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Product pricing based on customer perception quality and service convenience using interval type-2 fuzzy logic system

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ABSTRACT

In the competitive landscape of customer goods, particularly in the wrapping paper industry, pricing strategies are critical to achieving market success. This study presents a novel approach to product pricing by integrating customer perception quality and service and convenience factors using interval type-2 fuzzy logic system (IT2FLS). The customer perception quality factor is subdivided into material quality and aesthetics design sub-factors while the service and convenience factor comprise web-based ordering system as well as the web-based post-sale customer engagement. The methodology involves collecting data through customer surveys and expert evaluations to quantify the perceived importance and performance of each sub-factor. The IT2FLS is employed to handle the inherent uncertainty and imprecision in experts' judgment, providing a robust framework for aggregating these qualitative assessments into a comprehensive pricing model. This IT2FLS allows for the dynamic adjustment of pricing based on fluctuating customer perceptions and service levels. The outcome of the proposed IT2FLS is a pricing factor that serves as a multiplier for the standard product price established by the company. The new product prices have been validated also considering historical data and it was found that the prices remain acceptable to customers without drastically impacting sales. This study contributes to the body of knowledge on pricing strategies by offering a sophisticated, mathematically grounded approach that accounts for the complex, fuzzy nature of customer preferences. The proposed model not only enhances pricing accuracy but also provides a flexible tool for managers to adapt pricing strategies in real-time based on customer feedback and service performance.

1. Introduction

One of the essential determinants in the achievement of product sales success is the establishment of a price for the product that motivates customers to remit the full purchase cost. This approach is referred to product pricing strategy, which will increase the likelihood of customer willingness to pay (WTP), which at the planning phase, the WTP be analysed by monitoring the historical sales data in relation to price fluctuations and customers segments [1]. Conventional product price can be established by computing the production expenses and incorporating expected profit. Nevertheless, industry must take into account growth prospects that necessitate extra resources funded by revenues generated from product sales [2]. Therefore, establishing product prices becomes a vital task for the ongoing operation of an industry.

In order to enhance the WTP of the customers and getting more profit, it is crucial to establish product pricing exogenously, with a specific emphasis on customers [3]-[5]. The triangle of quality, performance and price of the product must be built upon customers perceptions. When customers have a bad perception of a product, they are unwilling to pay its selling price or make a purchase. Conversely, when the customers have a favourable perception of the product, the they will have a high WTP, which can lead to substantial profits [6]-[8]. The identification of factors that impact the quality and performance of a product must be conducted in accordance with the specific nature of the product intended for sale. For instance, a product that is widely consumed will possess value if it is consistently available to meet customer's demand. Therefore, the assessment of product quality and performance will be based on the service level to the customers that related to inventory management [9]-[11]. Unlike unique-made products, the quality of a product is influenced by the quality [12]-[14], the product design [15]-[17] as well as the quality of the services [18]-[20].

The assessment of customer perception of the quality of the product can be conducted by providing questionnaires to the customers. Nevertheless, it has been seen that quantitative evaluations of customers' opinions might differ despite having same perceptions. Hence, employing a modelling approach that relies on natural language variables, such as "high", "in between high and medium", "medium", "in between medium and low", or "low" that have continuous domain, rather than numerical values that have discrete domain, will result in a more equitable study of customers opinions. Fuzzy logic system (FLS) will be the suitable method for that purpose [21]. While FLS has been extensively utilised by earlier academics, there is a need for an interval set to represent the subjective opinions of modellers when a single set is insufficient. During its evolution, the fuzzy set in FLS has transformed into an interval fuzzy set, which is now referred to as interval type-2 fuzzy logic (IT2FLS) [22]. The IT2FLS is able to cope with uncertainty better than type-1 fuzzy logic [23].

There are numerous previous studies on product pricing. Nanni and Ordanini [24] have investigated the effect of digital signage for promoting price discount. Finding of that study mentioned that digital signage has significant effect to promote discounted price to the customers compared to traditional method, when it was analysed using linear model. Other studies that implemented discount strategy in the product pricing can be found in [25]-[27]. Several previous researchers have conducted studies examining the correlation between customer perceived quality and product pricing [28]-[30]. The study findings indicate that superior product quality can be used to establish selling prices that exceed the norm. Nevertheless, certain categories of products are not subject to a decrease in consumer opinion regarding product quality when discounts are offered [31].

