Jurnal Teknovasi
Volume 09, Number 01, 2022, 9 – 18
ISSN : 2540-8389

ESTIMATION OF HARD PLAIN RUBBER ROLL MANUFACTURING PROCESS TIME USING LINEAR REGRESSION METHOD

Nandy Muladi[1]*, Kusnadi[2], Asep Erik[3]

Universitas Singaperbangsa Karawang[1,2,3]
E-mail:nmuladi98@gmail.com

Submited : 09 Februari 2021
Revision : 16 Maret 2021
Accepted : 01 April 2021

ABSTRACT

Competition in the industrial world today requires producers to compete in providing good quality products with short production times and relatively low production costs. This relates to production machines which have an important role to produce products with good quality. PT. Voith Paper Rolls Indonesia is a service and manufacturing company engaged in roll repair and manufacture of roll cover materials. One of the production processes carried out during roll repair is the turning process which is carried out twice. In the turning process, there is often a significant time difference between the actual time and the estimated time obtained from the existing formulation. Therefore,

Keywords: Formulation, Simple Linear Regression, Independent Variable, IBM SPSS Application.

INTRODUCTION

In today's competitive industrial world, producers are required to compete to provide good quality products with short production times and relatively low production costs. Production machines are very important to produce products with good quality. Machines with good technological equipment will produce products with good characteristics and the production process will be faster. That way the processing time required for production will follow the speed of machine performance.

The production process at PT. Voith Paper Rolls Indonesia is one of the production processes carried out according to customer requests. In general, there are 20 series of production processes consisting of arrival inspection, turning process, drilling process, grinding process, cleaning process, heating process, sandblasting process, grooving process, final inspection process and delivery. Before carrying out the production process, technical & product quality units will make Work Instructions (WI) or work instructions. Work instructions are made for the whole process carried out according to customer requests. In the work instructions there is a column containing the estimated processing time obtained from the existing formulation for calculating the estimated processing time of the entire machine.

The company stated that the formulation used to determine the current estimated processing time is no longer feasible because there is a significant time difference between the estimated time and the actual time, especially in the turning process. This is due to improvements made by the mechanical part in engine performance which makes the actual processing time required faster. Meanwhile, operators often delay the work process because the estimated time required based on

the existing formulation for the work process listed in the work instructions is quite long. Therefore, the focus will be on the report. This practical work is an effort to improve the formulation for calculating the estimated time of turning process on lathe A on a hard plain rubber roll by analyzing the effect of surface area on the actual processing time using a simple linear regression method through the IBM SPSS application.

Linear Regression Analysis

Regression analysis is one of the existing methods in statistical science, and is still widely used today. The main purpose of this regression analysis is to see the causal relationship that occurs between one variable and another. The causative variable of the regression is also known as variable X, explanatory variable, explanatory variable, or independent variable. While the affected variable is known as the Y variable, the affected variable, the dependent variable, or the dependent variable.

This analysis is included in the Machine Learning section, specifically in the Supervised Learning section because the existing Y variable will be used as a label in the machine learning process. Regression analysis can also be used to make predictions or forecasts of what will happen next. Linear Regression Analysis is one part of the regression analysis method. In this analysis there is only one variable X and one variable Y.

Benefit

Regression analysis is used in almost all areas of life, be it in industry, government, engineering, economics and so on. And here are some of the benefits that can be obtained by applying regression analysis:

1. Make estimates of the average and the value of the dependent variable based on the value of the independent variable.
2. To test the dependency characteristic hypothesis.
3. Predicting the average value of the independent variable based on the value of the independent variable outside the range of the sample.

Often this intangible benefit is a critical point in the running of a company's business wheels. Because it is intangible, the following aspects are often ignored or not traced to resistance, namely:

1. Increased employee satisfaction
2. Improving the quality and amount of information
3. Improved operational efficiency and flexibility
4. Increased processing time
5. Improving the quality of planning
6. Improving the quality of control and supervision

METHOD

Normality test

Normality test is one of the procedures performed to determine whether the data comes from a population that is normally distributed or is in a normal distribution. The normal distribution is a symmetrical distribution that has the mean, mode and median located at the center or can be interpreted as a certain distribution that has a bell-like shape when described in the form of a histogram.

The normal distribution is one of the important distributions because the normality of the data distribution becomes an assumption that is a requirement to determine the type of statistics used for the next analysis stage. In addition, data with a normally distributed population is needed as a condition for conducting research using the regression analysis methoe linear.

