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EVALUATION OF HANDS-ON ENTREPRENEURSHIP TRAININGS ON THE BASIS OF PROVINCES, NUTS-I AND NUTS-II REGIONS BY FUZZY BWM AND AROMAN METHODS

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Abstract

The level of a country's entrepreneurship ecosystem is an important indicator that serves the economic development of that country. In today's world, governments resort to various instruments to strengthen the entrepreneurship infrastructure. In Türkiye, a significant part of these activities is implemented by KOSGEB. Since 2010, Hands-On Entrepreneurship Trainings are one of the initiatives that contribute to this objective. In this study, the performances of each province, NUTS-I regions and NUTS-II regions in Türkiye in terms of benefiting from entrepreneurship supports are analysed. The criteria used during the evaluation are weighted by Fuzzy BWM method where the most important criterion is determined as "number of enterprises supported following the trainings". In the performance ranking performed by AROMAN method TR6, TR3 and TR4 regions are ranked in the first three order as the most successful NUTS-I regions. In addition, a similar evaluation is carried out in terms of provinces and NUTS-II regions.

Keywords: *Entrepreneurship, KOSGEB, MCDM, Fuzzy BWM, AROMAN.*

UYGULAMALI GİRİŞİMCİLİK EĞİTİMLERİNİN İL, DÜZEY-I VE DÜZEY-II BÖLGELERİ BAZINDA BULANIK BWM VE AROMAN YÖNTEMLERİYLE DEĞERLENDİRİLMESİ

Öz

Bir ülkenin girişimcilik ekosistemin seviyesi, o ülkenin ekonomik kalkınmasına hizmet eden önemli bir göstergedir. Günümüz dünyasında ise hükümetler, girişimcilik altyapısını güçlendirmek amacıyla çeşitli enstrümanlara başvurmaktadır. Türkiye'de ise bu konudaki faaliyetlerin önemli bir kısmı KOSGEB tarafından yürütülmektedir. 2010 yılından itibaren uygulanmaya başlanan Uygulamalı Girişimcilik Eğitimleri, bu amaca hizmet eden uygulamalardan birisidir. Bu araştırmada, Türkiye'deki her bir ilin, Düzey-I bölgelerinin ve Düzey-II bölgelerinin girişimcilik desteklerinden yararlanma açısından performansları incelenmiştir. Değerlendirme esnasında kullanılan kriterler Bulanık BWM yöntemiyle ağırlıklandırılmış olup en önemli ölçüt, "eğitim sonrası desteklenen işletme sayısı" olarak belirlenmiştir. AROMAN yöntemiyle gerçekleştirilen performans sıralamasında ise TR6, TR3 ve TR4 en başarılı Düzey-I bölgeleri olarak ilk üç sırada yer almıştır. Ayrıca, benzer bir değerlendirme il ve Düzey-II bölgeleri açısından da gerçekleştirilmiştir.

Anahtar kelimeler: *Girişimcilik, KOSGEB, ÇKKV, Bulanık BWM, AROMAN.*

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1. INTRODUCTION

The expression of entrepreneurship refers to the ability to initiate the required steps in order to actualise innovative business opportunities within the framework of a particular vision, creativity, flexibility and skill level. From this point of view, entrepreneurship can be defined as the ability to implement some practices concerning business life in a manner different from ordinary business methods and can be considered as a reflection of leadership skills in some sense (Schumpeter, 1951, p. 255). Individuals with entrepreneurial personality have features such as determined and enthusiastic about revealing new opportunities and creating added value, even at the expense of a number of risks. To express the situation more precisely, individuals with a strong entrepreneurial mind-set have distinctive behavioural attitudes such as taking initiatives and accepting the possibility of failure at the very beginning. In addition, their ability to benefit from existing resources and opportunities in their favour in a practical and economical manner is extremely strong (Frederick et al., 2019, p. 9).

The legal regulations put in force by governments to encourage the entrepreneurship ecosystem are of vital importance in today's world in terms of ensuring their own economic growth and eliminating employment problems. Within the scope of these legal regulations, supports are provided in the form of grant programmes, low-interest or interest-free loans, tax reductions or exemptions, insurance premium supports, customs duty exemption, value added tax exemption or free land allocation, etc. Subsidising entrepreneurs in financial terms is, of course, an extremely meaningful approach in terms of eliminating the obstacles in front of entrepreneurs. However, before embarking on an investment venture, most would-be entrepreneurs should be sufficiently informed about the possible problems they are likely to encounter and the issues they should be aware of.

Small and Medium Scaled Industry Development and Support Directorate (KOSGEB), established in 1990 in Türkiye with the Law No. 3624, provides various supports to enterprises with SME status (Küçük ve Orta Ölçekli İşletmeleri Geliştirme ve Destekleme İdaresi Başkanlığı Teşvik ve Muafiyetleri Kanunu, 1990). Within the scope of KOSGEB's duties and responsibilities determined in accordance with the law, it is aimed to provide supports to enterprises for their activities such as investment, production, management, planning, marketing and co-operation. In addition to these duties, taking required measures for development and dissemination of entrepreneurship culture and environment, implementing all kinds of facilitating activities for enterprises and entrepreneurs are particularly emphasised (Bakanlıklara Bağlı, İlgili, İlişkili Kurum ve Kuruluşlar ile Diğer Kurum ve Kuruluşların Teşkilatı Hakkında Cumhurbaşkanlığı Kararnamesi, 2018). Therefore, entrepreneurship trainings, which cover the basic topics that entrepreneurs should pay attention before putting their ideas into practice, are conducted by KOSGEB in this context.

The New Entrepreneur Support implemented within the scope of the Entrepreneurship Support Programme, launched in 2010 by KOSGEB in Türkiye, is a financial support mechanism that remained active for the applications of entrepreneur candidates until the end of the year 2018. Within the scope of this scheme, new entrepreneur candidates were initially subjected to 60 hours of practical training. With the regulation enacted in 2012, the training duration was initially increased to 72 hours, and ~~in~~ it was decreased to 32 hours in 2016. Hands-On Entrepreneurship Trainings were carried out face-to-face from 2010 to 2019 and approximately one and a half million entrepreneur candidates participated in these trainings during this period. Since then, trainings have been provided through online KOSGEB E-Academy (Altunay, 2020).

The Nomenclature of Territorial Units for Statistics (NUTS) is a statistical classification method designed by the Statistical Office of the European Union (EUROSTAT) in 1970s to ensure that regional statistics are generated based on a single spatial classification in the European Union (EU) and has been included in EU legislation since 1988. The use of the NUTS in Türkiye started under the coordination of the Undersecretariat of the State Planning Organisation (DPT) and the Turkish Statistical Institute (TÜİK) within the scope of the Accession Partnership Document and put into force in 2002. The regions classified in order to serve as a basis for the studies carried out in the EU candidacy period and to benefit from structural funds within the scope of the EU cohesion policy convergence objective are represented in Table 1, Figure1 and Figure 2.

