An Investigation on the Combined Effects of E-Commerce and Digitalization on Production Sectors usingNonagonal Fuzzy Relational Maps

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Abstract

In this internet age, the people of our nation are getting adapted themselves to the growing technological traits. Currently the government declares many reforms for the upliftment of hi-tech nation. The overall development of any country depends on the promotion of production sectors, which decide the growth rate of economy. Instance has now become the essential goal of industries, this can be made possible only if interconnections and interlinks are vibrant. To lay a suitable platform for such strong bonds, Digitalization has been fostered into the attributes of science and technology. In these days people are moving away from conventional practices to contemporary trends and one kind of it is E-Commerce. Both Digitalization and E-Commerce are gaining high concern among the production sectors. The individual effects of these two on production sectors have been analyzed by many researchers in many perspectives. This paper mainly aims in determining the combined effects of both on the production development. The analysis is difficult due to the existing uncertain environment, to handle such situationsfuzzy relational maps with Nonagonal weights is used.

Key words: E-Commerce, Digitalization, Nonagonal Weightage, Fuzzy Relational Maps.

Introduction

Production sectors (PS) are indeed the backbone of every nation's growth. Therefore several accelerating strategies for the growth of PS have to be concentrated for laying the wayof its advancement. Currently the customers expect unique and novel products. The

attitude of instant accomplishment is gaining high concern amidst the customers which isnow emerging as a great challenge to PS. Nowadays people are getting attracted to E-commerce and adapted to Digitalization. The core aim of these two electronic tactics is instance. In this existing scenario the production sectors have to incorporate these tactics for their tenacious sustenance. E- Commerce and Digitalization has almost reached people of all economic levels, therefore the inculcation of these both into the set-up of production sectors will be highly beneficial to this internet society. This paper aims in determining the combined relational consequences of E-Commerce and Digitalization on the production sectors. To handle the situations of uncertainty, fuzzy relational maps are used with nonagonal weights. FRMs are used normally to determine the associations, but in this paper efforts were taken to make the analysis with Nonagonal FRMs.

The paper is structured as follows: section 2 consists of concepts related to work, section 3 explains the methodology, section 4 elucidates the adaptation of the method to the problem, section 5 comprises of discussions and section 6 concludes the work.

2. Fuzzy Relational Maps and its related concepts

Fuzzy Relational Maps (FRM) are very similar to Fuzzy Cognitive Maps (FCM), but in FCM the association of the concepts belong to the same domain,[1,2] but in FRM the association is dealt with the concepts of domain and range space. The connotations between two different spheres are taken into consideration.A FRM is a directed graph which associates the concepts of domain and range space with nodes as fuzzy sets and edges with simple weights or fuzzy weights. A cyclic FRM contains cycles which indicates the existence of feedback which in turn assists in finding the fixed point.[3,4]

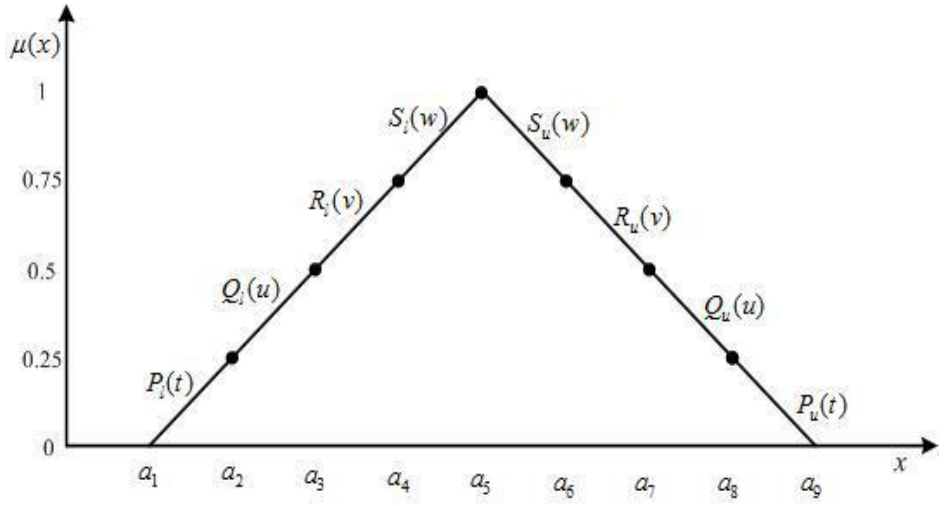
2.1 Nonagonal Fuzzy Number

The fuzzy experts have defined many types of fuzzy numbers, the most common is triangular and trapezoidal, they have also defined the membership functions of higher type of fuzzy numbers to tackle the imprecise circumstances.[5,6] In this paper Nonagonal fuzzy numbers is considered for study.