In this Job Training report, normality test will be carried out with the type of One Sample Kolmogorov-Smirnov test with a significance level (α) of 0.05 (5%). According to (Nuryadi,

Astuti, Utami, & Budiantara, 2017) the basis for making normality test decisions can be done by setting the following hypothesis:

H0 = Data comes from a normally distributed population

H1 = Data does not come from a normally distributed population

Then the acceptance or rejection of the hypothesis is determined based on the significance level test (α) as follows:

- If the value of Sig. or significance or probability count > , then accept H0, meaning the data comes from a normal distribution.
- If the value of Sig. or significance or probability count < , then reject H0, meaning the data does not come from a normally distributed population.

Linearity Test

Linearity test is one of the procedures performed to determine whether each independent variable has a linear relationship with the dependent variable. In this Job Training report, linearity test was carried out with the type of ANOVA test with a significance level (α) of 0.05 (5%). According to (Cahyaningtyas, 2015) the basis for making decisions on linearity tests can be done by setting the following hypotheses:

H0 = Data has a significant linear relationship

H1 = Data does not have a significant linear relationship

Then the acceptance or rejection of the hypothesis is determined based on testing the significance level (α) and the F value as follows:

1. If the value of Sig. > and the calculated F value < F table, then accept H0, meaning the data has a significant linear relationship.
2. If the value of Sig. < and the calculated F value > F table, then reject H0, meaning the data does not have a significant linear relationship.

Linear Regression Analysis

According to (Muhid, 2019) linear regression analysis is one of the methods used to find out how a dependent variable can be predicted through the independent variable. Linear regression analysis is divided into two, namely multiple linear regression analysis and simple linear regression analysis.

Multiple linear regression analysis is used to estimate the magnitude of the coefficients resulting from linear equations. In multiple linear regression analysis involves two or more independent variables (independent variables) which are used to predict the value of the dependent variable. Therefore multiple linear regression analysis can calculate the magnitude of the influence between two or more independent variables (independent variable) with one dependent variable (dependent variable) and can predict the dependent variable (dependent variable) using two or more independent variables (independent variables).

Simple linear regression analysis is used to estimate the magnitude of the coefficients resulting from linear equations. In simple linear regression analysis, one independent variable (independent variable) is used to predict the value of the dependent variable. The results of simple linear regression analysis is a regression equation or mathematical formula to find the value of the dependent variable from the known value of the independent variable.

IBM SPSS Application

SPSS (Statistical Product and Service Solution) is an application program that has quite high analytical capabilities and a data management system with descriptive menus and simple dialog boxes so that the operating system is easy to understand. SPPS is one of the most widely used application programs to perform statistical analysis in social sciences such as marketing research,

quality control and improvement and scientific research. (Basuki, 2015).

SPSS was first released in 1968 after being developed by Norman H. Nie who is a postgraduate political scientist at Stanford University and C. Hadlai Hull. Initially the SPPS application program was created with the aim of processing statistical data for the social sciences, so that SPSS stands for Statistical Package. for the Social Sciences. Currently SPSS is expanding its capabilities to serve various types of users, such as being used for scientific research, production processes in factories and others.
Since 2009 SPSS was acquired by IBM Corporation and is known as PASW (Predictive Analytic Software). Some of the features offered in this application program include IBM SPSS Data Collection for data collection, IBM SPSS Statistics for analyzing data, IBM SPSS Modeler for predicting trends, and IBM Analytical Decision Management for decision making.

Definition of Lathe

In general, a lathe or turning machine is a type of machine tool whose work process moves to rotate the workpiece and uses a cutting chisel as a tool to cut the workpiece. The lathe is one of the production process machines that is used to form workpieces with a cylindrical shape (Angga Zeptiawan Sastal, 2018). Process on the lathebegins by installing the workpiece on the chuck (clamp) attached to the machine spindle. After that, the spindle and the workpiece will rotate at a predetermined speed so that the tool will be positioned on the rotating workpiece. Generally, the chisel on the lathe is stationary, in its development there is already a rotating chisel while the workpiece is at rest. The lathe is one of the conventional production process machines which requires manual skills from the operator in the process. Conventional lathes are divided into four types based on the dimensions of the workpiece, namely, (1) light lathes, (2) medium lathes, (3) standard lathes and (4) heavy lathes.

Research sites

The research was carried out at PT Voith Paper Rolls Indonesia in the KIIC Karawang area.

Methodology

1. Problem Identification in Technical & Product Quality Units

In the process of making job travel, technical & product quality units must include the estimated time for the entire process to be passed by the roll being worked on. The estimated time obtained is derived from the existing calculation formulation. However, the calculation formulation was declared unfit for use by the company because there was a significant time difference between the estimated time and the actual time, especially for the turning process.