The dynamic nature of exogenous factors in affecting product prices makes FLS a viable option for modelling these issues. Zhao et al. [32] did a study on estimating the selling prices of products for two competing companies. They utilised FLS to create a model that takes into account unpredictable market conditions that impact the product prices. Establishing the selling price of a product can also be accomplished by identifying the suitable marketing approach for the new product. Liao [33] utilised the fuzzy-analytical hierarchy and multi-segment goal programming method to ascertain the optimal approach for a new product, and subsequently establish the appropriate selling price for the product. Cardone et al [34] have used a fuzzy partition-driven genetic algorithm to determine the selling price of a real estate by considering both customer preferences and market offerings. A robust-fuzzy pricing has been considered in the sustainable supply chain design [35] and an optimised fuzzy inference system has been utilised to predict oil and gas price [36]. Previous studies have shown that FLS has great potential for accurately representing uncertainty in product pricing.

This study examines the product pricing analysis of wrapping paper products, specifically taking into account exogenous aspects such as customer perception quality and service and convenience factors. From the customer's standpoint, the perceived quality of a wrapping paper product is determined by the quality of raw materials that are pliable yet resistant to tearing, as well as an aesthetical design. Additionally, the service and convenience aspects are analysed from the web-based ordering system that customers utilise to place an order online, as well as the web-based post-sale customer engagement that facilitates discussions following a purchase. The investigation will be conducted based on three the expert perspectives in the company under investigation, specifically from the domains of marketing, purchasing, and data analysis. In order to account for the subjective nature of the experts, the IT2FLS method is employed to represent their perspectives. Output of the proposed IT2FLS is a pricing factor that will be utilised as a multiplier for the company's predetermined typical selling price. The recommended selling price will be confirmed by comparing it to previous data on selling prices that are still deemed acceptable by the market. This work makes a noteworthy contribution by utilising IT2FLS in determining the pricing of wrapping paper products. It takes into account two external criteria mentioned earlier and also includes a validation mechanism that uses historical data on appropriate selling price.

2. Method

This research was conducted in five distinct stages: firstly, the current situation was analysed through system descriptions; secondly, input data in the form of questionnaire responses from consumers were processed; thirdly, an IT2FLS model was created; fourthly, the output of the IT2FLS model was analysed; and finally, the results obtained were analysed to ensure feasible for presentation to the company under investigation. The final step is drawing conclusions Fig. 1 depicts the flow diagram of this study.

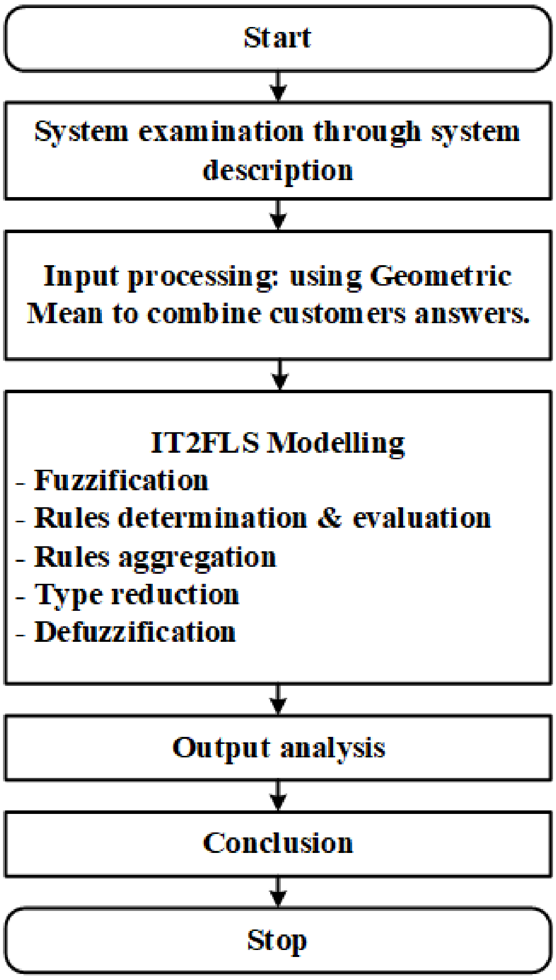

Fig. 1. Flow diagram of this study

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2.1. System description

This study was conducted at a wrapping paper company that manufactures and sells the products, both within the country and internationally. In addition to taking into account production costs, selling prices have until far been established based on intuition, without evaluating perceived quality and customers' convenience and the impact of price changes on sales volume. Actually, when customers are satisfied, increasing the selling price does not affect the sales volume. Nevertheless, the company has not conducted any analysis on this matter either.

