

PAPER • OPEN ACCESS

## Preface

To cite this article: 2019 *J. Phys.: Conf. Ser.* **1282** 011001

View the [article online](#) for updates and enhancements.



**IOP | ebooks™**

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the [collection](#) - download the first chapter of every title for free.

# **PROCEEDINGS**

**SICBAS 2018**

**THE 1<sup>st</sup> SRIWIJAYA INTERNATIONAL CONFERENCE ON BASIC  
AND APPLIED SCIENCES**

**“Sciences for Sustainable Development”**

Horison Ultima Hotel Palembang, South Sumatra - Indonesia  
November 6-7<sup>th</sup>, 2018



## PREFACE

The 1<sup>st</sup> SRIWIJAYA INTERNATIONAL CONFERENCE ON BASIC AND APPLIED SCIENCES (SICBAS 2018) with the theme “Sciences for Sustainable Development”. The conference held on November 6-7<sup>th</sup>, 2018 at the Horison Ultima Hotel Palembang, South Sumatra, Indonesia. This event is launched so as to provide a chance and venue for researchers to come together for research presentations and dissemination’s. The conference is biennial important event to publish communicate they research results in basic and applied sciences.

Hopefully this international proceeding will be able to encourage students, teachers, lecturers, practitioners, researchers, and higher education community in developing scientific and academic atmosphere in Indonesia.

On behalf of the committee of the SICBAS 2018 we would like to thank to all parties for their participation in supporting this publication and we would like to invite all of researchers and scientists to take a part in the 2<sup>nd</sup> SICBAS which will be held in 2020 by The Faculty of Mathematics and Natural Sciences, Sriwijaya University.

Palembang, November 7<sup>th</sup> 2018  
Chairman,

Dr. Fiber Monado

## ORGANIZING COMMITTEE

### Advisory Board

Prof. Anis Saggaf (Sriwijaya University, Indonesia)  
Prof. Zainuddin Nawawi (Sriwijaya University, Indonesia)  
Prof. Khairurrijal (ITB, Indonesia)  
Associate Prof. Minetaka Sugiyama (Osaka University, Japan)  
Prof. Ibrahim Mohamed (University of Malaya, Malaysia)  
Prof. Mitra Djamal (ITB, Indonesia)

### Scientific Board

Prof. Iskhaq Iskandar (Sriwijaya University, Indonesia)  
Prof. Kamaruzzaman Seman (USIM, Malaysia)  
Prof. Irawati (ITB, Indonesia)  
Eko Siswanto, Ph.D. (JAMSTEC, Japan)  
Dr. Haris Gunawan (Peatland Restoration Agency, Indonesia)  
Dr. Hagi Yulia Sugeha (LIPI, Indonesia)  
Dr. Rashid Mehmood (Ottawa Hospital Research Institute, Canada)  
Prof. Aldes Lesbani (Sriwijaya University, Indonesia)

### Local Committee (Sriwijaya University, Indonesia)

Chairman : Dr. Fiber Monado  
Vice Chairman : Dr. Frinsyah Virgo  
Secretary : Dr. Bambang Suprihatin  
Treasurer : Dr. rer. nat. Indra Yustian  
Members:

- Dr. Rozirwan
- Dony Setiawan, M.Si
- Dr. Poeji Loekitowati
- Dr. Eliza
- Dr. Arum Setiawan
- Dr. Siti Sailah, M.Si
- Hermansyah, Ph.D
- Anna Ida Sunaryo P, S.Pi., M.Si
- Dr.rer.nat. Mardiyanto, M.Si
- Dr. Fitri Maya Puspita, M.Sc
- Dr.rer.nat. Risfidian Mohadi
- Dr. Idha Royani
- Dr. T. Zia Ulqodry
- Dr. Akhmad Aminuddin Bama, M.Si
- Zainal Fanani, S.Si., M.Si
- Sutopo, S.Si., M.Si
- Alfensi Faruk, M.Sc
- Akmal Johan, M.Si
- Andy Agussalim, M.Sc
- M. Fuad, M.Kom
- Sisca Oktarina, M.Sc
- Miyanto, S.AP

