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Bipolar interval valued signed neutrosophic graphs

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Abstract

In this article, we combine the concept of bipolar neutrosophic set with graph theory, we introduced the bipolar interval valued neutrosophic graphs, strong bipolar interval valued neutrosophic graphs, degree of bipolar interval valued neutrosophic graphs and introduce the bipolar interval valued signed neutrosophic graphs and investigate some of their properties with proofs and examples.

Keywords

Bipolar, signed, balanced, Interval Valued Neutrosophic.

AMS Subject Classification

03E72, 05C72, 05C78, 05C99.

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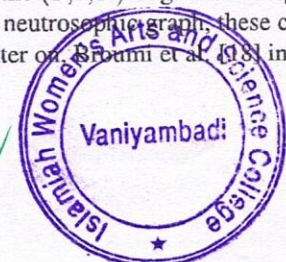
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1. Introduction

Neutrosophic sets proposed by smarandache [11,12] is a powerful mathematical tool for dealing with incomplete, indeterminate and inconsistent information in real world. They are a generalization of the theory of fuzzy sets, intuitionistic fuzzy set, interval valued fuzzy set and interval valued intuitionistic fuzzy sets [8]. The neutrosophic sets are characterized by a truth membership function (T) an indeterminacy membership function (I) and a falsity membership function (F) independently, which are within the real standard or nonstandard unit interval $]^{-}0, 1^{+}[$. In order to practice NS in real life applications conveniently, Wang et al.[5] introduced the concept of a single valued neutrosophic sets (SVNS), a subclass of the neutrosophic sets. The same author introduced the concept of interval valued neutrosophic sets, which is more precise and flexible than single valued neutrosophic sets. The IVNS is a generalization of single valued neutrosophic sets, in which three membership functions are independent and their value

belong to the unit interval $[0, 1]$ some more work on single valued neutrosophic sets, interval valued neutrosophic sets and their application may be found on [1,2,4-7,13-17,19-21]

Graph theory has now become a major branch of applied mathematics and it is generally regarded as a branch of combinatorics. Graph is a widely used tool for solving combinational problems in different areas such as geometry, algebra, number theory, topology, and optimization and computer science [9,10]. Most important thing which is to be noted that, when we have uncertainty regarding either the set of vertices or edges or both, the model becomes a fuzzy graph. The extension of fuzzy [3] graph theory have been developed by several researches including intuitionistic fuzzy graphs considered the vertex sets and edge sets as intuitionistic fuzzy sets. Interval value fuzzy graphs considered the vertex sets and edge sets as interval valued intuitionistic fuzzy sets. Bipolar fuzzy graph considered the vertex set and edge sets as bipolar fuzzy sets. M-polar fuzzy graph considered the vertex sets and edge sets as m-polar fuzzy sets. But, when the relations between nodes (or vertices) in problems are indeterminate, the fuzzy graph and their extensions are failed. For this purpose, smarandache have defined four main categories of neutrosophic graphs, two based on literal indeterminacy, which called them; I edge neutrosophic graph and I-vertex neutrosophic graph, these concept ate studied deeply and has gained popularity among the researches due to its applications via real world problems the two other graph based on (T, I, F) components and called them; the (T, I, F) -edge neutrosophic graph and the (T, I, F) -vertex neutrosophic graph, these concept are not developed at all. Later on, Roumi et al. [9] introduced a



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third neutrosophic graph model this model allow the attachment of truth-membership (T), indeterminacy-membership (I) and falsity-membership degrees (F) both to vertices and edges and investigated some of their properties. The third neutrosophic graph model is called single valued neutrosophic graph (SVNG) the single valued neutrosophic graph model is called single valued graph and intuitionistic fuzzy graph. Also the same authors introduced neighborhood degree of a vertex and closed neighborhood degree of vertex in single valued neutrosophic graph as a generalization of neighborhood degree of a vertex and closed neighborhood degree of vertex in fuzzy graph and intuitionistic fuzzy graph in the literature the study of interval valued neutrosophic graph is still blank we shall focus on the study of interval valued neutrosophic graphs. Then, Sudhakar et al. [22-25] introduced the concept of interval valued signed neutrosophic graph and self-centered interval valued signed neutrosophic graph.

In this paper, Bipolar interval valued neutrosophic graphs and Bipolar interval valued signed neutrosophic graphs are developed.

2. Preliminaries

In this section, we mainly recall some notions related to neutrosophic sets signal valued neutrosophic sets, interval valued neutrosophic sets, and bipolar interval valued neutrosophic graphs.

