International Journal of Mechanical, Industrial and Aerospace Sciences
ISSN: 2517-9950
Vol:7, No:10, 2013

Pricing Strategy Selection Using Fuzzy Linear Programming

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***Abstract*—**Marketing establishes a communication network between producers and consumers. Nowadays, marketing approach is customer-focused and products are directly oriented to meet customer needs. Marketing, which is a long process, needs organization and management. Therefore strategic marketing planning becomes more and more important in today's competitive conditions. Main focus of this paper is to evaluate pricing strategies and select the best pricing strategy solution while considering internal and external factors influencing the company's pricing decisions associated with new product development. To reflect the decision maker's subjective preference information and to determine the weight vector of factors (attributes), the fuzzy linear programming technique for multidimensional analysis of preference (LINMAP) under intuitionistic fuzzy (IF) environments is used.

***Keywords*—**IF Sets, LINMAP, MAGDM, Marketing.

I. Introduction

MARKETING is a vital factor in accelerating economic activities between producers and consumers. Finding needed goods and services at desired location with readily available amounts is very important for consumers. Thereby consumers can easily benefit from goods and services in the extent of their purchasing power.

Marketing, which is a long process, needs organization and management. Therefore the term "marketing strategy" is widely used. At the most macro level, marketing strategy focuses on manipulations of marketing mix variables (4P) – product, price, place and promotion [1]. Another definition of strategy in marketing with a broader perspective of strategy claims that strategic market planning is a four-step process: defining the business, setting a mission, selecting functional plans for marketing, production, and other areas, and budgeting for those plans [2]. Thus the strategic marketing planning becomes more and more important in today's competitive conditions.

One of the marketing mix variables is the price of the product and decisions surrounding the overall pricing strategies of company. Pricing is the process of determining what a company will receive in exchange for its products. Price, is basically about the charging of the product however, pricing is not that simple. Price should be considered with the segmentation and the positioning of the product because price naturally brings a classification to the product. Besides, pricing strategy proceeds with the product's life cycle. List price, discounts, allowances, payment periods, credit terms etc. should be considered throughout the process. For a company, decisions concerning price determination depend on determinants in the market as well as the consumer portfolio or the target market of the company, the financial and organizational structure of the company itself and the characteristics of the product. Therefore, it is a multi-attribute decision making (MADM) problem.

In MADM problems, a decision maker (DM) is often faced with the problem of selecting, evaluation or ranking alternatives that are characterized by multiple, usually conflicting, attributes [3]. LINMAP is a MADM method and is based on pair-wise comparisons of alternatives given by decision makers and generates the best compromise alternative as the solution that has the shortest distance to the positive ideal solution (PIS) [4]. In evaluation process of alternatives there are quantitative and qualitative attributes and in this study, the alternatives are evaluated on qualitative attributes through using intuitionistic fuzzy sets (IFS) [5], [6]. As IF set is an appropriate tool to capture the fuzziness in information, the LINMAP under IFSs is used to describe the DM's preferences given through pair-wise comparisons with hesitancy degrees [7].

During the last years, in the literature there are several studies about strategic marketing planning; by Lin et al., implementing fuzzy analytic network process for the selection of the best marketing strategy as a multiple criteria decision making problem [8], by Wu et al., modeling the marketing strategy decision-making problem as a multi-criteria decision-making problem, implementing of the integration of the analytic network process and TOPSIS to determine the appropriate marketing strategy [9], by Tsai et al., proposing an integrated model for evaluating airlines' websites effectiveness which is based on the perspectives of ''marketing mix 4Ps'' and ''website quality'' for the web-based marketing using the analytic network process [10], and by Wang, providing a reference for planning brand marketing with a hybrid multi-criteria decision making model combining the decision making trial and evaluation laboratory with analytic network process and VIKOR methods [11].

