Managing Tourism in North East India using Fuzzy Linear Programming

Prabjot Kaur[1,*], Mahuya Deb[2], Arya Shankar[3]
[1,3]Department of Mathematics
Birla Institute of Technology, Mesra, Ranchi, Jharkhand
[2]Department of Advanced Computing
St. Josephss University, Bengaluru
*Corresponding author: prabjotkaur@bitmesra.ac.in

Abstract

The best allocation of limited resources to activities with the aim of accomplishing the desired goal, such as maximization of profit or minimization of cost, is the focus of linear programming. The relationships between activities in linear programming models satisfy the proportionality and additivity requirements since they are linear interactions. This feature of linear programming is extended to the tourism industry which is one of the major industries in the global economy with respect to invested capital and earnings of foreign currencies. In todays era of design thinking, automation, and met averse, there is a very close margin between solutions to similar real-world problems. This is where the need and demand for fuzzy and imprecise linear programming arises. The membership functions provide the model developer the freedom to grade the imprecision as per his/her preference, thereby enabling a unique solution for each problem. While considering the tourism problem a number of factors like natural resources, people, history, culture, security, accommodation, entertainment, political stability, cost of services, tour operator, tour information, and advertisement play an important role in enhancing the sector to a large extent. Combined and classified they come under the following categories like leisure tourism, therapeutic/spa tourism, conference tourism, political tourism, sports/recreational tourism, cultural tourism, social tourism, conference tourism, recreational tourism, sports tourism, religious tourism, health tourism, etc. Each of these sectors requires careful investment on the part of the Government and other stake holders for development purpose. i.e. only a proper marketing mix will ensure a better return for the state. Taking this aspect into consideration the authors decided to introduce a hypothetical LP maximization model for the tourism industry in North East. Cost and space allocation are the constraints in the model. Among the various categories, three tourism forms (heritage, eco-tourism, and pilgrimage tourism) are considered which are used to optimize the allocation of the States marketing budget in tourism in such a way that the appropriate sector provides the greatest likelihood of producing the strongest return on investment. The maximization of profit has been done using various methods, like Werner's, Verdegay's, and Zimmermans. The authors have concluded the results based on the sensitivity analysis that has been done in the process of maximizing profit along with a maximal satisfaction level.

Keywords: Tourism, fuzzy linear programming, optimization, decision making

1 Introduction

The travel, tourism, and hospitality sector in India have the potential to promote grassroots sustainable development and promote economic expansion. Over 39.3 million jobs were created in the sector in 2013, which also brought USD 18.13 billion to foreign currency profits and INR 2.178 lakh crore to India's GDP. However, India only accounts for 0.64% of global tourist visits, despite having enormous potential. According to Public and Social Policies Management (PSPM), YES BANK, December 2014, India is likely the only nation that offers a variety of tourism options. These include beach tourism (India has the longest coastline in the East), spiritual tourism, Ayurveda and other types of Indian medicine, heritage tourism, Eco-tourism, mountain tourism, forest tourism, and adventure tourism. On the basis of their occurrence and the results of engaging in tourism, Professors Bernecker and Kaspar(183) list some more categories of tourism as follows: leisure tourism, therapeutic/spa tourism, conference tourism, political tourism, and sports/recreational tourism. The following additional categories of tourism can also be created depending on the preferences and expectations of the travellers: nature tourism, cultural tourism, social tourism, conference tourism, leisure tourism, sports tourism, religious tourism, health tourism, etc. [Paylos, 2013]. The tourism industry plays a crucial role in the expansion of other vital industries with high growth and employment potential, including those in the healthcare, infrastructure, and education sectors, as well as the alignment of macroeconomic policies with issues of regional development. Important initiatives like the e-Visa, the opening of new airports and rail stations, infrastructure, insurance, and real estate sectors have created viable impetus, essential for continuing critical mass momentum and investment in the under-leveraged inbound segment given the rapid evolution of global travel dynamics. When seen from the perspective of tourism, the North East is certainly a wonderland. For international visitors seeking peace and quiet, the waterfalls, forests, rhinoceroses, colorful birds, nature paths, the sun sinking over the mountains, lush tea gardens, and golf courses with helipads are travelers. The aesthetics and vibrant festivals that take place all year long will be a bonus harvest for them. This massive influx of visitors has profound commercial ramifications in addition to spiritual ones. Following significant government initiatives, a variety of product offers, a growing economy, rising levels of disposable income, and a rise in international tourist inflow, East and North East India have seen an unprecedented 27% gain in foreign tourist inflow. The enormous potential of this resource-rich region is still largely unrealized due to issues with its law and order, poor infrastructure and connection, unemployment, and slow economic growth, among other things.