## Editorial Team

Editor in Chief : Dr.rer.nat Risfidian Mohadi, M.Si

Deputy of chief editor : Dr. Idha Royani

### Reviewer Board Members

1. Prof. Dr. Iskhaq Iskandar Universitas Sriwijaya
2. Prof. Dr. Aldes Lesbani Universitas Sriwijaya
3. Dr. Adhitya Ronnie Effendie Universitas Gajah Mada
4. Dr. Arum Setiawan Universitas Sriwijaya
5. Dr. Azhar Kholiq Affandi Universitas Sriwijaya
6. Dr. Bambang Suprihatin Universitas Sriwijaya
7. Dr. Eliza Universitas Sriwijaya
8. Dr. Fauziyah Universitas Sriwijaya
9. Dr. Fiber Monado Universitas Sriwijaya
10. Dr. Fitri Maya Puspita Universitas Sriwijaya
11. Dr. Frinsyah Virgo Universitas Sriwijaya
12. Dr. Harry Wijayanti Universitas Sriwijaya
13. Dr. Heri Satria Universitas Lampung
14. Dr. Hermansyah Universitas Sriwijaya
15. Dr. Idha Royani Universitas Sriwijaya
16. Dr. Masturi Universitas Negeri Semarang
17. Dr. Menik Ariani Universitas Sriwijaya
18. Dr. Poeji Lukitowati Universitas Sriwijaya
19. Dr. Rahadi Wirawan Universitas Mataram
20. Dr. rer.nat Mardiyanto Universitas Sriwijaya
21. Dr. rer.nat. Maya Shovitri Institut Teknologi Sepuluh November
22. Dr. Siti Sailah Universitas Sriwijaya
23. Dr. Yulianto Suteja Universitas Udayana
24. Dr. Zia Ulqodri Universitas Sriwijaya
25. Dr.rer.nat Risfidian Mohadi Universitas Sriwijaya
26. Dr. A. Aminuddin Bama Universitas Sriwijaya
27. Anna Ida Sunaryo, M.Si Universitas Sriwijaya

# Table of contents

Volume 1282

2019

◀ Previous issue    Next issue ▶

**Sriwijaya International Conference on Basic and Applied Science 6–7 November 2018, Palembang, Indonesia**

Accepted papers received: 26 June 2019

Published online: 14 August 2019

Open all abstracts

## Preface

**OPEN ACCESS** 011001

Preface

+ Open abstract     View article     PDF

**OPEN ACCESS** 011002

Peer review statement

+ Open abstract     View article     PDF

## Papers

### Mathematics and Applied Mathematics

**OPEN ACCESS** 012001

On selected issues of Boolean function application in symmetric key cryptography against side channel attacks

Kamaruzzaman Seman, Muhammad Fahim Roslan, Azni Haslizan Ab Halim and M Nor Azizi Syam Mohd Sayuti

+ Open abstract     View article     PDF

**OPEN ACCESS** 012002


The effect of interactive demonstration method on heat energy learning

Ria Triayomi

+ Open abstract     View article     PDF

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our **OPEN ACCESS** Privacy and Cookies policy.

