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# Implementation of North West Corner Method and Modified Distribution Method in Optimizing Fish Distribution Costs Using Matlab Program

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**ABSTRACT**

Calculating distribution costs using the transportation method seeks to solve the problem of goods sent from source to destination so that the most optimal amount of transportation costs will be obtained to maximize profits. CV. Horizon Sibolga Group is a company that provides raw fish for sale to fish processing consumers. The company is located at Gatot Subroto street Number. 108 Pondok Batu Sarudik, Central Tapanuli Regency, North Sumatra Province. In this study, the North West Corner method will be used to find an initial feasible solution, and the Modified Distribution method will be used as an optimization test. If the test results show an optimal solution, then the allocation has been optimal and can be said to have reached the most profitable value. These results were obtained using Matlab software. Before the calculation, the company incurs distribution costs for a year of Rp. 963,000,000. From the research results, the total cost obtained after using the North West Corner method as an initial feasible solution is Rp. 928,831,000, and after using the Modified Distribution method as an optimization test, the total distribution cost is Rp. 923,058,000. So that the method used can save costs of Rp. 39,942,000, with a percentage of 4.14%.



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## 1. INTRODUCTION

The water treatment methods that are generally used are related to pollution in water. The pollution that must be considered in most water supplies is pathogenic bacteria, turbidity and floating materials, color, taste and smell, and organic compounds. Traditionally, well bore water and turbid water can be rarefied with alum, (Nasir et al., 2014).

Water is of great benefit to life, to humans, animals, plants, agriculture, industry and to the balance of nature. Various industries also need water for treatment activities such as palm oil mills. (Rahayu et al., 2019). Water used as boiler filler if not treated will detect calcium and magnesium salts contained in water and will settle due to exposure to heat. This precipitate is attached to the walls – the walls of the boiler become crusty. (Irawan et al., 2019), so before the water enters the station in the factory, we must first analyze the minerals contained in it. The main source of water will usually be treated by adding soda ash chemicals, aluminum sulfate and polymer to the coagulation-flocculation and sedimentation process to obtain water that is in accordance with water quality standards in the factory. (Rahardja, 2019). Sedimentation is one of the processes of separating a mixture of solids and liquids (slurry) into clear liquids and sludge. This process utilizes the force of gravity (Rumbino & Abigael, 2020).

Most alum is undissolved and will precipitate as an Al(OH) floc, which can confine the colloids and carry them down, so that deposits or collisions between particles can be increased by slow stirring, resulting in solids that can be precipitated. (Suprihatin, Ono Suparno, 2013: 112). The provision of clean water, in addition to its quantity, must also meet applicable standards. Water quality standards are quality standards that are set based on physical, chemical, radioactive and bacteriological properties that indicate the quality requirements of the water. (Nainggolan et al., 2019)

## 2. RESEARCH METHODE

### a. Place and time of research

The place or area that will be used as the location in this research is in the laboratory. This research was conducted from 05 to 07 October 2022.

### b. Research Design

In general, water treatment (groundwater/surface) is carried out by adding certain chemicals (coagulants, pH regulators, and disinfectants) to the water, followed by sedimentation (precipitation) or flotation (flotation) of sludge and filtration (filtration) through sand media. (Kencanawati & Mustakim, 2017). In research, steps are needed to solve the problem so that it is more systematic. The steps are as follows:

1) The initial stage of research is to analyze jartes on source water samples in the laboratory. Jar test is a laboratory-scale experiment that serves to determine the optimum dose of coagulants used in the clean water treatment process. If the experiment is carried out appropriately. (Oktaviasari & Mashuri, 2016).
2) The next stage is the collection of data, both primary data obtained directly from the results of testing in the laboratory and secondary data obtained from companies related to the water treatment system.
3) The results of the data collection that have been obtained will be analyzed using the 3-factorial RAL (Complete Random Design) statistical method.
4) The results of the data processing analysis will find answers from the problem formulation of this study