2 Literature Review

As part of a larger development planning process for changing the area's tourist development, the authors of [5] offer a formulation for linear programming and a vector analysis that assess the available tourism forms in the Dirfis area in Greece. The purpose of the article is to examine how three different types of tourismconference, ecotourism, and pilgrimagecontribute to the local tourism industry in light of the available resources. The authors [6] provide a strategic plan that can aid in the growth of sustainable tourism in popular tourist spots. The A'SWOT (AHP-SWOT) hybrid method was developed by combining the AHP and the SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis (Analytic Hierarchy Process). The AHP approach was used to prioritise these aspects after a SWOT analysis was conducted to identify the key strategic factors. The researchers [9] investigated the potential applications of LP in the hotel sector. A straightforward optimization problem was attempted to be graphically solved in a hotel's F&B production division, and an ideal solution was obtained. In [11], concepts of revenue optimization are explained with regard to the tourism and hotel industries. Also, deterministic linear programming models of airlines and hotels are presented, and the solution is proposed through a genetic algorithm. Again in [7], a linear programming model is presented as a means to support the formulation of tourist policy in the case of the West Frisian Islands. A model is constructed that calculates the maximum employment effect that can be reached by different levels of government and shows the optimal combination of policy tools in order to achieve this maximum. The researchers discuss the quality of the tourism industry and the programming for its development in Iran in [12]. Based on a case study of all elements of Iran's tourism industry system, this study employs a unified assessment of the industry's quality. SWOT analysis aided in determining the weaknesses and threats, aiming to raise the quality of the indicators. In addition, linear programming from the standpoint of internal and external relations with the national economy has been applied. In [17], the levels of sustainable tourism and environmental sustainability were practically measured in different cities of Kerman Province using a composite indicator, a linear programming model, the Delphi method, and the questionnaire technique. The results of this study showed that the tourism opportunities were not used appropriately in these cities and tourist destinations, and those environmental aspects had very bad situations compared to social and economic aspects. In other words, environmental health had the lowest level of sustainability. The researchers in [19] discussed the concept of over-tourism. It aims to provide more clarity with regard to what tourism entails by placing the concept in a historical context and presenting results from a qualitative investigation among 80 stakeholders in 13 European cities. Seven over-tourism myths are identified that may inhibit a well-rounded understanding of the concept. The researchers in [8] created a model to investigate tourist preferences that used ten attributes of tourist destinations. Fuzzy set theory [2] was adopted as the main analysis method to find the tourists preferences. In [10], a numerical method for solving fuzzy linear programming problems with fuzzy decision variables is proposed. The purpose of this work is to derive the analytic formula of error estimation regarding the approximate optimal solution. In [3], fuzzy set theory is used as a case study in the e-commerce industry for the city of Shiraz. An electronic system in the form of a website is developed, which tourists can use to find appropriate accommodation by inputting data related to their interests and needs. In light of the above literature, the present study is an attempt in this direction to analyze the contribution of different forms of tourism to the overall revenue of the government. Once proper sectors are identified by the authority, proper investment could be made for their further development. Using fuzzy linear programming, the problem is formulated and solved using fuzzy programming techniques. In recent literature very few formulations of single objective linear programming problem under fuzzy environment and application in tourism. The novelty is to improve the quality of policy decisions via optimization approach and allow decision-makers to tap the great tourism resource potentials like geographical, climate, natural attractions, cultural, and ancient heritages. Basically how we will profit from tourism in a remote area via theoretical and then practical ways.The study concludes that the tourist will have approximately 99% satisfaction if parameters are changed from 5% to 20%.This will have very less impact on net profit earned through tourism.

3 Preliminaries

Let X denotes a universal set. Then a fuzzy (Zadeh(1965)) subset A of X is defined by its membership function $\mu_A : X \to [0,1]$ which assign to each element x in X a real number μ_A in the interval $[0,1]$,where the value of μ_A at x represents the grade of membership of x in A. The nearer the values of μ_A is unity, the higher the grade of membership of x in A.