Table 1: NUTS-I and NUTS- regions in Türkiye

NUTS-I Code	NUTS-I Regions	NUTS-II Code	NUTS-II Provinces
TR1	Istanbul	TR10	Istanbul
TR2	Western Marmara	TR21	Tekirdağ, Edirne, Kırklareli
		TR22	Balıkesir, Çanakkale
TR3	Aegean	TR31	Izmir
		TR32	Aydın, Denizli, Muğla
		TR33	Manisa, Afyonkarahisar, Kütahya, Uşak
TR4	Eastern Marmara	TR41	Bursa, Eskişehir, Bilecik
		TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR5	Western Anatolia	TR51	Ankara
		TR52	Konya, Karaman
TR6	Mediterranean	TR61	Antalya, Isparta, Burdur
		TR62	Adana, Mersin
		TR63	Hatay, Kahramanmaraş, Osmaniye
TR7	Central Anatolia	TR71	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
		TR72	Kayseri, Sivas, Yozgat
TR8	Western Black Sea	TR81	Zonguldak, Karabük, Bartın
		TR82	Kastamonu, Çankırı, Sinop
		TR83	Samsun, Tokat, Çorum, Amasya
TR9	Eastern Black Sea	TR90	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
TRA	North-eastern Anatolia	TRA1	Erzurum, Erzincan, Bayburt
		TRA2	Ağrı, Kars, Iğdır, Ardahan
TRB	Middle East Anatolia	TRB1	Malatya, Elâzığ, Bingöl, Tunceli
		TRB2	Van, Muş, Bitlis, Hakkâri
TRC	South-eastern Anatolia	TRC1	Gaziantep, Adıyaman, Kilis
		TRC2	Şanlıurfa, Diyarbakır
		TRC3	Mardin, Batman, Şırnak, Siirt

(**Source:** Şimşek, 2013)

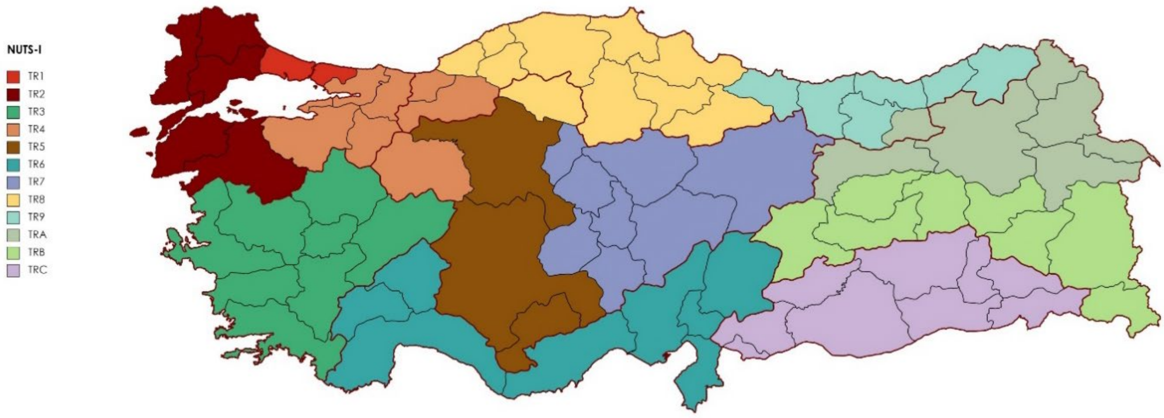

Figure 1: NUTS-I regions in Türkiye

Figure 2: NUTS-II regions in Türkiye

Only a limited number of publications are available relevant with Hands-On Entrepreneurship Trainings, which have been organised by KOSGEB since many years. In this study, a comprehensive analysis is carried out on the extent to which Hands-On Entrepreneurship Trainings contribute to the entrepreneurship culture on the basis of provinces, NUTS-I and NUTS-II regions. The parameters at the forefront in the process of performance evaluation for entrepreneurship ecosystem are also determined in this context.

On the basis of the issues summarised so far, the effectiveness of Hands-On Entrepreneurship Trainings organised face-to-face by KOSGEB is investigated within the scope of this research on the basis of provinces, NUTS-I regions and NUTS-II regions. The comparative performances of both provinces and NUTS-I and NUTS-II regions are determined by taking into account the number of trainings organised for each province, the number of participants joined to the trainings, the number of enterprises supported following the trainings and the total support amounts submitted. In the first stage, which evaluation criterion has a higher level of importance is determined by Fuzzy Best-Worst Method (F-BWM). In line with the importance level of these criteria, performance orders of all provinces, NUTS-I and NUTS-II regions in terms of entrepreneurship supports are determined by means of Alternative Ranking Order Method Accounting for Two-Step Normalization (AROMAN).

In the first section of the study, the concept of entrepreneurship, the duties and responsibilities of KOSGEB institution and the reasons for emergence of NUTS-I and NUTS-II regions in Türkiye are presented. In the second section, a literature review of the publications related to entrepreneurship trainings implemented in the world and in Türkiye is presented. This section also includes previous publications related to the criterion weighting and multi criteria decision making methods employed in the research. The third section involves the description of steps to implement the F-BWM method used for criterion weighting and the AROMAN method used to sort alternatives. Finally, the fourth section consists the implementation phase, which includes the determination of the weights of the criteria used in the evaluation and the ordering the alternatives.

2. LITERATURE REVIEW

Some of the studies published worldwide regarding the effect of entrepreneurship trainings on entrepreneurship orientation can be summarised as follows.

Mwatsika (2016) tried to determine in which sectors individuals who receive entrepreneurship training tend to create businesses and investigated whether value-creating activities emerge in consequence of these trainings. Therefore, it is also determined how effective the organisations providing entrepreneurship training are in this regard. Ringo Ho et al. (2018) investigated the effect of systematic entrepreneurship education, in which active and passive learning activities are applied together, on the perception of entrepreneurship in adolescents. Based the findings, it is observed that the entrepreneurship perceptions of adolescents receiving such training are at a much higher level. Ferrandiz et al. (2018) aimed to determine whether a new entrepreneurship curriculum planned to be implemented contributes to students' entrepreneurial endeavours. The results revealed that the new curriculum contributes favourably in terms of the projects presented by the participants on entrepreneurship. It also provides an approach for a more detailed identification of the factors influencing entrepreneurial culture. Boldureanu et al. (2020) conducted a study on how the presentation of successful and role-modelling entrepreneurship cases to higher education students during their education would change their perspectives about entrepreneurship. The research revealed the evidence that such exemplary cases encourages students about entrepreneurship. Qian et al. (2022) conducted a study on undergraduate students to examine the relationship between their entrepreneurial passion and entrepreneurial behaviours and concluded that individuals with a sense of curiosity and invention skills have a much higher entrepreneurial capacity.

Some of the studies published in Türkiye related with the effect of entrepreneurship trainings upon entrepreneurship tendencies are as follows.

Taşdoğan et al. (2023) conducted a study on the adequacy of entrepreneurship education provided to students in universities and concluded that students are more willing to work in the public sector and do not have sufficient information in terms of access to finance even if they are engaged in entrepreneurial ventures. Aksoy et al. (2019) studied the individuals who participated in the trainings organised by KOSGEB and revealed the relationships between economic, social, entrepreneurial and individualistic factors that are effective in the entrepreneurship process and parameters such as gender, income level, experience and education. Put forward a critical approach towards the supports offered by KOSGEB regarding entrepreneurship, Ünüvar and Darıcı (2021, pp. 79–85) highlighted the drawbacks of evaluating traditional and progressive entrepreneurship supports separately. They emphasised that decision makers should also seek the opinions of sector representatives, chambers and academicians in this process.

The publications regarding the F-BWM method employed for prioritisation of criteria and the AROMAN method applied for ordering the alternatives can be summarised as indicated in Table 2.

Table 2: Literature review of the methods employed

Method	Author	Subject
Fuzzy BWM	(Guo & Zhao, 2017)	Selection of sustainable supplier
	(Amoozad Mahdiraji et al., 2018)	Key Factors of Sustainable Architecture
	(Gan et al., 2019)	Selection of resilient supplier
	(Ghoushchi et al., 2019)	prioritization of failures
	(Ecer & Pamucar, 2020)	Selection of sustainable supplier
	(Tu et al., 2020)	Water Resources Security Evaluation
	(Amiri et al., 2021)	Selection of sustainable supplier
	(Khan et al., 2021)	Management of halal supply chain
	(Kurniawan & Puspitasari, 2021)	Selection of sustainable supplier
	(Ghorabaee et al., 2021)	Sustainable public transportation evaluation
	(Roy & Shaw, 2022)	Credit rating model
	(Görçün & Doğan, 2023)	Mobile crane selection
	(Ecer et al., 2024)	Evaluation of cryptocurrency exchanges
AROMAN	(Bošković et al., 2023)	Electric vehicle selection
	(Kara et al., 2024)	Assessing Türkiye's sustainable competitiveness

3. METHODS

Since the rationale of this research is to measure the impact of Hands-On Entrepreneurship Trainings on the basis of provinces, NUTS-I and NUTS-II regions and to evaluate the order of success for each alternative, the criteria are prioritised and weighted by means of F- BWM method in line with this objective. Subsequently, the ordering of the contribution by each province, NUTS-I region and NUTS-II region to entrepreneurship ecosystem is determined by AROMAN method. Eventually, sensitivity analysis is conducted in order to confirm the validity of the method implemented.

