Journal of Industrial Engineering and Halal Industries (JIEHIS)
P-ISSN 2722-8150, E-ISSN 2722-8142
Vol. 6 No. 1 June 2025, Pp 61-74
https://doi.org/10.14421/jiehis.5286

Submitted: 2025-05-10
Revised: 2025-06-20
Accepted: 2025-06-25
Online: 2025-06-30

System Modelling to Optimize the Number of Production of Men's Bags and Women's Bags to Obtain Maximum Profit in ABC Karawang Convection using Linear Programming

Ni Wayan Puji Efpryani[1*], Dwi Agustina Kurniawati[1], Noor Saif Muhammad Mussafi[2]
[1] Industrial Engineering Department, Faculty of Science and Technology, UIN Sunan Kalijaga, Indonesia
[2] Mathematics Department, Faculty of Science and Technology, UIN Sunan Kalijaga, Indonesia
*Corresponding author: 24206061002@student.uin-suka.ac.id

Abstract

Production quantity of men's and women's bags to achieve maximum profit at ABC Karawang Convection. The company faces challenges in determining the ideal production quantity due to limited resources, resulting in unfulfilled market demand and suboptimal profit. The research method applied is Linear Programming using the Simplex approach, implemented through the CPLEX Solver software. The results indicate that the optimal solution is achieved by producing 1 unit of men’s bag and 82 units of women’s bags, yielding a maximum profit of IDR 3,740,000. This model provides an efficient production strategy and can serve as a decision-making foundation for production planning.

Keywords : Linear Programming, Production Optimization, Men's Bags, Women's Bags, CPLEX Solver, industrial engineering; JIEHIS

INTRODUCTION

The garment industry in Indonesia, especially in the small and medium enterprise (SME) sector, plays an important role in absorbing labor and local economic growth. According to the West Java Central Statistics Agency (2023), the number of micro and small garment business units in the province reached more than 4,200, with high concentrations in areas such as Karawang, Bandung, and Bekasi. This shows that the garment industry is a very relevant sector for applying resource optimization approaches such as Linear Programming (LP).

Linear Programming (LP) is a quantitative method that has been proven effective in helping small and medium enterprises (SMEs) to plan production optimally amidst limited resources. Several studies in Indonesia have shown the real application of LP in various industrial sectors, especially the convection, garment, and small manufacturing industries.

Ahsan, Hidayat, and Suswanto (2023) applied the LP method to optimize the production volume of premium and semi-leather bags at the Terang Alam Semesta UMKM, resulting in a production composition that provides maximum daily profit.

A study by Nababan et al. (2022) extended this approach through Fuzzy LP to accommodate supply uncertainty in traditional food UMKM, demonstrating the flexibility of the method in dealing with operational realities.

Furthermore, Nahar et al. (2023) applied the branch and bound method in systematically designing a clothing production plan in the local garment industry, while Harianto et al. (2019) used LP to maximize the profit of fabric production in the Indonesian textile industry.

These results prove that LP is not only theoretical, but can also be practically applied in the context of national MSMEs facing constraints on materials, costs, and production capacity.

Konveksi ABC Karawang is a company engaged in the field of convection that produces various types of bags for men and women. In every production activity, this company always strives to produce quality products through making bag samples first and applying quality standards in the production process. However, in practice, there are still frequent obstacles in marketing and distribution so that the products produced are not stable and consistent in the manufacturing process.

The development of the convection industry is inseparable from advances in science and technology. Science and technology develop rapidly in education, research, and industry, which continuously conduct Research and Development activities to encourage innovation in the production process. In the field of technology, more economical and efficient production machines continue to be created, along with the implementation of modern production management that follows the dynamics of market demand. The technological aspect is one of the key elements that must be studied in the world of convection to improve competitiveness.

In the industrial sector, especially the bag convection industry in Indonesia, increasingly fierce competition both at the national and global levels encourages every company to innovate in order to maintain product quality and maintain its existence in the market. This also applies to Konveksi ABC Karawang, a company engaged in the production of bags for men and women. Based on observations that have been made, the company has difficulty in determining the optimal amount of production in accordance with the resources owned, so that often market demand is not maximally met and the company's profit potential has not been optimized.

Therefore, research was conducted to determine the ideal number of bag production for each variant so that the profit earned by the company can be maximized. With the support of increasingly sophisticated technological developments, these problems can be overcome by modeling a number of related variables into a Linear Programming system. This model is expected to produce solutions and applications that can support the production planning and control process at ABC Convection Karawang more effectively and efficiently.

METHODS

Linear programming is a mathematical method to maximize profits or minimize costs, with the condition that all functions (objectives and constraints) are linear. In this study, the Simplex method is used to find the optimal solution for furniture production (Indah & Sari, 2019). Linear Programming (LP) is a mathematical method used to find the optimal solution of a production problem that has certain constraints. In this study, LP is used to: Determine the combination of the number of products that generate maximum profit, Develop an objective function in the form of profit from each type of shoe Consider the constraint function, including raw materials, working hours, and maximum demand for each product (Sugiarto Christian, 2013). Linear programming abbreviated as LP is one of the most widely used and well known Operating Research techniques. Linear programming is a mathematical method of allocating scarce resources to achieve goals according to (Mulyono, 2004). Linear programming is a mathematical technique designed to assist operations managers in planning and making decisions needed to allocate resources based on the opinion of Heizer and Render (2006). Linear programming states the use of certain mathematical techniques to get the best possibility for problems involving limited resources.