II. Basic Concepts of Marketing Strategy

In order to propose a marketing strategy selection model, marketing and marketing strategy should be defined. The essence of marketing is a transaction – an exchange – intended to satisfy human needs and wants [12]. Marketing is not just an activity of a department in a company; it is a management requiring process. Marketing consists of five main steps; (1)

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research, (2) segmentation, market targeting, positioning, (3) marketing mix constitution, (4) implementation of the strategy and (5) control [13]. The second and the third steps form the marketing strategy. Marketing strategy involves two key questions: Which customers will the company serve? How to create a value for these customers [14]?

Marketing strategy starts with segmentation. Segmentation is to find customer groups which are homogeneous between them and heterogeneous compared to other groups [15]. Segmentation aims to find the distinctive qualities of current markets, divide markets into segments according to these qualities, determine the size and the growth of these segments and observe the competitors. Next comes the market targeting. Basically the target market is the segment served. The target market must be clearly identifiable to simplify the marketing communications and large enough to achieve required profit. A company might consider five basic strategies for target market selection: (1) single segment targeting, (2) selective targeting, (3) mass market targeting, (4) product specialization, (5) market specialization [16]. Once the target market is defined, the company must consider creating a value for its customers. This step is called positioning. A position is a complex set of perceptions, impressions and feelings and it is important to note that customers position the company's value offering with or without its help [17].

Positioning step is more important for the new products because once a product is positioned for the customer, it is nearly impossible to change. Last step of the marketing strategy is creating the marketing mix. Marketing mix elements, also known as 4P's, are product, price, promotion and place [18]. Each P represents different strategies for marketing and is vital for the success. It is a framework which helps to structure the approach to each market. The mix is a bundle of variables which are offered to the customer.

An effective marketing program blends each marketing mix element into an integrated marketing program designed to achieve the company's marketing objectives by delivering value to consumers. The marketing mix constitutes the company's tactical tool kit for establishing strong positioning in target markets [14]. In other words, each of these elements has special concerns and difficulties. Building a marketing mix is complicated and effortful for a company.

III. Methodology

A. Definition of Intuitionistic Fuzzy Sets (IFS)

IFSs were first introduced by Krassimir T. Atanassov in 1986 and were developed in 1999 [5], [6]. The concept of an intuitionistic fuzzy set (IFS) can be viewed as an alternative approach to define a fuzzy set in cases where available information is not sufficient for the definition of an imprecise concept by means of a conventional fuzzy set [19].

Let $X = \{x_1, x_2, \ldots, x_n\}$ be a finite universal set. An IF set A in X is defined as:
$A = \{\langle x_l, \mu_A(x_l), \upsilon_A(x_l)\rangle | x_l \in X\}$ with the functions;

$$\mu_A : X \to [0,1], \quad x_l \in X \to \mu_A(x_l) \in [0,1]$$

and

$$\upsilon_A : X \to [0,1] \quad , \quad x_l \in X \to \upsilon_A(x_l) \in [0,1]$$

defining the degree of membership ($\mu_A(x_l)$) and the degree of non-membership ($\upsilon_A(x_l)$) of the element $x_l \in X$ to the set $A \subseteq X$ and for every $x_l \in X$, $0 \le \mu_A(x_l) + \upsilon_A(x_l) \le 1$.

$\pi_A(x_l) = 1 - \mu_A(x_l) - \upsilon_A(x_l)$ is Atanassov's intuitionistic fuzzy index, the degree of indeterminacy membership, of the element x_l in the set A and for every $x_l \in X$, $0 \le \pi_A(x_l) \le 1$.

B. Distance between IFSs

Distance between intuitionistic fuzzy sets was first introduced by Atanassov [6]. Let $A = \{\langle x_l, \mu_A(x_l), \upsilon_A(x_l)\rangle | x_l \in X\}$ and $B = \{\langle x_l, \mu_B(x_l), \upsilon_B(x_l)\rangle | x_l \in X\}$ be two IF sets in the set X. $\pi_A(x_l)$ and $\pi_B(x_l)$ are their IF indexes respectively.