3.1 Fuzzy Number

Fuzzy Number [22] is a fuzzy set A on R must possess at least the following three properties that A must be a normal fuzzy set; must be a closed interval for every α_A must be a closed interval for every $\alpha \, \epsilon \, (0,1]$; The support of $A, 0{+}_A$ must be bounded.

4 Linear Programming framework for the Tourism Development Problem

4.1 Model Developments

It is assumed that the State wants to develop a particular area and therefore a proper investment plan has to be decided upon. Based on the available tourist resources, the government or the various stakeholders must design its development policy [5]. For demonstrating the management of the tourism scenario in the state the following assumptions are made:

Decision Variable:

- Number of Heritage and culture sites infrastructures x_1
- Number of eco-tourism sites infrastructures x_2
- Number of infrastructures at pilgrimage locations x_3

Profits per sector are:

- Heritage and culture Tourism: 6 monetary units Eco Tourism: $4mu$
- Pilgrimage Tourism: $3mu$
- The goal of the state is to maximize revenue i.e. $maximize : 6x_1 + 4x_2 + 3x_3$
- The region that can be used to build the "logistics" infrastructure is $50000m2$.

Constraints:

- The prerequisites for each category are as follows:

- Heritage and Culture Tourism: 800 $\tau\mu$.
- Eco-Tourism: 600 $\tau\mu$.
- Pilgrimage Tourism: 500 $\tau\mu$.

The overall cost of property 39;s maintenance should not be more than the mu. The real cost for each category is: Heritage and culture sites: Tourism: $10mu$ Eco Eco-tourism Tourism: $8mu$ Pilgrimage Tourism: $3mu$ The model can thus be developed now as it has been simplified to a simple linear programming problem. The model can help maximize profit from ecotourism, pilgrimage tourism, and, conference tourism while optimally using important limited resources like land area. The companys objective maximize its gain, i.e.,

$$\begin{aligned} \text{Maximize Z} \quad & 6x_1 + 4x_2 + 3x_3 \\ \text{subject to} \quad & 8x_1 + 6x_2 + 5x_3 \leq 500 \\ & 10x_1 + 8x_2 + 3x_3 \leq 360 \\ & x_1, x_2, x_3 \geq 0 \end{aligned} \tag{1}$$

Two slack variables x_4 and x_5 are introductions for the maximization of the following linear programming problem:

$$\begin{aligned} f(x_1, x_2, x_3, x_4, x_5) = \quad & 6x_1 + 4x_2 + 3x_3 + 0x_4 + 0x_5 \\ \text{where} \quad & 8x_1 + 6x_2 + 5x_3 + x_4 + 0x_5 = 500 \\ & 10x_1 + 8x_2 + 3x_3 + 0x_4 + x_5 = 360 \\ & x_i \geq 0 \qquad i = 1, 2, 3, 4, 5. \end{aligned}$$

Using the simplex algorithm, profit maximization occurs when $x_1 = 11.5$ (i.e. when there are 11 heritage and culture sites), $X_2 = 0$ (i.e. there are no place for eco-tourism) and $X_3 = 81.5$ (i.e 81 pilgrimage areas). Max $Z = 313.5$. Heritage venues won't help maximize profits, thus they are consequently not thought to be relevant. While certainty, reliability and precision are frequently illusory concepts in real-world applications, linear programming models represent real-world situations with some sets of parameters that are determined by experts and decision makers. As a result, experts and decision-makers are often unable to determine the precise value of parameters or may not be able to precisely specify the objective functions or constraints. The use of fuzzy linear programming has the advantage that the decision-maker can model the issue in accordance with the current state of knowledge because it is typically impractical to describe the restrictions and the goal function in precise terms. Many real-world problems find their solution in traditional theory. In original LPP, coefficients and right-hand sides must be well defined. The use of deterministic and stochastic models to model real-world situations necessitates a lot of data processing. In todays era of design thinking, automation and met averse, these is very close margin between solutions of similar real-world problems. Thus the need and demand of fuzzy and imprecise linear programming arises here. Some model parameters can only be approximated roughly in the event of genuine problems. While imprecise input is substituted by average data in classical models, fuzzy models allow decision makers to model their subjective imaginations as exactly as they can explain them. Therefore, the classical LP are not applicable, instead, the Fuzzy Linear Programming [1, 13] is used to model such situations. By introducing fuzziness to LP, such problems can be overcome. When a decision must be made in a fuzzy environment, LP may be modified in one of the three ways listed below. The objective function should not be maximised, to start. In other words, a level of aspiration that cannot be clearly defined as optimal must be reached. Second, the limitations might be ambiguous. The $\leq$ sign might not have a traditional definition or be used in a strictly mathematical sense, but there might be some room for error. When the limitations represent aspirational levels that are not well defined, this can occur. Last but not least, data may be inaccurate due to a lack of precision or some ambiguity in the data collection technique.

