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A FUZZY BASED MARKETING PERFORMANCE MEASUREMENT MODEL WITH A REAL CASE STUDY

GERÇEK VAKA ÇALIŞMASI İLE BULANIK TEMELLİ PAZARLAMA PERFORMANS ÖLÇÜM MODELİ

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ABSTRACT

The level of efficiency for business and process control is based on performance measurements. Performance measurement is a mixed system that contains many different criteria such as customer behaviour, sales, employees and product range. Businesses need to measure sales performance to maintain sustainable competition lines and improve their strategies. In this paper, a performance measurement in the clothing industry has been carried out and a pioneering company data has been utilized as the application area. In the paper, Interval Valued Pythagorean Fuzzy Analytical Hierarchy Process (IV-PFAHP) method and Interval Valued Pythagorean Fuzzy Technique for Order Preference by Similarity to Ideal Solution (IV-PFTOPSIS) method have been suggested to deal with marketing performance assessment process with a real case study. The paper focuses on IV-PFAHP and IV-PFTOPSIS methods to handle uncertainty in the marketing performance assessment process for the clothing industry. The results revealed that the proposed approach produces reliable outcomes representing the vagueness of the decision-making process.

Key Words: Marketing Performance, Buyer Behavior, Pythagorean Fuzzy Sets, AHP, TOPSIS

ÖZ

İşletme ve süreç kontrolü adına verimlilik seviyesi performans ölçümlerine dayanmaktadır. Performans ölçümü; müşteri davranışı, satış, çalışanlar ve ürün yelpazesi gibi birçok farklı kritere sahip karma bir sistemdir. İşletmeler, sürdürülebilir rekabet çizgilerini devam ettirmek ve stratejilerini geliştirmek için satış performansını iyi ölçmelidir. Bu çalışmada, hazır giyim sektöründe bir performans ölçümü yapılmış ve uygulama alanı olarak hazır giyim sektöründe öncü bir firmanın verileri kullanılmıştır. Çalışmada, Aralık Değerli Pisagor Bulanık Analitik Hiyerarşi Süreci (IV-PFAHP) yöntemi ve Aralık Değerli Pisagor Bulanık TOPSIS (IV-PTOPSIS) yöntemi hibrit olarak kullanılmış ve gerçek bir vaka çalışması ile pazarlama performansı değerlendirme sürecinin ele alınması önerilmiştir. Çalışma, giyim endüstrisi için pazarlama performansı değerlendirme sürecinde belirsizliği giderme ve daha iyi sonuç elde etme amacıyla IV-PFAHP ve IV-PFTOPSIS yöntemlerine odaklanmaktadır. Elde edilen sonuçlar, önerilen yaklaşımın karar verme sürecindeki belirsizlikte daha iyi tepki verdiği ve güvenilir sonuçlar ürettiğini ortaya koymaktadır.

Anahtar Kelimeler: Pazarlama performansı, alıcı davranışı, Pisagor bulanık kümeler, AHP, TOPSIS

1. INTRODUCTION

Performance is a quantitative and qualitative concept that specifies what an individual or group doing a job can achieve and what they can provide for the intended purpose. Performance evaluation refers to all the work carried out to measure and determine the effectiveness level of the work and impact on business results that the employees are working on. The success of the performance evaluation method contributes to the development of the company and contributes to the long-term success of the company by knowing the degree of success of the managers. While this process is a simple process that concerns the sales unit, performance evaluation has recently become an important measurement tool for each unit of the company. Classic sales performance measurements are calculated only by turnover measurement. Today's marketing is transitioning from transaction marketing to relationship marketing. It used to mean selling a product to as many customers as possible. Now try to sell as many products as possible to a customer. Businesses want to provide long-term power to compete and increase market share, and therefore they need to establish a regular, long-term relationship with customers. An enterprise accepts the cost of acquiring existing customers rather than the cost of winning a new customer. Looking at all these data, it is important to look at not only the turnover they provide, but also the customer loyalty and satisfaction they receive when measuring the performance of sales and sellers. One of the most important measures in determining the targets of enterprises and evaluating the situation is the sales performance assessment. The point of intersection required for the sales of enterprises is the customer and stores. The primary expectations of the enterprises are to stay in the minds of the customers, to create customer satisfaction and loyalty.

In this study, sales performance of a company in the clothing industry was mentioned. In contrast to classical sales performance evaluations, product sales rates as internal factors and customer as external factors were included in the analysis. Sales performance has been given a different perspective.

2. LITERATURE REVIEW

Performance is the level of fulfilment of a job or the resulting outcome, according to the criteria set. Performance is a concept that demonstrates the company's success and failure, its potential to realize its goals and responsibilities, its adaptation to and development of a changing competitive understanding. Competence in service, efficiency and forehandedness in production, define performance in general (Kubali, 1999). The degree of approach to expected objectives can be defined as performance evaluation. Performance Evaluation System is a system that measures the progress, development process and efficiency, of the companies in line with the criteria determined by the companies. Assessing business performance means evaluating to what extent the entity has achieved its founding objectives (Bayyurt, 2007). If the objectives are complex and uncertain, the performance criteria may at best provide a partial presentation of the organization's final objectives (Speklé & Verbeeten, 2014). In order to evaluate the performance, input and output results in a specified time interval should be measured. These measured results indicate the degree of success or failure of the company. Businesses are established for a purpose and continue to work according to this purpose. In this context, business performance can be defined as the evaluation of all efforts to achieve business objectives (Zerenler & University, 2005). In most organizations, these evaluations are carried out periodically, usually annually or semi-annually, and are normally recorded on some standard rating scales (DeNisi, Cafferty, & Meglino, 1984). In order to develop their management and achieve sustainable success, businesses must designate performance evaluation criteria and reveal links between these criteria. The assessment should be multi-faceted and objective. When these factors are measured qualitatively and quantitatively, means that the reached or approach to the desired performance level if the result is parallel to the predetermined mission, purpose and objectives (Cakmak, 2008). Performance evaluation is an important factor in the information and control system of most complex organizations (Beer, 1981). The rapidly changing globalized business environment, combined with unprecedented developments in technology fronts, forces companies to become more innovative and agile in their