An Euclidean distance between IF sets A and B is [6], [20],

$$d(A,B) = \sqrt{\frac{1}{2}\sum_{l=1}^{n}\begin{bmatrix} \left(\mu_A(x_l) - \mu_B(x_l)\right)^2 \\ +\left(\upsilon_A(x_l) - \upsilon_B(x_l)\right)^2 \\ +(\pi_A(x_l) - \pi_B(x_l))^2 \end{bmatrix}} \tag{1}$$

C. Multi-Attribute Group Decision Making (MAGDM) Problems Using IFSs

Atanassov's IF sets are used in MADM problems by [7], [21]. Assume that there is a group consisting of P decision makers who have to rank n alternatives A_i based on m attributes C_j. Let that $A = \{A_1, A_2, \ldots, A_n\}$ is an alternative set comprised of n alternatives and $C = \{C_1, C_2, \ldots, C_m\}$ be the set of m attributes. Suppose that μ_{ij} and υ_{ij} are the degree of membership and non-membership of the alternative $A_i \in A$ with respect to the attribute $C_j \in C$. The evaluation of the alternative $A_i \in A$ with respect to the attribute $C_j \in C$ is an IFS. The intuitionistic indices $\pi_{ij} = 1 - \mu_{ij} - \upsilon_{ij}$ are the hesitation quantity of the decision maker where $0 \le \mu_{ij} + \upsilon_{ij} \le 1$, $\mu_{ij} \in [0,1]$ and $\upsilon_{ij} \in [0,1]$ are the degree of satisfaction and the degree of non-satisfaction, respectively. Let
$D_i = (D_{i1}, D_{i2}, \ldots, D_{im}) = (\langle\mu_{i1}, \upsilon_{i1}\rangle, \langle\mu_{i2}, \upsilon_{i2}\rangle, \ldots, \langle\mu_{im}, \upsilon_{im}\rangle)$ be the vector of Atanassov's IFSs of all m attributes for alternative $A_i \in A$ where $D_{ij} = \langle\mu_{ij}, \upsilon_{ij}\rangle$ $(i = 1,2,\ldots,n\,;\ j = 1,2,\ldots,m)$ is an Atanassov's IFS. Then the MAGDM problem is defined in the matrix format;

$$D^p = \left(\langle\mu_{ij}^p, \upsilon_{ij}^p\rangle\right)_{n\times m} = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_m \end{array} \\ \begin{pmatrix} \langle\mu_{11}^p, \upsilon_{11}^p\rangle & \langle\mu_{12}^p, \upsilon_{12}^p\rangle & \cdots & \langle\mu_{1m}^p, \upsilon_{1m}^p\rangle \\ \langle\mu_{21}^p, \upsilon_{21}^p\rangle & \langle\mu_{22}^p, \upsilon_{22}^p\rangle & \cdots & \langle\mu_{2m}^p, \upsilon_{2m}^p\rangle \\ \vdots & \vdots & \vdots & \vdots \\ \langle\mu_{n1}^p, \upsilon_{n1}^p\rangle & \langle\mu_{n2}^p, \upsilon_{n2}^p\rangle & \cdots & \langle\mu_{nm}^p, \upsilon_{nm}^p\rangle \end{pmatrix} \end{array} \tag{2}$$

D^p is an Atanassov's IF decision matrix for decision maker p and is used to represent the MAGDM problem under Atanassov's IF environment [7], [21].

D. Consistency and Inconsistency Measurements

Let A^+ be an Atanassov's IF positive ideal solution (IFPIS) represented by an IF set $A^+ = (\langle \mu_1^+, \upsilon_1^+ \rangle, \langle \mu_2^+, \upsilon_2^+ \rangle, \ \ , \langle \mu_m^+, \upsilon_m^+ \rangle)$. It is unknown a priori and needs to be determined, where $A_j^+ = \{\langle \mu_j^+, \upsilon_j^+ \rangle\} = \{\langle x_j, \mu_j^+, \upsilon_j^+ \rangle\}$ $(j = 1,2,\ldots,m)$ is an Atanassov's IF set on attribute C_j.