012002 

- 
- OPEN ACCESS** 012011  
A non-proportional hazards model with time-dependent variables for under-five mortality in Indonesia  
Alfensi Faruk, Erlan Syahputra, Endro Setyo Cahyono and Sari Mutiara Aisyah  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012012  
Implementation of branch and cut method on  $n$ -sheet model in solving two dimensional cutting stock problem  
Putra BJ Bangun, Sisca Octarina and Ari Putra Pertama  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012013  
Analysis of dengue fever disease transmission using suspected-infected-recovered (SIR) model  
Endro Setyo Cahyono, Alfensi Faruk and Bambang Suprihatin  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012014  
Pattern recognition for study period of student in Mathematics Department with C4.5 algorithm data mining technique at the Faculty of Mathematics and Natural Science Universitas Sriwijaya  
Sugandi Yahdin, Anita Desiani, Ali Amran, Desty Rodiah and Solehan  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012015  
**Gilmore and gomory model on two dimensional multiple stock size cutting stock problem**  
**Sisca Octarina, Vinny Ananda and Evi Yuliza**  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012016  
A path analysis model of students' statistics achievement  
Dian Cahyawati, Wahyudin and Sufyani Prabawanto  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012017  
Timetable creation of BRT Trans Musi Palembang on AAL Ampera route  
Irmeilyana, Indrawati, Ali Amran and Reyfaldo Tomy  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012018  
Analyzing characteristics of Songket Palembang weavers productivity using path analysis  
Privacy and Cookies policy. 

PAPER • OPEN ACCESS

## Gilmore and gomory model on two dimensional multiple stock size cutting stock problem

To cite this article: Sisca Octarina *et al* 2019 *J. Phys.: Conf. Ser.* **1282** 012015

View the [article online](#) for updates and enhancements.

You may also like

- [Predicting AC loss in practical superconductors](#)  
F Gömory, J Šouc, M Vojeniak et al.
- [AC losses in a commercial Bi:2223/Ag tape](#)  
S Çelebi and Düzgün
- [Critical current and AC loss analysis of a superconducting power transmission cable with ferromagnetic diverters](#)  
M Vojeniak, J Šouc and F Gömory



The Electrochemical Society  
Advancing solid state & electrochemical science & technology

243rd Meeting with SOFC-XVIII

Boston, MA • May 28 – June 2, 2023

Accelerate scientific discovery!

Learn More & Register





# Gilmore and gomory model on two dimensional multiple stock size cutting stock problem

SiscaOctarina\*, VinnyAnanda, EviYuliza

Department of Mathematics, Faculty of Mathematics and Natural Sciences  
UniversitasSriwijaya, South Sumatra, Indonesia

Email: \*sisca\_octarina@unsri.ac.id

**Abstract.** Two-dimensional Multiple Stock Size Cutting Stock Problem (MSS2DCSP) is an optimization problem in determining the optimal cutting pattern of materials with length and width variables. The optimal cutting pattern is needed to minimize the number of materials used. This research implemented the pattern generation algorithm to generate Gilmore and Gomory models on every variation of material size. The first stage generated the pattern based on the length, followed by a pattern generated based on the width on the next stage. Then, Gilmore and Gomory models were generated according to the size of the material, where the Gilmore and Gomory model constraints ensured that strips cut in the first stage cutting were used in the second stage cutting and met all product requirements. The Branch and Bound method were used to determine the minimum size of the material sheets needed.

## 1. Introduction

Manufacturing is one of the most prominent industry in Indonesia. The industry uses a great variety of materials including iron, leather, paper, glass, and wood, where some raw materials have a standardized size. Companies must cut the raw material to smaller sizes according to their needs. This process often produced residual cuts called trim loss. Trim loss is formed due to improper cutting patterns, resulting in an excessive use of raw materials. This is a problem to manufacturing companies, as they must minimize raw materials usage to maximize productivity.

Research on cutting patterns has been widely carried out including the Pattern Generation (PG) algorithm to solve CSP [1]. The implementation of the PG algorithm in a 2-dimensional multiple stock CSP was completed using the Column Generation Technique (CGT) [2]. On the other side, the implementation of PG algorithm in 2-dimensional CSP with predetermined cutting locations and the completion using Branch and Bound Algorithm have also been done [3]. CGT was also used to solve the Multiple Width CSP (MWCSP) [4].

Two dimensional CSP with different raw material sizes is then solved by a modified heuristic algorithm [5]. Further research on 2-dimensional CSP by guillotine cutting was also completed using Column Generation Heuristic [6]. While the research on 2-dimensional CSP with different raw material sizes and there was little damage to each raw material used was also completed using the heuristic algorithm [7].