The company currently possesses a website system that serves the purpose of marketing and engaging with the customers. Innovation activities frequently involve modifications to products, such as altering its colour, pattern, and design. Nevertheless, the impact of the product's innovation on customers satisfaction has not been examined, and this analysis should serve as the foundation for establishing the product pricing.

2.2. Input processing

The input dataset utilised in this study comprises the outcomes of a questionnaire administered to a sample of numerous customers of the company. Every input factor will be queried with several questions, and each question item will be assigned a weight based on its significance from the customer's viewpoint and assessed using a Likert scale. Geometric Mean method (as shown in Eq. (1)) is a regularly employed approach by previous researchers to derive the final value from a dataset that includes minimum, average, and maximum values [37]-[38]. This method can alleviate the consequences of extremely high or extremely low data, and the final value is formulated as follows [39].

$$G_q(a_1, a_2, \dots, a_n) = \left(\prod_{i=1}^{n} a_i\right)^{1/n} \tag{1}$$

Where:

G : the geometric mean value of question-q.
a : raw data
n : number of data

The aggregate score for the factor will be calculated by summing the weighted value of each question, expressed by Eq. (2).

$$FS_f = \sum_{q=1}^{Q} G_q \times w_q \tag{2}$$

Where:

FS : aggregate score of input factor-*f*
w : weight of question-*q* of factor-*f*
Q : number of questions for input factor-*f*

2.3. IT2FLS modelling

Analysing data using a traditional FLS typically involves four steps that are fuzzification, determining and evaluating fuzzy rules, using an inference engine, and output defuzzification. However, this study used IT2FLS analysis, which utilises interval fuzzy sets for both input and output variables. Therefore, an additional step, known as type reduction, is required prior to the output defuzzification step. In this study, there are 4 input variables namely material quality (*MQ*), aesthetic design (*AD*), web-based ordering system (*WO*), and web-based post-sale customer engagement (*QA*) to determine the output which is pricing factor (*PF*) as explained in the previous section. Fig. 2 shows the steps of converting the input variables into output using the proposed IT2FLS, while the subsequent sub-sections provide a comprehensive explanation of each of these steps.

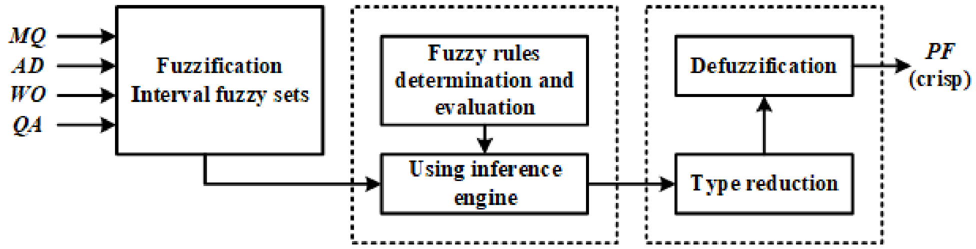
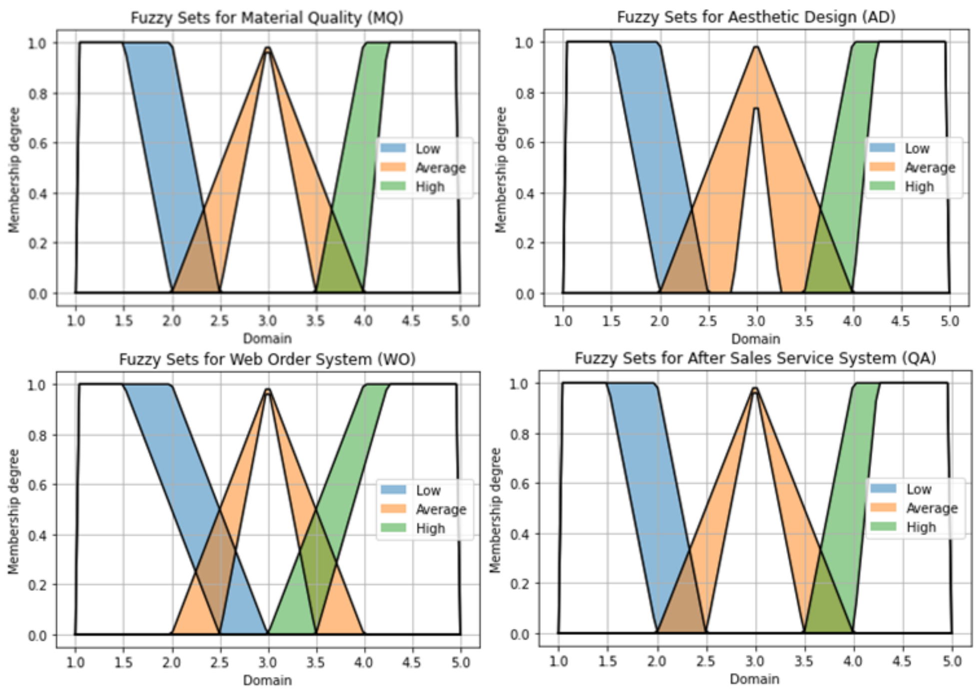