Flow diagram summarising the entire research briefly is presented in Figure 3.

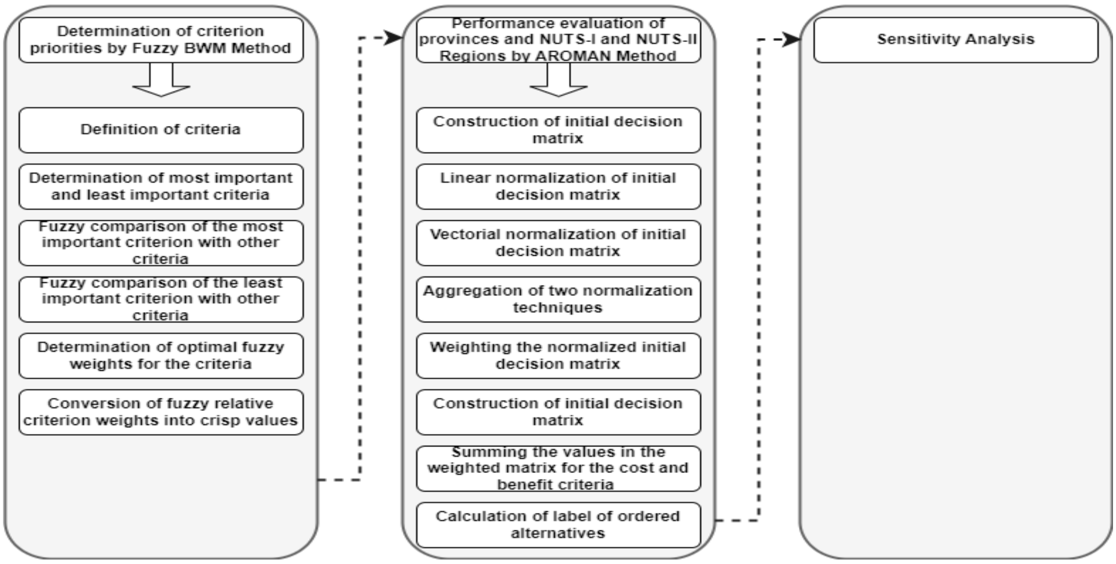

Figure 3: Flowchart of the research

3.1. Fuzzy BWM Method

Proposed in 2015 by Rezaei, the BWM method (2015) aims to determine the relative importance levels of the criteria used in multi-criteria decision-making applications. The initial stage of this approach is identification of the most important and least important criteria by the expert decision makers (DM). In the following stage, the most and least important criteria are individually compared with each other criterion employed for the evaluation. At the last stage, the final weights of the criteria are calculated within the scope of the maximin approach, and hence the importance order of the criteria is determined. The fact that applied method requires less comparison data and produces more reliable outputs as a result of consistent comparisons, are indicators that confirm the trustworthiness of the method. Based on the fact that it is not always possible to determine the exact values or boundaries in decision-making processes related to real-life applications, fuzzy modelling methods are often employed as an alternative for such situations. Regarding this consideration, a fuzzy version of the BWM method was proposed by Guo and Zhao which rendered this approach preferable in the research. Unlike the conventional BWM method, the pairwise comparisons of the best and worst criteria with respect to others are performed by means of a linguistic scale involving triangular fuzzy numbers instead of integers as indicated in Table 3 (Guo & Zhao, 2017).

Table 3: Linguistic scale for F-BWM method

Linguistic Scale	Response Scale
Equally Important (EI)	$(1;\ 1;\ 1)$
Weakly Important (WI)	$(2/3;\ 1;\ 3/2)$
Fairly Important (FI)	$(3/2;\ 2;\ 5/2)$
Very Important (VI)	$(5/2;\ 3;\ 7/2)$
Absolutely Important (AI)	$(7/2;\ 4;\ 9/2)$

Within the scope of this method, it is required to make use of optimisation programmes to determine the fuzzy weights for all criteria. Afterwards, the values involving these triangular fuzzy numbers are converted into crisp or, more specifically, graded mean integration representation (GMIR) values. Just as in the conventional BWM method, the consistency ratio (CR) value should be taken into consideration in the F-BWM method in order to verify the validity of pairwise comparisons according to the consistency index (CI) values indicated in Table 4.

Table 4: Consistency ratios for F-BWM method

Linguistic Scale	Equally Important (EI)	Weakly Important (WI)	Fairly Important (FI)	Very Important (VI)	Absolutely Important (AI)
$\tilde{a}_{BW}$	(1; 1; 1)	(2/3; 1; 3/2)	(3/2; 2; 5/2)	(5/2; 3; 7/2)	(7/2; 4; 9/2)
CI	3.00	3.80	5.29	6.69	8.04

In addition, the required steps implemented for determination of criterion weights by F-BWM method can be listed as follows (Guo & Zhao, 2017; Kurniawan & Puspitasari, 2021).

In F-BWM applications, a total of $2n-3$ pairwise comparisons are performed, where n represents the number of criteria. One of these comparisons is conducted between the most important criterion and the least important criterion, $n-2$ of them are conducted among the most important criterion and the other criteria, and $n-2$ of comparisons are conducted among the other criteria and the least important criterion.

Step1. Definition of criteria

In the first stage, n criteria to be used in decision making processes are defined in the form of $\{C_1, C_2, C_3, \ldots\ldots, C_n\}$.

Step 2. Determination of most important and least important criteria

The decision makers involved in the research determine the criterion with the highest importance (C_B) and the criterion with the least importance (C_W) among the existing criteria.

Step 3. Fuzzy comparison of the most important criterion with other criteria

In this step, the highest important criterion C_B is compared with the least important criterion C_W and with other criteria C_i according to the linguistic scale. These pairwise comparisons conducted are symbolised by $\tilde{a}_{ij}$ and the obtained fuzzy best-to-others vector is represented by $\tilde{A}_B = (\tilde{a}_{B1}, \tilde{a}_{B2}, \tilde{a}_{B3}, \ldots\ldots, \tilde{a}_{Bn})$. Since the most important criterion, C_B, will also be compared with itself in the meantime, it should be ensured that this value is assumed as $\tilde{a}_{BB} = (1; 1; 1)$.

Step 4. Fuzzy comparison of the least important criterion with other criteria

In this step, the importance level of all other C_i criteria over the least important C_W criterion is determined by considering the fuzzy linguistic scale. The obtained fuzzy others-to-worst vector is represented by $\tilde{A}_W = (\tilde{a}_{1W}, \tilde{a}_{2W}, \tilde{a}_{3W}, \ldots\ldots, \tilde{a}_{nW})$. Since the least important criterion, C_W, will also be compared with itself in the meantime, it should be ensured that this value is assumed as $\tilde{a}_{WW} = (1; 1; 1)$.

