materials, labor and capital are the input factors. This study uses sales as an output variable, while operating expenses and interest expenses are used as input variables. It is found that on average all the firms were not operated efficiently. However, with the technical efficiency score of 98.5%, there is still a room for improvement. Furthermore, it also found that size of the firms, which is represented by their total assets, found significantly contributed to the efficiency. This implies that larger firms tend to be able to all the sample firms were well managed their asset to increase their production efficiency. In addition, this study reveals that instead of reducing efficiency, crisis periods tend to increase production efficiency. It is also found that there is an industry contributed more to the overall efficiency and an industry that contributed negatively to the efficiency.

1. Introduction

This study examines the technical efficiency of Indonesian publicly listed firms. The motivation for this investigation are: to determine the technical efficiency of individual listed firms from all industrial sectors; and to identify whether the size of the firm and global financial crisis have a significant impact on the firm's efficiency. The novel idea of this study is to use technical efficiency measures derived from the Cobb-Douglas production function, instead of the traditional financial performance measures. In particular, unlike traditional financial performance measures such as the ratio analysis, the efficiency measures the firm's performance by considering all the possible outputs produced by using all the achievable input factors.

The capital market has a significant role in the Indonesian economy. It contributes as much as 12 percent in 2017 [1]. However, most of the empirical studies of the Indonesian listed firms more focus on capital market efficiency related to stock performance. Only a few studies employed a comprehensive performance measurement method, which considering all the possible outputs produced from all input factors such as data envelopment analysis since most of the empirical studies of the Indonesian capital market more focus on capital market efficiency related to the stock performance.

Considering the crucial role of the capital market, this study the technical efficiency and productivity growth of listed Indonesian firms, since there still a few studies that incorporate all industrial sectors, except for banks and financial institutions since most of the study only examined the manufacturing sector. Findings from the previous studies show that the average technical efficiency of

the manufacturing industry in the period over 1993 to 2000 were only 55.87 percent. The study also found that the most efficient sector was the metal product sector, whilst the least efficient was the food sector (Margono & Sharma, 2006). In addition, Setiawan, Emvalomatis, & Lansik (2012) found that industrial concentration negatively affects the technical efficiency of the food sector.

This study applies a three steps approach. In the first step, I estimate the individual firm's level of technical efficiency. Furthermore, this study also investigates the total factor productivity (TFP) growth and decompose it into technical efficiency change, and technological progress of each firm in all industry, and all firms in each industry. In the third step, aside from the DEA measure, this research uses a parametric test using panel data to check the effect of factors other than the inputs on the firm's technical efficiency.

The data cover 91 listed Indonesian firms from all industrial sectors, except for banking and other financial institutions with a total of 1183 observations from 2004-2016. In the second step, I investigate factors that affect technical efficiency including the firm's size and the global financial crisis periods. The results show that the average technical efficiency of the listed firms was 98.5 percent, which means that there is still room for improving it by 1.5 percent to be fully efficient. Furthermore, on average the Malmquist TFP for all firms was 1.003. This result indicates that there has been only a 0.3 percent gain in productivity. Further statistics show that the TFP growth driven by 1 percent through technological change. It means that technological change is the main contributor to the productivity growth of the Indonesian listed firms rather than the 'catching up' through efficiency change. Also, this study found that larger firms are more efficient compared to small firms. Furthermore, the crisis drives the firms to be more efficient.

This paper is structured as follows. Section 2 presents brief literature on technical efficiency and factors affecting it, follows by data and variable measures in Section 3. Section 4 presents the empirical findings and the analysis and conclude the paper in Section 5.

2. Literature review

The Indonesian listed firms present a unique example. There are about 598 firms listed on the Indonesian Stock Exchange until August 2018. However, their stock's performance was mostly investigated using financial measures. Only a few studies were done using a comprehensive measure such as total factor productivity.

Firms efficiency and productivity have been a crucial aspect of measuring performance. Productivity relates to the quantity of output produced to input used in the production process. There are two prominent frontier analysis method to compute efficiency; there is the non-parametric data envelopment analysis (DEA), and the parametric stochastic frontier analysis (SFA). The Malmquist total factor productivity index and its decomposition firstly used by Caves, Christensen, & Diewert (1982b) in productivity analysis. The Malmquist Productivity Index is based on the output distance function and allows the total factor productivity (TFP) to be broken down into changes in managerial efficiency and changes in innovation (technological change). The index is measured as the geometric mean of indices for both period t and t+1 reference technologies.

This study employs the DEA Malmquist productivity index method which generally measures the relative efficiency of different decision business units (DMUs). A DMU is considered technically efficient if it can produce the maximum possible outputs using a certain amount of inputs, or to produce a certain quantity of outputs by employing a minimum number of resources. Therefore, by measuring the level of the efficiency of a DMU, it can be determined whether it operates at the optimal level or not (Farell, 1957).

Charnes, Cooper, and Rhodes (1978) introduced the DEA constant returns to scale (CRS) for measuring the efficiency of US non- profit organization. This approach takes into account the contribution of all production factors that generate outputs. Using the DEA approach, the TFP score can be estimated either input- oriented or output-oriented. The input-oriented, the DEA approach

determines the frontier by seeking the maximum possible contraction in the input usage, with the output held constant.