4.2 DECISION MAKING IN A FUZZY SCENARIO [18]

Decision making under fuzzy context is the confluence of fuzzy constraints and fuzzy objective functions . The distinction between constraint and goal function vanishes as a fuzzy environment attains ultimate symmetry. Zimmermann (1978) was the first to categorize fuzzy mathematical programming into symmetric and non-symmetric models. Subsequently, it has also been classified by Leung (1998) into four categories: - crisp objective and fuzzy constraints, fuzzy objective and crisp constraints, fuzzy objective and fuzzy constraints and robust programming. Linear programming can also be classified as follows: i. Linear programming problem with uncertain resources ii. A nonsymmetric model by Verdegay iii. Werner's methodology iv. Zimmermann's Model v. Chana's Methodology: A Nonsymmetric Model [4]. In this paper we have considered the objective function, constraints and both constraints and objective fuzzy.The approaches of Werner,Verdegay and Zimmermann depict fuzziness in the model in objectives and constraints.

4.2.1 Werners Method [16]

Werner proposed that the objective function is taken to be fuzzy as the total fuzzy resources or fuzzy inequality constraints. Tolerances given by p_i are fuzzy and given. The construction of membership function μ_0 for objective function is as:

$$\mu_0(x) = \begin{cases} 1 & if cx > Z^1 \\ \dfrac{1-(Z^1-cx)}{Z^1-Z^0} & if Z_0 < cx < Z_1 \\ 0 & if Z_0 < cx \end{cases}$$

where Z_1 and Z_0 are the values obtained after maximization and minimization of the single objective function.
A symmetric model is as

$$\begin{aligned} \text{Max} \quad & \alpha \\ \text{subject to} \quad & \mu_0(x) \geq \alpha \\ & \mu_i(x) \geq \alpha, \quad \forall\ i, \alpha \in [0,1]\ and\ x \geq 0 \end{aligned} \tag{2}$$

4.2.2 Chanas [2] & Verdegays Approach [15, 14]

In the Verdegays approach for non-symmetric model, the constraint is fuzzy while the objective function is not fuzzy. This means that the value of constraint is between 0 and 1 while the objective function has crisp value. The model can be understood as equivalent parametric programming:

$$\begin{aligned} &Maximize \quad cx \\ &\text{subject to} \quad (Ax)_j \le b_i + (1-\alpha)p_i \quad \forall\, i, \alpha \in [0,1] \; and \; x \ge 0 \end{aligned} \tag{3}$$

where p is tolerance parameter and b is basic value.

4.2.3 Solution of Zimmermann [21, 20]

By the Zimmermanns approach,the linear programming problem is solved by adding the objective function cx as a fuzzy goal to the constraints. It is not certain that Zimmermann method (ZM) will give the "best" option when this new LP has alternate optimal solutions (AOS). There are two possibilities: cx might have distinct bounded values for the AOS or it could be unbounded. But since most of the AOS may have same solution, it's possible that we don't offer the best possible solution to the decision maker (DM) unless we check the value of cx for all AOS; it's possible that cx is unbounded yet ZM presents a bounded solution as the best. Zimmermans Approach for solving the fuzzy LPP takes into account a direct relation between α and θ. Further, it takes the variance of tolerance parameter and the graph for same can be obtained.

Let $\alpha = 1 - \theta$ then equaion becomes

$$\begin{aligned} &Min \quad \theta \\ &\text{subject to} \quad cx \ge b_0 - \theta\, p_0 \\ &\qquad (Ax)_i \le b_i + \theta\, p_i, \qquad \forall\, i, \theta \in [0,1] \; and \; x \ge 0 \end{aligned} \tag{4}$$

The above formulated LPP is solved using Verdegay's and Werner approach.