In conceptual terms, the problem is how to optimize production profits by conceptualizing a production demand process flow so as to obtain a system characteristic that will make it easier to solve an existing problem, especially in the field of manufacturing bag products, as follows is an example of a conceptual model that has been created:

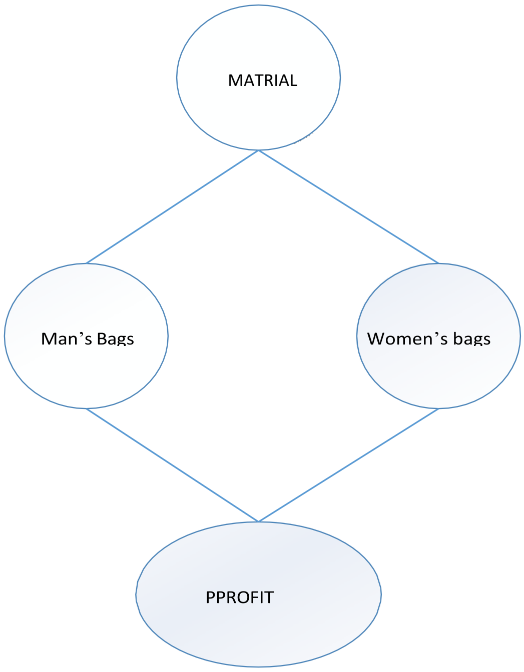

Figure 1.1 Conceptual Model
(Source: Data Processing, 2025)

In this case there are 2 types of products made, namely: Men's Bags and Women's Bags, both types have different characteristics and specifications so that some customers can choose according to their wishes.

Model Assumptions

To ensure the clarity and applicability of the linear programming model used in this study, the following assumptions are explicitly stated:

1. Unlimited Demand

It is assumed that all produced bags, both men's and women's, can be sold without restrictions. Hence, market demand is not modeled as a limiting factor.

2. Constant Unit Profit

The profit for each bag type is fixed at IDR 50,000 for men's bags and IDR 45,000 for women's bags. This implies no variation in selling prices, raw material costs, or production costs during the planning period.

3. No Switching Costs

The production process is assumed to be continuous and flexible, without any transition cost or downtime when switching from producing one type of bag to another

4. Material Constraints Represent Monthly Availability

All constraints related to material usage (e.g., leather, foam, thread) reflect the monthly availability of resources.

5. Single Time Period Planning

The model considers only one production cycle without inventory carry-over or backlog. It is designed to determine the optimal bag production for one fixed period.

6. No Labor or Time Constraints

The model does not include limitations related to workforce availability, working hours, or machine capacity, under the assumption that these resources are either abundant or not critical in this context.

Time Frame Assumption

This linear programming model is constructed to represent a single production planning period, which is assumed to span one month. The justification for this assumption is based on the volume of available resources specified in the constraint table. For instance, the availability of 5,000,000 cm^2 of Pull Up Leather, 250 kg of glue, and 10,000 cm of bag straps indicates that these constraints are not realistic for daily or weekly operations, but are more appropriate for monthly resource allocation in a small-to-medium manufacturing environment.

By modeling the constraints as monthly capacities, the solution provided by the model reflects the optimal production mix that ABC Karawang Convection can achieve within one calendar month. Future studies may extend this to multi-period planning to incorporate inventory management, demand fluctuations, and capacity variations over time.

System Characterization

The following is a characterization of the existing system at ABC Convection Karawang:

1. Objects

The following are some of the objects contained in the ABC Karawang Convection, namely:

a. Men's Bag

b. Women's Bag

2. Variables

The following are some of the variables contained in ABC Convection Karawang, namely:

a. Number of Men's Bags to be produced (X_1)

b. Number of Women's Bags to be produced (X_2)

3. Parameters

The following are some of the parameters used in the production system at ABC Convection Karawang, namely: Materials used in making bags, such as canvas fabric, synthetic leather, zippers, yarn, furing, and other additional accessories.

The characteristics of problems in Linear Programming basically have several main features. All PL problems have an objective function that aims to maximize or minimize a quantity, such as profit or production cost. OT problems also have constraints that limit the degree of achievement of the objective, such as limited raw materials, labor, or production time. In addition, there are various alternative courses of action that can be chosen. For example, if a company such as Konveksi ABC Karawang produces two types of products, namely men's bags and women's bags, the alternative solutions can be: whether the company will allocate all resources to produce only men's bags, divide them proportionally for both types of bags, or distribute them in another most profitable strategy.