Step 5. Determination of optimal fuzzy weights for the criteria

The most ideal fuzzy weight value for each criterion is the one that fulfils the conditions $\frac{\tilde{w}_B}{\tilde{w}_j} = \tilde{a}_{Bj}$ and $\frac{\tilde{w}_j}{\tilde{w}_W} = \tilde{a}_{jW}$ for each fuzzy pairs of $\frac{\tilde{w}_B}{\tilde{w}_j}$ and $\frac{\tilde{w}_j}{\tilde{w}_W}$. By obtaining a solution where the maximum absolute gaps of $\left|\frac{\tilde{w}_B}{\tilde{w}_j} - \tilde{a}_{Bj}\right|$ and $\left|\frac{\tilde{w}_j}{\tilde{w}_W} - \tilde{a}_{jW}\right|$ reach the minimum level for each j value, the conditions for all values of j will be fulfilled. Ultimately, the process of determining the optimum fuzzy weights $(\tilde{w}_1^*, \tilde{w}_2^*, \tilde{w}_3^*, \ldots\ldots, \tilde{w}_n^*)$ will be completed by means of nonlinear optimisation method by taking the following constraints into consideration as indicated in Equation (1).

$$\min \max_j \left\{ \left| \frac{\widetilde{w}_B}{\widetilde{w}_j} - \tilde{a}_{Bj} \right| . \left| \frac{\widetilde{w}_j}{\widetilde{w}_W} - \tilde{a}_{jW} \right| \right\}$$

$$s.t. \begin{cases} \sum_{j=1}^{n} R(\widetilde{w}_j) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1,2,3,\ldots\ldots,n \end{cases} \qquad \begin{aligned} \widetilde{w}_B &= (l_B^w, m_B^w, u_B^w) \\ \widetilde{w}_j &= (l_j^w, m_j^w, u_j^w) \\ \widetilde{w}_W &= (l_W^w, m_W^w, u_W^w) \\ \tilde{a}_{Bj} &= (l_{Bj}, m_{Bj}, u_{Bj}) \\ \tilde{a}_{jW} &= (l_{jW}, m_{jW}, u_{jW}) \end{aligned} \qquad (1)$$

The expressions in Equation (1) can be set up as a nonlinear optimisation problem as in Equation (2) indicated below.

$$\min \xi \qquad \xi = (l^{\xi}, m^{\xi}, u^{\xi})$$

$$s.t. \begin{cases} \left| \frac{\widetilde{w}_B}{\widetilde{w}_j} - \tilde{a}_{Bj} \right| \le \xi \\ \left| \frac{\widetilde{w}_j}{\widetilde{w}_W} - \tilde{a}_{jW} \right| \le \xi \\ \sum_{j=1}^{n} R(\widetilde{w}_j) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1,2,3,\ldots\ldots,n \end{cases} \qquad (2)$$

Considering that $l^{\xi} \le m^{\xi} \le u^{\xi}$ and $\xi^* = (k^*, k^*, k^*)$, $k^* \le l^{\xi}$, the expressions in Equation (2) can be reproduced as indicated in Equation (3) below.

$$\min \xi^*$$

$$s.t. \begin{cases} \left| \frac{(l_B^w, m_B^w, u_B^w)}{(l_j^w, m_j^w, u_j^w)} - (l_{Bj}, m_{Bj}, u_{Bj}) \right| \le (k^*, k^*, k^*) \\ \left| \frac{(l_j^w, m_j^w, u_j^w)}{(l_W^w, m_W^w, u_W^w)} - (l_{jW}, m_{jW}, u_{jW}) \right| \le (k^*, k^*, k^*) \\ \sum_{j=1}^{n} R(\widetilde{w}_j) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1,2,3,\ldots\ldots,n \end{cases} \qquad (3)$$

By the way, the optimal fuzzy weights $(\widetilde{w}_1^*, \widetilde{w}_2^*, \widetilde{w}_3^*, \ldots\ldots, \widetilde{w}_n^*)$ and ξ^* value will be calculated by means of equation (3). In addition to this calculation, the consistency ratio is determined via Equation (4) by considering the obtained ξ^* value and consistency index illustrated in Table 4. The closer this ratio is to zero; the more consistent results are obtained.

$$Consistency\ Ratio = \frac{\xi^*}{Consistency\ Index} \qquad (4)$$

Step 6. Conversion of the fuzzy relative criterion weights $\widetilde{w}_j^*$ to non-fuzzy (crisp value) w_j^* based on graded mean integration representation through Equation (5).

$$w_j^* = \frac{l_j + 4m_j + u_j}{6} \tag{5}$$

3.2. AROMAN Method

The AROMAN method, proposed and introduced to the literature by Boskovic et al. in 2023, is characterised by a number of advantages in comparison with other multi-criteria decision-making techniques. First of all, the alternatives subject to ordering can be evaluated in both quantitative and qualitative aspects. During the normalisation phase of the data, it is possible to obtain more robust normalised data by employing a combination of linear and vectorial approaches, which also involve their own sensitivity analysis. The proposed approach does not cover complex processing steps and enables ordering the alternatives by making calculations in a very simplified and practical manner. Finally, it is ensured that the benefit-oriented and cost-oriented criteria employed in the research are differentiated. These benefits of the method have been preferential in terms of its use in the research. The implementation steps for AROMAN method can be listed as follows (Bošković et al., 2023);

Step 1. Construction of initial decision matrix

In the first stage of the research, each alternative, criteria and predetermined values are allocated in the matrix X_{mxn} as given in Equation (6).

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \qquad \begin{array}{l} i = 1,2,3,\ldots\ldots,m \\ j = 1,2,3,\ldots\ldots,n \end{array} \tag{6}$$

Step 2. Linear normalization of initial decision matrix

Linear normalisation is performed for all data in the initial decision matrix by means of Equation (7).

$$\vartheta_{ij} = \frac{x_{ij} - \min_j x_{ij}}{\max_j x_{ij} - \min_j x_{ij}} \qquad \begin{array}{l} i = 1,2,3,\ldots\ldots,m \\ j = 1,2,3,\ldots\ldots,n \end{array} \tag{7}$$

Step 3. Vectorial normalization of initial decision matrix

Vectorial normalisation is performed for all data in the initial decision matrix by means of Equation (8).

$$\vartheta_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \qquad \begin{array}{l} i = 1,2,3,\ldots\ldots,m \\ j = 1,2,3,\ldots\ldots,n \end{array} \tag{8}$$

Both normalisation techniques involve the use of a single formula, without any distinction between cost-oriented or benefit-oriented criteria.

Step 4. Aggregation of two normalization techniques

The aggregation of both normalisation methods is achieved through the use of equation (9).

$$\vartheta_{ij}^{norm} = \frac{\beta.\vartheta_{ij} + (1-\beta).\vartheta_{ij}^*}{2} \qquad \begin{array}{l} i = 1,2,3,\ldots\ldots,m \\ j = 1,2,3,\ldots\ldots,n \\ \beta \in [0,1] \end{array} \tag{9}$$

The β value is expressed as a weighting factor, and proposers of the method considered $\beta = 0.5$ since the arithmetic mean is the most widely used aggregation method.

Step 5. Weighting the normalized initial decision matrix

In order to weight the normalised matrix, each value in this matrix is multiplied by the predetermined value of the corresponding criterion by Equation (10).

$$\hat{\vartheta}_{ij} = w_{ij}.\vartheta_{ij}^{norm} \qquad i = 1,2,3,\ldots\ldots,m \quad j = 1,2,3,\ldots\ldots,n \tag{10}$$

Step 6. Summing the values in the weighted matrix for the cost and benefit criteria separately

The values in the weighted matrix are summed separately for the cost-oriented and benefit-oriented criteria to determine L_i and $A_i$values of each alternative through Equation (11) and Equation (12).

$$L_i = \sum_{j=1}^{n} \hat{\vartheta}_{ij}^{(cost)} \qquad i = 1,2,3,\ldots\ldots,m \quad j = 1,2,3,\ldots\ldots,n \tag{11}$$

$$A_i = \sum_{j=1}^{n} \hat{\vartheta}_{ij}^{(benefit)} \qquad i = 1,2,3,\ldots\ldots,m \quad j = 1,2,3,\ldots\ldots,n \tag{12}$$

Step 7. Calculation of label of ordered alternatives

Final orders of the alternatives are determined in accordance with their label values R_i calculated by Equation (13).

$$R_i = L_i^{\lambda} + A_i^{(1-\lambda)} \qquad i = 1,2,3,\ldots\ldots,m \quad j = 1,2,3,\ldots\ldots,n \tag{13}$$

The parameter of λ in the formula corresponds to the diversity coefficient for cost and benefit criteria. For instance, in case of equal number of cost and benefit criteria, λ value can be considered as 0.5. However, in the case of a ranking computations involving only benefit or cost criteria, λ can also be accepted as 0.5 in order to avoid undefined results (Kara et al., 2024).