way of identifying and responding to the evolving needs and demands of their customers (Sharda, Delen, & Turban, 2016). In an innovative competitive environment, businesses must adapt to change and innovation, in order to continue one's existence and maintain their market share. Businesses should analyze their current situation in order to keep up with these changes and improve themselves. In order to be able to analyze their current situation, it is imperative that they performance measurement and development activities. It is observed that the enterprises which have an effective performance measurement system have a more dynamic structure than the non - existing enterprises (Zerenler & University, 2005). Performance evaluation for businesses helps them identify whether the strategy and organizational structure they have adopted will help them achieve their goals. The establishment of performance evaluation indicators, is the first step in practical evaluations of enterprises (Kuo & Chen, 2008). Because performance measurement provides information in strategy evaluation, it depends on the operation strategy and in this way generates information as an action of learning and continuous improvement (Franco-Santos et al., 2007). Performance measurement is also a management. This type of management, is an integrated approach that helps to define and implement strategies and to achieve continuous performance improvements and a competitive advantage (Kumru & University, 2012). Measuring and managing performance is a tool for getting good results from the business and employee. Managing performance enables, you to use resources active and efficiently. Thus, a correct management way is followed. In performance measurements, there are some benchmarks for determining performance. In order to be able to make an evaluation, first of all, the criteria affecting the performance should be determined. These criteria may vary for each business. These criteria, which have been determined in many different ways to date, have been applied to performance evaluation systems. Determining the criteria correctly affects the utility of performance measurement. Basic criteria; efficiency, profitability, qualification, quality, innovation etc. The decisions taken as a result of an accurate performance measurement made with the appropriate criteria for the business ensure that the enterprise takes the right steps in order to increase the success rate and reach the organizational goals. A clear understanding and comparability of research is important because of the variety of approaches used to look at performance measurement in business (Franco-Santos et al., 2007). Errors in performance measurement, unnecessary information collected and the time lost during the evaluation process, leads to large losses. Performance evaluation works can create big problems within the company when they are not well managed and not implemented well. Therefore, when creating performance criteria, criteria related to the related sector should be determined and the criteria that will be directly proportional to the objectives should be determined. The evaluation can be done by many methods. By measuring performance, past work is evaluated. As a result of past performance measurements, deficiencies, and factors that reduce performance are determined and efforts are made to improve them. It is not possible to develop what is not measurable, so it is necessary to identify and evaluate critical performance indicators for optimum management and development of the enterprise (Bayyurt, 2007). However, as a result of a detailed performance assessment, it can make a sound judgment about whether the institution is successful or unsuccessful and why this result is due (Yenice, 2006). Companies around the world use performance evaluation methods to improve their performance and monitor and control business processes. The performance measurement system provides information to compare existing results with existing targets. Performance measurement is a means of monitoring self-evaluation, goal-setting and development (Performance Measurement Guide, 1993). In the past, performance, profit and cost were determined as two-dimensional. Afterwards, new dimensions such as benefiting, quality, innovation, quality of working life, etc. were added to these two dimensions which were not seen enough, and the concept of multi-dimensional performance emerged (Karaman, 2009). Multidimensional performance dimensions have led to the development of measurement structures. Today, new dimensions such as employee behaviour, market status, product leadership and public responsibility have been added to this classification (Akal, 2000). Performance measurement is a method of objectively measuring how tasks are performed in the execution of

products, services or processes (Yuregir & Nakıboglu, 2007). In order to perform the correct performance evaluation, it is necessary to use an accurate performance measurement system. Objectives of performance measurement systems can be sorted as;

- To improve the service and product quality,
- Measure business success,
- Monitoring business progress compared to competitors in the sector,
- Identification of errors and deficiencies,
- To put the criteria in the correct order,
- Setting priorities,
- Measure profit and cost,
- Measure input and output quality,
- Making business processes understandable and improved,
- Testing the applicability of targets and plans,
- Creating management model,

When analyzed by sector, a store performance in the retail sector can also be measured by a different system, KPI (Key Performance Indicators). The KPI is a benchmark that a company uses to determine how well its operational and strategic goals are met. Investopedia's KPI (Key Performance Indicators) definition: in Key performance indicators (KPIs) are the measurable criteria that a company uses to measure its performance over time. These metrics are used to determine the progress of a company in achieving its strategic and operational goals, and to compare a company's financial and performance with other businesses in the industry. KPI indicators are indicators called Location, Product, Promotion, Employee, Customer, Price. The descriptions of these indicators are as follows;

- Place: Sales / square meters,
- Product: Stock return, Stock day / week / month / year
- Promotion: Increase sales
- People (Employee): Fee, Turn over speed
- People (Customer): Visit frequency, Time spent in store, Retrieval frequency, Lost stock rate, Sales / time, Basket value
- Price: Profit margin

Determination indicators, help to focus on goals and ensure that the entity remains true to these goals. Achieving success with KPI is possible through strong teamwork, effective communication and management. Thus, a sustainable education and development can be provided within a plan. To improve the performance measurement system in any way, there are some general rules. First of all, the firm's statement of duty should be explained clearly. The company's strategic goals, such as profitability, market share, quality, cost, flexibility, reliability, and innovation should be identified by using the task definition as a guide. The role of each strategic area in achieving various strategic goals should be made clear. Global performance metrics for each functional area that can define the company's overall top management and competitive position should be developed. Transmit strategic and performance targets, to a lower level in the organization. Determine more specific performance criteria for each level. The compliance of performance measures used in all functional areas should be ensured, to identify the competitive position, identify problem region, help the firm update strategic goals, and make tactical decisions and achieve goals and provide feedback after decisions are implemented, the performance measurement system should be used. Consider the current competitive environment, evaluate the suitability of the performance measurement system periodically. Efficient results can be achieved

when a performance evaluation system is integrated with the company's entire business processes. A well-designed and implemented performance measurement system helps to implement business strategies and supports the strategic control system of the enterprise (Kumru & University, 2012). Performance measurement is a mixed system that contains many different criteria such as customer behaviour, sales, employees and product range. Businesses need to measure sales performance to maintain sustainable competition lines and improve their strategies, and these measurements are all examples of decision-making. During decision-making processes, decision-makers can make their own assessments for each alternative. Some factors (limited field information, time, etc.) that influence decision makers in an uncertain environment cause decision-makers not to determine exact values. Various uncertainties in the decision-making process and various shortcomings and errors arising from these uncertainties may arise. Fuzzy logic is applied to overcome these uncertainties and deficiencies (Tepe, 2018). In the paper, Interval Valued Pythagorean Fuzzy Analytical Hierarchy Process (IV-PFAHP) method and Interval Valued Pythagorean Fuzzy TOPSIS (IV-PFTOPSIS) method have been suggested to deal with marketing performance assessment process with a real case study. The paper focuses on IV-PFAHP and IV-PFTOPSIS methods to handle uncertainty in the marketing performance assessment process for clothing industry.

3. THE PROPOSED FUZZY BASED METHODOLOGIES

The aim of this paper is to develop a novel Interval Valued Pythagorean Fuzzy (IVPF) compromise approach using correlation-based closeness indices to address high degrees of uncertainty when assessing marketing performance process. This paper efforts to develop a new Multi Criteria Decision Making (MCDM) approach involving a novel application of IVPF set theory to describe the uncertainties of decision-making according to the degrees of membership and non-membership that are represented by flexible interval values that reflect the degree of hesitation. In this section, the methods integrated with the proposed approach are examined. Then, the steps of the proposed approach are described in detail.