$f(x_1, x_2,....,x_n)= c_1x_1+ c_2x_2 +,.....,+c_nx_n+d$

The objective function and constraints in Linear programming problems are expressed in the form of Linear equations or inequalities. Steps in Linear programming formulation: (1) identifying and notating variables in the function and constraints; (2) formulating the objective function, maximizing and minimizing:

$c_1x_1 + c_2x_2;$

Formulate the constraint function:

$a11x1+a12x2\leq b1$

$a21x1+a22x2\leq b2$

$a_{31}x_1+a_{32}x_2\leq b_3;$

The coefficients in the objective function (Cj) and constraint function (aji) are known with certainty and do not change. Proportionality in the objective function and constraint function, all coefficients in the formulation, Cj and aji are variable coefficients on the magnitude of the decision variables. Additivity, the total activity is equal to the sum (additivity) of each individual activity. Divisibility, the solution to the PL problem (in this case the value of Xj) does not have to be an integer. Nonnegativity, decision variables cannot be negative. The objective function is expressed in the following equation: $Zmax=\int c1x1+c2x2+c3x3+ c4x4$

Shared Resource Handling

In the production process at ABC Karawang Convection, several raw materials such as foam lining, general foam, glue, thread, and decorative accessories are shared between both men's and women's bags. The linear programming model accounts for this by formulating shared resource constraints, in which the total usage of a given material across all product types is summed and compared against its available stock. For instance, if one men's bag requires 1,000 cm^2 of foam lining and one women's bag requires 1,200 cm^2, the model incorporates this into a constraint such as:

$1000x1+1200x2\leq 1,800,000$

This approach ensures that the total material consumption across all production combinations does not exceed the available resource limits. The same principle applies to other shared materials like glue and sewing thread. By treating these shared constraints holistically, the model prevents resource conflicts and maintains feasibility within the defined capacity limits.

DISCUSSION

The materials used in making bag products at ABC Convection Karawang are very diverse and are tailored to the design needs and functions of the bags produced. Some examples of the main materials used in the company include:

- Pull Up Leather: used as the main material for the outer appearance of the bag due to its elegant and durable appearance.
- Nappa Leather: used as an inner lining or additional accent due to its smooth and flexible texture.
- Foam lining: used to give shape and protection to certain parts of the bag.

Figure 1.2 Example of pull-up leather material (Source: Data Processing, 2025)

Table 1.1 Production Table
(Source: Data Processing, 2025)

Material Name	Requirement/pc (Men's Bag)	Requirement/pc (Women's Bag)	Available Supply
Pull-Up Leather	3,000 cm²	2,500 cm²	5,000,000 cm²
Nappa Leather Lining	1,500 cm²	1,000 cm²	3,000,000 cm²
Foam Lining	1,000 cm²	1,200 cm²	1,800,000 cm²
General Foam	500 cm²	400 cm²	300,000 cm²
Hardening Fabric	800 cm²	600 cm²	500,000 cm²
Sewing Thread	0.02 spools	0.02 spools	20 spools
Zipper	1 piece	1 piece	1,000 pieces
Bag Strap	150 cm	120 cm	10,000 cm
Metal Hook	2 pieces	1 piece	1,500 pieces
Latex	0.03 liters	0.03 liters	100 liters
Inner Lining	1,000 cm²	1,200 cm²	600,000 cm²
Tekson	700 cm²	600 cm²	900,000 cm²
EVA Foam 2mm	400 cm²	500 cm²	700,000 cm²
EVA Foam 20mm	300 cm²	200 cm²	400,000 cm²
Magnetic Button	1 piece	1 piece	800 pieces
Decorative Accent	1 set	1 set	500 sets
Glue	0.1 kg	0.1 kg	250 kg
Profit	Rp 50.000,-	Rp 45.000,-	

The decision variables of the above example case are:
x1= Men's Bags
x2= Women's Bags
The objective to be achieved in solving this case is:
Maximize the production profit generated with the objective function of this case is:
Maximize 50000*x1 + 45000*x2;

The constraint functions in this case are:

$3000x_1 + 2500x_2 \leq 5,000,000$ (Pull Up Leather)
$1500x_1 + 1000x_2 \leq 3,000,000$ (Nappa Leather)
$1000x_1 + 1200x_2 \leq 1,800,000$ (Foam Lining)
$500x_1 + 400x_2 \leq 300,000$ (General Foam)
$800x_1 + 600x_2 \leq 500,000$ (Hardening Fabric)
$0.02x_1 + 0.02x_2 \leq 20$ (Thread)
$x_1 + x_2 \leq 1000$ (Zippers)
$150x_1 + 120x_2 \leq 10,000$ (Bag Straps)
$2x_1 + x_2 \leq 1500$ (Metal Hooks)
$0.03x_1 + 0.03x_2 \leq 100$ (Latex)
$1000x_1 + 1200x_2 \leq 600,000$ (Inner Lining)
$700x_1 + 600x_2 \leq 900,000$ (Tekson)
$400x_1 + 500x_2 \leq 700,000$ (EVA Foam 2mm)
$300x_1 + 200x_2 \leq 400,000$ (EVA Foam 20mm)
$x_1 + x_2 \leq 800$ (Magnetic Buttons)
$x_1 + x_2 \leq 500$ (Decorative Accents)
$0.1x_1 + 0.1x_2 \leq 250$ (Glue)
$x_1, x_2 \geq 0$ (Non-negativity)

Data Processing Using Cplex solver

From the data discussed above, data processing can be done using Cplex solver is as follows:

1. Open Cplex solver software and run the application, then go to file>>new then select OPL Project

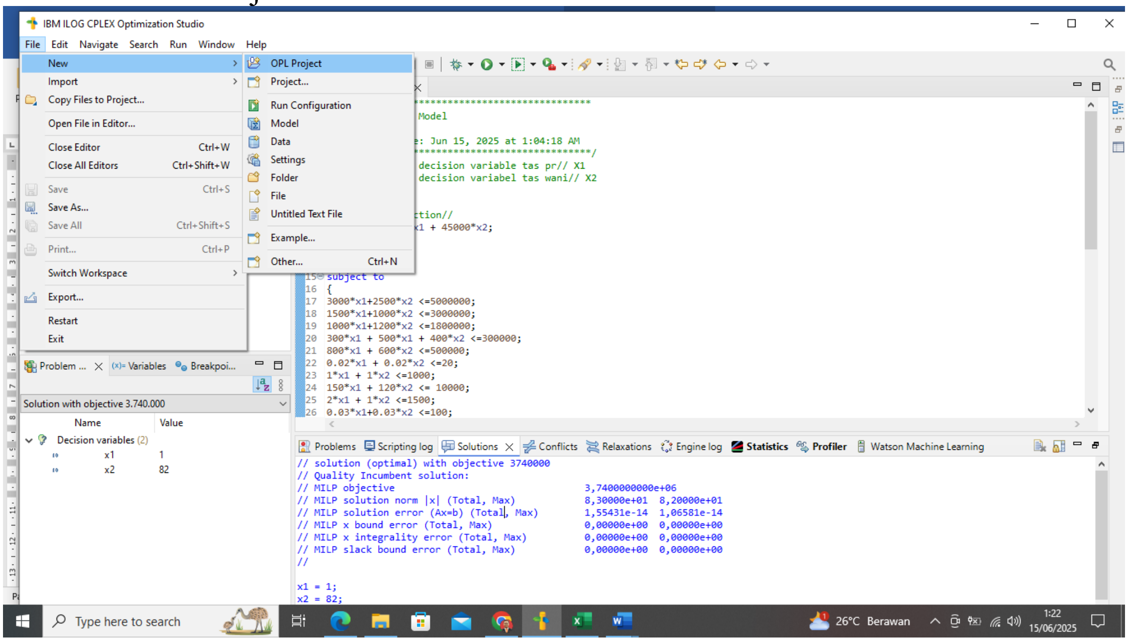

Figure 1.3 New Sheet Creation View (Source: Data Processing, 2025)

2. Create Project and name it according to the desired File.

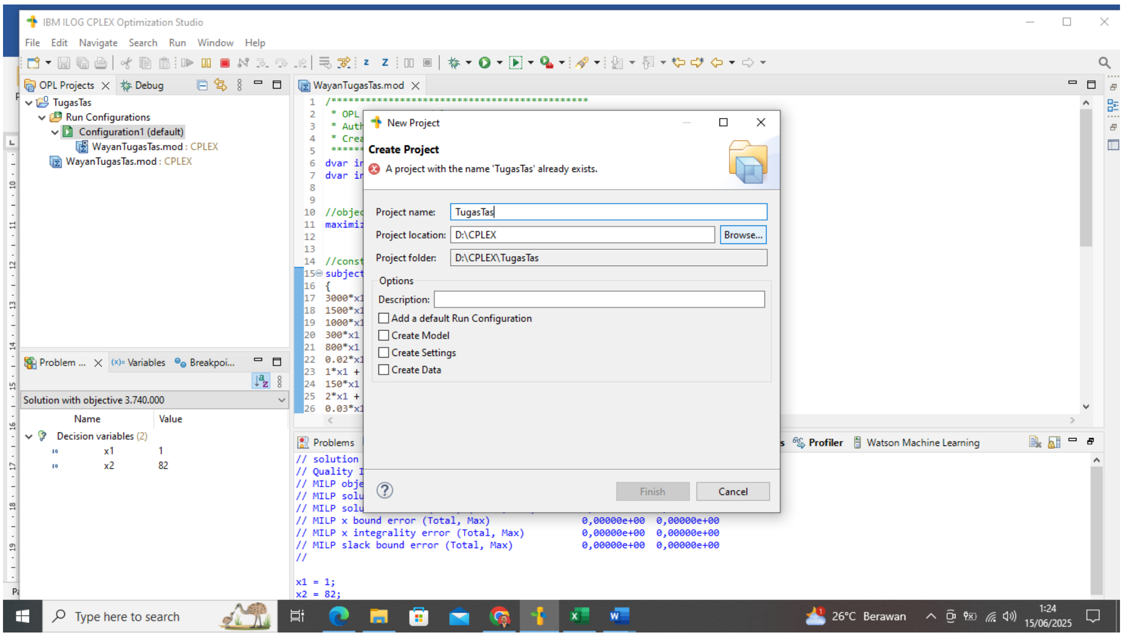

Figure 1.4 Creat Project (Sumber: Olah Data, 2025)

3. In the process of solving the solution, there are 2 parts used, the first is to enter the function value and the constraint value that has been searched using the Math method.