Using (1), the square of the weighted Euclidean distance between the alternative i and the IFPIS A^+ can be calculated as

$$S_i^p = \sum_{j=1}^m \omega_j \left[d\left(D_{ij}^p, A_j^+\right)\right]^2 = \frac{1}{2}\sum_{j=1}^m \omega_j \left[\left(\mu_{ij}^p - \mu_j^+\right)^2 + \left(\upsilon_{ij}^p - \upsilon_j^+\right)^2 + \left(\pi_{ij}^p - \pi_j^+\right)^2\right] \quad (3)$$

where ω_j is the weight of each attribute $C_j \in C$ ($0 \leq \omega_j \leq 1$ and $\sum_{j=1}^m \omega_j = 1$), the vector of weights $\omega = (\omega_1, \omega_2, \ldots, \omega_m)^T$ is unknown a priori and needs to be determined [7].

Assume that the decision maker gives her/his preferences between alternatives by $\Omega = \{(k,l) | A_k \rho A_l, (k,l = 1,2,\ldots,n)\}$ from his/her knowledge and experience, where the symbol "ρ" is a preference relation given by the decision maker.

Using (3) the decision maker can calculate the squares of the weighted Euclidean distance between each pair of alternative $(k,l) \in \Omega$ and the Atanassov's IFPIS as follows [7]:

$$S_k^p = \sum_{j=1}^m \omega_j \left[d\left(D_{kj}^p, A_j^+\right)\right]^2 \quad (4)$$

$$S_l^p = \sum_{j=1}^m \omega_j \left[d\left(D_{lj}^p, A_j^+\right)\right]^2 \quad (5)$$

The alternative A_k is closer to the Atanassov's IFPIS than the alternative A_l if $S_l^p \geq S_k^p$. So the ranking order of alternatives A_k and A_l is determined by S_l^p and S_k^p based on (ω, A^+) which must be consistent with the preference given by the decision maker. (ω, A^+) should be properly chosen for consistency of the ranking order of alternatives A_k and A_l determined by S_l^p and S_k^p, and the preference provided by the decision maker [7]. To measure inconsistency between the ranking order of alternatives A_k and A_l, an index $\left(S_l^p - S_k^p\right)^-$ is defined as follows [7]:

$$\left(S_l^p - S_k^p\right)^- = \begin{cases} S_k^p - S_l^p & (S_l^p < S_k^p) \\ 0 & (S_l^p \geq S_k^p) \end{cases} \max\left(0, S_k^p - S_l^p\right) \quad (6)$$

$\left(S_l^p - S_k^p\right)^-$ is defined to be 0. The ranking order of alternatives A_k and A_l is inconsistent with the preferences given by the decision maker if $S_l^p < S_k^p$. [7].

A total inconsistency index of the decision maker p is defined as:

$$B^p = \sum_{(k,l)\in\Omega^p} \left(S_l^p - S_k^p\right)^- = \sum_{(k,l)\in\Omega^p} \max\left(0, S_k^p - S_l^p\right) \quad (7)$$

An index $\left(S_l^p - S_k^p\right)^+$ to measure consistency between the ranking order alternatives A_k and A_l and the preferences given by the decision maker preferring A_k to A_l can be defined as follows [7]:

$$\left(S_l^p - S_k^p\right)^+ = \begin{cases} S_l^p - S_k^p & (S_l^p \geq S_k^p) \\ 0 & (S_l^p < S_k^p) \end{cases} = \max\left(0, S_l^p - S_k^p\right) \quad (8)$$

A total consistency index of the decision maker p is defined as:

$$G^p = \sum_{(k,l)\in\Omega^p} \left(S_l^p - S_k^p\right)^+ = \sum_{(k,l)\in\Omega^p} \max\left(0, S_l^p - S_k^p\right) \quad (9)$$

The total inconsistency and consistency indices *B* and *G* are all IFSs.