A Nonagonal Fuzzy number is defined as (a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9) and the membership function is defined as

$$\mu D(x) = \begin{cases} \frac{1}{4}\frac{x-a_1}{a_2-a_1}, & a_1 \le x \le a_2 \\ \frac{1}{4}+\frac{1}{4}\frac{x-a_2}{a_3-a_2}, & a_2 \le x \le a_3 \\ \frac{1}{2}+\frac{1}{4}\frac{x-a_3}{a_4-a_3}, & a_3 \le x \le a_4 \\ \frac{3}{4}+\frac{1}{4}\frac{x-a_4}{a_5-a_4}, & a_4 \le x \le a_5 \\ 1-\frac{1}{4}\frac{x-a_6}{a_7-a_6}, & a_5 \le x \le a_6 \\ \frac{3}{4}-\frac{1}{4}\frac{x-a_7}{a_7-a_6}, & a_6 \le x \le a_7 \\ \frac{1}{2}-\frac{1}{4}\frac{x-a_8}{a_8-a_7}, & a_7 \le x \le a_8 \\ \frac{1}{4}\frac{a_9-x}{a_9-a_8}, & a_8 \le x \le a_9 \\ 0, & \text{Otherwise} \end{cases}$$

The membership function of nonagonal fuzzy number is represented below



3. The new approach of Fuzzy Relational maps with Nonagonal Weights

Let F1, F2,…Fm and G1, G2,..Gnrepresents the nodes of FRM. [7] The association between the nodes is expressed in terms of linguistic variables which is the quantified with Nonagonal fuzzy numbers[8,9].The relational matrix R is obtained from the graphical representation of the FRM. The average matrix R_{Avg} is acquired from R. The input vector X is taken and it is

passed into the matrix $R_{Avg.}$ The resultant vector is threshold and it is once again passed into R_{Avg}^{T} . The steps are repeated alternatively until the arrival of limit cycle.

4. Adaptation of Problem to NFRM

The attributes of E-commerce and Digitalization have been premeditatedby variousacademicians. The integration of these two technological pillars with the production sectors in the context of Mathematical associations is an inventive effort [10].

The attributes of E-Commerce are as follows

F1 - High Ubiquity

F2 - Quick Global Reach

F3 - Very High Universal Standards

F4 – Richness

F5 - Greater Interactivity

F6 - Huge Information Density

F7 – Personalization

The Attributes of Digitalization are as follows

G1 -Robust

G2 - Rapid communication

G3 - Inventive technology

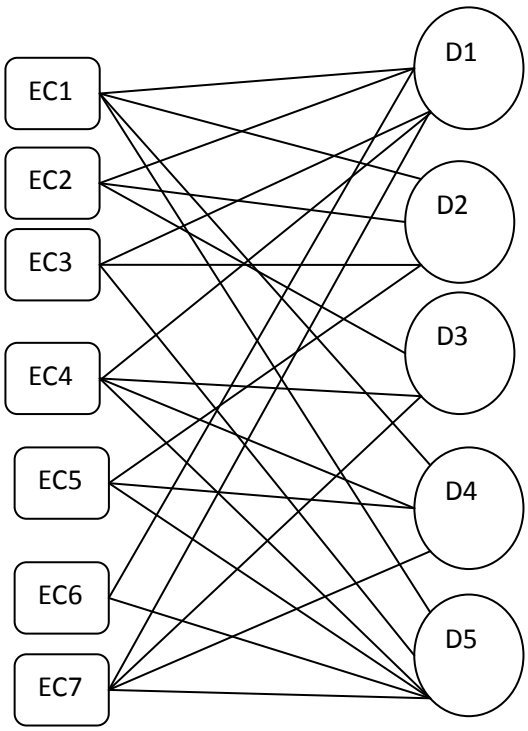
G4- Quick Transaction

G5 - Accessible Approaches

The relational Matrix R is determined from the existing relations between the attributes Fm's and Gn's.