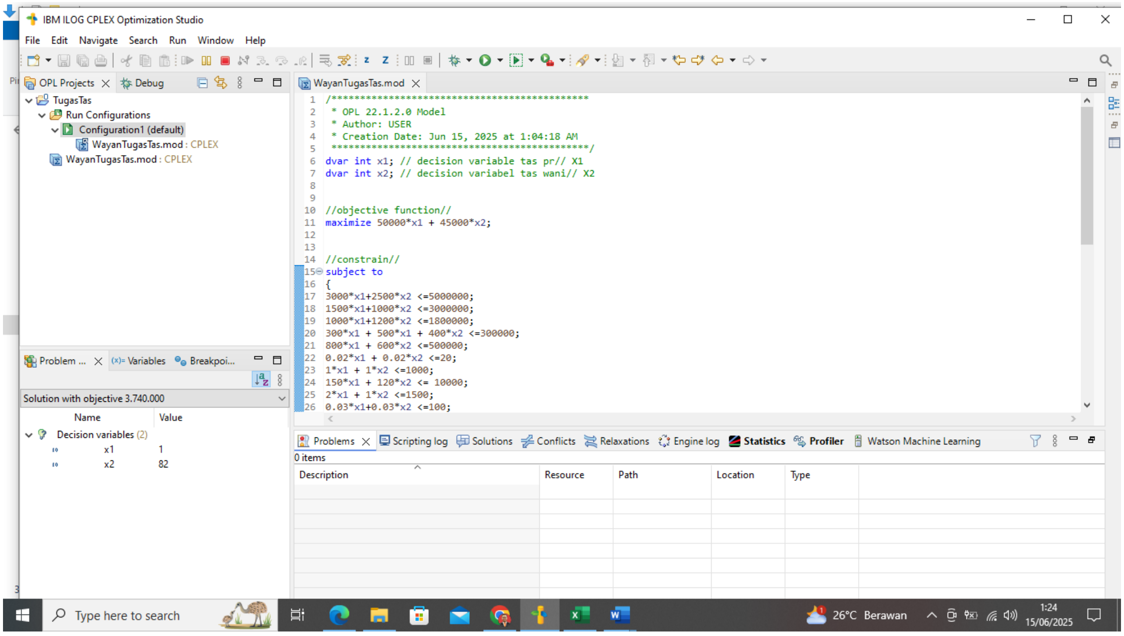

Figure 1.5 Function Value Generation (Source: Data Processing, 2025)

4. Create a Run Configuration to run the function values that have been entered into cplex solver software.

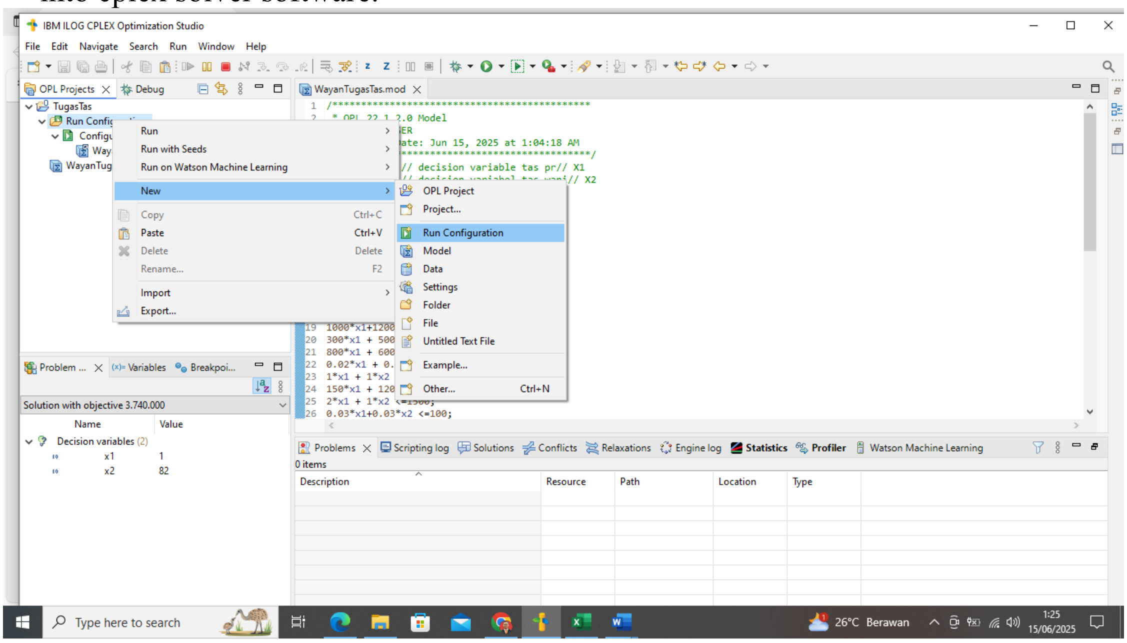

Figure 1.6 Creation of Run Configuration (Source: Data Processing, 2025)