Fig. 2. The steps of converting input variables into output using the proposed IT2FLS

2.3.1. Fuzzification

The first step of the IT2FLS is the fuzzification of the input and output variables. This procedure involves converting precise input values into fuzzy sets to account for the uncertainty and imprecision that is inherent in real-world data. The Likert scaled input variables will be modelled using Interval Type-2 Fuzzy Sets (IT2FS), which may accommodate a range of membership values instead of a single precise value. This approach captures the inherent uncertainty and imprecision in expert judgement. The fuzzy sets in the IT2FS for each input variable will be determined by combining triangular and trapezoidal fuzzy sets. The middle interval will reflect the most probable range of values, while the full range will indicate the level of variability.

Similarly, the output variable will also undergo fuzzification. This procedure entails establishing the limits of the intervals for the membership functions by utilising historical pricing factor data and expert knowledge. The final PF output will serve as a multiplier for the standard selling price of the product, which includes production expenses and the expected profit. According to historical data, the lowest *PF* value is observed when the company does not effectively manage the quality of raw materials and design, as well as the timeliness of response to consumers. Under those circumstances, the company is only able to increase the selling price by 10%, resulting in a minimum PF value of 1.1. The company attained its best PF score by prioritising the quality and design of the product, together with promptly addressing consumer needs. Under those circumstances, the selling price can increase by up to 250% without causing a major decrease in sales volume, therefore, the domain of PF is discovered to be between 1.1 and 2.5. Fig. 3 below shows the IT2FS for the input and output variables.



(a) IT2FS for input variables

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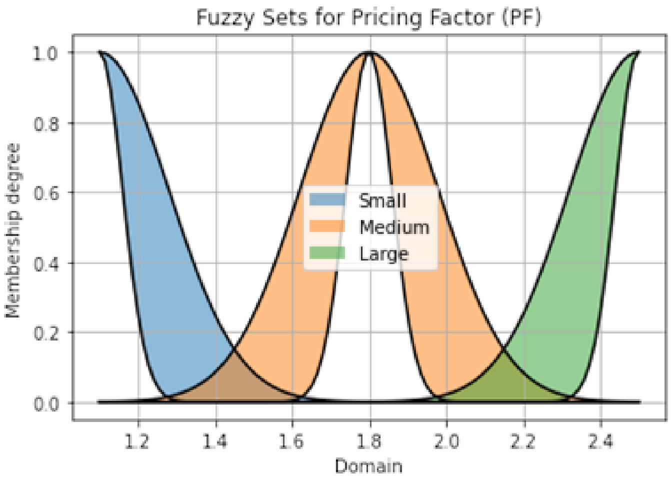

(b) IT2FS for the output variable

Fig. 3. IT2FS for the input and output variables

2.3.2. Fuzzy rules determination and evaluation

Human experts with domain-specific knowledge are responsible for determining the fuzzy rules that are essential to IT2FLS [40]-[43]. In this study, the rules in the IT2FLS were established by three human experts within the company, specifically individuals with expertise in data science, marketing, and product design. There are 12 fuzzy rules as follows:

R1 : IF MQ is High OR AD is High AND WO is High OR QA is High THEN PF is Large

R2 : IF MQ is Average AND AD is High AND WO is High AND QS is Average the PF is Large

R3 : IF MQ is Average AND AD is High AND WO is Average OR QS is Average the PF is Large

R4 : IF MQ is Average OR AD is Average AND WO is High OR QS is High the PF is Large

R5 : IF MQ is Low AND AD is Average AND WO is High AND QS is High the PF is Medium

R6 : IF MQ is Average AND AD is High AND WO is Average AND QS is Average the PF is Medium