3.3. Sensitivity Analysis

Several multiple criteria decision-making studies are concluded with a sensitivity analysis to test the robustness of the methodology employed. Some of these analyses are carried out by applying a partial change in the weight of the criterion values (Yazdani et al., 2019; Qahtan et al., 2023), while some are implemented by sequentially decreasing the weight of most important criterion (Badi et al., 2023; Bouraima et al., 2023; Puška et al., 2022; Mešić et al., 2022). Furthermore, checking whether the same solution is achieved with other MCDM methods or not is another practical use of sensitivity analysis (Kumar et al., 2023; Bonab et al., 2023; Wei & Zhou, 2023). In some researches, different results can be obtained by use of different values of one or more parameters within the ranking technique itself (Yaran Ögel et al., 2023; Ecer & Pamucar, 2022; Biswas et al., 2020). Likewise, since the AROMAN method employed in this research includes a λ parameter, the sensitivity analysis of the method is performed in this manner.

4.PERFORMANCE EVALUATION OF PROVINCES, NUTS-I AND NUTS-II REGIONS

4.1. Prioritization of Evaluation Criteria

The criteria required to evaluate the impact of Hands-On Entrepreneurship Trainings on the basis of provinces, NUTS-I regions and NUTS-II regions are obtained from the General Directorate of KOSGEB. These criteria indicated in Table 5 are ordered in accordance with their importance by the contribution and consensus of five decision makers consisting of representatives from the Chamber of Industry and Commerce, Chamber of Merchants and Craftsmen, Development Agency, Organised Industrial Zone and Association of Young Entrepreneurs. By doing so, the criteria of highest and lowest importance are also determined.

Table 5: List of criteria

Criterion Code	Criteria
C_1	Number of trainings organised
C_2	Number of participants joined to the trainings
C_3	Number of enterprises supported following the trainings
C_4	Total amount of financial supports submitted

The first approach emphasised during the evaluation stage was that the criterion "number of enterprises supported following the trainings" (C_3) should have the highest importance since the priority of this research is to determine the effectiveness of the Hands-On Entrepreneurship Trainings. The "total amount of financial supports submitted" (C_4) criterion, which emerged as a result of this data, is determined as the second evaluation criterion in researching whether these trainings have reached their objectives. The criterion "number of participants joined to the trainings" (C_2) occupies the third order in the ranking as it is an indicator for determining the entrepreneurial tendencies of the participants in the province or region. Finally, "number of trainings organised" (C_1) is considered as the criterion of the lowest importance. All criteria employed in the analysis are benefit oriented.

After determining the order of their significance, the relative superiority of these criteria over each is evaluated by considering the linguistic scale defined in Table 3. Best-to-other vector $\tilde{A}_B = (\tilde{a}_{B1}, \tilde{a}_{B2}, \tilde{a}_{B3}, \ldots\ldots, \tilde{a}_{Bn})$ which indicates the relative superiority of C_3 criterion over the remaining criteria is emerged as $\tilde{A}_B = [(5/2;\ 3;\ 7/2), (3/2;\ 2;\ 5/2), (1;\ 1;\ 1), (2/3;\ 1;\ 3/2)]$ according to the evaluations of DMs as indicated in Table 6.

Table 6: Best-to-other vector $\tilde{A}_B$

	C_1	C_2	C_3	C_4
$C_B(C_3)$	VI	FI	EI	WI

In similar manner, others-to-worst vector $\tilde{A}_W = (\tilde{a}_{1W}, \tilde{a}_{2W}, \tilde{a}_{3W}, \ldots\ldots, \tilde{a}_{nW})$ which represents the superiority of other criteria over C_1 criterion is generated as $\tilde{A}_W = [(1;\ 1;\ 1), (2/3;\ 1;\ 3/2), (5/2;\ 3;\ 7/2), (3/2;\ 2;\ 5/2)]$ in line with the evaluations of DMs as indicated in Table 7.

Table 7: Others-to worst vector $\tilde{A}_W$

	$C_W\ (C_1)$
C_1	EI
C_2	WI
C_3	VI
C_4	FI

Considering these pairwise comparison values, the following optimisation problem is formulated by means of Equation (1), Equation (2) and Equation (3).

$\min \xi^*$

$l3 - 2.5 * u1 - k \leq 0;\ l3 - 2.5 * u1 + k \geq 0$

$m3 - 3 * m1 - k \leq 0;\ m3 - 3 * m1 + k \geq 0$

$u3 - 3.5 * l1 - k \leq 0;\ u3 - 3.5l1 + k \geq 0$

$l3 - 1.5 * u2 - k \leq 0;\ l3 - 1.5 * u2 + k \geq 0$

$m3 - 2 * m2 - k \leq 0;\ m3 - 2 * m2 + k \geq 0$

$u3 - 2.5 * l2 - k \leq 0;\ u3 - 2.5 * l2 + k \geq 0$

$l3 - 0.67 * u4 - k \leq 0; l3 - 0.67 * u4 + k \geq 0$

$m3 - m4 - k \leq 0;\ m3 - m4 + k \geq 0$

$u3 - 1.5 * l4 - k \leq 0;\ u3 - 1.5 * l4 + k \geq 0$

$l2 - 0.67 * u1 - k \leq 0;\ l2 - 0.67 * u1 + k \geq 0$

$m2 - m1 - k \leq 0;\ m2 - m1 + k \geq 0$

$u2 - 1.5 * l1 - k \leq 0;\ u2 - 1.5 * l1 + k \geq 0$

$l4 - 1.5 * u1 - k \leq 0;\ l4 - 1.5 * u1 + k \geq 0$

$m4 - 2 * m1 - k \leq 0;\ m4 - 2 * m1 + k \geq 0$

$u4 - 2.5 * l1 - k \leq 0;\ u4 - 2.5 * l1 + k >= 0$

$$0.167 * l1 + 0.667 * m1 + 0.167 * u1 + 0.167 * l2 + 0.667 * m2 + 0.167 * u2 + 0.167 * l3 + 0.667 * m3 + 0.167 * u3 + 0.167 * l4 + 0.667 * m4 + 0.167 * u4 = 1$$

$l1 - m1 \leq 0;\ m1 - u1 \leq 0;\ l2 - m2 \leq 0;\ m2 - u2 \leq 0;\ l3 - m3 \leq 0;\ m3 - u3 \leq 0;$

$l4 - m4 \leq 0;\ m4 - u4 \leq 0$

$l1 > 0;\ l2 > 0;\ l3 > 0;\ l4 > 0;\ \xi^* \geq 0$

The fuzzy weights of all variables are calculated by Lingo 18 optimisation software as follows;

$\widetilde{w}_1^* = (0.1275; 0.1367; 0.1367)$ $\widetilde{w}_2^* = (0.1396; 0.1852; 0.2278)$

$\widetilde{w}_3^* = (0.2933; 0.3704; 0.3976)$ $\widetilde{w}_4^* = (0.2536; 0.3219; 0.3671)$

$\xi^* = (0.0485; 0.0485; 0.0485)$

Since the relative importance level of the most important C_3 criterion over the least important C_1 criterion is assessed as Very Important (VI), the consistency index is considered as 6.69. Therefore, consistency ratio as defined in Equation (4) is calculated as;

$$CR = \frac{0.0485}{6.69} = 0.00725$$

which proves the consistency of pairwise comparisons since the value is quite close to zero.