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3. Data and variable measures

The Indonesian listed firms present a unique example. There are about 598 firms listed on the Indonesian Stock Exchange until August 2018. However, their stock's performance was mostly investigated using the traditional financial ratio analysis. Only a few studies were done using a comprehensive measure such as total factor productivity.

This study applied panel data by combining a time series and cross-sectional data of 91 publicly listed firms with total of 1183 observations. The sample includes all the listed firms over the period from 2004 to 2016 except for financial firms due to their unique asset composition, stringent government regulation, and uniqueness of the industry.

In answering the research question, this study employs the data envelopment analysis (DEA) methodology which calculates the relative efficiency of DMUs which can be advantage the need for assigning a priori measures of relative importance of to any inputs or outputs. In addition, a firm considered as 100% efficient if the performance of other firms cannot be improved without worsening some of its other inputs or outputs. According to Boussofiane, Dyson, & Thanassoulis (1991), DEA is a non-parametric" ...linear programming method used for evaluating the efficiency of decision-making units (DMUs or firms), where the presence of incommensurate inputs and outputs makes the measurement of overall efficiency difficult". It uses data as inputs and output quantities of a group of firms to construct a piece-wise frontier over the data points. This frontier created by the solution of a sequence of linear programming problems, one for each firm in the sample. Efficiency measures are then calculated relative to this frontier, which represents an efficient technology. Hence, this method is an ideal measure for a broad measurement of efficiency. Moreover, it allows efficiency is measured without having to specify either the form of production function or the weights for inputs and outputs used".

Charnes, Rhodes, & Cooper, (1978) first used the DEA constant returns to scale. It takes into account multiple inputs that are used in the production process to produce outputs, to calculate total factor productivity. Total factor productivity (TFP) index is the ratio of the weighted aggregate output to a weighted aggregate input quantity index. This study designed to apply DEA-Malmquist productivity index to measure a firm's TFP. The Malmquist index of total factor productivity change (TFPCH) over period t and $t+1$ is the product of technical efficiency change (EFFCH) and technological change (TECHCH) or innovation as expressed below.

$$\text{TFPCH} = \text{EFFCH} \times \text{TECHCH} \quad (1)$$

The TFP growth is a geometric means of two output-based Malmquist TFP indices: one index uses period t technology and the other period $t+1$ technology [2]. Following Fare & Grosskopf, (1994), the Malmquist productivity change index is written as comprising the two indices as presented in the equation 2:

$$m_0(y_t, x_t, y_{t+1}, x_{t+1}) = \frac{d_0^{t+1}(y_{t+1}, x_{t+1})}{d_0^t(y_t, x_t)} \left[\frac{d_0^t(y_{t+1}, x_{t+1})}{d_0^{t+1}(y_{t+1}, x_{t+1})} \times \frac{d_0^t(y_t, x_t)}{d_0^{t+1}(y_t, x_t)} \right]^{1/2} \quad (2)$$

where, y and x represent outputs and inputs across time t to $t+1$. The Malmquist indices are relative to the previous year.¹

This result can be decomposed into efficiency change and technological efficiency change as given by:

$$\text{Technical efficiency change} = \frac{d_0^t(y_t, x_t)}{d_0^s(y_s, x_s)} \quad (3)$$

and

$$\text{Technological change} = \left[\frac{d_0^s(y_t, x_t)}{d_0^t(y_t, x_t)} \times \frac{d_0^s(y_s, x_s)}{d_0^t(y_s, x_s)} \right]^{\frac{1}{2}} \quad (4)$$

The technical efficiency change measures the change in efficiency between period t and $t+1$, while the technological change captures the shift in the technology applied over time. A value greater than one in both cases indicates growth in productivity: that is positive factor values. A value lower than 1 indicates a decline in TFP, while a value above 1 demonstrates a TFP growth. Since EFFCH can be decomposed into pure technical efficiency change (PECH) and scale efficiency change (SECH), thus the value suggests that the DMUs have reached managerial efficiency and operate at an efficient scale. Also, the technological change (TECHCH) indicates the change in the technology used in the production processes.

The efficiency score in this study is measured by sales as the output variable and operating expenses and interest expenses as input factors. Furthermore, this study also examines the effect of a firm's size using \ln of total assets and crisis period on technical efficiency, using random effect multiple regression method. This study also takes into account the effect of different industrial characteristics of the sample. Furthermore, to check the consistency of the variable used, a robustness test is conducted by replacing the total assets with number of employees as a proxy for the firm's size.

Panel Regression

The efficiency measure is modeled as being associated with the global financial crisis and the firms' size. To identify the possible relation, a panel data regression was applied. The dependent variables are the firms' technical efficiency, while the independent variables are firm' size, proxies by the \ln of total assets, the industry classification, and the global financial crisis year of 2008-2010. Using a dummy variable, a value of 1 consider as the crisis period and zero otherwise. The model is as follows:

$$Y_{i,t} = \alpha_0 + Size_{i,t} + DCrisis_t + DIndustry_i + \varepsilon_{i,t} \quad (5)$$

As is the procedure n panel data regression, random effect and fixed effect was tested. The statistical test suggested using the random effect as an appropriate model.

4. Results and Discussion

4.1. Descriptive Statistics and Variables

Table 1 depicts the descriptive statistics of the key variables used in this study. Table 1 presents descriptive statistics of the key variables used in this study. The high value of the standard deviation indicates a considerable variation of the size of the sample firms used in the study.