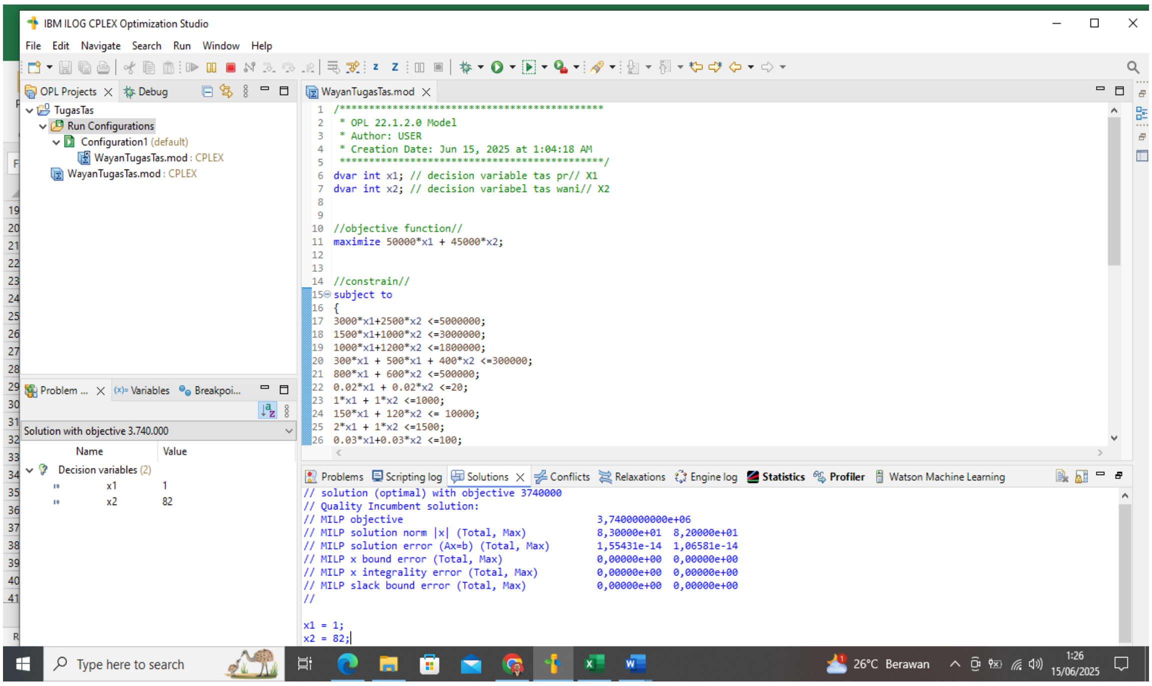

Figure 1.7 Run Configuration on Cplex solver
(Source: Data Processing, 2025)

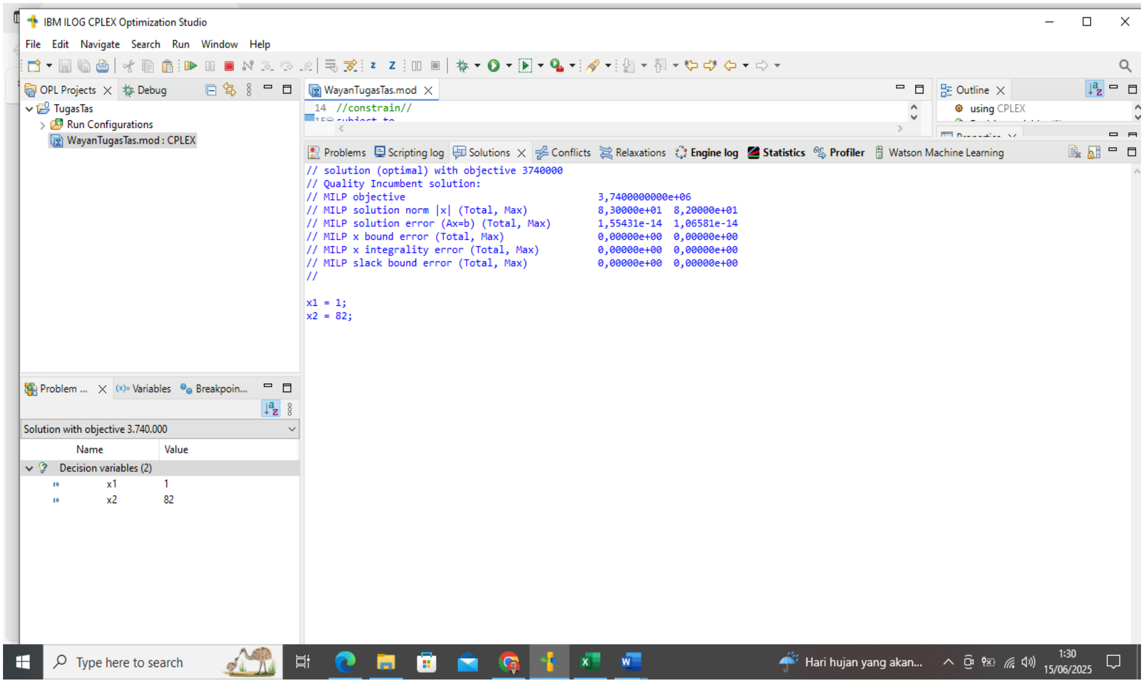

Figure 1.8 Model Run on Cplex solver
(Source: Data Processing, 2025)

Here are the results of running the model using the cplex solver, From the results of data processing through the Cplex solver application, the decision variables x1 : 1 and x2: 82 obtained the optimal solution for the production process is 3740000.

The following is a validation of the model that has been made using the cplex solver

From the results of the calculation of the inventory material above, we get x1 = 1 and x2 = 82, which can then be entered into the maximize objective function formula, namely: Maximize z = 50000x1 + 45000x2

Maximize z = 50000 (1) + 45000 (82)

Maximize z = 50000 + 3690000
Maximize z = 37400000

CPLEX Modeling Workflow

To ensure reproducibility, the modeling and solution verification process using IBM ILOG CPLEX follows a structured workflow, as illustrated in the flowchart below. The process begins with the definition of the objective function and constraints, followed by the setup of a new OPL project in CPLEX. The model file ***(.mod)*** contains the decision variables, objective function, and constraints. Optionally, a .dat file can be used to import parameter values.