In the final stage, the calculated fuzzy weights of criteria are converted into crisp values via Equation (5) as follows.

$$w_1^* = \frac{0.1275 + 4 * 0.1367 + 0.1367}{6} = 0.1352 \quad w_2^* = \frac{0.1396 + 4 * 0.1852 + 0.2278}{6} = 0.1847$$

$$w_3^* = \frac{0.2933 + 4 * 0.3704 + 0.3976}{6} = 0.3621 \quad w_4^* = \frac{0.2536 + 4 * 0.3219 + 0.3671}{6} = 0.3181$$

$$w^* = (0.1352; 0.1847; 0.3621; 0.3181)$$

4.2. Determination of Entrepreneurship Performances for Provinces and Regions

Hands-On Entrepreneurship Trainings, which have been implemented by KOSGEB in Türkiye since 2010, have facilitated a large number of participants to initiate new businesses. While a considerable number of participants joined these trainings with a serious intention of initiating a new business, a significant number of participants completed their trainings by considering the opportunities that would arise in the future. Therefore, this research aims to examine whether Hands-On Entrepreneurship Trainings have achieved their actual objectives on the basis of provinces, NUTS-I and NUTS-II regions.

The details of all provinces, NUTS-I regions and NUTS-II regions that are included as alternatives in the implementation steps of AROMAN method were presented in Table 1. However, in order to provide a brief overview, only the calculation steps for NUTS-I regions have been presented, and the initial decision matrixes for provinces and NUTS-II regions are attached as Appendix-I and Appendix-II.

In line with the data obtained from KOSGEB “number of trainings organised”, “number of participants joined to the trainings”, “number of enterprises supported following the trainings” and “total amount of financial supports submitted" in NUTS-I regions constitute the initial decision matrix X_{mxn} according to Equation (6) as indicated in Table 8.

Table 8: Initial decision matrix

NUTS-I Regions	C_1	C_2	C_3	C_4
w	**0.1352**	**0.1847**	**0.3621**	**0.3181**
TR1	3,656	140,811	5,544	129,807,817
TR2	1,639	44,098	2,411	57,202,016
TR3	5,385	166,140	8,323	209,957,748
TR4	4,402	143,433	7,142	187,542,683
TR5	3,135	83,379	5,682	150,001,915
TR6	4,283	143,809	9,377	233,509,131
TR7	2,428	78,020	4,509	106,804,618
TR8	2,912	97,857	5,710	140,559,573
TR9	1,141	46,340	2,931	81,781,831
TRA	1,379	49,668	2,571	63,322,221
TRB	2,387	74,587	4,831	122,180,782
TRC	2,764	100,197	7,117	197,771,858

Linear normalised matrix ϑ_{ij} and vectorial normalised matrix ϑ^*_{ij} are calculated by means of Equation (7) and Equation (8) respectively. In the following step, the aggregated normalised matrix ϑ^{norm}_{ij} is derived by integrating both normalization techniques by Equation (9) as represented in Table 9.

Table 9: Normalized decision matrix

NUTS-I Regions	C_1	C_2	C_3	C_4
TR1	0.23039	0.29447	0.18014	0.16514
TR2	0.06620	0.03018	0.02944	0.02740
TR3	0.37113	0.36369	0.31380	0.31719
TR4	0.29112	0.30164	0.25700	0.27467
TR5	0.18798	0.13752	0.18677	0.20345
TR6	0.28143	0.30267	0.36450	0.36187
TR7	0.13043	0.12288	0.13035	0.12150
TR8	0.16983	0.17709	0.18812	0.18554
TR9	0.02567	0.03630	0.05445	0.07403
TRA	0.04504	0.04540	0.03714	0.03901
TRB	0.12709	0.11350	0.14584	0.15067
TRC	0.15778	0.18348	0.25580	0.29407

The exemplary computation steps for x_{11} value in the initial decision matrix are as follows;

$$\vartheta_{11} = \frac{3{,}656 - 1{,}141}{5{,}385 - 1{,}141} = 0.59260 \qquad \vartheta^*_{11} = \frac{3{,}656}{\sqrt{3{,}656^2 + \cdots .. + 2{,}764^2}} = 0.32896$$

$$\vartheta^{norm}_{11} = \frac{0.5 * 0.59260 + (1 - 0.5) * 0.32896}{2} = 0.23039$$

Following the normalisation of the initial decision matrix, the weighting of this normalised matrix $\hat{\vartheta}_{ij}$ is performed by Equation (10) and the corresponding results are displayed in Table 10.

Table 10: Weighted normalized decision matrix

NUTS-I Regions	C_1	C_2	C_3	C_4
TR1	0.03114	0.05439	0.06522	0.05252
TR2	0.00895	0.00557	0.01066	0.00872
TR3	0.05016	0.06718	0.11362	0.10088
TR4	0.03935	0.05572	0.09305	0.08736
TR5	0.02541	0.02540	0.06763	0.06471
TR6	0.03804	0.05591	0.13198	0.11509
TR7	0.01763	0.02270	0.04720	0.03864
TR8	0.02295	0.03271	0.06811	0.05901
TR9	0.00347	0.00671	0.01972	0.02355
TRA	0.00609	0.00839	0.01345	0.01241
TRB	0.01718	0.02096	0.05281	0.04792
TRC	0.02133	0.03389	0.09262	0.09353

where $\hat{\vartheta}_{11} = 0.1352 * 0.23039 = 0.03114$.

In order to determine L_i and A_i values of each alternative, the values in the weighted matrix are summed separately for the cost-oriented and benefit-oriented criteria through Equation (11) and Equation (12). Since there is no cost-oriented criterion in the evaluation, the L_i values emerge to be zero. Final orders of the alternatives are determined in accordance with their label values R_i calculated by Equation (13) as illustrated in Table 11.

Table 11: L_i, A_i, R_i values and orders of NUTS-I Regions

NUTS-I Regions	L_i	A_i	R_i	Order
TR1	0.00000	0.20328	0.45087	5
TR2	0.00000	0.03390	0.18411	12
TR3	0.00000	0.33185	0.57606	2
TR4	0.00000	0.27548	0.52486	3
TR5	0.00000	0.18314	0.42795	6
TR6	0.00000	0.34101	0.58396	1
TR7	0.00000	0.12617	0.35520	9
TR8	0.00000	0.18279	0.42754	7
TR9	0.00000	0.05344	0.23116	10
TRA	0.00000	0.04033	0.20082	11
TRB	0.00000	0.13887	0.37265	8
TRC	0.00000	0.24137	0.49129	4

where;

$$L_1 = (0.0000 + 0.0000 + 0.0000 + 0.0000) = 0$$

$$A_1 = (0.03114 + 0.05439 + 0.06522 + 0.05252) = 0.20328$$

$$R_1 = L_i^{\lambda} + A_i^{(1-\lambda)} = 0^{0.5} + 0.20328^{(1-0.5)} = 0.45087$$

The obtained order demonstrates that TR6 region (Mediterranean) covering TR61, TR62, and TR63 NUTS-II regions and Antalya, Isparta, Burdur, Adana, Mersin, Hatay, Kahramanmaraş, and Osmaniye provinces displays the highest performance among the NUTS-I regions in terms of achieving the objectives of the Hands-On Entrepreneurship Trainings organised by KOSGEB.

The evaluations implemented on the basis of NUTS-II regions and provinces are summarized in Table 12 and Table 13.