### c. Research Methodology

This research was conducted using descriptive and analytical methods, namely methods that describe the situation that occurred in the field and existing data, then processed, analyzed and further processed using statistical methods using the complete random design (RAL) method and continued with the results of the anova test table / fingerprint to see the influence of adding chemicals to external water purification. The data obtained from the experimental results will certainly be analyzed to find out the results. To analyze data from a complete random design, a variety will be carried out based on the tabulation of the data obtained and with the following steps:

1) Looks for Free Degree (DB) values
2) Finding the Sum of Squares (JK)
3) Finding the Middle Square (KT)
4) Looks up F count and F probability table (0.05)
5) Summing up the results of the analysis
   - If obtained If F calculates < F table (α=5 %) means that the treatment has no noticeable effect on the observed response, meaning that Ho is received at a real level (α) of 5 %.
   - If F calculates > F table (α=5 %) means that the treatment exerts a noticeable influence on the observed response, meaning that Ho is received at a real level (α) of 5 %. (Bambang Admadi, et al., 2011:12)

## 3. RESULT AND ANALYSIS

### Data Collection and Processing

Results addition of each of the chemical ingredients / standard solutions from the results of the study on the jartes dose table. From the results of water purification testing using the jartes method, each test is seen the level of water clarity using the turbidity tool and the results are recorded in the observation data table.

Table 3.1. Results of Recapitulation of Observational Data

| Combination Treatment | | | *Water turbidity* results | | | Total |
|---|---|---|---|---|---|---|
| | | | Deuteronomy | | | |
| T | S | F | I | II | III | |

| | | | | | | |
|---|---|---|---|---|---|---|
| T (2ml) | S ( 1ml) | F (1 ml) | 4.53 | 4.5 | 4.52 | 13.55 |
| | | F (1.5 ml) | 4.28 | 4.26 | 4.28 | 12.82 |
| | | F (2 ml) | 4.09 | 4.07 | 4.08 | 12.24 |
| T (2ml) | S (1.5 ml) | F (1 ml) | 4.51 | 4.54 | 4.52 | 13.57 |
| | | F (1.5 ml) | 4.25 | 4.24 | 4.22 | 12.71 |
| | | F (2 ml) | 4.07 | 4.05 | 4.08 | 12.2 |
| T (2ml) | S (2 ml) | F (1 ml) | 4.54 | 4.5 | 4.53 | 13.57 |
| | | F (1.5 ml) | 4.2 | 4.22 | 4.21 | 12.63 |
| | | F (2 ml) | 4.08 | 4.09 | 4.07 | 12.24 |
| T (2.5 ml) | S ( 1ml) | F (1 ml) | 3.53 | 3.5 | 3.52 | 10.55 |
| | | F (1.5 ml) | 3.32 | 3.34 | 3.33 | 9.99 |
| | | F (2 ml) | 3.08 | 3.08 | 3.07 | 9.23 |
| T (2.5 ml) | S (1.5 ml) | F (1 ml) | 3.51 | 3.53 | 3.5 | 10.54 |
| | | F (1.5 ml) | 3.35 | 3.3 | 3.34 | 9.99 |
| | | F (2 ml) | 3.1 | 3.13 | 3.1 | 9.33 |
| T (2.5 ml) | S (2 ml) | F (1 ml) | 3.5 | 3.52 | 3.51 | 10.53 |
| | | F (1.5 ml) | 3.31 | 3.33 | 3.3 | 9.94 |
| | | F (2 ml) | 3.12 | 3.1 | 3.11 | 9.33 |
| T (3 ml) | S ( 1ml) | F (1 ml) | 3.44 | 3.42 | 3.45 | 10.31 |
| | | F (1.5 ml) | 3.2 | 3.21 | 3.23 | 9.64 |
| | | F (2 ml) | 3.04 | 3.01 | 3.03 | 9.08 |
| T (3 ml) | S (1.5 ml) | F (1 ml) | 3.41 | 3.39 | 3.4 | 10.2 |
| | | F (1.5 ml) | 3.24 | 3.26 | 3.23 | 9.73 |
| | | F (2 ml) | 3.06 | 3.04 | 3.05 | 9.15 |
| T (3 ml) | S (2 ml) | F (1 ml) | 3.47 | 3.45 | 3.48 | 10.4 |
| | | F (1.5 ml) | 3.26 | 3.24 | 3.25 | 9.75 |
| | | F (2 ml) | 3.03 | 3.01 | 3.04 | 9.08 |
| Grand Total | | | | | | 292.3 |