Based on this background, this study expanded from the application of CGT on 1-dimensional CSP into 2-dimensional CSP with various sizes of raw materials. This study uses data of CSP based on a plate, where the plate provided consisted of multiple stock sizes and was completed using the Branch



and Bound method. The importance of this model can be used to find the proper cutting pattern with minimal trim loss. This model can also be applied to another cutting stock problem.

## 2. Literature Review

Literary studies that support and relate to this research, including Cutting Stock Problem (CSP), Pattern Generation (PG), Gilmore and Gomory Model, and Branch and Bound Method.

### 2.1. Cutting Stock Problem (CSP)

Cutting Stock Problem (CSP) was first introduced in England in 1930 by Leonid Kantorovich. Later in 1960, Gilmore and Gomory completed CSP using the Linear Program (LP) approach. After that, the development of CSP completion methods was carried out. CSP is a problem of cutting raw materials with a standard size that will be cut according to the demanded size of the product with a minimum trim loss [9].

### 2.2. Pattern Generation (PG)

The stocks with standard length ( $l'_k$ ) and standard width ( $w'_k$ ) where  $k$  indicates the number of raw materials used and  $k = 1, 2, 3, \dots$ , have cut to the certain length ( $l_i$ ) and width ( $w_i$ ) with  $n$  sizes of demand and  $i$  is the number of demand sizes and  $i = 1, 2, 3, \dots, n$ . The objective is to find the cutting pattern with minimum trim loss and fulfill the demand.

The steps in PG algorithm according to [1] are as follows:

1. Sort the length  $l_i$  ( $i = 1, 2, \dots, n$ ) in decreasing order.
2. Fill the first column ( $j = 1$ ) of the matrix

$$a_{ijk} = \left\lfloor \frac{l'_k - \sum_{z=1}^{i-1} a_{zjk} l_z}{l_i} \right\rfloor \quad (1)$$

3. Count the cut loss from the cutting pattern

$$c_{jk} = l'_k - \sum_{i=1}^n a_{ijk} l_i \quad (2)$$

4. Set index level (row index)  $i$  to  $n - 1$ .

5. Check the current vertices in  $i$  level, e.g. vertex  $(i, j)$ . If the vertex has 0 value ( $a_{ijk} = 0$ ), go to Step 7. Otherwise, generate new column  $j = j + 1$  with the following elements:

- a. Elements to fill the preceding vertex  $(i, j)$  is  $a_{zjk} = a_{z(j-1)k}$  ( $z = 1, 2, \dots, i - 1$ ). (3)

- b. Elements to fill vertex  $(i, j)$  is  $a_{ijk} = a_{i(j-1)k} - 1$ . (4)

- c. The remaining vertex from  $j$ , fill with Eq (1)

6. Count the cut loss from the  $j$ -th cutting pattern by using Eq(2). Go back to step 4.

7. Reduction of index  $i$ , with  $i_f = i_{f-1} - 1$ , where  $f = 1, 2, 3, \dots, n - 1$ . If  $i_f > 0$  redo Step 5. If  $i_f = 0$ , then STOP.

### 2.3. Gilmore and Gomory Model

The two-dimensional CSP model was first proposed by Gilmore and Gomory in 1961. Gilmore and Gomory completed a two-dimensional CSP in two stages. The first stage produced strips that had been cut based on length or width, which then would be cut back into the demand item in the second stage. Gilmore and Gomory formulated this problem into the Model (5).