5 PROBLEM WITH VARYING TOLERANCES AND GRAPHICAL INTERPRETATIONS USING WERNERS METHOD

$$\begin{aligned} MaxZ \quad & 6x_1 + 4x_2 + 3x_3 \\ \text{subject to} \quad & 8x_1 + 6x_2 + 3x_3 \le 500 \\ & 10x_1 + 8x_2 + 3x_3 \le 360 \\ & x_1, x_2, x_3 \ge 0 \end{aligned} \tag{5}$$

we get,

$$Z = 313.81 \qquad x_1 = 11.54 \qquad x_2 = 0.00 \qquad x_3 = 81.54$$

Tolerance set at $P_i = 5\%$

$$\begin{aligned} MaxZ \quad & 6x_1 + 4x_2 + 3x_3 \\ \text{subject to} \quad & 8x_1 + 6x_2 + 3x_3 \le 500 + 50\theta \\ & 10x_1 + 8x_2 + 3x_3 \le 360 + 18\theta \\ & x_1, x_2, x_3 \ge 0 \end{aligned}$$

$$\mu_1(x) = \begin{cases} 1 & if g_1(x) < 500 \\ 1 - \dfrac{(g_1(x) - 500)}{25} & if 500 < g_1(x) < 525 \\ 0 & if g_1(x) > 525 \end{cases}$$

$$\mu_2(x) = \begin{cases} 1 & if g_2(x) < 360 \\ 1 - \dfrac{(g_2(x) - 360)}{18} & if 360 < g_2(x) < 378 \\ 0 & if g_2(x) > 378 \end{cases}$$

Table showing the tolerance level set at 5%

θ	x_1	x_2	x_3	Z
0	11.54	0.00	81.54	313.85
0.1	11.60	0.00	81.95	315.42
0.2	11.65	0.00	82.35	316.98
0.3	11.71	0.00	82.76	318.55
0.4	11.77	0.00	83.17	320.12
0.5	11.83	0.00	83.58	321.69
0.6	13.42	0.00	81.52	325.11
0.7	11.94	0.00	84.39	324.83
0.8	12.00	0.00	84.80	326.40
0.9	12.06	0.00	85.21	327.97
1.0	12.12	0.00	85.62	329.54

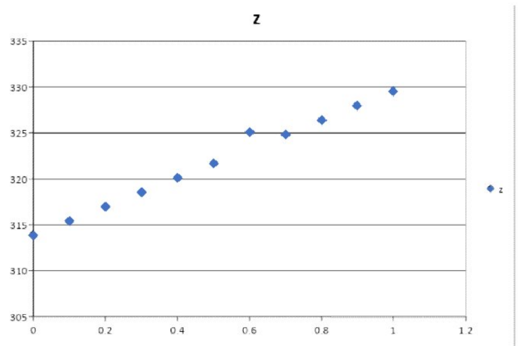

Figure 1: Theta versus z at 5% tolerance parameter.

Tolerance set at $P_i = 10\%, P_1 = 50, P_2 = 36$

$$\begin{aligned} MaxZ \quad & 6x_1 + 4x_2 + 3x_3 \\ \text{subject to} \quad & 8x_1 + 6x_2 + 3x_3 \leq 500 + 50\theta \\ & 10x_1 + 8x_2 + 3x_3 \leq 360 + 36\theta \\ & x_1, x_2, x_3 \geq 0 \end{aligned} \tag{6}$$

8

θ	x_1	x_2	x_3	Z
0	11.54	0.00	81.54	313.85
0.1	11.65	0.00	82.35	316.98
0.2	11.77	0.00	83.17	320.12
0.3	11.88	0.00	83.98	323.26
0.4	12.00	0.00	84.80	326.40
0.5	14.97	0.00	76.10	318.12
0.6	12.23	0.00	86.43	332.68
0.7	12.35	0.00	87.25	335.82
0.8	12.46	0.00	88.06	338.95
0.9	12.58	0.00	88.88	342.09
1.0	12.69	0.00	89.69	345.23

Table 1: Table showing the tolerance level set at 5%

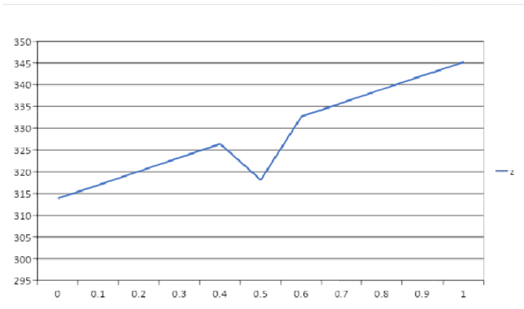

Figure 2: Theta versus z at 10% tolerance parameter.