**Table 3. 2 Chemical Ingredients for each addition to the Jartes analysis process**

| | | |
|---|---|---|
| **T factor 1%** | | |
| Alum 1 | T (2 ml) | **Total Combinations = 27** |
| Alum 2 | T (2.5 ml) | |
| Alum 3 | T (3 ml) | |
| | | |
| **Factor S 1%** | | |
| Soda Ash 1 | S (1 ml) | **Repetition = I, II, III** |
| Soda Ash 2 | S (1.5 ml) | |
| Soda Ash 3 | S (2 ml) | |
| | | |
| **Factor F 0.02%** | | |
| Floc 1 | F (1 ml) | **Total Units = 81** |

| | |
|---|---|
| Floc 2 | F (1.5 ml) |
| Floc 3 | F (2 ml) |

Based on clean water treatment techniques, one way to reduce turbidity is by using alum. Alum as a coagulant material is better known to the public because it has high economic value, is easy to get and easy to store. (Amalia & IW, 2017), this study uses chemical alum, soda ash, and floculand. The results of the recapitalization of the research data obtained will be processed using the statistical analysis method using the complete random design (RAL) method and continued with the results of the anova / fingerprint test table. There are 2 sources of diversity among the observational data obtained in the Anova test, namely: diversity of treatment and error of the experiment. Both are used to indicate whether the difference in observations between treatments is real or by chance alone. The difference in treatment is said to be noticeable when the diversity of treatments is large enough compared to the error of the experiment. (Made susilawati, 2015:11-13), in this study to see every influence of factors whether they have a real effect or not a real effect on each factor where the formulation of the hypothesis consists of:

**Conjecture hypothesis / Null hypothesis (Ho)**

- All **treatments independently** have no real impact on water purification.
- All **treatments in 3 combinations of 2 factors** have no noticeable effect on water purification
- All **treatments in 1 combination of 3 factors** have no effect ta on water purification

**Independent testing of the First alternative Hypothesis (H1)**

3 independent factors, namely: Alum (T), Soda ash (S), and Floc (F)

**Second Alternative Hypothesis Testing (H2) 3 combinations of 2 factors**

3 combinations of 2 factors, namely:

- Alum with soda ash (T,S),
- Alum with Floc (T,F), and
- soda ash with floc (S,F)

**Third alternative Hypothesis Testing (H3) 1 combination 3 factors**

1 combination of 3 factors namely: Alum, soda ash, Floc (T, S, F)

To get the results of the study, the author has made a table of auxiliary factors in helping to get the results of the Anova test / list of fingerprints, here is the table that has been created:

**Table 3.3 Factor Auxiliary Table (T)**

| Factor Auxiliary Table (T) | Total |
|---|---|
| T (2 ml) | 115.53 |
| T (2.5 ml) | 89.43 |
| T (3 ml) | 87.34 |
| Total | 292.3 |

**Table 3.4 Factor Auxiliary Table (S)**

| Factor Auxiliary Table (S) | Total |
|---|---|
| S (1 ml) | 97.41 |
| S (1.5 ml) | 97.42 |
| S (2 ml) | 97.47 |
| Total | 292.3 |

**Table 3.5 Factor Auxiliary Table (F)**

| TS Auxiliary Table | Total |
|---|---|
| T1S1 | 38.61 |
| T1S2 | 38.48 |
| T1S3 | 38.44 |
| T2S1 | 29.77 |

**Table 3.6 Factor Auxiliary Table (TS)**

| | |
|---|---|
| T2S2 | 29.86 |
| T2S3 | 29.8 |
| T3S1 | 29.03 |
| T3S2 | 29.08 |
| T3S3 | 29.23 |
| Total | 292.3 |

| Factor Auxiliary Table (F) | Total |
|---|---|
| F (1 ml) | 103.22 |
| F (1.5 ml) | 97.2 |
| F (2 ml) | 91.88 |
| Total | 292.3 |