¹ The output begins at year 2.

Table 1. Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
Total Sales	4,870,754,025	12,201,194,895	1,714,617	116,333,000,000
Operating Expenses	1,413,781,467	5,673,731,102	12,446	77,836,000,000
Interest Expenses	1,438,434,081	688,614,254	182	14,413,805,135
Total Assets	5,730,642,536	16,202,282,471	18,366	179,611,000,000
No of Employees	5,049	14,245	7	156,097
No of firms	91			
No of observation	1,183			

4.2. Firms' technical efficiency

As seen in Appendix 1, most of the firms (92.31%) in the sample operated in decreasing to scale, 3.30 % increasing returns to scale and only 4.40% managed efficiently. This condition implies that most of all the listed firms need to enhance their production efficiency by reducing the number of inputs used.

Table 2. Summary of Technical Efficiency

	CRS	VRS	SCALE
Mean	0.939	0.958	0.981
Min	0.874	0.888	0.879
Max	1.000	1.000	1.000

Table 2 provides summary results of the technical efficiency including overall technical efficiency (CRS TE), pure technical efficiency (VRS TE), and scale efficiency. The results show that the average overall efficiency score is 0.939. As for the case of VRS, the score ranges from 0.888 (the lowest) and 1.000 (the highest).

4.3. The effect of size and global financial crisis on technical efficiency

Considering that firms in the sample have different size, this paper also takes into account the size effect on firms' technical efficiency. Results in Table 3 show that size significantly affects technical efficiency. This result implies that larger firms are more efficient than those of small firms. This result implies that the older firms which have more experience can use their input efficiently to increase efficiency significantly. Furthermore, the crisis period has a positive and significant impact on a firm's technical efficiency. This finding indicates that the global financial crisis pushes the firm doing its business efficiently.

To take into account the possible effect of the different characteristics of the industry in the sample, this study uses a dummy variable for the industry, where the footwear industry as the basis. The result shows that there is no significant impact on the industry characteristics on the firm's technical efficiency.

Table 3. The Effect of Size, Crisis, and Industry Classification on Efficiency

Independent Variables	Coefficient	Standard error
Constant	0.6062	0.0255
Size	0.0115***	9.00E-04
Crisis	0.02673***	0.0026
Foods and Beverages	0.0025	0.0134
Chemical	0.0029	0.0130
Basic Metal	0.0306	0.0129
Textile	0.0057	0.0133
Rubber	0.0028	0.0138
Processed	0.0013	0.0133
Computers & Telecommunication	0.0001	0.0141
Transportation	-0.0231	0.0138
Pulp and Paper	-0.0067	0.0144
R-squared		
64.9%		

Notes: *** indicates 1% significant level

4.4. Total factor productivity and its contributors

Table 4 provides new evidence on the relative managerial efficiency (EFFCH), innovation (TECHCH), and productivity growth (TFPCH) of all sample firms from 2004 to 2016. It shows that there is a decreasing trend in productivity by 0.1 percent over the period. The mean value of the managerial efficiency or efficiency change (Catching-up to the average frontier), technological change (innovation) and productivity change summarizes in Table 3 over the test period. The result shows that the main TFP was 0.999 index point, which is the average productivity decline over the study period was 0.1 index point. The results show that the mean managerial efficiency was 0.999, which is the average efficiency loss by 0.001 index point (1-0.999). This number suggests a loss equal to 0.1 percent per year. This loss was due to a very low-efficiency (EFFCH) index of 0.177, in period 2011-2012.

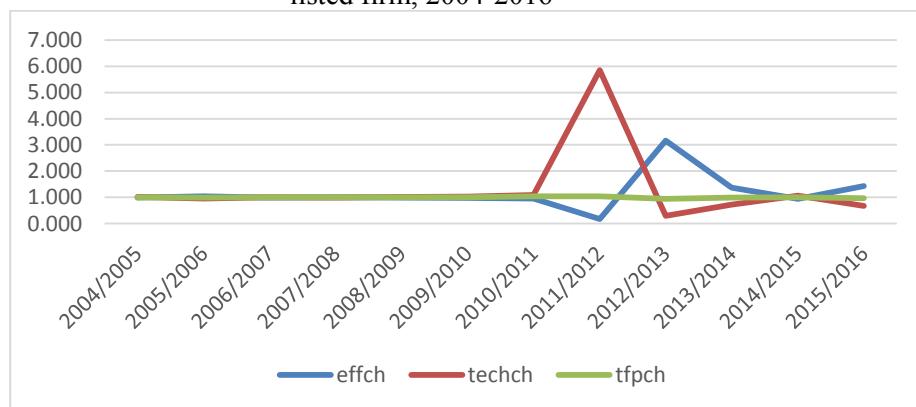
Table 4: Malmquist Index Summary of Annual Means of Listed Firms

year	effch	techch	tfpch
2004/2005	0.988	1.016	1.004
2005/2006	1.040	0.960	0.998
2006/2007	0.997	1.005	1.002
2007/2008	1.006	0.993	1.000
2008/2009	0.989	1.014	1.002
2009/2010	0.985	1.025	1.010
2010/2011	0.951	1.092	1.039
2011/2012	0.177	5.846	1.036
2012/2013	3.167	0.297	0.940
2013/2014	1.368	0.725	0.991
2014/2015	0.939	1.067	1.003
2015/2016	1.433	0.675	0.967