3.1. Fuzzy Sets

In decision-making logic, the decision is defined as the choice of a viable action in which the utility function is maximized. Therefore, it is the search for an optimum and viable action or strategy. Expressions with uncertainty make it difficult to make decisions clear. In classical logic systems, making analyzes and making judgments are difficult. Classic logic systems are not concerned with uncertainties. However, fuzzy is a concept that deals with uncertainty. In the classical logic system, there is ‘right' or ‘wrong'. In this system, it is considered impossible to realize a third possibility and these situations are often called paradoxes. Classical logic has two values like (0-1) and fuzzy logic has values in the range [0-1]. In other words; accuracy is a function that associates values in a set containing an infinite number of accuracy values between the classical false and true, or numerically, to the real number range [0,1] (Tepe &Kaya, 2018).

3.2. Interval Valued Type 2 Fuzzy Sets

Type-2 fuzzy sets allow handling linguistic uncertainties, which can be expressed as: “words can mean different things to different people”. In type-2 fuzzy sets, the secondary membership function can take multiple values and assign a distribution to these values. If a uniform distribution is assigned, the value of the secondary membership functions is called as interval-valued type-2 fuzzy sets.

3.3. Pythagorean Fuzzy Sets

During the decision-making process, decision-makers can make their own assessments for each of the alternatives. Some factors that influence decision makers in an uncertain environment cause decision-makers to be unable to determine exact values. Fuzzy logic is applied to cope with these uncertainties. The Pythagorean fuzzy set is based on two basic functions. These are membership notes and non-membership functions. The Pythagorean fuzzy set logic is more concerned with the

ambiguity of these two basic functions. It helps to best model the uncertainties and subjective expressions of decision makers (Tepe &Kaya, 2018).

Definition 1. Let X be a defined set. Pythagorean fuzzy set $\tilde{P}$ is expressed as follows (Tepe, 2018):

$\tilde{P} \cong \{ x, \mu_{\tilde{P}}(x), V_{\tilde{P}}(x); x \in X\}$ (3.1)

$\mu_{\tilde{P}}(x)$: $X \rightarrow$ [0,1] defines being a member.

$V_{\tilde{P}}(x)$: $X \rightarrow$ [0,1] defines not being a member.

For every $x \in X$,:$0 \leq \mu_{\tilde{P}}(x)^2 + V_{\tilde{P}}(x)^2 \leq 1$ (3.2)

The degree of uncertainty is calculated as follows:

$\pi_{\tilde{p}}(x) = \sqrt{1 - \mu_{\tilde{P}}(x)^2 - V_{\tilde{P}}(x)^2}$ (3.3)

Definition 2. An interval valued Pythagorean fuzzy set is defined as follows:

$\tilde{Q} = \{x, \mu_{\tilde{Q}}(x), v_{\tilde{Q}}(x); x \in X\}$ (3.4)

$\mu_{\tilde{Q}}(x) = [\mu^L_{\tilde{Q}}(x), u^U_{\tilde{Q}}(x)] \subset [0,1]$ and $v_{\tilde{Q}}(x) = [v^L_{\tilde{Q}}(x), v^U_{\tilde{Q}}(x)] \subset [0,1]$. (3.5)

For $\tilde{Q}$, equality (3.5) is expressed as follows:

$0 \leq \mu^u_{\tilde{Q}}(x)^2 + v^u_{\tilde{Q}}(x)^2 \leq 1$ (3.6)

3.4. Interval Valued Pythagorean Fuzzy Sets

Given that the information is sometimes unclear due to various restrictions, it is not possible for the decision maker to make choices in terms of net numbers. In this case, it is always preferable to give them in the form of interval valued numbers. Interval-Valued Pythagorean Fuzzy (IVPF), is a novel tool to deal with vagueness. An IVPF set A defined in X is given as

$A = \{\langle x, [\mu^L_A(x), \mu^U_A(x)], [\nu^L_A(x), \nu^U_A(x)]\rangle \mid x \in X\}$ (3.7)

where $0 \leq \mu^L_A(x) \leq \mu^U_A(x) \leq 1, 0 \leq \nu^L_A(x) \leq \nu^U_A(x) \leq 1$, and $\left(\mu^U_A(x)\right)^2 + \left(\nu^U_A(x)\right)^2 \leq 1$

for all $x \in X$. Similar to PFSs, corresponding to interval-valued membership values, its hesitation interval relative to A is given as

$$\pi_A(x) = [\pi^L_A, \pi^U_A]$$
$$= \left[\sqrt{1 - \left(\mu^U_A(x)\right)^2 - \left(\nu^U_A(x)\right)^2}, \sqrt{1 - \left(\mu^L_A(x)\right)^2 - \left(\nu^L_A(x)\right)^2}\right] \quad (3.8)$$

If for every $x \in X, \mu_A(x) = \mu^L_A(x) = \mu^U_A(x), \nu_A(x) = \nu^L_A(x) = \nu^U_A(x)$, then IVPFS reduces to PFS. For an IVPFS A, the pair $\langle [\mu^L_A(x), \mu^U_A(x)], [\nu^L_A(x), \nu^U_A(x)]\rangle$ is called an Interval-Valued Pythagorean fuzzy number (IVPFN). For convenience, this pair is often denoted by

$\alpha = \langle [a, b], [c, d]\rangle$, where $[a, b] \subseteq [0,1], [c, d] \subseteq [0,1]$, and $b^2 + d^2 \leq 1$.

3.5 Interval Valued Pythagorean Fuzzy AHP Method

The Analytical Hierarchy Process (AHP) is a technique that takes into account the relationship between criteria and alternatives, and analyzes components by creating a hierarchical structure. With this method, criteria weight can be calculated and appropriate decision alternatives can be selected in order to determine the extent to which the criteria should be taken into consideration in the decision problems where many criteria are taken into consideration. In the AHP technique, criteria and alternatives are paired by decision makers. Double comparisons of criteria and alternatives are made. The importance weights of the criteria are determined. In the process of choosing among alternatives, the alternatives with the highest importance are chosen as a result of comparing the alternatives separately for each criterion. Various fuzzy AHP methods based on

type 1 fuzzy sets were presented in the literature. In recent years, fuzzy AHP methods based on type 2 fuzzy sets have been proposed to overcome high uncertainties in decision making process.

Interval Valued Pythagorean Fuzzy AHP consists of the following steps.

Step 1: In accordance with the expert opinions for the specified criteria, a decision matrix is formed for the criteria specified in (3.9), including the comparison of the criteria with the specified scale.

$$\widetilde{D}_{\text{nxn}} = \begin{bmatrix} \tilde{d}_{11} & \tilde{d}_{12} & \cdot & \cdot & \tilde{d}_{1n} \\ \tilde{d}_{21} & \tilde{d}_{22} & \cdot & \cdot & \tilde{d}_{2n} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \tilde{d}_{m1} & \tilde{d}_{m2} & \cdot & \cdot & \tilde{d}_{nn} \end{bmatrix} \quad (3.9)$$

In case of more than one expert; The geometric mean values of the experts will be calculated for n criteria and alternatives.