$$\text{Minimize } Z = \sum_{j \in J_0} \lambda_j^0 \quad (5)$$

Subject to:

$$M' \bar{\lambda} = \mathbf{0} \quad (5.a)$$

$$M'' \bar{\lambda} \geq \mathbf{b} \quad (5.b)$$

$$\bar{\lambda} \geq \mathbf{0} \text{ and integer} \quad (5.c)$$

Where as

$J_0$  is the feasible cutting pattern which used in the first stage,  $\lambda_j^0$  is the  $j$ th cutting pattern which is used in the first stage,  $\lambda_j^s$  is the  $j$ th cutting pattern which corresponds to the set of  $s$  th cutting pattern in the second stage, where  $s \in \{1, 2, \dots, m'\}$ ,  $\mathbf{b}$  is the column vector where the entries are the number of

demand of  $i$ th item,  $\bar{\lambda} = [\lambda_1^0 \dots \lambda_j^0 \lambda_1^1 \dots \lambda_j^1 \dots \lambda_1^{m'} \dots \lambda_j^{m'}]^T$ ,  $M'$  and  $M''$  is the first row and last row from  $M$  matrix.

#### 2.4. Branch and Bound Method

The Branch and Bound method is an approach to solve problems based on the division of all feasible solutions to a problem into smaller sub-problems [9]. Then, this sub-problem is solved systematically until the optimal solution is obtained.

In determining the vertex that must be investigated first and the vertex that does not cut there is the most common searching strategy, namely:

- a. Depth-First (Last-In, First-Out)  
This method completes the last resolved sub-problem at branching.
- b. First-In, First-Out  
This method completes the first subproblem solved in branching.
- c. Best-Bound-First  
This method does branching on vertices with the largest Z value.

Steps in Branch and Bound method:

- a. Initialization
- b. Selection of a vertex
- c. Update lower bound
- d. Infeasible deduction
- e. Limit cutting
- f. Update upper bound and cutting optimality
- g. Branching

### 3. Methodology

This study implements PG algorithm into the Gilmore and Gomory model of the Two Dimensional Multiple Stock Size Cutting Stock Problem (2DMSSCSP). The steps in this study are as follows:

- a. Describe data. The data includes the length and width of the raw material, the length and width of the product, and the number of products demanded.
- b. Sort the size of the product from the largest to the smallest size, then implemented into the PG algorithm.
- c. Apply the PG algorithm to the 2-dimensional CSP to obtain the first cutting pattern based on the length, and a cutting pattern based on width for the second stage.
- d. Form a searching tree cutting pattern based on the PG algorithm and represent it in table form.
- e. Form a table of Gilmore and Gomory model.
- f. Form the Gilmore and Gomory model based on the first cutting pattern and the second cutting pattern.
- g. Complete the Gilmore and Gomory model using the Branch and Bound method and the Linear Interactive General Optimizer (LINGO) application 13.0.
- h. Analyze the final results.

### 4. Results

This research used the data with the plated material of the stock. The sizes of stocks can be seen in Table 1. The sizes and the number of demand for products can be seen in Table 2.

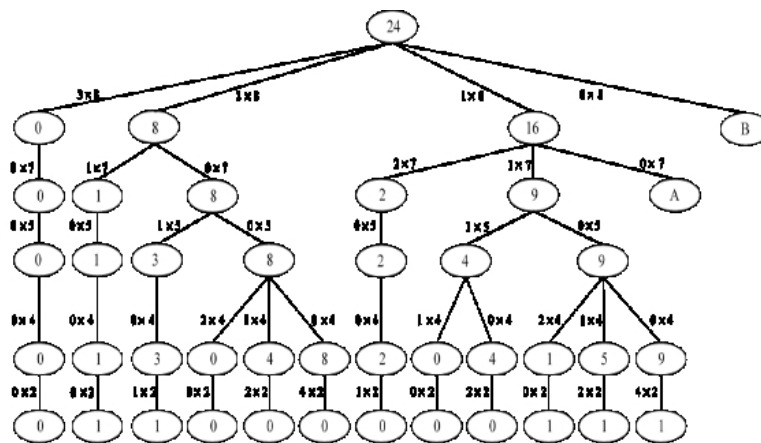
**Table 1.** The sizes of stocks

The $i$ -th stocks	Length (inches)	Width (inches)
1	24	14
2	24	13
3	18	10
4	13	10