The next tolerance level is set at $P_i = 15\%, P_1 = 75, P_2 = 54$

$$\begin{aligned} MaxZ \quad & 6x_1 + 4x_2 + 3x_3 \\ \text{subject to} \quad & 8x_1 + 6x_2 + 3x_3 \leq 500 + 75\theta \\ & 10x_1 + 8x_2 + 3x_3 \leq 360 + 54\theta \\ & x_1, x_2, x_3 \geq 0 \end{aligned} \tag{7}$$

θ	x_1	x_2	x_3	Z
0	11.54	0.00	81.54	313.85
0.1	11.71	0.00	82.76	318.55
0.2	71.31	0.00	251.95	323.26
0.3	12.06	0.00	85.21	327.97
0.4	12.23	0.00	86.43	332.62
0.5	12.40	0.00	87.65	337.38
0.6	12.58	0.00	88.88	342.09
0.7	12.75	0.00	90.10	346.80
0.8	12.92	0.00	91.32	351.51
0.9	13.10	0.00	92.55	356.22
1.0	14.13	0.00	90.88	357.46

Table 2: Table showing the tolerance level set at 15%

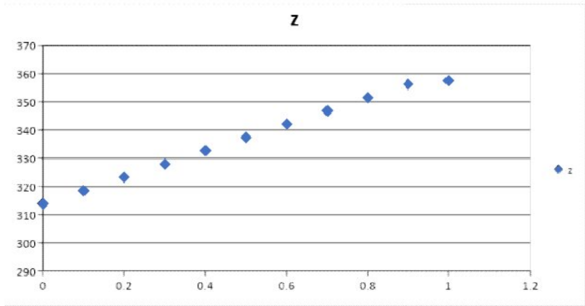

Figure 3: Theta versus z at 15% tolerance parameter.

The next tolerance level is set at $P_i = 20\%, P_1 = 100, P_2 = 72$

$$\begin{aligned} MaxZ \quad & 6x_1 + 4x_2 + 3x_3 \\ \text{subject to} \quad & 8x_1 + 6x_2 + 3x_3 \leq 500 + 100\theta \\ & 10x_1 + 8x_2 + 3x_3 \leq 360 + 72\theta \\ & x_1, x_2, x_3 \geq 0 \end{aligned} \tag{8}$$

θ	x_1	x_2	x_3	Z
0	0.00	0.00	0.00	0.00
0.1	11.77	0.00	83.17	320.12
0.2	12.00	0.00	84.80	326.40
0.3	12.23	0.00	84.43	332.68
0.4	12.46	0.00	88.06	338.95
0.5	12.92	0.00	89.69	345.23
0.6	12.58	0.00	81.52	351.51
0.7	13.15	0.00	92.95	357.78
0.8	13.38	0.00	94.58	364.06
0.9	13.62	0.00	96.22	370.34
1.0	13.85	0.00	97.85	376.62

Table 3: Table showing the tolerance level set at 20%

5.1 Zimmermann Approach [13]

The formulation is that both the objective function and constraints are fuzzy:

$$\begin{aligned} Min \quad & \theta \\ \text{subject to} \quad & cx \geq b_0 - \theta p_0 \\ & (Ax)_i \leq b_i + \theta p_i, \qquad \forall\ i, \theta \in [0,1]\ and x \geq 0 \end{aligned}$$

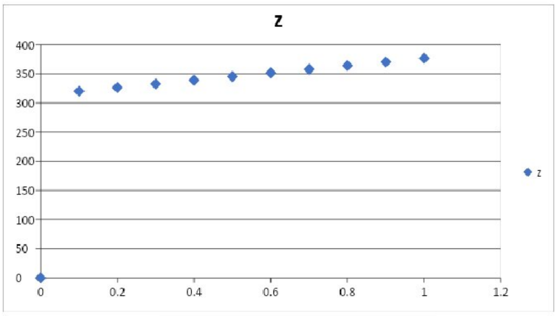

Figure 4: Theta versus z at 20% tolerance parameter.