Table 3.7 Factor Auxiliary Table (TF)

| TF Auxiliary Table | Total |
|---|---|
| T1F1 | 40.69 |
| T1F2 | 38.16 |
| T1F3 | 36.68 |
| T2F1 | 31.62 |
| T2F2 | 29.92 |
| T2F3 | 27.89 |
| T3F1 | 30.91 |
| T3F2 | 29.12 |
| T3F3 | 27.31 |
| Total | 292.3 |

Table 3.8 Factor Auxiliary Table (SF)

| SF Auxiliary Table | Total |
|---|---|
| S1F1 | 34.41 |
| S1F2 | 32.45 |
| S1F3 | 30.55 |
| S2F1 | 34.31 |
| S2F2 | 32.43 |
| S2F3 | 30.68 |
| S3F1 | 34.5 |
| S3F2 | 32.32 |
| S3F3 | 30.65 |
| Total | 292.3 |

**Data Analysis Procedure**

To analyze the data from a complete random design will be made test results in the form of a fingerprint table / Anova, In this study the author used the help of Microsoft Excel in calculating the data that has been obtained, As for the formula we will use as follows:

Table 3.9. How to analyze data

| The Analyzed | How to Analyze |
|---|---|
| DB (T) | Number of treatments T – 1 ➡ 3-1 = 2 |
| DB (S) | The number of treatments S - 1 ➡ 3-1 = 2 |
| DB (F) | Number of treatments F – 1 ➡ 3-1 = 2 |
| DB T x S | DB T x DB S ➡ 2 x 2 = 4 |
| DB T x F | DB T x DB F ➡ 2 x 2 = 4 |
| DB S x F | DB S x DB F ➡ 2 x 2 = 4 |
| DB T x S x F | DB T x DB S x DB F ➡ 2 x 2 x 2= 8 |
| DB Error | Total DB – Other DBs = 80 – (2+2+2+4+4+4+8) = 80-26 = 54 |
| DB Total | Sum of 3 factors x subduction = (3 x 3 x3 x 3) -1 = 81 -1 = 80 |

Advanced table. 3.9

| | |
|---|---|
| FK | = $292.3^2$/ 81 Total units = **1054.806049** (see table 3.1) |
| JK T | =SUMSQ (115.53 2 + $89.43^2$ +$87.34^2$) / 27 – FK<br>= **18.27474321** (see table 3.3 ) |
| JK S | =SUMSQ (97.41 2 + $97.42^2$ + $97.47^2$) / 27-FK<br>= **7.6543200000** (see table 3.4 ) |
| JK F | =SUMSQ (103.22 2 + 97.2 2 + 91.88 2 ) / 27-FK<br>= **2.384424691** (see table 3.5) |
| JK T x S | =SUMSQ ($38.61^2$+ ....+$29.23^2$ ) / 9 - (FK) - (JK T) - (JK S)<br>= **0.004553086** (see table 3.6) |
| JK T x F | =SUMSQ ($40.69^2$+ ....+$27.31^2$ ) / 9 - (FK) - (JK T) - (JK F)<br>= **0.024293827** (see table 3.7) |
| JK S x F | =SUMSQ ($34.41^2$+ ....+$30.65^2$ ) / 9 - (FK) - (JK T) - (JK F)<br>= **0.004049383** (see table 3.8 ) |