In the case of more than one expert; the geometric mean values will be calculated for the evaluation of the k expert on the basis of the n number criteria and alternatives. Geometric mean calculation; recommended by (Peng & Yang, 2015) for interval-valued Pythagorean fuzzy weighted average (IVPFWG) and the specified equation in (3.10) (Rahman and etc., 2017) w_i weights are reduced to 1/k. (Onar and etc., 2015)

$$\text{IVPFWG}\ (\widetilde{d_1}, \widetilde{d_2}, \ldots\ \widetilde{d_k})$$

$$= \left(\left[\prod_{i=1}^{k} (\mu_i^L)^{W_i}, \prod_{i=1}^{k} (\mu_i^U)^{W_i}, \right] \left[\sqrt{1 - \prod_{i=1}^{k} (1 - v_i^L)^2)^{W_i}}, \right] \left[\sqrt{\prod_{i=1}^{k} (1 - v_i^U)^2)^{W_i}} \right] \right) \quad (3.10)$$

$$\text{IVPFWG}\ (\widetilde{d_1}, \widetilde{d_2}, \ldots\ \widetilde{d_k})$$

$$\left(\left[\prod_{i=1}^{k} (\mu_i^L)^{\frac{1}{k}}, \prod_{i=1}^{k} (\mu_i^U)^{W_i}, \right] \left[\sqrt{1 - \prod_{i=1}^{k} (1 - v_i^L)^2)^{\frac{1}{k}}}, \right] \left[\sqrt{\prod_{i=1}^{k} (1 - v_i^U)^2)^{\frac{1}{k}}} \right] \right)$$

Step 2: In order to reduce the criterion values from an interval fuzzy numbers to a type I fuzzy number, an internal multiplicative matrix must be formed. When calculating the inner multiplicative matrix, it is necessary to first create the score matrix specified in (3.11)

$$\tilde{S}_{ij} = \begin{pmatrix} \tilde{s}_{11} & \tilde{s}_{12} & \cdot & \cdot & \tilde{s}_{1j} \\ \tilde{s}_{21} & \tilde{s}_{22} & \cdot & \cdot & \tilde{s}_{2j} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \tilde{s}_{i1} & \tilde{s}_{i2} & \cdot & \cdot & \tilde{s}_{ij} \end{pmatrix} \quad (3.11)$$

Equations in (3.11) and (3.13) are used to reduce the fuzzy number to the Type I fuzzy number.

$$\tilde{s}_{ij} = (\tilde{\mu}_{ij})^2 - (\tilde{v}_{ij})^2 = \left[\left({\mu_{ij}^L}^2 - {v_{ij}^U}^2 \right), {\mu_{ij}^U}^2 - {v_{ij}^L}^2 \right] \quad (3.12)$$

$$\tilde{s}_{ji} = (\tilde{\mu}_{ji})^2 - (\tilde{v}_{ji})^2 = \left[\left({\mu_{ji}^L}^2 - {v_{ji}^U}^2 \right), {\mu_{ji}^U}^2 - {v_{ji}^L}^2 \right] \quad (3.13)$$

Step 3: $\tilde{a}_{ij} = \sqrt{1000^{\tilde{s}_{ij}}}$, as shown in (3.14) below, $\tilde{A}$ internal multiplicative matrix is generated.

$$\tilde{A}_{nxn} = \begin{bmatrix} 1000^{\tilde{s}_{11}} & 1000^{\tilde{s}_{12}} & \cdot & \cdot & 1000^{\tilde{s}_{1n}} \\ 1000^{\tilde{s}_{21}} & 1000^{\tilde{s}_{22}} & \cdot & \cdot & 1000^{\tilde{s}_{2n}} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ 1000^{\tilde{s}_{n1}} & 1000^{\tilde{s}_{n2}} & \cdot & \cdot & 1000^{\tilde{s}_{nn}} \end{bmatrix} \quad (3.14)$$

Step 4: $\tilde{a}_{ij}$ values and the equation in (3.15) are used to calculate the priority vector.

$$\widetilde{W}_i = \frac{\sum_{j=1}^{n} \tilde{a}_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} \tilde{a}_{ij}} = \left[\frac{\sum_{j=1}^{n} \tilde{a}_{ij}{}^{L}}{\sum_{i=1}^{n}\sum_{j=1}^{n} \tilde{a}_{ij}{}^{L}} , \frac{\sum_{j=1}^{n} \tilde{a}_{ij}{}^{U}}{\sum_{i=1}^{n}\sum_{j=1}^{n} \tilde{a}_{ij}{}^{U}} \right] = [w_i^L , w_i^U] \quad (3.15)$$

Step 5: From the obtained priority vector values, with the (3.16), the likelihood degree (p) is calculated.

$$\mathrm{p}(\widetilde{\mathrm{w}}_i \geq \widetilde{\mathrm{w}}_j) = \frac{\min\left\{\widetilde{w}_i^U - \widetilde{w}_i^L + \widetilde{w}_j^U - \widetilde{w}_j^L, \max(\widetilde{w}_i^U - \widetilde{w}_j^L, 0)\right\}}{\widetilde{w}_i^U - \widetilde{w}_i^L + \widetilde{w}_j^U - \widetilde{w}_j^L} \quad (3.16)$$

Step 6: By using the degree of likelihood the priority weight is determined by the equation indicated in (3.17).

$$\mathrm{w}_i = \frac{1}{n}\left[\sum_{j=1}^{n} p_{ij} + \frac{n}{2} - 1\right] \quad (3.17)$$

Step 7: Priority weights are normalized with (3.18).

$$W_i^T = \frac{\mathrm{w}_i}{\sum_{i=1}^{n} w_i} \quad (3.18)$$

All of the above-mentioned processes for the criteria are likewise made for the evaluation of alternatives on a criterion basis, and the normalized priority weights of the alternatives φ_i are calculated.

Step 8: Finally, the sequence value of each alternative is calculated by the following (3.19).

$$\mathrm{P}_j = \sum_{i=1}^{n} W_i^T \cdot \varphi_i \quad (3.19)$$

As a result; with the highest priority value, alternate P_j is selected.

3.6 Interval Valued Pythagorean Fuzzy TOPSIS Method

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method developed is one of the well-known multi criteria decision making methods. TOPSIS method is based on selection of alternative which have the shortest distance from the positive-ideal solution and the farthest distance from the negative-ideal solution.