mean 0.999 1.000 0.999

Figure 1 describes the trend of the efficiency change (managerial efficiency), technological change (innovation), and productivity of the Indonesian listed firms. It indicates that there were decreasing managerial efficiency during the period of 2008/2009 until 2011/2012. In contrast, productivity grew significantly during the period of 2011/2012. These trends may be due to the substantial growth of innovation by 9.2 percent. This paradox may occur due to the significant relief of the Indonesian economy from the global financial crisis of 2008/2009. It is proven by a momentous improvement of the country competitiveness rank by ten points from 1999. Furthermore, this condition rises the investors' confidence in the Indonesian stock market as the result of an escalation of the country's investment grade from BB to BBB by the S&P.

Figure 1. Trend of managerial efficiency, innovation and productivity growth of Indonesian listed firm, 2004-2016



This study also examines the productivity growth and its decomposition into efficiency change and technological change of each firm in a specific industry. Findings reported in Table 5 shows that the chemical industry gains the highest productivity growth which mainly driven by 0.3 percent shift in the fitted frontier, that is from the adoption of newer ways of doing business, such as using new advanced technology (technological change).

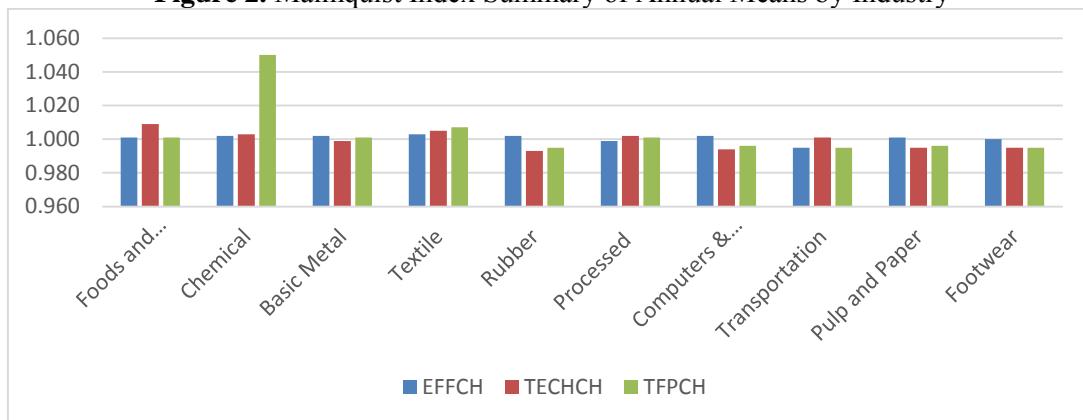
Table 5. Malmquist Index Summary of Annual Means by Industry

No	Industry	EFFCH	TECH CH	TFPCH
1	Foods and Beverages	1.001	1.009	1.001
2	Chemical	1.002	1.003	1.050
3	Basic Metal	1.002	0.999	1.001
4	Textile	1.003	1.005	1.007
5	Rubber	1.002	0.993	0.995
6	Processed	0.999	1.002	1.001
7	Computers & Telecommunication	1.002	0.994	0.996
8	Transportation	0.995	1.001	0.995
9	Pulp and Paper	1.001	0.995	0.996
10	Footwear	1.000	0.995	0.995
Mean		0.999	1.000	0.999

Results in Table 4 also show that the textile industry has the highest growth in managerial efficiency, follows by the foods and beverages industry, which has the most top growth of technology used in the business processes. Both grew by 0.3 and 0.9 percent respectively.

Figure 2 describes the comparison of the total factor productivity growth in its decomposition into managerial efficiency (EFFCH), and innovation (TECHCH) of each industry over the study period from 2004 to 2016. The Figure shows that the chemical industry has the highest productivity growth, while rubber, transportation and footwear industries share the same productivity deterioration by 0.5 percent during the observation periods. This number indicated a decrease in productivity

Figure 2. Malmquist Index Summary of Annual Means by Industry



5. Conclusion

The objective of this study is to measure the efficiency and productivity growth of the Indonesian listed firms over a 13year period, 2004-2016. Also, this study also examines the impact of size and the global financial crisis on the firm's technical efficiency. As a summary of the findings of this study, it is noted that Indonesian firms experienced a productivity decline during the study period. The deterioration of productivity was mainly due to the decreasing of managerial efficiency. This means that firms' failure to catching-up to the frontier technology. Finally, this study identified two factors that affected the firm's efficiency, which is the firm's size and crisis periods.