E. LINMAP Model for MAGDM Using IFSs

Maximize $\left\{\sum_{p=1}^P \sum_{(k,l)\in\Omega^p} Z_{kl}^p\right\}$ (10)

subject to:

$$\sum_{j=1}^m w_j \sum_{p=1}^P \sum_{(k,l)\in\Omega^p} \left[\left(\mu_{lj}^{p^2} - \mu_{kj}^{p^2}\right) + \left(\upsilon_{lj}^{p^2} - \upsilon_{kj}^{p^2}\right) + \left(\pi_{lj}^{p^2} - \pi_{kj}^{p^2}\right) + 2\left(\mu_{lj}^p - \mu_{kj}^p\right) + 2\left(\upsilon_{lj}^p - \upsilon_{kj}^p\right)\right]$$
$$- \sum_{j=1}^m u_j \sum_{p=1}^P \sum_{(k,l)\in\Omega^p} \left[4\left(\mu_{lj}^p - \mu_{kj}^p\right) + 2\left(\upsilon_{lj}^p - \upsilon_{kj}^p\right)\right]$$
$$- \sum_{j=1}^m v_j \sum_{p=1}^P \sum_{(k,l)\in\Omega^p} \left[2\left(\mu_{lj}^p - \mu_{kj}^p\right) + 4\left(\upsilon_{lj}^p - \upsilon_{kj}^p\right)\right] \geq 2h$$

$$\sum_{j=1}^m w_j \left[\left(\mu_{kj}^{p^2} - \mu_{lj}^{p^2}\right) + \left(\upsilon_{kj}^{p^2} - \upsilon_{lj}^{p^2}\right) + \left(\pi_{kj}^{p^2} - \pi_{lj}^{p^2}\right) + 2\left(\mu_{kj}^p - \mu_{lj}^p\right) + 2\left(\upsilon_{kj}^p - \upsilon_{lj}^p\right)\right]$$
$$- \sum_{j=1}^m u_j \left[4\left(\mu_{kj}^p - \mu_{lj}^p\right) + 2\left(\upsilon_{kj}^p - \upsilon_{lj}^p\right)\right]$$
$$- \sum_{j=1}^m v_j \left[2\left(\mu_{kj}^p - \mu_{lj}^p\right) + 4\left(\upsilon_{kj}^p - \upsilon_{lj}^p\right)\right] + 2 Z_{kl}^p$$
$$\geq 0 \ (k,l) \in \Omega^p, \qquad p = 1,2,\ldots,P$$

$$Z_{kl}^p \geq 0, \ (k,l) \in \Omega^p, \qquad p = 1,2,\ldots,P$$

$$u_j + v_j \leq w_j, \ \ u_j \geq 0, \ v_j \geq 0, \qquad j = 1,2,\ldots,m$$

$$\sum_{j=1}^m w_j = 1 \ , \ \ w_j \geq \varepsilon, \qquad j = 1,2,\ldots,m$$

where $\begin{cases} u_j = w_j \mu_j^* \\ v_j = w_j \upsilon_j^* \end{cases}$ (11)

When the problem is solved, the best values of $\langle \mu_j^*, \upsilon_j^* \rangle$ are calculated using (11).

IV. Proposed Model

A. Alternatives of the Model

Many internal and external factors influence pricing decisions, including the nature of the market, economic conditions, the company's overall marketing strategy, objectives, and marketing mix, as well as organizational considerations. Price is only one element of the company's broader marketing strategy. If the company has selected its target market and positioning carefully, then its marketing mix strategy, including price, will be fairly straightforward [14]. The price creates a positioning in customers' minds. Setting an initial price for a new product is vital for the success of this product. Therefore, the purpose of the model proposed in this study is to select the best pricing strategy for the company in NPD process.

Therefore the alternatives of the model are the base pricing strategies classified by Ferrell & Hartline [16]:

- *Price Skimming:* Setting a high price relative to the competition, thereby skimming the profits off the top of the market.
- *Prestige Pricing:* Setting the prices at the top end of all competing products in a category to indicate a higher quality.
- *Value-Based Pricing:* Setting reasonably low prices but still offer high-quality products and adequate customer services.
- *Competitive Matching:* Setting the prices by focusing on matching competitors' prices and price changes.
- *Penetration Pricing:* Setting relatively low prices to maximize sales, gain widespread market acceptance, and capture a large market share quickly.