Step 1: D_{ij} decision matrix is created.

$$D_{ij} = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1n} \\ d_{21} & d_{22} & \cdots & d_{2n} \\ \vdots & \vdots & & \vdots \\ d_{m1} & d_{m2} & \ldots & d_{mn} \end{bmatrix} \quad (3.20)$$

Step 2: Equality (3.21) is used to establish the standard decision matrix in equality (3.22).

$$r_{ij} \frac{d_{ij}}{\sqrt{\sum_{k=1}^{m} d_{kj}^2}} \quad (3.21)$$

$$R_{ij} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \ldots & r_{mn} \end{bmatrix} \quad (3.22)$$

$\sum_{1=1}^{n} W_i = 1$ Weight values are determined. (3.23)

Step 3: The weighted decision matrix in Equation (3.24) is created.

$$V_{ij} = \begin{bmatrix} r_{11}w_1 & r_{12}w_2 & \cdots & dr_{1n}w_n \\ r_{21}w_1 & r_{22}w_2 & \cdots & r_{2n}w_n \\ \vdots & \vdots & & \vdots \\ r_{m1}w_1 & r_{m2}w_2 & \ldots & d_{mn}w_n \end{bmatrix} \quad (3.24)$$

Step 4: By using Equation (3.25) and (3.26), positive ideal and negative ideal solution values are obtained.

$$A^* = \left\{(max_i\, v_{ij} \,|j \in J), min_i\, v_{ij} | j \in J')\right\} \quad (3.25)$$

$$A\text{-} = \left\{(min_i\, v_{ij} \,|j \in J), max_i\, v_{ij} | j \in J')\right\} \quad (3.26)$$

Step 5: Using Equation (3.27) and (3.28), ideal and negative ideal separation measures are calculated.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^*)^2} \quad (3.27)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \quad (3.28)$$

Step 6: The proximity is calculated according to the ideal solution. In Equation (3.29) C_i^*, is the absolute closeness of the decision point to the ideal solution.

$$C_i^* = \frac{S_{\bar{i}}}{S_{\bar{i}} + S_i^*} \quad (3.29)$$

Since the TOPSIS method is not exactly appropriate to represent uncertainties, fuzzy TOPSIS method based on type 1 and type 2 fuzzy sets have been proposed by different researchers in order to better represent uncertainties. In this paper, in order to handle the uncertainty and to make the risk analysis better, the Interval-Valued Pythagorean Fuzzy TOPSIS Method proposed (Garg, H.,2017).

Step 1: Construction of Pythagorean fuzzy decision matrix.

$$D = \begin{pmatrix} \alpha_{11} & \alpha_{12} & \cdots & \alpha_{1n} \\ \alpha_{21} & \alpha_{22} & \cdots & \alpha_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{m1} & \alpha_{m2} & \ldots & \alpha_{mn} \end{pmatrix} \quad (3.30)$$

Step 2: Normalization.

$$r_{ij} = \begin{cases} \alpha_{ij} ; & j \in B \\ \alpha_{ij}^{c} ; & j \in C \end{cases} \tag{3.31}$$

Step 3: Construct the score matrix.

$$R = \begin{pmatrix} M_{(r_{11})} & M_{(r_{12})} & \dots & M_{(r_{1n})} \\ M_{(r_{21})} & M_{(r_{22})} & \dots & M_{(r_{2n})} \\ \vdots & \vdots & \ddots & \vdots \\ M_{(r_{m1})} & M_{(r_{m2})} & \dots & M_{(r_{mn})} \end{pmatrix} \tag{3.32}$$

Step 4: Determine the distance separation of each alternative from ideal and anti-ideal alternatives.

$$d(A_i, a^+) = \sqrt{\sum_{j=1}^{n} \left\{ \omega_j \left(M(a^+) - M(r_{ij}) \right)^2 \right\}^2} \tag{3.33}$$

$$d(A_i, a^-) = \sqrt{\sum_{j=1}^{n} \left\{ \omega_j \left(M(r_{ij}) - M(a^-) \right)^2 \right\}^2} \tag{3.34}$$

Step 5: Compute the closeness coefficient (CC).

$$CC_i = \frac{d_i(A_i, a^-)}{d_i(A_i, a^+) + d_i(A_i, a^-)} , \quad i = 1,2, \dots, m \tag{3.35}$$

Step 6: Rank the alternative.

4. Steps of the Proposed Approach

The proposed approach involves the IVPFAHP and IVPFTOPSIS methods. The main steps of the proposed approach are in Figure 1.

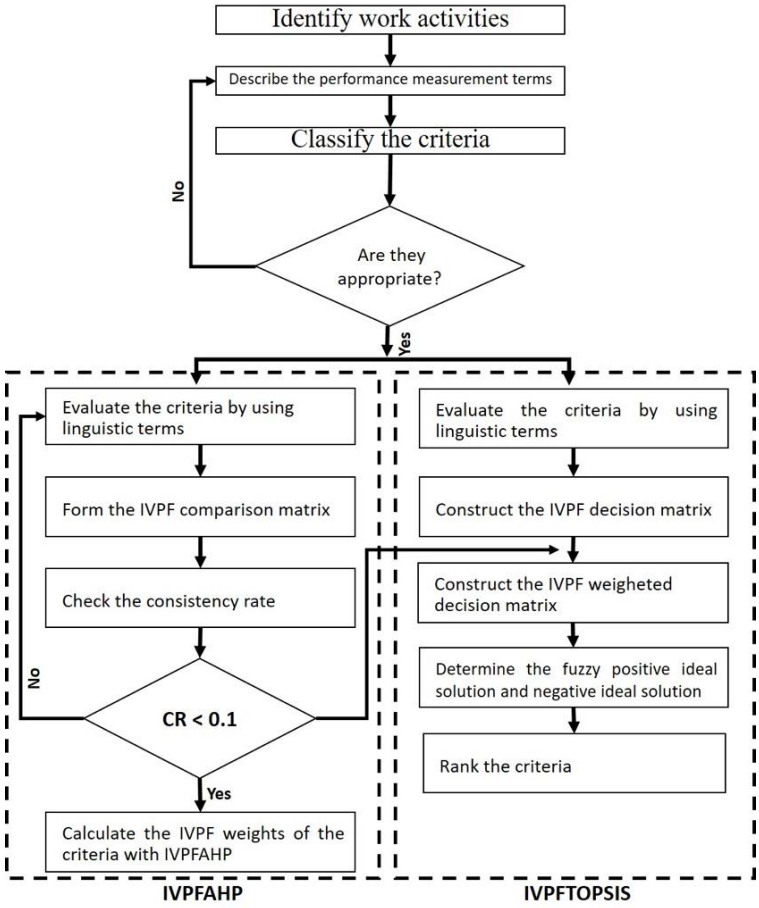

Figure 1. Framework of the proposed marketing performance assessment process

5. A Real Case Application

5.1. Sales Performance Table

Figure 2: Sales performance table

The dimensions that affect sales performance are determined as store, product, employee, brand and date. These dimensions are based on internal and external factors such as store size, location, product features, employee, product information, shopping dates.