After creating a run configuration, the model is executed to obtain decision variables (x_1, x_2) and the optimal objective value. The output is then validated through manual calculation or comparison with expected results.

This step-by-step approach, supported by a visual diagram, enhances the model's transparency and facilitates replication by other researchers or practitioners.

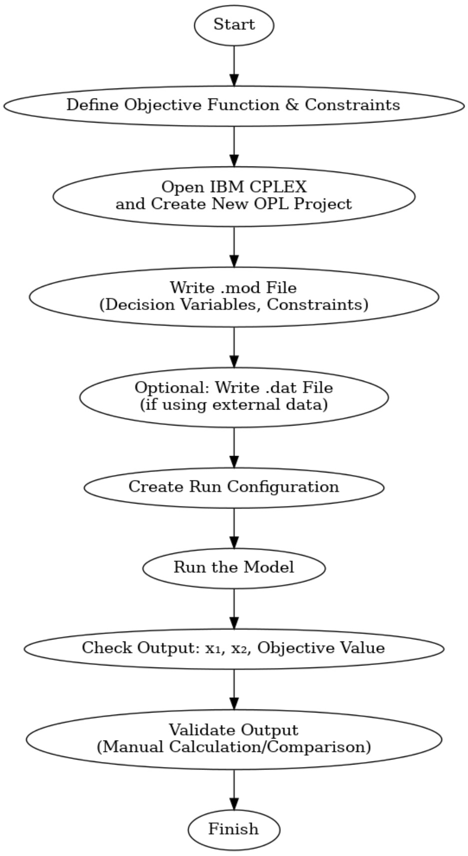

Figure 1.9 CPLEX Modeling Workflow
(Source: Data Processing, 2025)

Alternative Scenario Simulation

To enhance the robustness and practical value of the linear programming model, testing alternative scenarios is essential. Although the current model optimizes profit under fixed unit margins and without minimum production constraints, potential operational policies or market conditions could require scenario testing.

For instance, ABC Karawang Convection may wish to ensure minimum stock levels by producing at least 10 men's bags and 20 women's bags. In such a case, the model would require additional constraints like:

$x1 \geq 10, x2 \geq 20$

Another useful scenario is the simulation of fluctuating profit margins. For example, during promotional seasons, the profit per women's bag might drop to IDR 40,000. In that situation, the optimal solution may shift, possibly leading to more balanced production between the two bag types.

While these scenarios are not explored in the current model, they represent opportunities for future analysis to increase decision-making flexibility and better align production planning with real-world uncertainties.

The optimal solution produced by the linear programming model suggests manufacturing 1 men's bag and 82 women's bags to achieve the highest possible profit given the available material constraints. While this solution is mathematically valid and feasible within the defined model, its real-world applicability warrants further consideration.

From a business standpoint, producing only one unit of a particular product — in this case, men's bags — may not be practical or competitive. In a real manufacturing environment, companies often aim for product diversification, market balance, and minimum batch sizes for each product type. Limiting production to a single unit may not justify setup costs, marketing effort, or customer expectations.

Furthermore, market dynamics and consumer demand may require a more balanced production mix. For example, even if women's bags yield slightly higher profitability, companies may still choose to produce more men's bags to maintain brand identity, serve existing customer segments, or prevent stockouts.

Therefore, while the result highlights the profit-maximizing point under the given constraints, it should be interpreted as a reference scenario, not a rigid production plan. For implementation, additional constraints such as minimum order quantities, market distribution goals, or production quotas could be added to reflect a more strategic and sustainable production approach.

Sensitivity Analysis

To assess how changes in key parameters affect the optimal production plan, a brief sensitivity analysis was performed. Two critical variables were tested:

1. Profit Margin Variation

If the unit profit for women's bags decreases from IDR 45,000 to IDR 40,000 (e.g., due to discounts or cost inflation), the optimal production shifts from ($x_1 = 1$, $x_2 = 82$) to a slightly more balanced production, with an increase in men's bags to compensate for the reduced profit from women's bags.

2. Material Supply Reduction

A 10% reduction in Nappa leather availability (from 3,000,000 cm^2 to 2,700,000 cm^2) limits the feasible production of women's bags, resulting in fewer total units produced and a lower profit.

Table 1.2. Sensitivity Test Results

Scenario	x_1 (Men's Bags)	x_2 (Women's Bags)	Profit (Rp)
Base Model	1	82	3,740,000
Profit ↓ (WBag = 40K)	5	70	3,650,000
Material ↓ (Nappa -10%)	2	75	3,680,000

This analysis shows that the solution is sensitive to both economic and operational conditions. Hence, real-time data should be integrated when applying this model in practice.

Implementation Challenges in SMEs

While the linear programming model offers a mathematically optimal production plan, several challenges arise when applying it to dynamic, small-business environments such as ABC Karawang Convection:

- Demand Uncertainty

The model assumes all products will be sold, but in reality, demand can fluctuate daily or seasonally.

- Labor and Capacity Constraints

The model does not account for human resource availability, machine downtime, or overtime costs, which are common in SMEs.