| | |
|---|---|
| JK T x S x F | =SUMSQ (13.55²+.....+9.08²)/3 - FK - JK T - JK S - JK F - JK TS - JK TF - JK SF = **0.01074321** (see table 3.1) |
| JK Error | Total JK – Other JK = **0.011066667** |
| JK Total | =SUMSQ(4.53 2 + 4.28 2 + .....+3.25² + 3.04²) – FK = **20.71395062** |
| KT (T) | JK T / DB T =18.27474321 / 2 = **9.137371605** |
| KT(S) | JK S / DB S = 7.6543200000 / 2 = **3.8271600000** |
| KT (F) | JK F / DB F = 2.384424691 / 2 = **1.192212346** |
| KT T x S | JK T x S / DB T x S = 0.004553086 / 4 = **0.001138272** |
| KT T x F | JK T x F / DB T x F = 0.024293827 / 4 = **0.006073457** |
| KT S x F | JK S x F / DB S x F = 0.004049383 / 4 = **0.001012346** |
| KT T x S x F | JK T x S x F / DB T x S x F = 0.01074321 / 8 = **0.001342901** |
| KT Error | JK Error /DB Error = 0.011066667 / 54 = **0.000204938** |
| F Hit (T) | KT T /KT Error = 9.137371605 / 0.000204938 = **44.585.96988** |
| F Hit(S) | KT S /KT Error = 3.8271600000 / 0.000204938 = **0.186746989** |
| F Hit (F) | KT F /KT Error = 1.192212346 / 0.000204938 = **5.817421687** |
| F Hit T x S | KT T x S/KT Error = 0.001138272 / 0.000204938 = **5.554216866** |
| F Hit T x F | KT T x F/KT Error = 0.006073457 / 0.000204938 = **29.63554217** |
| F Hit S x F | KT S x F/KT Error = 0.001012346 / 0.000204938 = **4.939759036** |
| F Calculate T x S x F | KT T x S x F/KT Error = 0.001342901 / 0.000204938 = **6.552710844** |
| F table | = fINV(0,05,DB you want to view,DB error) |

**Anova Test Results (Analysis of Variance)**

From the results of the test data using the formulation above with the help of the Microsoft Excel application, the results of the fingerprint table / Analysis of Variance are obtained as follows:

**Table.3.10 Diversity Fingerprint Test Results /Anova**

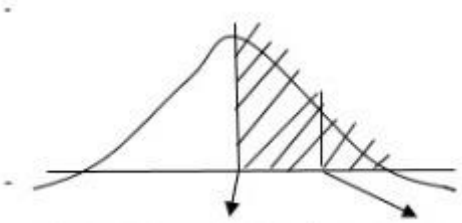
| SK (diversity fingerprint) | DB (free degree) | JK (sum of squares) | KT (middle square) | F count | F tab ( 0.05) | Ket |
|---|---|---|---|---|---|---|
| T | 2 | 18.27474321 | 9.137371605 | 44.586 | 3.168246 | N |
| S | 2 | 7.6543200000 | 3.8271600000 | 0.18675 | 3.168246 | MR |
| F | 2 | 2.384424691 | 1.192212346 | 5.81742 | 3.168246 | N |
| TS | 4 | 0.004553086 | 0.001138272 | 5.55422 | 2.542918 | N |
| TF | 4 | 0.024293827 | 0.006073457 | 29.6355 | 2.542918 | N |
| SF | 4 | 0.004049383 | 0.001012346 | 4.93976 | 2.542918 | N |
| TSF | 8 | 0.01074321 | 0.001342901 | 6.55271 | 2.115223 | N |
| Error | 54 | 0.011066667 | 0.000204938 | | | - |
| Total | 80 | 20.71395062 | 0.258924383 | | | - |

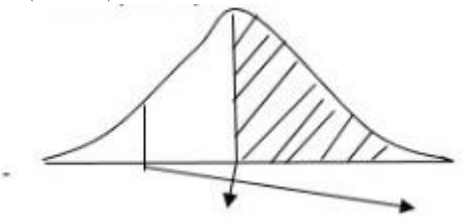
Description =
N : (Real effect)

TN: (No real effect)

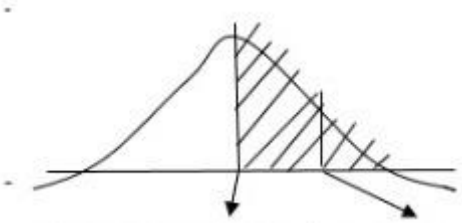
From the results of the diversity fingerprint test table / Anova, we can see and make a description of the results, namely:

**Independent testing of the first alternative hypothesis (H1)**

1) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals independently on Alum (T) on water purification is:
   - Ho : treatment has no real effect on alum independently
   - H1 : the treatment exerts a noticeable effect on the observed self-giving.
   - Significant rate : 5% = ά = 0.05
   - Critical regions : Ho is rejected if Fcount > Ftable (ά=0.05) and Ho is accepted if Fcount < Ftable (ά=0.05)
   - 
   - F table 3.168245967 F Hits 44.585.96988
   - Result of the decision : F count 44.585.96988 > F table 3.168245967 So it can be concluded that H0 is rejected at the real level ά. which means that the treatment exerts a noticeable influence on the observed response.

2) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals independently on Soda ash (S) on water purification is:
   - Ho : treatment has no real effect on soda ash independently
   - H1 : the treatment exerts a noticeable effect on the soda ash independently observed.
   - Significant rate : 5% = ά = 0.05
   - Critical regions : Ho is rejected if Fcount > Ftable (ά=0.05) and Ho is accepted if Fcount < Ftable (ά=0.05)
   - 
   - F table 3.168245967 F Hits 0.186746989
   - Result of the decision : F count 0.186746989 < F table 3.168245967 So it can be concluded that H0 is accepted at the real level ά. which means that the treatment has no real effect on the observed response

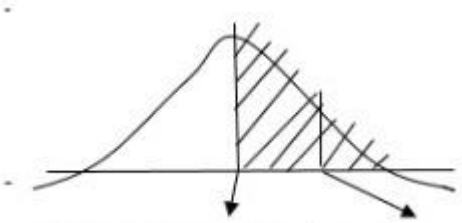
3) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals independently on Flocculand (F) on water purification is:
   - Ho : treatment has no real effect on alum independently
   - H1 :p behavior exerts a noticeable effect on the observed self-administered alum.
   - Significant rate : 5% = ά = 0.05
   - Critical regions : Ho is rejected if Fcount > Ftable (ά=0.05) and Ho is accepted if Fcount < Ftable (ά=0.05)



- F table 3.168245967 F Hits 5.817.421687
- Result of the decision : F count 5.817.421687 > F table 3.168245967 So it can be concluded that H0 is rejected at the real level ά. which means that the treatment exerts a noticeable effect influence on the observed response.

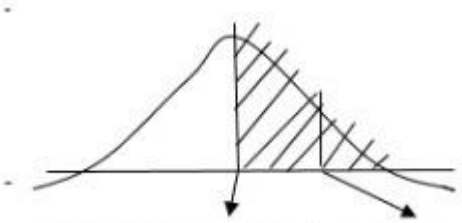
**Testing the second alternative hypothesis (H2) in 3 combinations of 2 factors**

1) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 3 combinations of 2 factors between Alum and Soda ash (TS) on water purification is:
   - Ho : the treatment has no real effect on 3 combinations of 2 factors between Alum and Soda ash (TS) on water purification.
   - H2 : the treatment has a noticeable effect on 3 combinations of 2 factors between Alum and Soda ash (TS) on water purification.
   - Significant rate : 5% = ά = 0.05
   - Critical regions : Ho is rejected if Fcount > Ftable (ά=0.05) and Ho is accepted if Fcount < Ftable (ά=0.05)



   - F table 2.542917526 F Hits 5.554216866
   - The result of decision F count 5.554216866 > F table 2.542917526 So it can be concluded that H0 is rejected at the real level ά. which means that the treatment exerts a noticeable influence on the observed response.

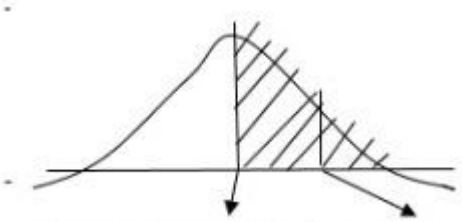
2) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 3 combinations of 2 factors between Alum and Flocculland (TF) on water purification is:
   - Ho : treatment has no real effect on 3 combinations of 2 factors between Alum and Flocculland (TF) on water purification.
   - H2: the treatment has a noticeable effect on 3 combinations of 2 factors between Alum and Flocculland (TF) on water purification.
   - Significant rate : 5% = ά = 0.05
   - Critical regions : Ho is rejected if Fcount > Ftable (ά=0.05) and Ho is accepted if Fcount < Ftable (ά=0.05)



   - F table 2.542917526 F Hits 29.63554217
   - Result of the decision : F count 29.63554217 > F table 2.542917526 So it can be concluded that Ho is rejected at the real level ά. which means that the treatment exerts a noticeable influence on the observed response.

3) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 3 combinations of 2 factors between Soda ash and Flocculand (SF) on water purification is:

- Ho : the treatment has no real effect on a 3-factor combination of soda ash and Flocculand (TF) on water purification.
- H2 : the treatment has a noticeable effect on 3 combinations of 2 factors between soda ash and Flocculand (TF) on water purification.
- Significant rate : 5% = ά = 0.05
- Critical regions : Ho is rejected if Fcount > Ftable (ά=0.05) and Ho is accepted if Fcount < Ftable (ά=0.05)

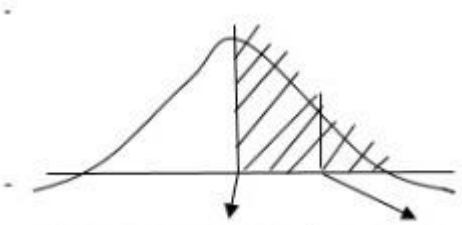


F table 2.542917526 F Hits 4.939759036

- Result of the decision : F count 4.939759036 > F table 2.542917526, So it can be concluded that H0 is rejected at the real level ά. which means that the treatment exerts a noticeable influence on the observed response.

**Third alternative hypothesis testing (H3) by 1 combination of 3 factors**

1) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 1 combination of 3 factors between Alum, Soda ash and Flocculand (TSF) on water purification is:
   - Ho : treatment has no real effect on 1 combination of 3 factors between Alum, Soda ash and Flocculland (TSF) on water purification.
   - H3 : the treatment has a noticeable effect on a combination of 3 factors between Alum, Soda ash and Flocculland (TSF) on water purification.
   - Significant rate : 5% = ά = 0.05
   - Critical regions : Ho is rejected if Fcount > Ftable (ά=0.05) and Ho is accepted if Fcount < Ftable (ά=0.05)



F table 2.115223279 F Hits 6.552710844

- Result of the decision : F count 6.552710844 > F table 2.115223279, So it can be concluded that H0 is rejected at the real level ά. which means that the treatment exerts a noticeable influence on the observed response.

**b. Analysis and Evaluation**

**Analysis**

Analysis of the test results of the addition of chemicals to external water purification independently:

1. From the addition of alum to external water purification there is a significant influence.
2. From the addition of soda ash to external water purification, there is no significant change because soda ash only gets the appropriate pH.
3. From the addition of flocculants to external water purification there is a significant influence.

Analysis of the test results of the addition of chemicals in 3 combinations of 2 factors:

1. From the addition of alum and soda ash to external water purification there is a significant influence.
2. From the addition of alum and flocculants to external water purification there is a significant influence.
3. From the addition of soda ash and flocculants to external water purification there is a significant influence.

Analysis of the test results of adding chemicals in 1 combination of 3 factors:

1. From the addition of alum, soda ash and flocculants to external water purification there is a significant influence.

### c. Evaluation

Companies should more often analyze jartes on external water to determine the appropriate dose to use because the water from the source has different conditions at all times because weather conditions cannot be conditioned such as the rainy season. Companies also have to control chemical distribution hoses more often because sometimes hoses can occur problems such as being covered by moss. So that the chemical cannot flow optimally, the impact is that the water will not be clear thoroughly.