**Table 2.**The demand sizes

<i>i</i> -th product	Length (inches)	Width (inches)	Number of Demand
1	2	1	5
2	4	2	5
3	5	3	2
4	7	4	3
5	8	5	2

Based on Table 1, there are 4 stocks with different length and width. There are 5 products with different length and width and also number of demand can be seen in Table 2. By implementing the PG algorithm, there are 63, 29, and 14 cutting patterns which correspond to the length of 24 inches, 18 inches, and 13 inches respectively. By cutting based on the width of 14 inches, 13 inches, and 10 inches, there are 70, 57, and 29 cutting patterns. One of the searching tree for 24 inches stocks can be seen in Figure 1.



**Figure 1.**The searching tree of cutting patterns based on length

Based on the cutting patterns, the next step is forming Gilmore and Gomory model that can be seen in Eq. (6-10).

$$\text{Minimize } \sum_{j=1}^{63} \lambda_j^0 \tag{6}$$

Subject to (5.a), (5.b) and (5.c)

$$\text{where } \bar{\lambda} = [\lambda_1^0 \dots \lambda_{63}^0 \lambda_1^1 \lambda_1^2 \dots \lambda_7^2 \lambda_1^3 \dots \lambda_{16}^3 \lambda_1^4 \dots \lambda_{23}^4 \lambda_1^5 \dots \lambda_{23}^5]^T$$

$$\text{Minimize } \sum_{j=1}^{63} \lambda_j^0 \tag{7}$$

Subject to (6.a), (6.b) and (6.c)

$$\text{where } \bar{\lambda} = [\lambda_1^0 \dots \lambda_{63}^0 \lambda_1^1 \lambda_1^2 \dots \lambda_6^2 \lambda_1^3 \dots \lambda_{14}^3 \lambda_1^4 \dots \lambda_{18}^4 \lambda_1^5 \dots \lambda_{18}^5]^T$$

$$\text{Minimize } \sum_{j=1}^{29} \lambda_j^0 \tag{8}$$

Subject to (6.a), (6.b) and (6.c)

$$\text{where } \bar{\lambda} = [\lambda_1^0 \dots \lambda_{29}^0 \lambda_1^1 \lambda_1^2 \dots \lambda_5^2 \lambda_1^3 \dots \lambda_8^3 \lambda_1^4 \dots \lambda_9^4 \lambda_1^5 \dots \lambda_6^5]^T$$

$$\text{Minimize } \sum_{j=1}^{14} \lambda_j^0 \tag{9}$$

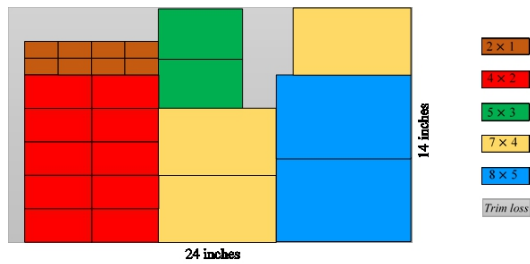
Subject to (6.a), (6.b) and (6.c)

$$\text{Where } \bar{\lambda} = [\lambda_1^0 \dots \lambda_{14}^0 \lambda_1^1 \lambda_1^2 \dots \lambda_5^2 \lambda_1^3 \dots \lambda_8^3 \lambda_1^4 \dots \lambda_9^4 \lambda_1^5 \dots \lambda_6^5]^T$$

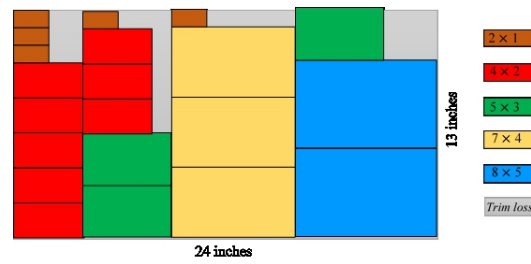
Model (6) is Gilmore and Gomory Model for the first stock, Model (7) is for the second stock and Model (8) and (9) are for the third and fourth stock respectively.