5.2. Criteria List

Table 1: Criteria list

Performance Evaluation Criteria List		
Store	Physical Size Store Distance/Proximity Proximity to Stores in the Same Segment	(S1) (S2) (S3)
Product	Product Body Product Colour Product Season Product Price	(P1) (P2) (P3) (P4)
Employee	Employees Shift Employees Break Number of Employees Employees Training Level	(E1) (E2) (E3) (E4)
Brand	Brand Reliability Customer Service Access to Stock Information Visitor / Customer Ratio	(B1) (B2) (B3) (B4)
Date	Special Days Weekend Summer Holiday	(D1) (D2) (D3)

The first criterion Store, is divided into 3 subheadings. These subheadings are Physical Size, Store Distance / Proximity and Stores in the Same Segment. Physical Size refers to the physical shopping environment that the store offers to customers. Physical Size criterion, the importance of the store's size ratio is evaluated by customers. Store Distance / Proximity, refers to customers accessibility to the store. Store Distance / Proximity criterion, importance of transportation to the store inside or outside the mall was evaluated. Proximity to Stores in the Same Segment, the effect of the proximity of the store with similar brands evaluated. Proximity to Stores in the Same Segment criterion, importance of being close to similar brands is evaluated by customers. The second criterion Product, is divided into 4 subheadings. Product Body criterion, expresses body information of the product. The third criterion Employee, is divided into 4 subheadings. Employee Shift criterion refers to the employee's hours of work. Brand Reliability depends on the demand of the consumer and the production of quality products. Factors that make up the brand value reveal brand reliability. Customer Service refers to the speed and correct communication of the brand in order to respond to customer demands. Access to Stock Information with the customer means helping the customer reach the relevant product. The sharing of stock information with the customer is one of the factors necessary for the customer to purchase the relevant product. Visitor / Customer Ratio refers finding the products that can be purchased in the store, refers to the rate of converting the visitor to the customer. The fifth criterion Date, is divided into 3 subheadings.

These subheadings are Special Days, Weekend and Summer Holiday.Special Days, Christmas, Birthdays, Mother's Day, Teachers' Day, Valentine's Day and etc. refers to the days. Weekend refers to non-working days. Summer Holiday refers to the term of June, July and August. The importance of all these criteria was evaluated by the customers. Taking all these into account, criteria list was created as given table 1.

5.3. Survey Reviews

Survey questions were answered by 337 people from 14 job group. The age ranges of the survey participants are as in graphic 1. The biggest part of the questionnaire is the 21-25 age range with 23%. The age range of 17-21 years with 19%, followed by the age range of 37-41.

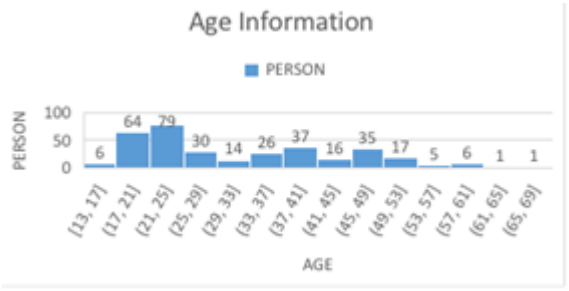

Figure 3: Age information

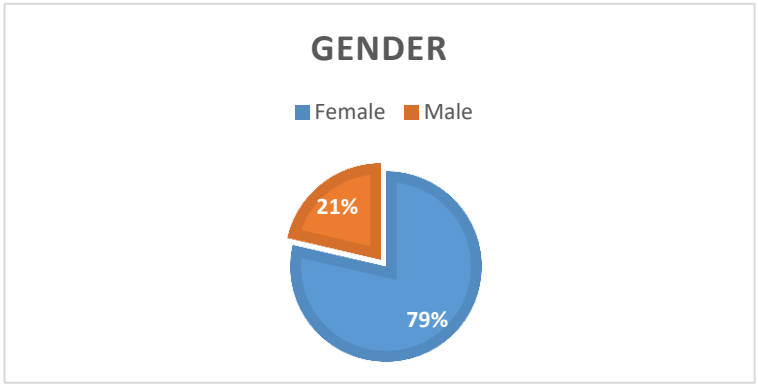

Figure 4: Gender information

In this survey of 337 people, the importance of shop criteria was evaluated by store customers. Evaluation was made with the following answers; Certainly Low Importance, Very Low Importance, Low Importance, Below Average Importance, Average Importance, Above Average Importance, High Importance, Very High Importance, Certainly High Importance and Exactly Equal. Thus, the criteria offered for store customers were placed in order of importance and evaluated.