	G1	G2	G3	G4	G5
F1	HM	H	NI	H	VH
F2	H	H	H	NI	NI
F3	H	H	NI	NI	H
F4	H	H	NI	VL	H
F5	NI	H	NI	VH	H
F6	VH	NI	NI	NI	H
F7	L	NI	M	H	VH

Fig.1. Graphical Representation of the Association of the Attributes



The concepts taken for the study has linguistic terms and their values are tabulated below

Linguistic Variables`	**Nonagonal Values**
No Influence (NI)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)
Very Low Influence (VL)	(0, 0.03, 0.07, 0.11, 0.15, 0.19, 0.23, 0.27)
Low Influence (L)	(0.15, 0.19, 0.23, 0.27, 0.31, 0.35, 0.39, 0.43, 0.47)
Moderate Influence (M)	(0.31, 0.35, 0.39, 0.43, 0.47, 0.51, 0.55, 0.59, 0.63)
High Moderate Influence (HM)	(0.47, 0.51, 0.55, 0.59, 0.63, 0.67, 0.71, 0.75, 0.79)
High Influence (H)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)
Very High Influence (VH)	(0.79, 0.83, 0.87, 0.91, 0.95, 0.99, 1, 1, 1)

	G1	G2	G3	G4	G5
F1	(0.47, 0.51, 0.55, 0.59, 0.63, 0.67, 0.71, 0.75, 0.79)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0.79, 0.83, 0.87, 0.91, 0.95, 0.99, 1, 1, 1)
F2	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)
F3	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)
F4	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0, 0.03, 0.07, 0.11, 0.15, 0.19, 0.23, 0.27)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)
F5	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0.79, 0.83, 0.87, 0.91, 0.95, 0.99, 1, 1, 1)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)
F6	(0.79, 0.83, 0.87, 0.91, 0.95, 0.99, 1, 1, 1)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)

F7	(0.15, 0.19, 0.23, 0.27, 0.31, 0.35, 0.39, 0.43, 0.47)	(0, 0, 0, 0, 0, 0.03, 0.07, 0.11, 0.15)	(0.31, 0.35, 0.39, 0.43, 0.47, 0.51, 0.55, 0.59, 0.63)	(0.63, 0.67, 0.71, 0.75, 0.79, 0.83, 0.87, 0.91, 0.95)	(0.79, 0.83, 0.87, 0.91, 0.95, 0.99, 1, 1, 1)

The above matrix is the modified matrix of the relational matrix R with the nonagonal weights.

The relational average matrix R_{Avg} is

	G1	G2	G3	G4	G5
F1	0.63	0.79	0.04	0.79	0.93
F2	0.79	0.79	0.79	0.04	0.04
F3	0.79	0.79	0.04	0.04	0.79
F4	0.79	0.79	0.04	0.12	0.79
F5	0.04	0.79	0.04	0.93	0.79
F6	0.93	0.04	0.04	0.04	0.79
F7	0.31	0.04	0.47	0.79	0.93

Let X = (1000000)

$X^* R_{Avg}$= (0.63 0.79 0.04 0.79 0.93) (11111) = Y

$Y * R_{Avg}^T$ = (3.18 2.45 2.45 2.53 2.59 1.84 2.54) (1111111) = X1

$X1 * R_{Avg}$= (4.28 4.03 1.46 2.75 5.06) (11111) = Y1

$Y1^* R_{Avg}^T$ = (3.18 2.45 2.45 2.53 2.59 1.84 2.54) (1111111) = X2

The limit points are (11111) and (1111111)

Let X = (0100000)

$X^* R_{Avg}$= (0.79 0.79 0.79 0.04 0.04) (11111) = Y

$Y * R_{Avg}^T$ =(3.18 2.45 2.45 2.53 2.59 1.84 2.54) (1111111) = X1

$X1 * R_{Avg}$= (4.28 4.03 1.46 2.75 5.06) (11111) = Y1

$Y1^* R_{Avg}^T$ = (3.18 2.45 2.45 2.53 2.59 1.84 2.54) (1111111) = X2

The limit points are (11111) and (1111111)

By repeating the same procedure the following pattern is obtained.

INPUT VECTOR	LIMIT POINT
(1000000)	(11111) & (1111111)
(0100000)	(11111) & (1111111)
(0010000)	(11111) & (1111111)
(0001000)	(11111) & (1111111)
(0000100)	(11111) & (1111111)
(0000010)	(11111) & (1111111)
(0000001)	(11111) & (1111111)

5. Discussion

The above table clearly indicates that each concept Fi in On position influences the other Fj's and also the association of Fi's with Gi's is witnessed. The final limit points clearly explain that the attributes of E-commerce and Digitalization are highly related with each other and also these attributes have high effects on the growth of these production sectors.The influential advantages of the combination of these two strategies are of greater significance.

Conclusion

This paper discusses about the factors constituting to the growth of production factors. Efforts were taken to develop new approach of determining the associational impacts of these concepts over one another. The analysis of the amalgamation of the traits of technological tactics is vital in these high tech days. The contributions of these two indomitable pillars on production sectors are at greater elevations. The blow of digital India campaign has also constituted to Digitalization. These two tactics has grown to be inseparable technological components of production sectors.

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