R7 : IF MQ is Average OR AD is Low AND WO is Average AND QS is High the PF is Medium

R8 : IF MQ is Average AND AD is Average AND WO is Average AND QS is High the PF is Medium

R9 : IF MQ is Low AND AD is Low AND WO is Low AND QS is Low the PF is Small

R10 : IF MQ is Low OR AD is Low AND WO is Low AND QS is Average the PF is Small

R11 : IF MQ is Low AND AD is Low AND WO is Average AND QS is Low the PF is Small

R12 : IF MQ is Low AND AD is Average AND WO is Average AND QS is Low the PF is Small

The conjunctions AND and OR in the antecedent will be modelled using the *min t-norm* and *max s-norm* methods which are more representative than other methods [44]-[46]. For the *min t-norm* when representing the AND logic, let's denote two IT2FS by $\hat{A}$ and $\hat{B}$, and their lower and upper membership functions by $\left[\underline{\mu}_A(x), \overline{\mu}_A(x)\right]$ and $\left[\underline{\mu}_B(x), \overline{\mu}_B(x)\right]$ respectively. The *min t-norm* operation is applied to both the lower and upper membership functions separately, as shown in Eq. (3) – Eq. (4).

$$\underline{\mu}_{A\cap B}(x) = min\left(\underline{\mu}_A(x), \underline{\mu}_B(x)\right) \tag{3}$$

$$\overline{\mu}_{A\cap B}(x) = min\left(\overline{\mu}_A(x), \overline{\mu}_B(x)\right) \tag{4}$$

Therefore, the final interval membership function as the result of the *min t-norm* is presented in Eq. (5).

$$\left[\underline{\mu}_{A\cap B}(x), \overline{\mu}_{A\cap B}(x)\right] = \left[min\left(\underline{\mu}_A(x), \underline{\mu}_B(x)\right), min\left(\overline{\mu}_A(x), \overline{\mu}_B(x)\right)\right] \tag{5}$$

The *max s-norm* uses max function when representing the OR logic, when it is applied to both the lower and upper membership functions, the formula is shown in Eq. (6) – Eq. (7).

$$\underline{\mu}_{A\cap B}(x) = max\left(\underline{\mu}_A(x), \underline{\mu}_B(x)\right) \tag{6}$$

$$\overline{\mu}_{A\cap B}(x) = max\left(\overline{\mu}_A(x), \overline{\mu}_B(x)\right) \tag{7}$$

The final interval membership function of the *max s-norm* is shown in Eq. (8).

$$\left[\underline{\mu}_{A\cap B}(x), \overline{\mu}_{A\cap B}(x)\right] = \left[max\left(\underline{\mu}_A(x), \underline{\mu}_B(x)\right), max\left(\overline{\mu}_A(x), \overline{\mu}_B(x)\right)\right] \tag{8}$$

Where:

$\underline{\mu}, \overline{\mu}$: lower membership function and upper membership function, respectively
A, B : input variables
x : crisp value of the input variable

2.3.3. Rules aggregation

The inference engine will be utilised to consolidate the output of each fuzzy rule, while the type reduction method will be employed to turn the type-2 fuzzy system into a type-1 fuzzy system. The inference engine utilises the centre-of-set method, and the equations employed are shown in Eq. (9) [47].

$$PF(x) = \bigcup_{\substack{f^n \in F^n(x) \\ y^n \in Y^n}} \frac{\sum_{n=1}^{N} f^n y^n}{\sum_{n=1}^{N} f^n} = [y_l, y_u] \tag{9}$$

The y_l and y_u can be determined by Eq. (10) - Eq. (11) [48]-[49].

$$y_l = \min_{k\in[1,N-1]} \frac{\sum_{n=1}^{k} \bar{f}^n \underline{y}^n + \sum_{n=k+1}^{N} \underline{f}^n \underline{y}^n}{\sum_{n=1}^{k} \overline{f}^n + \sum_{n=k+1}^{N} \underline{f}^n} \equiv \frac{\sum_{n=1}^{L} \bar{f}^n \underline{y}^n + \sum_{n=L+1}^{N} \underline{f}^n \underline{y}^n}{\sum_{n=1}^{L} \overline{f}^n + \sum_{n=L+1}^{N} \underline{f}^n} \tag{10}$$

$$y_u = \max_{k\in[1,N-1]} \frac{\sum_{n=1}^{k} \underline{f}^n \overline{y}^n + \sum_{n=k+1}^{N} \overline{f}^n \overline{y}^n}{\sum_{n=1}^{k} \underline{f}^n + \sum_{n=k+1}^{N} \overline{f}^n} \equiv \frac{\sum_{n=1}^{L} \underline{f}^n \overline{y}^n + \sum_{n=L+1}^{N} \overline{f}^n \overline{y}^n}{\sum_{n=1}^{L} \underline{f}^n + \sum_{n=L+1}^{N} \overline{f}^n} \tag{11}$$