The value of $\theta \in [0, 1]$ and non -negativity condition $x \geq 0$.
We obtain the formulation for our problem as

$$
\begin{aligned}
Min \quad & \theta \\
\text{subject to} \quad & 6x_1 + 13x_2 + 10x_3 + 20x_4 + 25x_5 + 21.25\theta \geq 21.25 \\
& 15x_1 + 3x_2 + 5x_3 + 6x_4 + 10x_5 + 15\theta \geq 15 \\
& x_1 + 3x_2 + 2x_3 + 5x_4 + x_5 + 4\theta \geq 4 \\
& 15x_1 + 3x_2 + 5x_3 + 6x_4 + 10x_5 - 0.75\theta \leq 15 \\
& x_1 + 3x_2 + 2x_3 + 5x_4 + x_5 - 0.2\theta \leq 4 \\
& x_5 - 0.125\theta \leq 0.25 \\
& x_1 + x_2 + x_3 + x_4 + x_5 - 0.50\theta \leq 1
\end{aligned} \tag{9}
$$

On solving the above formulation we obtain the table values as:

θ	x_1	x_2	x_3	$\alpha = 1 - \theta$	z
0	11.54	0	81.54	1	313.85
0.1	11.6	0	81.95	0.9	315.42
0.2	11.65	0	82.35	0.8	316.98
0.3	11.71	0	82.76	0.7	318.55
0.4	11.77	0	83.17	0.6	320.12
0.5	11.83	0	83.58	0.5	321.69
0.6	13.42	0	81.52	0.4	325.11
0.7	11.94	0	84.39	0.3	324.83
0.8	12.00	0	84.80	0.2	326.4
0.9	12.06	0	85.21	0.1	327.97
1.0	12.12	0	85.62	0	329.54

Table 4: Values obtained by Zimmermanns method

6 RESULTS AND DISCUSSIONS

As the value of p increases, the consistency of all other parameters increases. At 20% tolerance parameter, the satisfaction level is 100% & the value of $Z = 376.62$. At 15%

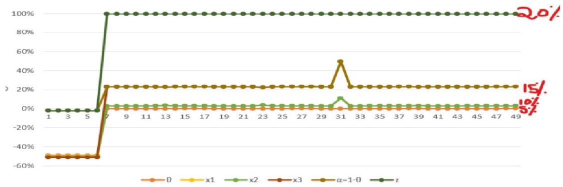

Figure 5: Solution by Zimmermanns approach and values for various tolerance parameters.

tolerance parameter the satisfaction level is 100% & the value of $Z = 357.46$. At 10% tolerance parameter the satisfaction level is 100% & the value of $Z = 345.23$. At 5% tolerance parameter the satisfaction level is 100% & the value of $Z = 329.54$. The decision maker can alter some circumstances whenever he wants to alter the original model and end the solution procedure whenever he is satisfied.

7 Conclusion

A simple linear programming model for revenue optimization of tourism industry is presented in this paper. Henceforth fuzziness is incorporated and their solution obtained through fuzzy linear programming approach. Fuzziness can help to offer a more natural description of uncertain data which depicts the real world phenomenon. Many real-world problems can be solved using general approaches for linear programming, but due to human nature, fuzziness and imprecision make a significant difference to these difficulties. Taking into account the vagueness, Fuzzy Linear Mathematical Programming is able to solve more problems with incremented levels of exactness. They are the mathematical tools which have immense potential for handling uncertainty inherent in real time data. Werners method and Verdegays method do not allow the freedom to solve for desired goal and objective like Zimmermann and Chanas does. In the case study that has been carried out, it can be understood that for various tolerance parameters, the maximum value of objective function changes. Hence, the value of tolerance which yields maximum results is selected. Thus the implementation of this approach can encourage tourism stakeholders such as national and local government, tourism businesses, and local communities to play a guiding role. This technique can improve the quality of policy decisions and allow decision-makers to take advantage of the great tourism resource potential, including geographical, climate, natural attractions, cultural, and ancient heritages. The future scope lies in multiobjective approach to tourism problem with fuzzy linear and non linear membership functions for objectives, constraints or both.

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