B. Attributes of the Model

The attributes of the model are the strategic marketing criteria mostly effective in the marketing strategy selection process as shown in Table I.

Innovation is the first criterion. The word innovation is derived from the Latin word "innovare", which means to renew or change. Nowadays it represents the new product development (NPD) process and Research and Development (R&D) operations for the companies. Second criterion, Manufacturing / Operations, consists of the production processes and other operations (logistics, outsourcing etc.) of the company except managerial activities. Capacity, flexibility, efficiency, effectiveness of the operations and cost structure are included in this criterion. Management criterion consists of quality of top and middle management, knowledge of business, culture, strategic goals and plans, entrepreneurial thrust, planning / operation system, loyalty / turnover, quality of strategic decision making [22]. Market criterion is related to the market that the company serves. Consumer criterion represents the company's potential customers who compose the company's target market/segment. Product criterion is one of the 4P's, which represents the substantial product acquired by the consumer.

TABLE I
Attributes of the Model

Heading	Attribute
Innovation	C1: New Product Capability
	C2: Research & Development
Manufacturing / Operations	C3: Cost Structure
	C4: Economies of Scale
	C5: Logistics
Management	C6: Management Style
	C7: Marketing Communication
	C8: Accessibility to Capital
Market	C9: Market Share
	C10: Market / Segment Size
	C11: Number of Competitors
Consumer	C12: Consumer Fidelity
	C13: Brand Image
Product	C14: Product Type Convenience
	C15: Breadth of the Product Line
	C16: Product Support
	C17: Price Elasticity of the Demand

V. Application

A. General Information

In order to evaluate the first application of the model, a computer and mobile phone manufacturer company has been chosen. This company has an important market share around the world. Since its foundation, this company uses the Blue Ocean Strategy as its general marketing strategy. Blue Ocean Strategy suggests that an organization should create new demand in an uncontested market space, or a "Blue Ocean", rather than compete head-to-head with other suppliers in an existing industry [23]. As a result, the demand of the products of this company considerably high and the brand image is reliable. The company is advantageous about the economies of scale and its fixed costs are minimized.

Launching of a new laptop of this company is selected for the application. With a marketing insight, this is a specialty product; which is unique, one-of-a-kind product that consumers will spend considerable time, effort, and money to acquire [16]. The product's type is convenient with the target market and the product line of this product has a broad range. This is not a new-to-the-world laptop however it has a faster micro-processor than the other laptops which belong to the same product line. Three decision makers, chosen by the company from the marketing department, will evaluate the alternatives for these attributes and will give their preference relations. Since this company is one of the market leaders, the last two alternatives are eliminated by the decision makers. In this application, the model has three alternatives: Price Skimming, Prestige Pricing and Value-Based Pricing. Briefly, the model has 17 attributes and 3 alternatives, as shown in Fig. 1, which will be evaluated by 3 decision makers.

International Journal of Mechanical, Industrial and Aerospace Sciences
ISSN: 2517-9950
Vol:7, No:10, 2013

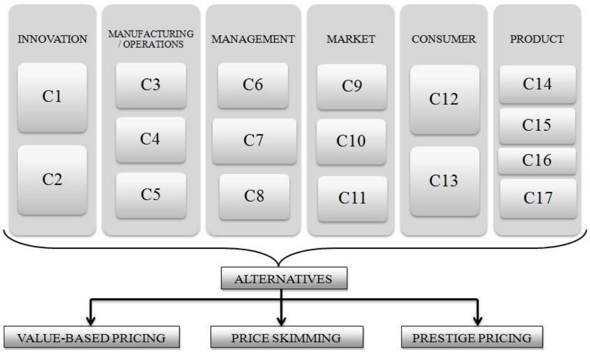

Fig. 1 The attributes and the alternatives of the application

B. Step by Step Procedure

The aim is to provide a LINMAP application extended with Atanassov's IF sets. The degree of indeterminacy membership (π) represents the hesitations mathematically. The proposed method is currently applied to evaluate marketing strategies and select the best pricing strategy while considering in addition the hesitations in the preferences of the decision makers. The computational procedure is summarized as follows:

Step 1. The experts, the company's marketing department managers identify the evaluation attributes.