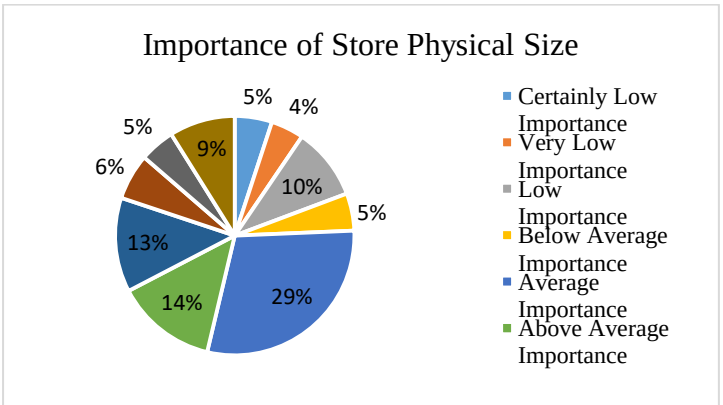

Figure 5: Importance of store physical size

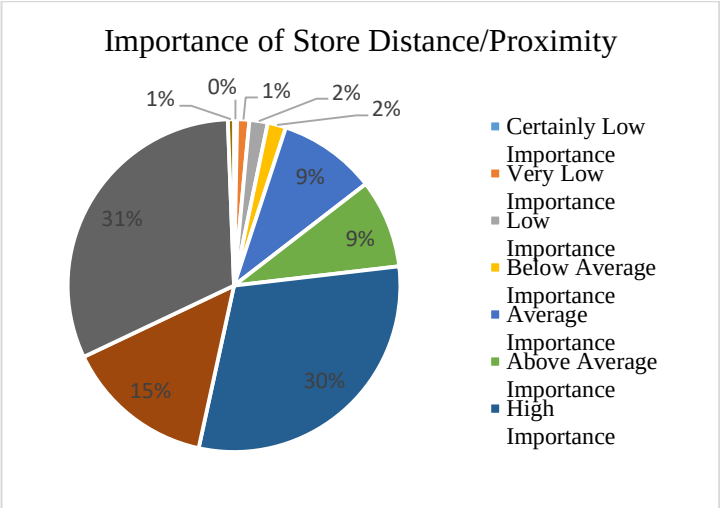

Figure 6: Importance of store distance

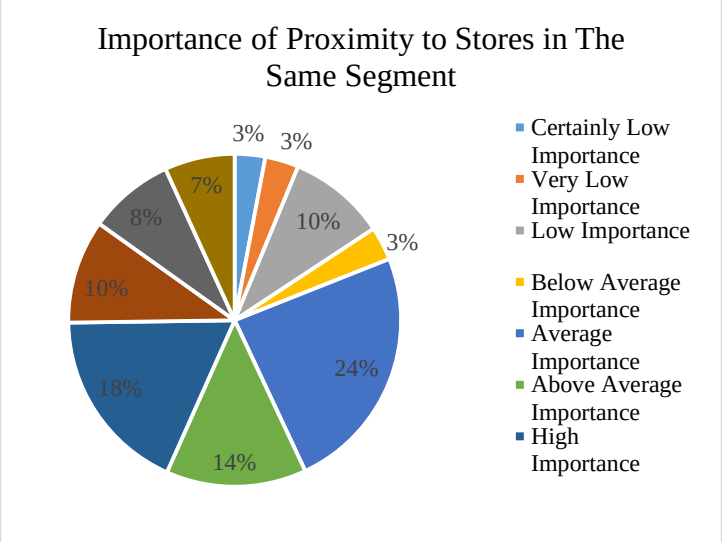

Figure 7: Importance of proximity to stores in the same segment

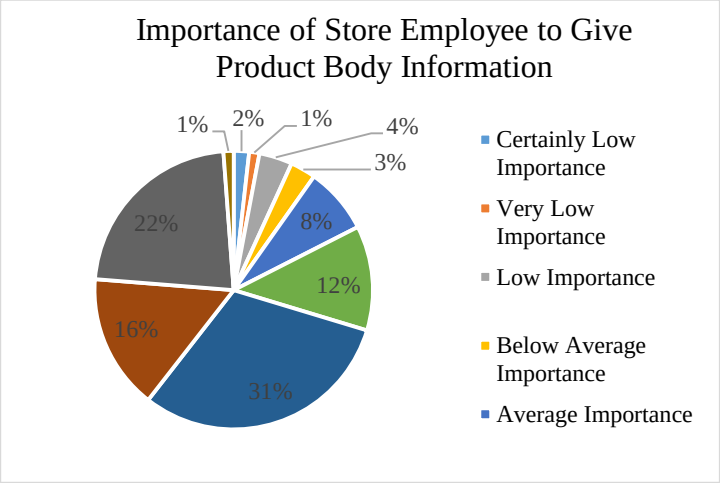

Figure 8: Importance of product body information

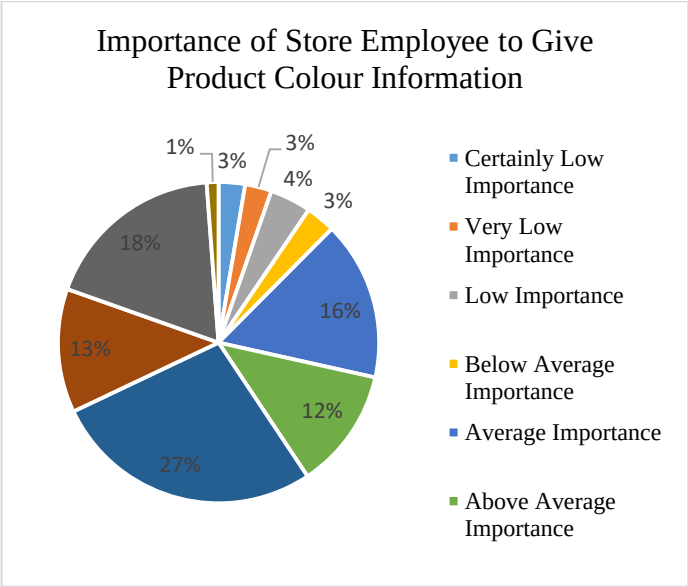

Figure 9: Importance of product colour information

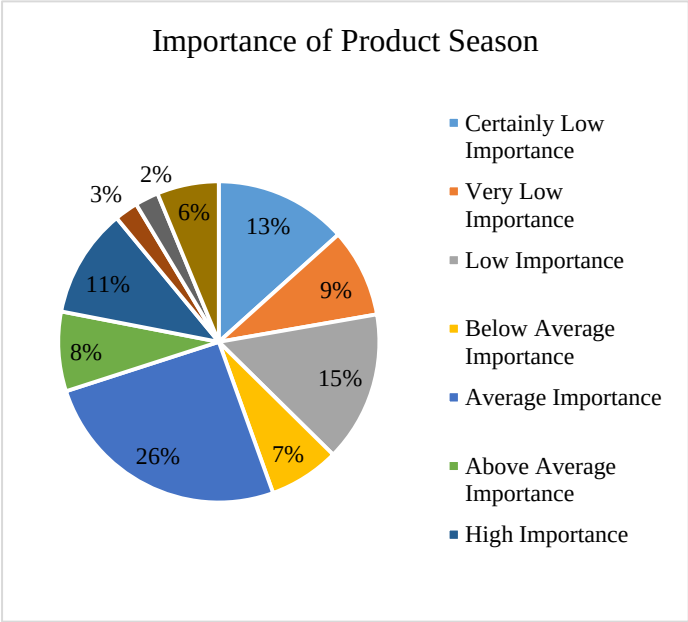

Figure 10: Importance of product season

Table 2: Comparison matrices owing to IVPFAHP for store

	S1				S2				S3			
S1	0.50	0.50	0.50	0.50	0.35	0.45	0.55	0.65	0.45	0.55	0.45	0.55
S2	0.55	0.65	0.35	0.45	0.50	0.50	0.50	0.50	0.55	0.65	0.35	0.45
S3	0.45	0.55	0.45	0.55	0.35	0.45	0.55	0.65	0.50	0.50	0.50	0.50

Table 3: Comparison matrices owing to IVPFAHP for product

	P1				P2				P3				P4			
P1	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.65	0.80	0.20	0.35	0.10	0.20	0.80	0.90
P2	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.65	0.80	0.20	0.35	0.10	0.20	0.80	0.90
P3	0.20	0.35	0.65	0.80	0.20	0.35	0.65	0.80	0.50	0.50	0.50	0.50	0.00	0.00	0.90	1.00
P4	0.80	0.90	0.10	0.20	0.80	0.90	0.10	0.20	0.90	1.00	0.00	0.00	0.50	0.50	0.50	0.50