The optimal solution by using Branch and Bound method and LINGO 13.0 shows that the value of  $Z = 1$  with  $\lambda_{10}^0 = 1, \lambda_5^2 = 2, \lambda_{21}^4 = 1, \text{ and } \lambda_{23}^5 = 1$  for the first stock,  $Z = 1$  with  $\lambda_8^0 = 1, \lambda_5^2 = 1, \lambda_{10}^3 = 1, \lambda_{18}^4 = 1, \text{ and } \lambda_{18}^5 = 1$  for the second stock,  $Z = 2$ , with  $\lambda_1^0 = 1, \lambda_9^0 = 1, \lambda_1^1 = 1, \lambda_5^2 = 1, \lambda_7^4 = 1, \lambda_8^4 = 1, \text{ and } \lambda_6^5 = 2$  for the third stock, and  $Z = 3$  with  $\lambda_2^0 = 1, \lambda_4^0 = 2, \lambda_3^2 = 1, \lambda_4^3 = 2, \lambda_8^4 = 1, \lambda_9^4 = 1, \lambda_6^5 = 1$  for the fourth stock.

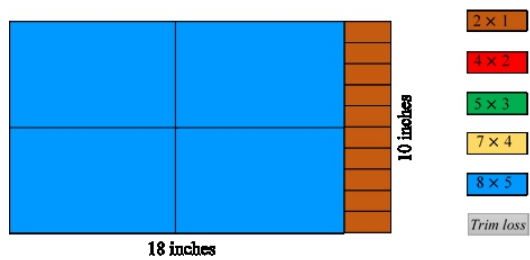
Based on the counting there are some of optimal cutting patterns that shown in Figure 2 to 8.



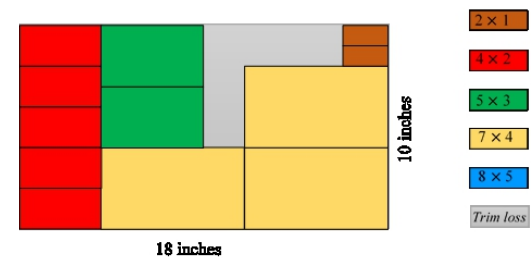
**Figure 2.**The combination of cutting patterns on firststock



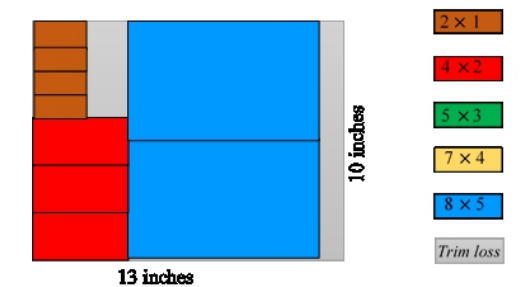
**Figure 3.**The combination of cutting patterns on second stock



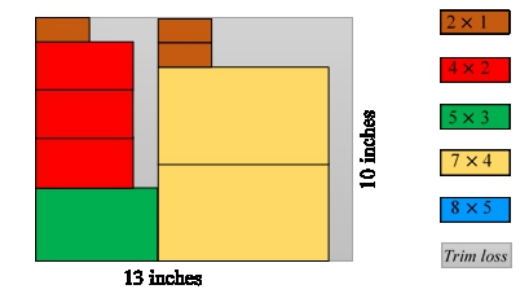
**Figure 4.**The first combination of cutting pattern on the third stock



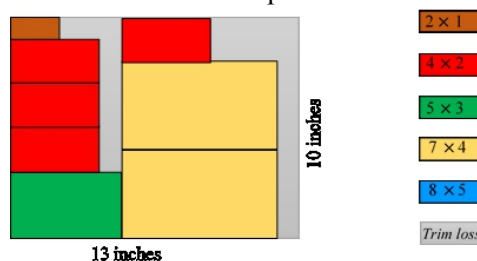
**Figure 5.**The second combination of cutting pattern on the third stock