Step 2. The experts, $P_p(p = 1,2,3)$ give their preference judgments between alternatives with paired comparisons as $\Omega_1 = \{(2,1),(1,3)\}$, $\Omega_2 = \{(2,3),(1,3)\}$, $\Omega_3 = \{(2,1)\}$.

Step 3. The experts use IF sets corresponding the linguistic variables (as shown in Table II) to evaluate the rating of alternatives with respect to each attribute [21].

TABLE II
LINGUISTIC VARIABLES AND CORRESPONDING IF SETS

Very Poor (VP)	⟨0.05, 0.95⟩
Poor (P)	⟨0.25, 0.7⟩
Fair (F)	⟨0.5, 0.4⟩
Good (G)	⟨0.7, 0.25⟩
Very Good (VG)	⟨0.95, 0.05⟩

Step 4. Obtain the data and ratings of all alternatives $A_i(i = 1,2,3)$ on every attribute $C_j(j = 1,2,\ldots,17)$ given by three experts $P_p(p = 1,2,3)$ as partly shown in Table III.

Step 5. Construct the decision matrices D^p using IF sets for each expert. In the same vein, construct the matrices D^2 and D^3 for the experts P_2 and P_3.

Step 6. Construct the linear programming model using (10)

Maximize $z_{21}^1 + z_{13}^1 + z_{23}^2 + z_{13}^2 + z_{21}^3$
subject to

0,11w1 + … - 1,55v17 ≤ -1

0,45w1 +… - 0,60v17 $-2\, z_{21}^1 \leq 0$
-0,45w1 + … + 1,30v17 $-2\, z_{13}^1 \leq 0$
0,24w1 - … + 1,50v17 $-2\, z_{23}^2 \leq 0$

-0,45w1 - … + 1,50v17 $-2\, z_{13}^2 \leq 0$

0,01w1 + … - 0,60v17 $-2\, z_{21}^3 \leq 0$

$-\omega_j + u_j + v_j \leq 0$

$\sum_{j=1}^{17} \omega_j = 1$

$\omega_j \geq 0.01\ (j = 1,2,\ldots,17)$

$z_{21}^1 \geq 0,\ z_{13}^1 \geq 0,\ z_{23}^2 \geq 0,\ z_{13}^2 \geq 0,\ z_{21}^3 \geq 0$

TABLE III
RATINGS OF THE ALTERNATIVES FOR THE FIRST FIVE ATTRIBUTES

Heading	Criterion	Alternatives	Decision Makers		
			P_1	P_2	P_3
Innovation	C_1: New Product Development	A_1	VG	VG	G
		A_2	G	F	G
		A_3	G	G	F
	C_2: R&D	A_1	VG	VG	VG
		A_2	F	P	F
		A_3	G	F	G
Manufacturing / Operations	C_3: Cost Structure	A_1	G	G	VG
		A_2	G	F	G
		A_3	VP	P	P
	C_4: Economies of Scale	A_1	F	P	F
		A_2	F	F	G
		A_3	VG	G	VG
	C_5: Logistics	A_1	P	VP	VP
		A_2	F	F	F
		A_3	G	VG	G

Step 7. Solve linear programming problem: To obtain the best weights and the IF Positive Ideal Solution (IFPIS), taking $h = 1.0$ and using D^p and Ω^p, solve (10).