Where:

f : firing interval of a fuzzy rule
y : output of a fuzzy rule
n : index of fuzzy rule
N : number of fuzzy rules
k : shifting point from lower to upper fuzzy set

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The value of k for L (lower) and U (upper) (as shown in Eq. (12) - Eq. (13)) will be decided when the following conditions are met.

$$\underline{y}^{L} \leq y_l \leq \underline{y}^{L+1} \quad (12)$$

$$\overline{y}^{U} \leq y_u \leq \overline{y}^{U+1} \quad (13)$$

This study utilised the Karnik-Mendel (KM) algorithm [47] for the type reduction, which is presented below.

The steps of KM algorithm for y_l are presented in Eq. (14) – Eq. (23).

Step 1 : Sort $\underline{y}_n = (n = 1, 2, \ldots, N)$ ascendingly, therefore $\underline{y}^1 \leq \underline{y}^2 \leq \cdots \leq \underline{y}^N$. Calculate the $F^n(x) \times \underline{y}^n$.

Step 2 : Initialise f^n by formula as follows

$$f^n = \frac{\underline{f}^n + \overline{f}^n}{2} \quad (14)$$

Step 3 : Compute:

$$y = \frac{\sum_{n=1}^{N} \underline{y}^n f^n}{\sum_{n=1}^{N} f^n} \quad (15)$$

Step 4 : Find the k $(1 \leq k \leq N-1)$ such that:

$$\underline{y}^k \leq y \leq \underline{y}^{k+1} \quad (16)$$

Step 5 : Define:

$$f^n = \begin{cases} \overline{f}^n, n \leq k \\ \underline{f}^n, n > k \end{cases} \quad (17)$$

Step 6 : Compute:

$$y' = \frac{\sum_{n=1}^{N} \underline{y}^n f^n}{\sum_{n=1}^{N} f^n} \quad (18)$$

Step 7 : Check if $y' = y$, if yes then stop and set $y_l = y$ and $L = k$. If no, go to Step 8.

Step 8 : Set $y = y'$ and go to Step 4.

Similar with KM algorithm for y_l, the KM algorithm for y_u is as follows:

Step 1 : Sort $\overline{y}_n = (n = 1, 2, \ldots, N)$ ascendingly, therefore $\overline{y}^1 \leq \overline{y}^2 \leq \cdots \leq \overline{y}^N$. Calculate the $F^n(x) \times \overline{y}^n$.

Step 2 : Initialise f^n by formula as follows

$$f^n = \frac{\underline{f}^n + \overline{f}^n}{2} \quad (19)$$

Step 3 : Compute:

$$y = \frac{\sum_{n=1}^{N} \overline{y}^n f^n}{\sum_{n=1}^{N} f^n} \quad (20)$$

Step 4 : Find the k $(1 \leq k \leq N-1)$ such that:

$$\overline{y}^k \leq y \leq \overline{y}^{k+1} \quad (21)$$

Step 5 : Define:

$$f^n = \begin{cases} \underline{f}^n, n \le k \\ \overline{f}^n, n > k \end{cases} \quad (22)$$

Step 6 : Compute:

$$y' = \frac{\sum_{n=1}^{N} \overline{y}^n f^n}{\sum_{n=1}^{N} f^n} \quad (23)$$

Step 7 : Check if $y' = y$, if yes then stop and set $y_u = y$ and $U = k$. If no, go to Step 8.

Step 8 : Set $y = y'$ and go to Step 4.

2.3.4. Defuzzification

The defuzzification formula considers the intermediate value of y_l and y_u as the crisp output. The defuzzification formula is presented by Eq. (24).

$$PF = \frac{y_l + y_u}{2} \quad (24)$$

2.4. Output analysis

The result of the suggested IT2FLS is a scalar value that represents a multiplier factor applied to the basic selling price of the product. Therefore, it is crucial to validate the multiplier factor in order to prevent an excessively high selling price that could lead to a significant decrease in product sales or possibly no sales whatsoever.