Table 12: Orders of NUTS-II regions

NUTS-II Regions	Order	NUTS-II Regions	Order
TR10	1	TR71	18
TR21	24	TR72	14
TR22	23	TR81	22
TR31	7	TR82	25
TR32	11	TR83	5
TR33	9	TR90	10
TR41	8	TRA1	21
TR42	2	TRA2	26
TR51	3	TRB1	13
TR52	19	TRB2	17
TR61	15	TRC1	20
TR62	4	TRC2	16
TR63	6	TRC3	12

Table 13: Orders of provinces

Province	Order	Province	Order	Province	Order
Adana	6	Edirne	65	Malatya	21
Adıyaman	54	Elazığ	23	Manisa	25
A.Karahisar	37	Erzincan	49	Mardin	9
Ağrı	70	Erzurum	20	Mersin	5
Aksaray	41	Eskişehir	29	Muğla	22
Amasya	40	Gaziantep	17	Muş	52
Ankara	2	Giresun	51	Nevşehir	58
Antalya	13	Gümüşhane	73	Niğde	68
Ardahan	78	Hakkâri	77	Ordu	27
Artvin	72	Hatay	31	Osmaniye	24
Aydın	44	Iğdır	79	Rize	57
Balıkesir	26	Isparta	43	Sakarya	7
Bartın	66	Istanbul	1	Samsun	18
Batman	32	Izmir	3	Siirt	59
Bayburt	81	K.Maraş	11	Sinop	55
Bilecik	69	Karabük	56	Sivas	38
Bingöl	53	Karaman	50	Şanlıurfa	16
Bitlis	60	Kars	61	Şırnak	74
Bolu	47	Kastamonu	48	Tekirdağ	45
Burdur	39	Kayseri	12	Tokat	30
Bursa	4	Kırıkkale	63	Trabzon	33
Çanakkale	64	Kırklareli	71	Tunceli	80
Çankırı	76	Kırşehir	62	Uşak	35
Çorum	42	Kilis	75	Van	19
Denizli	14	Kocaeli	10	Yalova	67
Diyarbakır	15	Konya	8	Yozgat	46
Düzce	28	Kütahya	34	Zonguldak	36

When this situation is analysed in terms of NUTS-II regions, it is revealed that TR10 region, which covers only Istanbul province, displays the highest performance in comparison with other NUTS-II regions. On the other hand, as long as the evaluation is conducted solely on a provincial basis, it can be easily confirmed that Istanbul has a much higher performance over other provinces.

4.3. Sensitivity Analysis of the Method

As stated in the Methods section of the study, the sensitivity analysis of some multi-criteria decision-making methods is carried out by substituting some parameters of the formulae involved in the technique itself. Within the scope of AROMAN method employed in this study, a λ parameter is used for calculation of the $R_i$value that renders the final ordering of alternatives. Nine different scenarios, where all values between 0.1 and 0.9 with an increment of 0.1 are applied are illustrated in Figure 4.

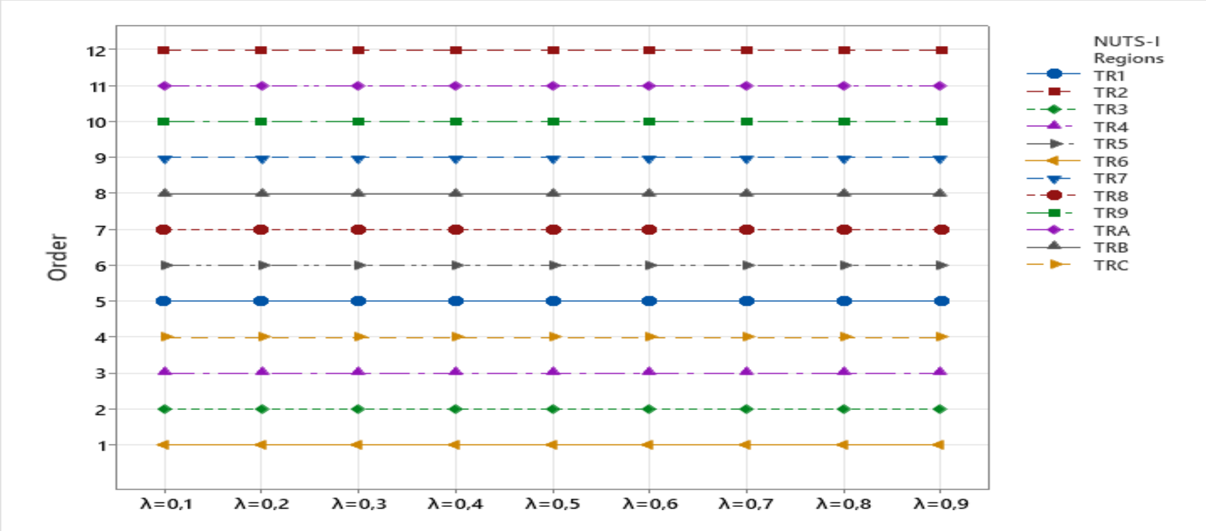

Figure 4: Sensitivity analysis of the AROMAN method

In accordance with all cases, it is confirmed that the order does not display any shift. These findings indicate that the methodology implemented yields robust results.

5.RESULTS AND DISCUSSION

Hands-On Entrepreneurship Trainings are educational programmes that aim to provide would-be entrepreneurs important knowledge and skills before they embark on competitive business life. During these trainings, it is emphasised to the participants that an investment does not only comprise purchasing machinery, equipment or a building; in addition to these, much more critical factors such as finance, marketing, human resources, accounting and teamwork should be taken into consideration. Through these training programmes, which are implemented in the guidance of academicians, advisors, investors or mentors who are specialised in their relevant discipline, it is aimed to equip a participant with the issues that an entrepreneur should pay attention to before initiating an investment. Entrepreneurship as a culture, which has an unquestionable contribution to the economy of a country, is continuously being fostered through various instruments implemented by governments.

Considering the importance of entrepreneurship ecosystem in a country, this study analyses the impact of Hands-On Entrepreneurship Trainings implemented by KOSGEB in Türkiye at the level of provinces, NUTS-I and NUTS-II regions. Therefore, the main rationale of the study emerged to investigate which provinces and NUTS-I or NUTS-II regions have been able to reap the benefits of these trainings, given that these trainings have been provided to approximately one and a half million participants across the country. Within the scope of this study, the performance order of each province and regions in terms of benefiting from entrepreneurship supports are also determined. Taking into account the data obtained from KOSGEB, the number of trainings organised, the number of participants attended to the trainings, the number of enterprises supported and the total amount of financial support are determined for each province and region.

With the participation of representatives from institutions such as Chamber of Industry and Commerce, Chamber of Merchants and Craftsmen, Development Agency, Organised Industrial Zone and Association of Young

Entrepreneurs, the order of importance and weights of these criteria were determined by fuzzy BWM method. Following the evaluation of these representatives and the application of the fuzzy BWM method, "number of enterprises supported following the trainings" is determined as the most significant criterion. Since the main objective of this study is investigating the positive effects of entrepreneurship trainings, such an evaluation should not be perceived as surprising at all. Likewise, as an extension of this approach, the criterion "total amount of financial supports submitted" is also considered as a criterion of secondary importance. Finally, the remaining criteria "number of participants joined to the trainings" and "number of trainings organised" are assessed as third and fourth importance criteria.

The performance order of the provinces and NUTS-I and NUTS-II regions in terms of entrepreneurship supports are determined by AROMAN method, which is one of the most up-to-date multi-criteria decision-making techniques. According to the data obtained from this method, the most successful NUTS-I region in terms of entrepreneurship support is TR6 region (Mediterranean) covering TR61, TR62 and TR63 NUTS-II regions and Antalya, Isparta, Burdur, Adana, Mersin, Hatay, Kahramanmaraş and Osmaniye provinces. The success rankings of other NUTS-I regions in terms of entrepreneurship supports are determined TR3 (Aegean), TR4 (Eastern Marmara), TRC (South-eastern Anatolia), TR1 (Istanbul), TR5 (Western Anatolia), TR8 (Western Black Sea), TRB (Middle East Anatolia), TR7 (Central Anatolia), TR9 (Eastern Black Sea), TRA (North-eastern Anatolia) and TR2 (Western Marmara) sequentially.