By solving linear programming problem, using MATLAB R11 on a Pentium IV PC with a 3 GHz CPU and 4 GB RAM, the results are obtained:

$$\omega = (\omega_1, \omega_2, \ldots, \omega_{17}) = (0.032, 0.038, \ldots, 0.060)$$

$$u = (u_1, u_2, \ldots, u_{17}) = (0.012, 0.005, \ldots, 0.002)$$

$$v = (v_1, v_2, \ldots, v_{17}) = (0.010, 0.025, \ldots, 0.054)$$

Using w, u and v values with (11), the IFPIS set is calculated.

$$A^+ = \{\langle \mu_j^+, v_j^+ \rangle\ (j = 1,2,\ldots,17)\} = \{\langle 0.37,0.33\rangle, \langle 0.16,0.66\rangle, \ldots, \langle 0.03,0.91\rangle\}$$

Step 8. Calculate the square of the weighted Euclidean distance S_i^p between each pair of alternative, D_i^p, and the IF positive ideal solution, A^+. The results are obtained using (3) and shown in Table IV.

TABLE IV
WEIGHTED EUCLIDEAN DISTANCES

	P_1	P_2	P_3
A_1	0.1635	0.1302	0.1702
A_2	0.3654	0.4356	0.4380
A_3	0.0977	0.0730	0.1122

According to these distances, the ranking orders of the three alternatives for the three experts are as follows:

For P_1: $A_3 \rho A_1 \rho A_2$ (Symbolizing "the expert P_1 prefers A_3 to A_1" by $A_3\, \rho\, A_1$)

For P_2: $A_3 \rho A_1 \rho A_2$

For P_3: $A_3 \rho A_1 \rho A_2$

Step 9. The group ranking order of all alternatives can be obtained using social choice functions such as Borda's function [24]. Borda's function ranks the alternatives in the order of the value of $f_b(x)$, Borda's scores of the alternatives are shown in Table V.

TABLE V
BORDA'S SCORES

	P_1	P_2	P_3	Borda's Score
A_1	1	1	1	3
A_2	0	0	0	0
A_3	2	2	2	6

The ranking order of the three alternatives is A_3, A_1 and A_2 according to the Borda's scores; in other words, the best alternative is A_3. The best alternative is Prestige Pricing, the second alternative is Value-Based Pricing and the last alternative is Price Skimming.

C. Concluding Remarks

In the application, the best solution is determined as Prestige Pricing strategy. This result is significant for a company whose products do not differ from the competitors' in terms of functionality and who stays distant from the highly competitive area, positions its products in an uncontested market neutralized of the competition.

"Market/Segment Size" criterion is determined as the most important criteria. Indeed, the company presents the products to a narrow target market and provides competitive advantage with superior design features.

The second important criterion is determined as "Product Support". This is significant for a company who adopts Blue Ocean positioning strategy, bringing the product criterion into the forefront, as well as multiplies and expands the core product with an improved product support service.

VI. CONCLUSION

In this paper, the use of intuitionistic fuzzy linear programming to strategic marketing development has been discussed. Three pricing strategies alternatives are determined in the study: (A_1) Value-Based Pricing, (A_2) Price Skimming, and (A_3) Prestige Pricing. 17 attributes; 2 innovation attributes, 3 manufacturing/operations attributes, 3 management attributes, 3 market attributes, 2 consumer attributes and 4 product attributes based on these alternatives are also stated. To reflect the DM's subjective preference information and to determine the weight vector of attributes, the LINMAP model under IF environment is constructed. The weights of the alternatives are obtained then ranked by using a social choice function.

At the end of this study, the method set "Market / Segment Size" (C10) as the key attribute and "Prestige Pricing" as the best pricing strategy solution.

The usefulness of the model was observed by its effect on the decision-making process in selecting an appropriate alternative and the case study shows that the LINMAP method under IF environment is applicable as an evaluation technique for marketing strategy alternatives. The current fuzzy linear programming model offers the decision maker some flexibility to incorporate his/her own priority in the model. Consequently, managers can use such approaches in making their strategic decisions in case of incomplete information and vagueness. The model provides a useful conceptual framework for evaluating pricing strategy alternatives and marketing managers can use such approaches in making their strategic decisions.

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