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APPENDIX 1

firm	crste	vrste	scale	
1	0.881	0.935	0.942	drs
2	0.905	0.947	0.956	drs
3	0.881	0.944	0.934	drs
4	0.874	0.989	0.883	drs
5	0.901	0.968	0.931	drs
6	0.881	0.958	0.919	drs
7	0.906	0.956	0.948	drs
8	0.884	0.932	0.948	drs
9	0.912	0.973	0.937	drs
10	0.863	0.933	0.925	drs
11	0.773	0.826	0.936	drs
12	0.794	0.836	0.949	drs
13	0.774	0.817	0.947	drs
14	0.766	0.851	0.900	drs
15	0.830	0.862	0.963	drs
16	0.848	0.925	0.916	drs
17	0.920	0.990	0.929	drs
18	0.886	0.927	0.956	drs
19	0.863	0.910	0.949	drs
20	0.758	0.818	0.926	drs
21	0.839	0.892	0.941	drs
22	0.975	1.000	0.975	irs
23	0.975	1.000	0.975	irs
24	1.000	1.000	1.000	-
25	0.787	0.878	0.896	drs
26	0.919	1.000	0.919	drs
27	0.953	1.000	0.953	drs
28	1.000	1.000	1.000	-
29	0.784	0.813	0.965	drs

30	0.782	0.800	0.978	drs
31	0.953	0.975	0.978	drs
32	0.965	0.975	0.989	drs
33	0.575	0.586	0.981	drs
34	0.820	0.822	0.998	drs
35	0.863	0.878	0.982	drs
36	1.000	1.000	1.000	-
37	0.880	0.885	0.995	irs
38	1.000	1.000	1.000	-
39	0.962	0.965	0.997	drs
40	0.946	0.978	0.967	drs
41	0.902	0.937	0.963	drs
42	0.975	0.994	0.981	drs
43	0.778	0.851	0.914	drs
44	0.803	0.859	0.935	drs
45	0.778	0.838	0.928	drs
46	0.833	0.889	0.938	drs
47	0.808	0.899	0.899	drs
48	0.889	0.910	0.977	drs
49	0.836	0.920	0.909	drs
50	0.810	0.861	0.941	drs
51	0.767	0.834	0.920	drs
52	0.757	0.846	0.896	drs
53	0.892	0.961	0.928	drs
54	0.923	0.964	0.957	drs
55	0.876	0.933	0.939	drs
56	0.884	0.933	0.948	drs
57	0.906	0.959	0.945	drs
58	0.918	0.947	0.969	drs
59	0.905	0.970	0.933	drs
60	0.904	0.977	0.925	drs
61	0.899	0.948	0.948	drs
62	0.895	1.000	0.895	drs
63	0.881	0.992	0.889	drs
64	0.874	0.931	0.939	drs
65	0.874	0.966	0.905	drs
66	0.895	0.934	0.958	drs
67	0.864	0.923	0.936	drs
68	0.860	0.949	0.906	drs
69	0.913	0.996	0.917	drs
70	0.891	0.971	0.917	drs
71	0.870	0.966	0.900	drs
72	0.891	0.954	0.934	drs

73	0.864	0.934	0.926	drs
74	0.893	0.906	0.986	drs
75	0.835	0.967	0.863	drs
76	0.891	0.935	0.953	drs
77	0.910	0.978	0.930	drs
78	0.844	1.000	0.844	drs
79	0.880	0.948	0.929	drs
80	0.892	0.928	0.961	drs
81	0.893	0.949	0.941	drs
82	0.916	0.995	0.920	drs
83	0.907	0.960	0.945	drs
84	0.887	0.961	0.923	drs
85	0.877	0.984	0.891	drs
86	0.894	0.955	0.936	drs
87	0.878	0.947	0.927	drs
88	0.906	0.967	0.937	drs
89	0.882	0.979	0.901	drs
90	0.880	0.945	0.931	drs
91	0.844	0.881	0.958	drs
mean	0.875	0.930	0.940	

Forecasting Intermittent Demand: A Case of Forecasting Passbook Printer at An Indonesian Company

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Abstract. This paper discusses the appropriate forecasting method for intermittent demand for an electronic product particularly the passbook printer at an Indonesian company, named ITWare. Intermittent demand tends to show a fluctuating pattern and has zero demand occurrences in certain periods. This research compares three methods of forecasting to predict the passbook printer demand at ITWare, namely Simple Exponential Smoothing (SES), Croston, and Syntetos-Boylan Approximation (SBA). We use the data from 2014-2015 to forecast demand in 2016 and use optimum alpha value which is obtained by using MS Excel Solver. The performance of forecasting method is determined based on mean squared error, and the results show that in this case, SES has the best performance compared to the other two methods.

1. Introduction

Information and communication technology (ICT) industry plays a significant role in the Indonesian economy and contributes about 2.7% to the country's gross domestic product (GDP) [1]. The contribution to GDP may continue to increase with the support from multinational companies, such as Microsoft, Oracle and IBM which provide IT services to the Indonesian companies. In terms of ICT hardware, the sales volume is expected to also increase continuously for the next five years [1].

Regarding the banking industry, Indonesia has more than 120 banks with 4 major players, namely, Bank Mandiri, Bank Central Asia, Bank Rakyat Indonesia, and Bank Negara Indonesia with a 5% of net interest margin, and their credit loans are expected to grow [1]. The growth in the banking industry will cause an increase in the demand for ICT services and hardware in the industry and becomes a challenge for companies in the ICT industry to provide products and services with competitive prices.

ITWare (the name of the company is not disclosed for confidentiality reason), is an Indonesian company in the ICT industry, a system integrator, that provides software development services and the related hardware. ITWare has a business line that provides passbook printer for the banking industry since 2012. The demand for the product has increased significantly in the year 2014, and the company starts to experience delay in its procurement process.