Some of the factors that cause the time difference, one of which is because there have been many improvements made to the mechanical unit / unit related to the machine used which makes the actual processing time faster than the actual processing time. estimated time. This causes operators to take advantage of time estimates based on existing formulations to delay their work. Another factor comes from operators who are sometimes negligent in inputting the start and end times of the process being carried out. This makes the actual processing time slower than the estimated time. Therefore, it is necessary to improve the calculation formulation for the estimated processing time, especially in the turning process 1 and 2 for hard plain rubber rolls in order to get an estimated processing time that is close to the actual time. Hard plain rubber roll is a roll with a cover material made of rubber, with a very hard hardness of 0-5 PnJ, and a plain or plain roll profile. This type of roll always has different actual times even with the same roll dimensions. Thing This is caused by several factors that have been mentioned in the previous paragraph.

2. Existing Formulation

Existing formulation used by unit/unit*technical*& product quality is a calculation formulation for the estimated time of the entire process. In this Job Training report, it will be limited to only looking at the existing calculation formulations for the estimated time of the turning process in order to get a comparison between the existing formulation and the improved formulation. Here is the existing formulation:

Jurnal Teknovasi
Volume 09, Number 01, 2022, 9 – 18
ISSN : 2540-8389

Table 1. Existing Formulation

0.15X +
3.5

The existing formulation that is owned is a formulationfor lathe A with an independent variable surface area and an undefined dependent variable. The existing formulation is used directly to produce an estimate of the time of the two turning processes with a confidence level of 30%. The following is the actual time and the results of the calculation of the estimated time using the existing formulation with the same roll data as the one to be processed:

a. Turning Process 1

Table 2. Turning Process Time 1 (Existing Formulation)

Existing Formulation - Turning Process Time 1 (Hours)					
Data	**Time Current**	**Estimate Time**	**Data**	**Time Current**	**Estimate Time**
1	1.87	6.69	16	6.10	6.40
2	5.87	6.00	17	2.72	3.56
3	2.47	5.50	18	2.83	3.56
4	2.82	4.90	19	3.05	4.00
5	1.88	5.71	20	4.00	3.55
6	3.15	5.00	21	5.08	4.20
7	2.25	4.90	22	3.55	4.50
8	3.63	5.50	23	4.00	5.50
9	2.93	6.00	24	6.20	7.00
10	2.73	6.00	25	2.28	5.50
11	5.05	5.00	26	5.20	6.19
12	2.00	4.62	27	4.32	3.56
13	4.08	4.62	28	4.00	3.56
14	2.82	4.90	29	3.08	4.90
15	2.20	4.80	30	3.97	4.50

b. Turning Process 2

Table 3. Turning Process Time 2 (Existing Formulation)

Existing Formulation - Turning Process Time 2 (Hours)					
Data to -	**Time current**	**Estimate Time**	**Data to -**	**Time current**	**Estimate Time**
1	4.37	6.86	16	5.43	7,10
2	5.73	6.50	17	2.75	4.34
3	3.22	5.50	18	2.60	4.34
4	2.80	5.00	19	2.42	5.00
5	4.00	6.01	20	2.40	4.50
6	2.95	5.00	21	4.28	4.50
7	4.10	5.00	22	4.92	5.50

8	2.33	5.50	23	5.50	5.50
9	2.37	6.50	24	7.65	7.50
10	3.40	6.50	25	2.72	5.50
11	7.58	6.56	26	5.88	6.78
12	3.02	4.82	27	4.83	4.34
13	2.15	4.82	28	4.08	4.34
14	2.80	5.00	29	4.08	5.00
15	3.58	4.90	30	4.00	5.50

Data collection technique

1. **Method**
   The data collection method used in this Job Training report is the document study and observation method. Document study is a method of collecting data that is not addressed directly to the object of research. Documents used in the form of secondary data obtained directly from the company. While the observation method is a method of collecting data carried out in order to observe human performance, work processes and other factors that affect work.
2. **Data Type**
   The type of data used in this Job Training report based on the nature and shape is quantitative data in the form of numbers from observations or measurements that can be calculated and measured. Based on the source of the retrieval is secondary data which is obtained or collected from existing sources. Meanwhile, based on the time of collection, it is time series or periodic data because the data used is roll processing data in 2019.
3. **Population Data**
   The population is all objects that are the target of research and have the same characteristics. The population of data used in this Job Training report is secondary data that comes directly from the company which includes 1000 roll work data for the past five years (2015-2019). The data obtained in the form of quantitative data regarding the dimensions, profile, type of material and the level of hardness of each roll.
4. **Data Sample**
   Sampleis part of the population that is taken to be used as an object of direct observation and is used as the basis for drawing conclusions. The sample used in this internship report is 30 data each for turning 1 and turning 2, with the classification of roll processing data in 2019 which has a plain profile roll with a type of cover roll rubber material and a cover hardness level of 0-5 PnJ (hard) as well as for roll dimensions machined on lathe A.