## 4. CONCLUSION

Based on the results of data processing using the RAL (Complete Random Design) method to see the influence of chemical addition factors on the purification of external water obtained, namely:

a. The influence of chemical addition factors on external water purification independently: in the addition of alum and flocculants to external water purification there is a significant influence. Meanwhile, the addition of soda ash to external water purification does not have a significant effect, this is because according to its function from the results of interviews with soda ash operators, it is only to get the appropriate pH so that it does not have a real effect independently.
b. The influence of chemical addition factors in 3 combinations of 2 factors: in the addition of alum with soda ash, alum with flocculants, and soda ash with flocculants on external water purification there is a significant influence
c. The influence of chemical addition factors in 1 combination of 3 factors: on the simultaneous addition of alum, soda ash and flocculants on external water purification there is a significant influence.

## REFERENCE

[1] Amalia, N., & IW, H. R. (2017). Effect of Various Alum Doses on the Turbidity of Dug Well Water in Dukuhlo Village Rt 1 Rw 6 Lebaksiu District, Tegal Regency in 2016. Keslingmas Bulletin, 36(3), 225–229. https://doi.org/10.31983/keslingmas.v36i3.2995
[2] Bambang Admadi Narsajuwono, I wayan Arnata, Gusti Ayu Kadek Diah Puspawati. (2011). Design of SPSS and EXCEL Theory Experiments. Published by : Cross-Words Publishing National Library: Catalog In Publication (KDT)
[3] Irawan, A., Heranurweni, S., & Nurhayati, T. (2019). Ph Water Simulation for Boiler Water and Air Chiller on Refrigerator Production Machine Using Fuzzy Logic. Elektrika, 11(1), 26. https://doi.org/10.26623/elektrika.v11i1.1541
[4] Kencanawati, M., & Mustakim. (2017). Analysis of Clean Water Treatment at WTP PDAM Prapatan, Balikpapan City. Journal of TRANSUKMA, 02(02), 2502–1028. http://transukma.uniba-bpn.ac.id/index.php/transukma/article/view/51/32
[5] Nainggolan, A. A., Arbaningrum, R., Nadesya, A., Harliyanti, D. J., & Syaddad, M. A. (2019). Simple Raw Water Treatment Tool With Filtration System. Widyakala Journal, 6, 12. https://doi.org/10.36262/widyakala.v6i0.187
[6] Nasir, S., Said, M., & Fachry, A. R. (2014). Treatment of river water into clean water with ultrafiltration methods for residents of Sukaraja Village, Ogan Komering Ilir Regency, South Sumatra. Proceedings of SNaPP 2014 Science, Technology, and Health, 171–178. www.kaboki.go.id
[7] Made Susilawati, S.Si., M.Si (2015). EXPERIMENTAL DESIGNS. Department of Mathematics, Faculty of Mathematics and Natural Sciences, UDAYANA UNIVERSITY.
[8] Prof. Dr.- Ing. Ir. Suprihatin, Dr. Ir. Ono Suparno, M.T. (2013). Water Treatment Process Technology for Students and Industry Practitioners. Printed by IPB Printing, PT Publisher IPB Press, IPB Campus Taman Kencana Bogor.
[9] Oktaviasari, & Mashuri. (2016). Optimization of Jar Test Process Parameters Using the Taguchi Method With a PCR-TOPSIS Approach (Case Study: PDAM Surya Sembada Kota Surabaya) | Semantic Scholar. 5(2), 372–377. https://www.semanticcholar.org/paper/Optimization-Parameter-Proses-Jar-Test-Menggunakan-PDAM-Oktaviasari-Mashuri/3eab6ccfcc9e849f45eefa6577a0c1a482106a81
[10] Rahardja, I. B. (2019). Calculation of the Number of Chemicals in External Water Treatment (Case Study in PMKS XYZ, Central Kalimantan). Journal of Citra Widya Education, 5(1), 77–82.
[11] Rumbino, Y., & Abigael, K. (2020). Determination of Particle Deposition Rate in Water Storage Ponds resulting from manganese ore leaching determination of particle deposition rate in water separation outcomes of manganese oil washing. Scientific Journal of Technology FST Undana, 14(1), 55–59.
[12] Rahayu, Amri, Y., & Harmawan, T. (2019). Analysis of pH and Total Hardness in Boiler Feed Water. Quimica: Journal of Science and Applied Chemistry, 1(April), 1–4.