Several previous researchers have examined the prediction of product selling prices by analysing its historical data [50]-[52] to have better market conditioning and resources planning. Hence, a reverse approach can be employed to validate the selling prices of products, by comparing them with past sales data. This study uses validating the output of product pricing by analysing historical sales data, including the number of sales and the prices at which the products were sold. The analysis was conducted using Microsoft Excel software to derive an equation that relates the selling price of a product to its sales volume. If the selling price result of the IT2FLS is substituted into the equation and does not result in zero sales, then the selling price of the IT2FLS product can be considered valid.

3. Results and Discussions

The questionnaire has been administered to 50 customers of the company and the weight, statistical result, the *G* and *FS* value is shown in Table 1.

Table 1. The weight, statistical result, *G* and *FS* value of the questionnaire

Questions	Weight	Minimum	Average	Maximum	*G*	*FS*
Factor: raw materials quality						
1. The wrapping paper feels durable and sturdy	0.15	3	4.05	5	3.93	3.95
2. Texture of the wrapping paper is smooth and consistent	0.05	3	4.72	5	4.14	
3. The colours of the wrapping paper are vibrant and true to the description	0.05	3	3.82	5	3.86	
4. The wrapping paper has an appealing finish (glossy & matte)	0.10	3	4.16	5	3.97	

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5. The thickness of the wrapping paper is suitable for various wrapping needs	0.05	3	4.78	5	4.15	
6. The wrapping paper does not tear easily during use	0.10	3	4.18	5	3.97	
7. The printed designs on the wrapping paper are of high quality	0.10	3	4.09	5	3.94	
8. The wrapping paper holds up well under tape and other adhesives	0.10	3	4.69	5	4.13	
9. The raw materials used in the wrapping paper appear to be of high quality	0.15	3	3.90	5	3.88	
10. The wrapping paper has a premium look and feel	0.15	3	3.73	5	3.82	
Factor: Aesthetic design						
1. The designs on the wrapping paper are visually appealing	0.20	3	4.11	5	3.95	
2. The color combinations used in the wrapping paper are attractive	0.10	3	3.73	5	3.82	
3. The patterns on the wrapping paper are unique and creative	0.10	2	4.75	5	3.62	
4. The wrapping paper designs suit a variety of occasions (e.g., birthdays, holidays, etc.)	0.10	3	4.23	5	3.99	3.94
5. The wrapping paper designs align well with current trends	0.10	3	4.27	5	4.00	
6. The overall aesthetic of the wrapping paper enhances the gift-giving experience	0.20	3	3.94	5	3.90	
7. I am likely to recommend the wrapping paper to others based on its design	0.20	3	4.69	5	4.13	
Factor: Quality of the web system to place customised order						
1. The website is easy to navigate	0.10	3	4.51	5	4.07	
2. The custom order process is straightforward and simple	0.10	3	3.80	5	3.85	
3. The website loads quickly and performs well	0.05	3	4.66	5	4.12	
4. The design and layout of the website are visually appealing	0.05	2	3.91	5	3.39	
5. It is easy to find information about product options and customisation	0.15	3	4.10	5	3.95	3.94
6. The website provides clear and detailed instructions for placing custom orders	0.10	3	4.46	5	4.06	
7. The payment process on the website is secure and efficient	0.10	3	3.99	5	3.91	
8. The customer support options available on the website are helpful	0.10	3	3.51	5	3.75	

9. The website accurately displays previews of custom wrapping paper designs	0.10	3	4.53	5	4.08	
10. Overall, I am satisfied with my experience using the website to place custom orders	0.15	3	4.35	5	4.03	
Factor: Quality of the web system for after sales service	0.10	3	4.21	5	3.98	4.04
1. The website is easy to use for accessing after-sales services	0.15	3	3.90	5	3.88	
2. It is simple to find the contact information for customer support on the website	0.15	3	4.59	5	4.10	
3. The response time from the customer support team is satisfactory	0.10	3	4.77	5	4.15	
4. The website provides useful and clear information about after-sales services	0.15	3	4.58	5	4.10	
5. The live chat or messaging system on the website is efficient and effective	0.15	3	4.29	5	4.01	
6. The website allows me to easily track and manage my after-sales service requests	0.20	3	4.51	5	4.07	
7. Overall, I am satisfied with the after-sales services provided through the website	0.10	3	4.21	5	3.98	

The IT2FLS has been implemented using the Python programming language. Based on Table 1 above, the input values for *MQ*, *AD*, *WO*, and *QA* are 3.95, 3.94, 3.94, and 4.04 correspondingly. The IT2FLS produces a PF of 1.8. The present basic selling price of the wrapping paper product is IDR 20,000. Therefore, the selling price (*SP*) for the next sales can be set at IDR 36,000, which is 1.8 times the current price.