**Figure 6.**The first combination of cutting pattern on the fourth stock



**Figure 7.**The second combination of cutting pattern on the fourth stock



**Figure 8.**The third combination of cutting pattern on the fourth stock

Figure 2 - Figure 8, show the combination of cutting pattern for each stock. There are one combination of first and second stock, two combinations of third stock and three combinations of

fourth stock. The number of products that will be produced based on the combination of cutting patterns can be seen in Table 3.

**Table 3.**The number of products that will be produced

No.	The size of demand	Number of products (plates)
1.	2 inches× 1 inch	33
2.	4 inches× 2 inches	33
3.	5 inches× 3 inches	9
4.	7 inches× 4 inches	13
5.	8 inches× 5 inches	11

Based on the results that can be seen in Table 3, there are five sizes of demand with each number of products. The greatest number of products are for 2 inches 1 inch and 4 inches 2 inches, 33 plates respectively.

## 5. Conclusion

Based on the result, the solution of Gilmore and Gomory model in MSS2DCSP by using Branch and Bound shows that the minimum number of stocks which used to fulfill the demands are 1 plate of 24 inches 14 inches, 1 plate of 24 inches 13 inches, 2 plates of 18 inches 10 inches, and 3 plates of 13 inches 10 inches.

## References

- [1] Suliman S M A 2001 Pattern generating procedure for the cutting stock problem *International Journal of Production Economics* **74** 293–301
- [2] Mellouli A and Dammak A 2008 An algorithm for the two-dimensional cutting stock problem based on a pattern generation procedure, *Information and Management Sciences* **19** (2) 201–218
- [3] Rodrigo W N P, Daundasekara W B, and Perera, A A I 2012 Pattern generation for two-dimensional cutting stock problem with location *Indian Journal of Computer Science and Engineering (IJCSE)* **3** (2) 354–368.
- [4] Octarina S, Bangun P B J, dan Sihombing J 2017 Application of pattern generation and column generation technique in multiple width cutting stock problem, *Proceeding National Seminar of Mathematics*, University of Tadulako
- [5] Rao J, Popplewell N, and Balakhrisnan S 2006 An improved heuristic for the two dimensional cutting stock problem with multiple sized stock sheet *International Journal of Industrial Engineering* **13** (2) 198–206
- [6] Furini F, Malaguti E, Duran R M, Persiani A, and Toth P 2012 A column generation heuristic for the two-dimensional two-staged guillotine cutting stock problem with multiple stock size. *European Journal of Operation Research* **218** (1) 251–260
- [7] Jin M, Ge P, and Ren P 2015A new heuristic algorithm for two-dimensional defective stock guillotine cutting stock problem with multiple stock size, *Technical Gazette* **22** (5) 1107–1116
- [8] Andrade R, Birgin E G, and Morabito R 2014 Two-stage two-dimensional guillotine cutting stock problem with usable leftover, *International Transactions in Operational Research* **23** (1) 121–145
- [9] Chen D S, Batson R G, and Dang Y 2010 *Applied Integer Programming Modeling and Solution* New Jersey, John Wiley & Sons.



# Sriwijaya International Conference on Basic and Applied Sciences



## Certificate

Number: 19/SicBas/2018

This is to certify that:

**Sisca Octarina**

served as

**Presenter**

in the Sriwijaya International Conference on Basic and Applied Sciences (SICBAS) 2018

*"Sciences for Sustainable Development"*

Palembang, November 6-7, 2018



**Prof. Dr. Iskhan Iskandar, M.Sc.**

Dean of Mathematics & Natural Sciences Faculty,  
Sriwijaya University



**Dr. Fiber Monado, M.Si.**

Head of Committee