Research variable

Basically, research variables are everything in any form and are determined by researchers to be studied so that they obtain information about it which is then concluded (Novian Ekawaty, 2019). In this Job Training report using one dependent variable and one independent variable with the following information:

Description of Independent Variable (x) Roll Surface Area

Independent variables or often also referred to as independent variables are variables that influence or cause changes in the dependent variable (the dependent variable) (Amanda & Fadhli, 2018). In this internship report, the independent variable used is the roll surface area in square meters (m^2).

Jurnal Teknovasi
Volume 09, Number 01, 2022, 9 – 18
ISSN : 2540-8389

Description of Dependent Variable (y) Actual Processing Time

The dependent variable or often also referred to as the dependent variable is a variable that is influenced or becomes the result of an independent variable (independent variable) (Amanda & Fadhli, 2018). In this Job Training report, the dependent variable used is machine processing time in hours.

Data processing

Turning Process Data

a. Turning Process 1

In the turning process 1 there are 30 surface area data and the actual processing time of roll work in 2019 as follows:

Table 4. Variable Data X and Y Turning Process 1

DATA VARIABLES X AND Y MANUFACTURING PROCESS 1					
Data To -	**Large Surface (X) (m^2)**	**Processing Time (Y) (Hours)**	**Data To -**	**Surface area (X) (m^2)**	**Processing Time**
1	7.26	1.87	16	12.58	6.10
2	8.24	5.87	17	5.24	2.72
3	4.94	2.47	18	5.24	2.83
4	4.77	2.82	19	8.29	3.05
5	4.39	1.88	20	5.87	4.00
6	8.59	3.15	21	7.04	5.08
7	3.68	2.25	22	9.26	3.55
8	4.23	3.63	23	6.03	4.00
9	7.65	2.93	24	9.21	6.20
10	5.91	2.73	25	5.08	2.28
11	11.00	5.05	26	8.24	5.20
12	2.10	2.00	27	5.24	4.32
13	2.10	4.08	28	5.16	4.00
14	4.77	2.82	29	3.68	3.08
15	3.64	2.20	30	7.09	3.97

b. Turning Process 2

In the turning process 2 there are 30 surface area data and the actual processing time of roll work in 2019 as follows:

Table 5. Variable Data X and Y Turning Process 2

X AND Y VARIABLE DATA MANUFACTURING PROCESS 2					
Data To -	**Surface area (X) (m^2)**	**Processing Time (Y) (Hours)**	**Data To -**	**Surface area (X) (m^2)**	**Processing Time(Y) (O'clock)**
1	7.26	4.37	16	12.58	5.43
2	8.24	5.73	17	5.24	2.75

3	4.94	3.22	18	5.24	2.60
4	4.77	2.80	19	8.29	2.42
5	4.39	4.00	20	5.87	2.40
6	8.59	2.95	21	7.04	4.28
7	3.68	4.10	22	9.26	4.92
8	4.23	2.33	23	6.03	5.50
9	7.65	2.37	24	9.21	7.65
10	5.91	3.40	25	5.08	2.72
11	11.00	7.58	26	8.24	5.88
12	2.10	3.02	27	5.24	4.83
13	2.10	2.15	28	5.16	4.08
14	4.77	2.80	29	3.68	4.08
15	3.64	3.58	30	7.09	4.00

Repair Formulation

The improvement formulation obtained is based on the results of hypothesis testing, namely the regression equation. For each turning process has a different formulation with a different level of confidence. The following is the formulation of the improvements obtained:

Table 6. Repair Formulations

Process	Formulation
Turning 1	1.540 + 0.321X
Turning 2	1.694 + 0.360X

Differentiation of the formulations for the two processes with the level of confidencewhich is 39.5% for the formulation of the turning process 1 and 35.8% for the formulation of the turning process 2 resulting in an estimated time that is close to the actual processing time with the following data:

a. Turning Process 1

Table 7. Turning Process Time 1 (Remedial Formulation)