Demand for passbook printer at ITWare is determined by purchase order (PO) from the customers (banks). The PO details the amount of demand and may be issued by the customer at the period stated in the contract. Thus, the demand for passbook printer is highly uncertain, with respect to the number and time. The current practice at ITWare is to forecast quarterly using sales force composite [2], whereby the sales manager forecasts based on his/her judgment and experiences in the previous

periods and, therefore a sudden peak demand causes stockout problem that results in late fine that must be paid by the company.

The main objective of this research is to select the best forecasting method to predict passbook printer demand at ITWare, which is intermittent (or irregular) in nature, to avoid or minimize inventory stockout. Demand is said to be intermittent if it is random with a large proportion of zero values, such as demand for service (spare) parts and high-priced capital goods [3]. Intermittent demand is hard to predict, and inaccurate forecast may cause major loss to the company due to obsolescence or unfulfilled demand. We specifically compare three forecasting methods for this purpose, namely simple exponential smoothing (SES), Croston's method [4], and Syntetos-Boylan Approximation [5] as these three methods are popular to be used in forecasting intermittent demand.

According to Syntetos et al., research regarding forecasting for intermittent demand has receives less attention [6]. Therefore, this research contributes to provide insights regarding intermittent demand of ICT hardware in banking industry, and the most suitable forecasting method for this kind of demand in the industry. The remainder of the paper is organized as follows. Relevant literature review is provided in Section 2, while research methodology is provided in Section 3, followed by results and discussion in Section 4, and conclusions in Section 5.

2. Literature review

Demand forecasting is a mixed of art and science that predicts demand in the future, and it is the basis for business decisions, such as production, inventory, personnel and facilities [2]. Accurate demand forecasting is the vital aspect of supply chain management [3]. Demand forecasting has three time-range, namely short-range (from three months until 1 year), medium-range (from three months to 3 years) and long-range (three years and more) [2]. According to Chopra and Meindl, forecasting has several characteristics as follows [7]. First, forecasting is always wrong and therefore, gives prediction result along with its forecasting error. Second, long-term forecasting is less accurate than short-term forecasting because long-term forecast has larger standard deviation than short-term forecast. Third, aggregate forecasting is more accurate than disaggregate forecasting due to its lower standard deviation than its counterpart. Lastly, the longer the company's supply chain, the bigger the distortion of information, received by the company.

According to Heizer et al., forecast has four components, namely trend (increasing or decreasing of data in long-term period), seasonality (pattern that shows repetition after certain period, may be in days, weeks, months, or quarters), cycles (pattern that appears every few years, usually related to business cycle), and random variations (data variations that has unclear patterns and cannot be predicted) [2]. Furthermore, Heizer et al. classify forecasting methods into qualitative (such as Delphi method and sales force composite) and quantitative approaches (such as time series and associative models) [2].

As previously mentioned, demand is classified as intermittent if it is spread in a period of time with no demand at certain periods [5]. According to Syntetos and Boylan, simple exponential smoothing (SES) and simple moving average are frequently used to forecast intermittent in practice, and both methods perform satisfactorily in forecasting real world intermittent data [5]. However, Syntetos et al. state that SES and Croston's method (as corrected by Rao [8]) are the two parametric methods that are frequently used to forecast intermittent demand [6]. SES predicts the mean level of demand for both non-zero and zero demand periods, thus treating those demand the same way [6], while Croston's method extends SES by building demand estimate from components, namely demand size when demand occurs, and the inter-demand interval [5]. Researchers, such as Willemain et al. state that Croston's method has better performance than SES in forecasting intermittent demand [3].

Syntetos and Boylan show that Croston's method is biased and later propose a modification of the method, known as Syntetos-Boylan approximation (SBA) [9]. Some researchers, such as Eaves and Kingsman, and Syntetos and Boylan, compare the performance of SBA to other forecasting methods (such as SES and Croston's method) and conclude that SBA has better performance in forecasting real intermittent data [5, 10].

Kaya and Demirel conduct a research to improve the performance of Croston's and Syntetos-Boylan Approximation methods by optimizing the smoothing parameter, alpha, and compare the performances to the methods using constant alpha [11]. Optimum alpha is determined by minimizing the mean squared error (MSE) using Excel Solver. Kaya and Demirel then propose a performance measure, geometric mean of mean squared error/average (GMAMSE/A), to compare the performances of the methods using constant and optimum alpha [11]. The results show that Syntetos and Boylan's method with optimum alpha has the best performance, followed by Croston's method with optimum alpha, then Syntetos and Boylan's method with constant alpha, and Croston's method with constant alpha.

3. Research method

As previously mentioned, the objective of the research is to forecast the demand for passbook printer at ITWare. We compare three forecasting methods that are popular for intermittent demand, namely SES, Croston's method, and SBA. As the demand started to be significant in 2014 (see Figure 1), we use the data of 2014-2015 to forecast demand in 2016.

The forecasting is conducted using the three methods with optimum smoothing parameter (alpha), which is determined using procedure from Kaya and Demirel using Excel Solver [11]. The performances of the methods are then compared based on the value of MSE/average demand.