On the other hand, the order of NUTS-II regions in terms of entrepreneurship performance is determined as TR10, TR42, TR51, TR62, TR83, TR63, TR31, TR41, TR33, TR90, TR32, TRC3, TRB1, TR72, TR61, TRC2, TRB2, TR71, TR52, TRC1, TRA1, TR81, TR22, TR21, TR82 and TRA2. In the final analysis, it was determined that Istanbul, Ankara, Izmir, Bursa, Mersin, Adana, Sakarya, Konya, Mardin and Kocaeli occupied the first ten orders when entrepreneurship performance is evaluated on the basis of provinces.

Following the abandonment of the face-to-face implementation of Hands-On Entrepreneurship Trainings in 2019, the trainings have been conducted via online platform. Since online trainings are accessible in every location in Türkiye, it was no longer possible to determine the relationship between the number of trainings organised and the number of new enterprises in that province. Therefore, the most important limitation of the study is that data after 2019 could not be included in the research.

There are a limited number of published articles on Hands-On Entrepreneurship Trainings organised by KOSGEB. In this study, unlike the others, it has been tried to determine to what extent the entrepreneurship trainings have achieved their objectives and to what extent the provinces and NUTS-I and NUTS-II regions have benefited from the outcomes of these trainings. Determination of which criteria should be taken into consideration in terms of performance evaluation for entrepreneurship ecosystem constitutes another unique aspect of the study. Ultimately, it is expected that the up-to-date multi-criteria decision-making method employed in this research can be used as a performance evaluation tool by countries, organisations, teams or individuals.

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APPENDIX-I

Province	C_1	C_2	C_3	C_4	Province	C_1	C_2	C_3	C_4
Adana	769	22,360	1,898	45,127,983	**K.Maraş**	426	16,450	1,492	38,280,152
Adıyaman	355	11,522	382	9,190,744	**Karabük**	184	6,972	427	9,986,725
A.Karahisar	389	16,135	594	14,179,597	**Karaman**	312	7,330	464	11,965,383
Ağrı	152	5,573	283	6,551,519	**Kars**	265	7,312	306	8,343,458
Aksaray	343	18,206	498	11,638,613	**Kastamonu**	413	18,006	379	8,320,538
Amasya	249	6,730	685	16,198,635	**Kayseri**	822	19,464	1,374	30,966,793
Ankara	2,074	57,065	3,809	98,098,537	**Kırıkkale**	120	4,581	391	9,800,229
Antalya	877	18,530	1,314	30,034,105	**Kırklareli**	271	4,859	256	5,798,184
Ardahan	66	1,668	177	3,886,416	**Kırşehir**	118	3,730	382	10,655,900
Artvin	123	3,312	233	6,935,600	**Kilis**	113	3,614	194	4,428,336
Aydın	408	9,383	560	13,529,160	**Kocaeli**	868	22,722	1,348	34,228,967
Balıkesir	444	13,660	1,022	24,530,223	**Konya**	749	18,984	1,409	39,937,995
Bartın	160	5,626	283	7,792,225	**Kütahya**	449	25,555	489	12,666,831
Batman	143	10,063	821	21,578,595	**Malatya**	571	14,601	1,103	27,196,480
Bayburt	44	1,151	89	2,501,228	**Manisa**	461	26,266	869	20,932,750
Bilecik	197	5,978	263	6,853,174	**Mardin**	348	13,661	1,554	45,394,450
Bingöl	176	5,612	449	13,921,798	**Mersin**	748	16,782	1,846	53,788,974
Bitlis	203	4,903	375	9,757,651	**Muğla**	502	11,927	1,063	26,967,512
Bolu	236	10,349	495	12,601,349	**Muş**	245	6,366	515	11,983,929
Burdur	197	23,849	499	13,066,500	**Nevşehir**	209	5,348	403	8,784,744
Bursa	1,036	21,286	1,841	51,360,817	**Niğde**	139	5,366	304	7,428,727
Çanakkale	324	6,203	325	7,152,879	**Ordu**	165	8,023	1,014	27,807,617
Çankırı	117	5,174	173	3,848,377	**Osmaniye**	388	12,834	1,061	25,281,581
Çorum	284	6,926	643	15,065,519	**Rize**	135	7,486	406	10,936,233
Denizli	669	16,974	1,245	34,125,668	**Sakarya**	1,096	52,107	1,173	29,639,419
Diyarbakır	233	15,137	1,142	43,774,566	**Samsun**	456	16,948	1,262	31,981,914
Düzce	332	14,052	899	24,018,809	**Siirt**	167	4,514	377	10,654,521
Edirne	197	6,595	289	7,513,019	**Sinop**	175	5,539	453	10,973,149
Elazığ	248	12,326	1,135	25,955,195	**Sivas**	384	11,043	604	14,887,081
Erzincan	307	10,754	474	11,385,879	**Şanlıurfa**	548	18,173	1,335	28,514,337
Erzurum	485	21,758	1,093	27,210,749	**Şırnak**	108	3,181	200	4,779,343
Eskişehir	492	12,843	807	20,940,568	**Tekirdağ**	403	12,781	519	12,207,711
Gaziantep	749	20,332	1,112	29,456,966	**Tokat**	446	12,396	836	19,513,567
Giresun	295	7,468	428	12,920,114	**Trabzon**	313	10,776	699	19,416,980
Gümüşhane	110	9,275	151	3,765,287	**Tunceli**	60	2,122	128	2,692,462
Hakkâri	180	4,019	148	2,959,632	**Uşak**	277	12,399	673	17,339,460
Hatay	652	14,351	745	15,845,369	**Van**	704	24,638	978	27,713,635
Iğdır	60	1,452	149	3,442,972	**Yalova**	145	4,096	316	7,899,580
Isparta	226	18,653	522	12,084,467	**Yozgat**	293	10,282	553	12,642,531
Istanbul	3,656	140,811	5,544	129,807,817	**Zonguldak**	428	13,540	569	16,878,924
Izmir	2,230	47,501	2,830	70,216,770					

APPENDIX-II

NUTS-II Regions	C_1	C_2	C_3	C_4	NUTS-II Regions	C_1	C_2	C_3	C_4
TR10	3,656	140,811	5,544	129,807,817	**TR71**	929	37,231	1,978	48,308,213
TR21	871	24,235	1,064	25,518,914	**TR72**	1,499	40,789	2,531	58,496,405
TR22	768	19,863	1,347	31,683,102	**TR81**	772	26,138	1,279	34,657,874
TR31	2,230	47,501	2,830	70,216,770	**TR82**	705	28,719	1,005	23,142,064
TR32	1,579	38,284	2,868	74,622,340	**TR83**	1,435	43,000	3,426	82,759,635
TR33	1,576	80,355	2,625	65,118,638	**TR90**	1,141	46,340	2,931	81,781,831
TR41	1,725	40,107	2,911	79,154,559	**TRA1**	836	33,663	1,656	41,097,856
TR42	2,677	103,326	4,231	108,388,124	**TRA2**	543	16,005	915	22,224,365
TR51	2,074	57,065	3,809	98,098,537	**TRB1**	1,055	34,661	2,815	69,765,935
TR52	1,061	26,314	1,873	51,903,378	**TRB2**	1,332	39,926	2,016	52,414,847
TR61	1,300	61,032	2,335	55,185,072	**TRC1**	1,217	35,468	1,688	43,076,046
TR62	1,517	39,142	3,744	98,916,957	**TRC2**	781	33,310	2,477	72,288,903
TR63	1,466	43,635	3,298	79,407,102	**TRC3**	766	31,419	2,952	82,406,909

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