Prior to being proposed to the company, the new selling price will be verified by comparing it with the historical selling price and sales volume. Table 2 displays past data regarding the selling price and the corresponding sales volume (*SV*). On the other hand, Fig. 4 illustrates the trend line of the relationship between the selling prices and the sales volume.

Table 2. The past data on the selling price and the corresponding sales volume

Data	Selling Price	Sales Volume
1	24000	120
2	32000	90
3	24000	100
4	15000	145
5	26000	95
6	16000	143
7	20000	140
8	20000	138
9	29000	100
10	18000	137
11	30000	98
12	27000	111

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13	18000	140
14	21000	137
15	28000	105

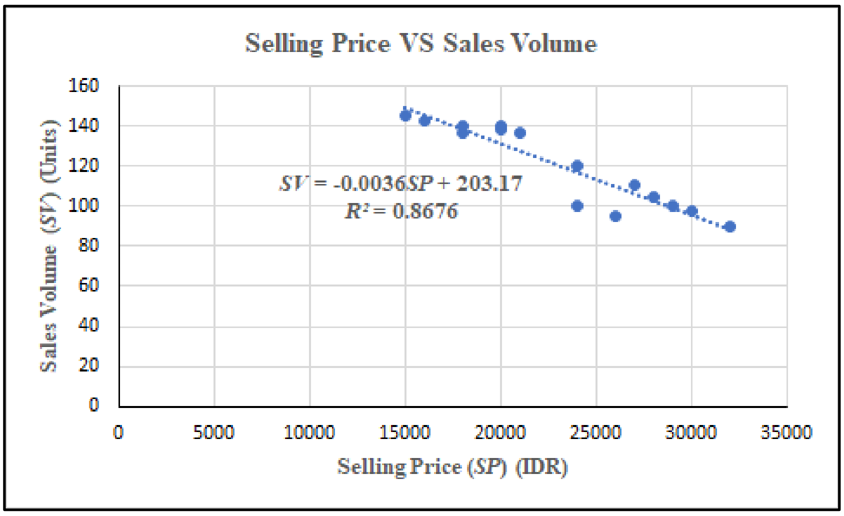

Fig. 4. Trend line of the relationship between the selling prices and the sales volume

The *SV* equation indicates that when all input factors are perceived as unfavourable by customers and no sales occur (*SV* = 0), the maximum *SP* is determined to be IDR 56,436, -. Since the suggested new *SP* remains below the maximum *SP*, it can be concluded that the new product *SP* is worth recommending to the company. Given the new *SP* and assuming that all input elements are perceived unfavourable by customers, the projected *SV* can be calculated as -0.0036 × 36000 + 203.1774 = 74 units. However, the *SV* can be enhanced by increasing the input factors from the customers' perspective, hence making the implementation of the new product's *SP* of IDR 36,000 more viable for the company.

The determination of selling pricing in this study primarily relies on customers perceptions of product quality and service systems. This approach ensures that the selling price of new products is still considered affordable by customers. Historical data clearly demonstrates that the new price remains below the maximum price that consumers are willing to tolerate. This study diverges significantly from the approach taken by previous researchers, specifically Coskun and Yalciner [2], who determined the selling price of products by reducing the overall cost to a level that remained satisfactory to consumers. FLS is employed as a validation technique for proposed new prices.

4. Conclusion

This study presents the development of an IT2FLS with the purpose of recommending the most suitable pricing for wrapping paper. The system takes into account several criteria such as material quality, aesthetic design, web-based ordering system, and web-based post-sale customer engagement. The proposed model recommends a price that is below the maximum threshold at which the company does not make any sales, demonstrating its potential for practical implementation in the company's pricing strategy. By leveraging the IT2FLS, the company can better navigate the complexities of market dynamics, customer preferences and experts' opinion.

While the study provides valuable insights, it is not without limitations. Future research could expand the model's scope by including additional factors and applying it to other product categories. Optimisation of the fuzzy sets' parameters, real-world validation and iterative refinement of the model based on actual sales data are recommended to further enhance its reliability and effectiveness.

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