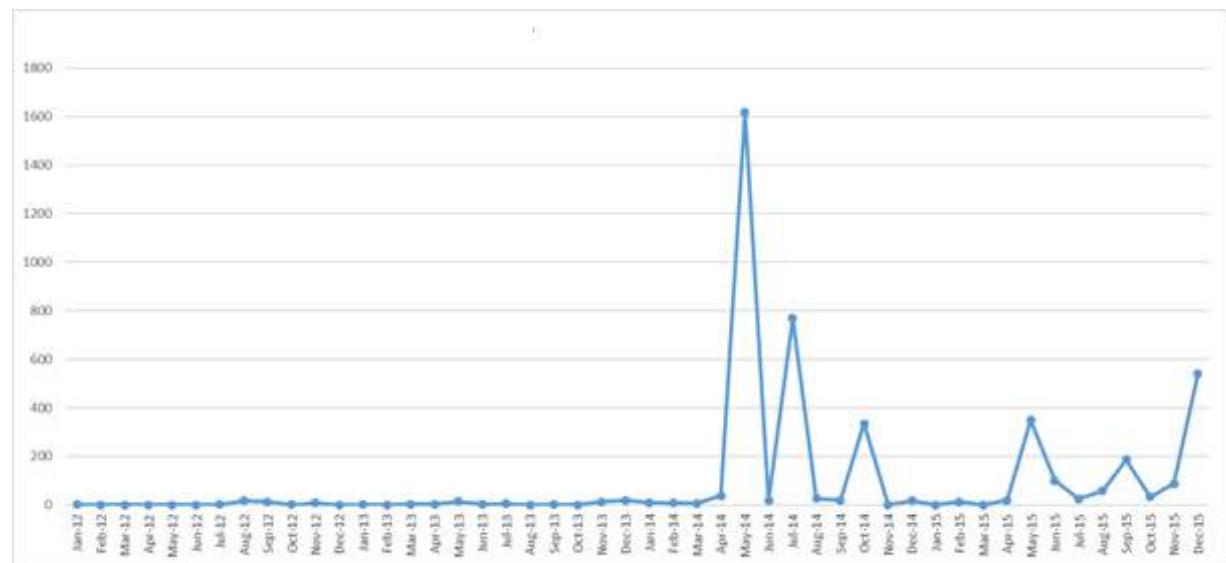


Figure 1. Real demand data in the periods of 2012-2015

3.1. Simple exponential smoothing (SES)

The method starts with determining the initial level (L_0), which can be the actual demand of the first period or the average demand (D_i) in all periods [7], such as in the following formulation.

$$L_0 = \frac{1}{n} \sum_{i=1}^n D_i \quad (1)$$

For the subsequent periods, the level is determined using the following formulation, with α as the smoothing constant and t is the time period.

$$L_{t+1} = \alpha D_{t+1} + (1 - \alpha)L_t \quad (2)$$

Then, the forecasted demand for the next period is determined using the following formulation. It indicates that forecasting projection for the next period is equal to the level at period t .

$$F_{t+1} = L_t \quad (3)$$

3.2. Croston's method

Croston's method compensates SES by forecasting separately the value of non-zero demand (D_t) and the inter-arrival time of non-zero demands (Q_t) [4]. The smoothed estimates are calculated using the following formula.

$$D_t \begin{cases} > 0, z_t = \alpha D_t + (1 - \alpha)z_{t-1} \\ = 0, z_t = z_{t-1} \end{cases} \quad (4)$$

$$Q_t \begin{cases} > 0, p_t = \alpha Q_t + (1 - \alpha)p_{t-1} \\ = 0, p_t = p_{t-1} \end{cases} \quad (5)$$

$$Y_t = \frac{z_t}{p_t} \quad (6)$$

Where:

Y_t = Forecast for the next period

z_t = The smoothed estimates for demand

p_t = The smoothed estimates for inter-arrival time of non-zero demands

α = Smoothing constant

3.3. Syntetos-Boylan Approximation (SBA)

Syntetos and Boylan indicate that Croston's method is biased and may result in significant error if incorrect value of alpha is used [9]. Therefore, Syntetos and Boylan propose a correction of Formulation 6 to the following [5]:

$$Y_t = \left(1 - \frac{\alpha}{2}\right) \frac{z_t}{p_t} \quad (7)$$

Through the above correction, alpha plays a role to correct the bias to Croston's method and results in better forecast projection.

3.4. Optimization of Alpha and MSE

Kaya and Demirel propose a procedure to optimize the smoothing constant, alpha, to improve the performance of the forecasting method [11]. The objective of the method is to determine the value of alpha that will minimize the mean squared error (MSE), which is calculated by averaging the square of the forecast errors (E_t) as in the following formulations.

$$MSE_n = \frac{1}{n} \sum_{t=1}^n E_t^2 \quad (9)$$

$$E_t = F_t - D_t \quad (10)$$

The optimization procedure is like the following. In the first step, data that will be used in the forecasting process (training set), are represented as the first i periods of data. Then, the forecasting method (SES, Croston's or SBA) is applied to the training set. Next, optimization of the smoothing constant, alpha, is conducted by minimizing the MSE of the training set by using MS Excel Solver. Then, forecasting of the next period is done by using the optimum alpha obtained in the previous step, and the optimization procedure is repeated by increasing the training set by 1, until all periods are forecasted. Thereafter, the MSE per average demand of the testing set (forecasted demand) is calculated for each forecasting method.