Table 4: Comparison matrices owing to IVPFAHP for employee

	E1				E2				E3				E4			
E1	0.50	0.50	0.50	0.50	0.55	0.65	0.35	0.45	0.55	0.65	0.35	0.45	0.65	0.80	0.20	0.35
E2	0.35	0.45	0.55	0.65	0.50	0.50	0.50	0.50	0.45	0.55	0.45	0.55	0.65	0.80	0.20	0.35
E3	0.35	0.45	0.55	0.65	0.45	0.55	0.45	0.55	0.50	0.50	0.50	0.50	0.65	0.80	0.20	0.35
E4	0.20	0.35	0.65	0.80	0.20	0.35	0.65	0.80	0.20	0.35	0.65	0.80	0.50	0.50	0.50	0.50

Table 5 Comparison matrices owing to IVPFAHP for brand

	B1				B2				B3				B4			
B1	0.50	0.50	0.50	0.50	0.45	0.55	0.45	0.55	0.45	0.55	0.45	0.55	0.45	0.55	0.45	0.55
B2	0.45	0.55	0.45	0.55	0.50	0.50	0.50	0.50	0.55	0.65	0.35	0.45	0.55	0.65	0.35	0.45
B3	0.45	0.55	0.45	0.55	0.35	0.45	0.55	0.65	0.50	0.50	0.50	0.50	0.45	0.55	0.45	0.55
B4	0.45	0.55	0.45	0.55	0.35	0.45	0.55	0.65	0.45	0.55	0.45	0.55	0.50	0.50	0.50	0.50

Table 6: Comparison matrices owing to IVPFAHP for date

	D1				D2				D3			
D1	0.50	0.50	0.50	0.50	0.55	0.65	0.35	0.45	0.45	0.55	0.45	0.55
D2	0.35	0.45	0.55	0.65	0.50	0.50	0.50	0.50	0.45	0.55	0.45	0.55
D3	0.45	0.55	0.45	0.55	0.45	0.55	0.45	0.55	0.50	0.50	0.50	0.50

Table 7: Weight for IVPFAHP

Weight								
S1	0.2707	P1	0.2500	E1	0.3094	B1	0.2448	D1	0.4059
S2	0.4587	P2	0.2500	E2	0.2828	B2	0.3132	D2	0.2696
S3	0.2707	P3	0.1250	E3	0.2828	B3	0.2210	D3	0.3244
		P4	0.3750	E4	0.1250	B4	0.2210		

According to the results of the IVPFAHP method used in the application Store Distance/Proximity (S2), Special Days (D1), Product Price (P4), and Summer Holiday (D3) were determined as the highest values.

Table 8: Comparison matrices owing to IVPFTOPSIS for store

	S1				S2				S3			
A	0.50	0.80	0.50	0.80	0.80	0.44	0.10	0.97	0.80	0.44	0.10	0.97
B	0.80	0.44	0.10	0.97	0.40	0.87	0.60	0.71	0.10	0.97	0.80	0.44

Table 9: Comparison matrices owing to IVPFTOPSIS for product

	P1				P2				P3				P4			
A	0.70	0.60	0.25	0.92	0.60	0.71	0.40	0.87	0.25	0.92	0.70	0.60	0.80	0.44	0.10	0.97
B	0.70	0.60	0.25	0.92	0.70	0.60	0.25	0.92	0.60	0.71	0.40	0.87	0.80	0.44	0.10	0.97

Table 10: Comparison matrices owing to IVPFTOPSIS for employee

E1				E2				E3				E4			
0.50	0.80	0.50	0.80	0.50	0.80	0.50	0.80	0.70	0.60	0.25	0.92	0.40	0.87	0.60	0.71
0.50	0.80	0.50	0.80	0.25	0.92	0.70	0.60	0.80	0.44	0.10	0.97	0.50	0.80	0.50	0.80

Table 11: Comparison matrices owing to IVPFTOPSIS for brand

	B1				B2				B3				B4			
A	0.80	0.44	0.10	0.97	0.70	0.60	0.25	0.92	0.50	0.80	0.50	0.80	0.80	0.44	0.10	0.97
B	0.80	0.44	0.10	0.97	0.70	0.60	0.25	0.92	0.70	0.60	0.25	0.92	0.50	0.80	0.50	0.80

Table 12: Comparison matrices owing to IVPFTOPSIS for date

	D1				D2				D3			
A	0.80	0.44	0.10	0.97	0.70	0.60	0.25	0.92	0.50	0.80	0.50	0.80
B	0.60	0.71	0.40	0.87	0.50	0.80	0.50	0.80	0.70	0.60	0.25	0.92

Table 13: Weight for IVPFTOPSIS

	S	P	E	B	D	Score
A	0.6809	0	0.4389	0.6848	0.7701	0.51494
B	0.3191	1	0.5611	0.3152	0.2299	0.48506

In the second phase of the study, the sales performance weights obtained by IV-PFAHP were used to evaluate two different branches of the pioneer clothing company. Branch A is located on the street and branch B is located within the mall. In addition, branch B sells season-end products and organizes various campaigns on special days. According to the results for IV-PFTOPSIS branch B has been identified as in a better marketing performance.

6. Conclusions

Performance measurement is a mixed system that contains many different criteria such as customer behaviour, sales, employees and product range. Businesses need to measure sales performance to maintain sustainable competition lines and improve their strategies, and these measurements are all examples of decision-making. In this paper, a new marketing performance analysis methodology is proposed based on AHP–TOPSIS integration extended with IVPF sets. The IVPFAHP is used to calculate the weights of marketing performance parameters. After calculating the weights of marketing performance parameters, two branches of a sales performance of a company in the clothing industry is calculated using the IVPFTOPSIS. A case study on the assessment of marketing performance was carried out for the sector. According to the results of the IVPFAHP method used in the application Store Distance/Proximity (S2), Special Days (D1), Product Price (P4), and Summer Holiday (D3) were determined as the highest values. The location of the store affects shopping. The fact that the store is located in a central location makes it easier for you to reach the store. It is also an important criterion in the reasons for being preferred in the mall. Every country has its own special days like Christmas, Birthdays, Mother's Day, Teachers' Day and etc. In order to increase the sales of stores and benefit from human circulation these days, they should increase the number of employees in the store, arrange special promotions for that day and make necessary arrangements in the store. Another important criterion that affects sales performance is the price of the product. When you look at the beginning and end of season sales rates, you can see how much the price factor effects. In order to become advantageous in price competition, stores should sell more affordable products without compromising quality. Due to the increase in the rate of going on holiday in the summer season, the need for shopping is increasing. During these periods, the shops should bring the products suitable for the summer season to the forefront. When all criteria are taken into consideration, issues that need to be addressed especially in the case of improving the sales performance of an existing store or opening a new store; good determination of store location, sales increase activities should be performed on special days, product price should be determined according to the segment addressed and it is a good management of the shopping needs brought by the summer season. For further research, some new marketing performance assessment methods based on the other type of fuzzy sets such as hesitant and intuitionistic can be improved and the obtained results can be compared.

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