Repair Formulation - Turning Process Time 1 (Hours)					
Data To -	**Actual Time**	**Estimated time**	**Data To -**	**Actual Time**	**Estimated time**
1	1.87	3.87	16	6.10	5.58
2	5.87	4.19	17	2.72	3.22
3	2.47	3.13	18	2.83	3.22
4	2.82	3.07	19	3.05	4.20
5	1.88	2.95	20	4.00	3.42
6	3.15	4.30	21	5.08	3.80
7	2.25	2.72	22	3.55	4.51
8	3.63	2.90	23	4.00	3.48
9	2.93	4.00	24	6.20	4.50
10	2.73	3.44	25	2.28	3.17

11	5.05	5.07	26	5.20	4.19
12	2.00	2.21	27	4.32	3.22
13	4.08	2.21	28	4.00	3.20
14	2.82	3.07	29	3.08	2.72
15	2.20	2.71	30	3.97	3.81

b. Turning Process 2

Table 8. Turning Process Time 2 (Remedial Formulation)

Repair Formulation - Turning Process Time 2 (Hours)					
Data To -	**Actual Time**	**Estimated time**	**Data To -**	**Actual Time**	**Estimated time**
1	4.37	4.31	16	5.43	6.22
2	5.73	4.66	17	2.75	3.58
3	3.22	3.47	18	2.60	3.58
4	2.80	3.41	19	2.42	4.68
5	4.00	3.27	20	2.40	3.81
6	2.95	4.79	21	4.28	4.23
7	4.10	3.02	22	4.92	5.03
8	2.33	3.22	23	5.50	3.86
9	2.37	4.45	24	7.65	5.01
10	3.40	3.82	25	2.72	3.52
11	7.58	5.65	26	5.88	4.66
12	3.02	2.45	27	4.83	3.58
13	2.15	2.45	28	4.08	3.55
14	2.80	3.41	29	4.08	3.02
15	3.58	3.00	30	4.00	4.25

CONCLUSION

Based on the results of data processing that has been carried out in CHAPTER V, several conclusions can be drawn as follows: The data used to be analyzed using a simple linear regression method is stated to come from a normally distributed population with the results of the normality test: Asymp.Sig value. (2-tailed) on the Column Roll Surface Area 0.06 > 0.05 Asymp Value.*Sig.*(2-tailed) in the Turning Process Time 1 column 0.06 > 0.05 Asymp Value.*Sig.*(2-tailed) in the Turning Process Time 2 column 0.2 > 0.05. The data used to be analyzed using the simple linear regression method is stated to have a linear relationship between the dependent variable and the independent variable for both turning processes with the results of the linearity test: The results of the hypothesis test stated that there was a significant relationship between surface area (independent variable) and turning time (dependent variable). There is a contribution of 39.5% of the surface area affecting the time of turning process 1 and 35.8% of surface area affecting the time of turning process of turning 2. Thus it can be stated that the surface area factor is still strong enough to predict the time of the turning process. The improved formulation has a confidence level of 39.5% for turning process 1 and 35.8% for turning process 2, which is greater than the level of confidence possessed by the existing formulation of 30%. Thus, it can be stated that the improvement formulation can be used for the current state. The improvement formulation is the regression equation obtained.

Jurnal Teknovasi
Volume 09, Number 01, 2022, 9 – 18
ISSN : 2540-8389

REFERENCE

[1.] Amanda, R., & Fadhli, M. (2018). Education Statistics (Theory and Practice in Education). Medan: CV. Widya Puspita.
[2.] Angga Zeptiawan Sastal, YG (2018). The Effect of Cutting Speed on Changes in Chisel Temperature and Lathe Chisel Thirst in the Medium Carbon Steel Turning Process. Scientific Journal of Mechanical Engineering Students, 2 - 4.
[3.] Basuki, AT (2015). Use of SPSS in Statistics. Yogyakarta: Danisa Media. Cahyaningtyas, TI (2015). Prerequisite Test for Analysis: Normality, Homogeneity and Linearity.
[4.] *Inferential Statistics*, 13 - 20.
[5.] Muhid, A. (2019). Statistical Analysis 5 Steps to Practice Statistical Analysis With SPSS For Windows. Sidoarjo: Zifatama Jawara.
[6.] Novian Ekawaty, RL (2019). ANALYSIS OF THE INFLUENCE OF SERVICE QUALITY ON CUSTOMER LOYALTY TO THE BOOKING SITE
[7.] ONLINE TRAVELOKA. Journal of Management and Business Vol 4 No 2.
[8.] Nuryadi, Astuti, TD, Utami, ES, & Budiantara, M. (2017). Fundamentals of Research Statistics. Yogyakarta: SIBUKU MEDIA.