4. Results

The actual demand for passbook printer at ITWare in the period of 2012-2015 is shown in Figure 1. As previously mentioned, we use data from 2014-2015 to forecast demand in 2016, using the abovementioned three forecast methods. The forecasting results are presented in Figures 2 to 4, while the level of accuracy of the forecasts in terms of their MSE per average demand is presented in Table 1.

It can be seen from Table 1 that SES has the lowest value of MSE per average demand which means that SES is the best forecast method in this case, compared to Croston's method and SBA. The results are different from previous research, such as by Syntetos and Boylan [5] and Kaya and Demirel [11], which implies that SBA performs better than Croston's and other methods in forecasting intermittent demand. The difference may be due to the fact that at ITWare, the number of periods with zero demand in the training set is only 3, i.e. demand in some periods are small but not zero, hence, the demand is not that "intermittent". Thus, Croston's and SBA which are specifically developed for forecasting intermittent demand do not perform well in this case.

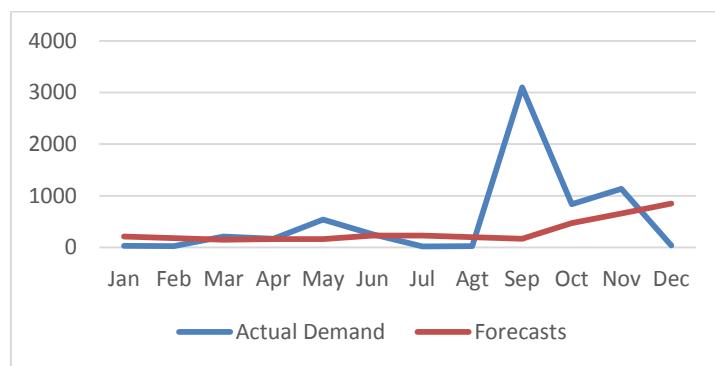


Figure 2. Forecasting results using SES

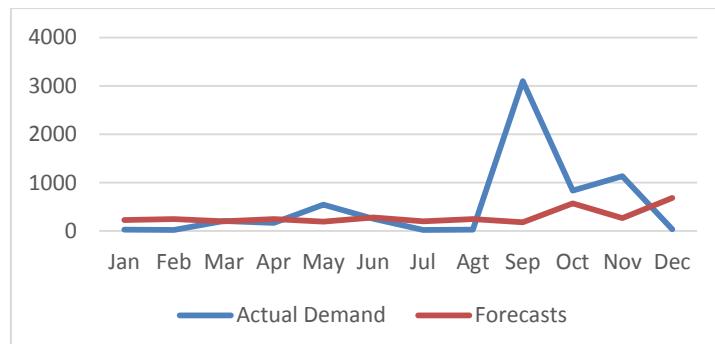


Figure 3. Forecasting results using Croston's method

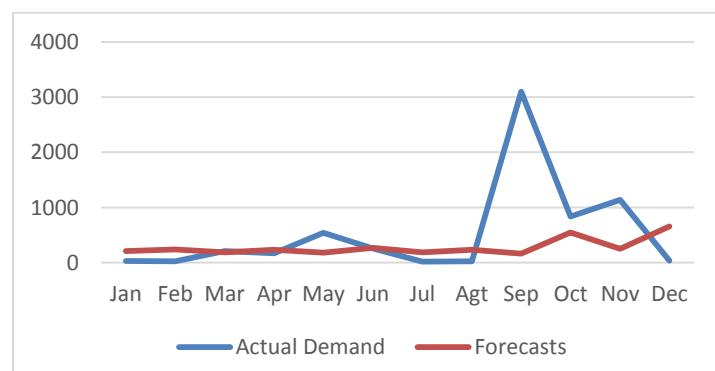


Figure 4. Forecasting results using SBA

Table 1. The level of accuracy of the forecasting methods

Methods	MSE/Average Demand
Simple Exponential Smoothing	1,552.86
Croston's Method	1,579.86
Syntetos-Boylan Approximation	1,590.40

However, we can see from Figures 2 to 4 that peaked demand in the month of September 2016 cannot be forecasted accurately by the three methods, thus may result in the delay in fulfilling the demand. Therefore, the results should be interpreted with cautions as procurement delay leads to fines that must be paid by the ITWare to the customers.

5. Conclusions

The demand for passbook printer at ITWare is highly uncertain, in terms of quantity and time, and can be considered as intermittent demand as it has zeros in certain periods. Based on previous research, the three methods which are usually used to forecast intermittent demand, are namely Simple Exponential Smoothing, Croston's methods, and Syntetos-Boylan Approximation (SBA). This paper compares the three methods to forecast demand of passbook printer at ITWare, by using demand data from 2014-2015 to forecast demand in 2016.

The results show that based on the MSE per average demand, SES has the best performance, compared to Croston's method and SBA. The results are different from previous research and may be due to the fact that the demand data that is used in the forecasting process is not that "intermittent" or demand in some periods are small but not zero. Therefore, two methods that are specifically developed for intermittent demand have poor performance in this case.

The results also show that peaked demand in a certain period cannot be predicted accurately by the three forecasting methods, and thus, it may cause procurement delay that results in fines that must be paid by ITWare. Therefore, besides having a forecasting method, ITWare must also have an inventory policy that determines the level of inventory that should be held by the company to accommodate the uncertain demand and prevent stockouts.

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