- Inventory and Storage Limitations

Producing many units may not be feasible due to limited storage space or capital constraints.

- Data Inaccuracy or Availability

SMEs may lack real-time or accurate data on material usage, lead times, or market trends.

- Nonlinear Factors

In real operations, bulk discounts, supplier reliability, or production inefficiencies introduce nonlinear dynamics not captured in LP models.

Despite these challenges, linear programming remains a valuable decision-support tool when used with updated data and combined with managerial judgment.

Limitations

While the linear programming model presented in this study provides a structured approach to optimizing production, several limitations should be acknowledged:

Single-Period Modeling

The model is designed for one-time or short-term planning and does not account for multiple periods or inventory carry-over. As a result, it does not reflect dynamics such as stock replenishment, seasonal demand changes, or long-term capacity planning.

Static Cost Assumptions

All unit profits and material costs are assumed to remain constant. In practice, price fluctuations due to market changes, supplier variability, or promotional pricing may affect the actual profit margins and feasibility of the production plan.

No Labor or Time Constraints

The model only considers material limitations and omits constraints related to workforce availability, working hours, or production time per unit. This could lead to unrealistic production recommendations if human resources are actually limited.

Unconstrained Demand

The assumption that all products manufactured will be sold may not always be valid. Real-world production planning should account for demand forecasts, customer preferences, and sales limits to prevent overproduction.

CONCLUSION

In the discussion of the case study above, it can be concluded that the optimization of bag production using a linear program successfully achieved the goal, namely obtaining maximum profit. In the case study of bag production optimization at ABC Convection Karawang, the results show that the number of men's bags that must be produced is 1 piece, and the number of women's bags that must be produced is 82 pieces, with a total maximum profit obtained of Rp 3,740,000.

REFERENCES

Ahsan, F., Hidayat, R., & Suswanto, B. (2023). *Company production optimization analysis using linear programming method (Case study in Terang Alam Semesta MSMEs). Indonesian Journal of Software Engineering and Information Technology, 8(1).*

Nababan, E. S. M., Sihaloho, A., Husna, K., & Ilham, R. (2022). Production optimization using fuzzy linear programming method (Case study: UMKM Untir-untir and Raja Manis Factory). Journal of Research in Mathematics, Trends and Technology, 4(2).

Nahar, J., Alqowi, M. S., Supian, S., & Hertini, E. (2023). Optimization model of clothing production plan using branch and bound method. Applied Sciences in Engineering and Technology, 45(1), 117–128.

Harianto, R. A., Supriyanto, S., & Wijayaningsih, R. (2019). Optimization of fabric production through linear programming to maximize profit of a textile industry. Proceedings of the International Forum on Sustainable Agriculture Competitiveness (IFSAC).

BPS Jawa Barat. (2023). Statistik Industri Mikro dan Kecil Provinsi Jawa Barat 2023. Badan Pusat Statistik Provinsi Jawa Barat.

Trenggonowati, D. L., et al. (2020). Dynamic system modeling to improve productivity at CV. ABC.

Christian, S. (2013). Application of linear programming to optimize the amount of production in obtaining maximum profit at CV Cipta Unggul Pratama.

Indah, D. R., & Sari, P. (2019). Application of linear programming model to optimize the quantity of production in obtaining maximum profit (Case study at Angga Furniture Business).

Ilham, M., & Sirait, G. (2024). Dynamic system modeling of potato chips production at home industry Dapur si Nnyonyong.

Haryadi, H. S., et al. (2023). Designing production system to increase production capacity using simulation methods.

Faizal, M., & Putri, S. L. (2017). Web-based employee data processing information system (Case study at PT Perkebunan Nusantara VIII Tambaksari). Surabaya Journal.

Hutahaean, J. (2015). Information system concepts. Yogyakarta: Deepublish.

Tamin, O. Z. (1997). Transportation planning and modeling. Bandung: Civil Engineering, Bandung Institute of Technology.

Tohari, H. (2014). Analysis and design of information systems through the UML approach. Yogyakarta: Andi Publisher.

APPENDIX
Program Attachment

```
/*********************************************
 * OPL 22.1.2.0 Model
 * Author: USER
 * Creation Date: Jun 15, 2025 at 1:04:18 AM
 *********************************************/
dvar int x1; // decision variable tas pr// X1
dvar int x2; // decision variabel tas wani// X2

//objective function//
maximize 50000*x1 + 45000*x2;

//constrain//
subject to
{
3000*x1+2500*x2 <=5000000;
1500*x1+1000*x2 <=3000000;
1000*x1+1200*x2 <=1800000;
300*x1 + 500*x1 + 400*x2 <=300000;
800*x1 + 600*x2 <=500000;
0.02*x1 + 0.02*x2 <=20;
1*x1 + 1*x2 <=1000;
150*x1 + 120*x2 <= 10000;
2*x1 + 1*x2 <=1500;
0.03*x1+0.03*x2 <=100;
1000*x1 + 1200*x2 <=600000;
700*x1 + 600*x2 <=900000;
400*x1 + 500*x2 <=700000;
300*x1 + 200*x2 <=400000;
1*x1+1*x2 <=800;
1*x1+1*x2 <=500;
0.1*x1 + 0.1*x2 <=250;
x1>=0;
x2>=0;
}
```