Definition 2.1. Let U be an universe of discourse; then the neutrosophic set A is an object having the form $A = \{ \langle x : T_A(x), I_A(x), F_A(x) \rangle, x \in U \}$, where the functions $T, I, F : U \rightarrow]^{-}0, 1^{+}[$ define respectively the degree of membership, the degree of indeterminacy and the degree of non-membership of the element $x \in U$ to the set A with the condition.

$$^{-}0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3^{+}$$

The functions $T_A(x), I_A(x)$, and $F_A(x)$ are real standard or nonstandard subsets of $]^{-}0, 1^{+}[$ since it is difficult to apply NSS to practical problem. Wang et al introduced the concept of a SVNS, which is an instance of a NS and can be used in real scientific and engineering applications.

Definition 2.2. Let X be a space of points (objects) with generic elements in X denoted by x . A single valued Neutrosophic set A (SVNS A) is characterized by truth membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$ and a falsity-membership function $F_A(x)$. For each point x in X . $T_A(x), I_A(x), F_A(x) \in [0, 1]$. A SVNS can be written as $A = \{ \langle x : T_A(x), I_A(x), F_A(x) \rangle, x \in X \}$.

Definition 2.3. Let $A = (T_A, I_A, F_A)$ and $B = (T_B, I_B, F_B)$ be single valued neutrosophic sets on a set X . If $A = (T_A, I_A, F_A)$ is a single valued neutrosophic relation on a set X , then $A = (T_A, I_A, F_A)$ is called a, single valued neutrosophic relation on

$$B = (T_B, I_B, F_B) \text{ If}$$

$$T_B(x, y) \leq \min(T_A(x), T_A(y))$$

$$I_B(x, y) \geq \max(I_A(x), I_A(y))$$

$$F_B(x, y) \geq \max(F_A(x), F_A(y)) \text{ for all } x, y \in X$$

A single valued neutrosophic relation A on X is called symmetric if $T_A(x, y) = T_A(y, x), I_A(x, y) = I_A(y, x), F_A(x, y) = F_A(y, x)$ and $T_B(x, y) = T_B(y, x), I_B(x, y) = I_B(y, x), F_B(x, y) = F_B(y, x)$ and for all $x, y \in X$.

Definition 2.4. A single valued neutrosophic graph with underlying set V is defined to be a pair of $G = (A, B)$ where,

1. The functions $T_A : V \rightarrow [0, 1], I_A : V \rightarrow [0, 1]$ and $F_A : V \rightarrow [0, 1]$ denote the degree of truth membership degree of indeterminacy-membership and falsity-membership of the element $v_i \in V$ respectively, and $0 \leq T_A(v_i) + I_A(v_i) + F_A(v_i) \leq 3$ for all $v_i \in V(1, 2, \dots, n)$.

2. The functions $T_B : E \subseteq V \times V \rightarrow [0, 1], I_B : E \subseteq V \times V \rightarrow [0, 1]$ and $F_B : E \subseteq V \times V \rightarrow [0, 1]$ are defined by

$$T_B(\{v_i, v_j\}) \leq \min[T_A(v_i), T_A(v_j)]$$

$$I_B(\{v_i, v_j\}) \geq \max[I_A(v_i), I_A(v_j)]$$

$$F_B(\{v_i, v_j\}) \geq \max[F_A(v_i), F_A(v_j)]$$

denotes the degree of truth membership, indeterminacy-membership and falsity-membership of the edge $(v_i, v_j) \in E$ respectively, where $0 < T_B(\{v_i, v_j\}) + I_B(\{v_i, v_j\}) + F_B(\{v_i, v_j\}) \leq 3$ for all $(v_i, v_j) \in E (i, j = 1, 2, \dots, n)$.

Definition 2.5. A bipolar neutrosophic set A in X is defined as an object of the form

$A = \{ \langle x, T^P(x), I^P(x), F^P(x), T^N(x), I^N(x), F^N(x) \rangle : x \in X \}$ where $T^P, I^P, F^P : X \rightarrow [0, 1]$ and $T^N, I^N, F^N : X \rightarrow [-1, 0]$. The positive membership degree $T^P(x), I^P(x), F^P(x)$ denotes the truth membership, indeterminate membership and false membership of an element $x \in X$ corresponding to a bipolar neutrosophic set A and the negative membership degree $T^N(x), I^N(x), F^N(x)$ denotes the truth membership indeterminate membership and false membership of an element $x \in X$ to some implicit counter-property corresponding to a bipolar neutrosophic set A .

Example 2.6. Let $X = \{x_1, x_2, x_3\}$

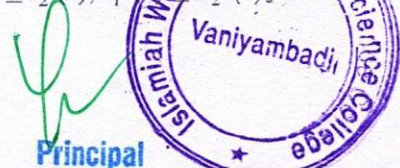
$$A = \langle x_1, 0.5, 0.3, 0.1, -0.6, -0.4, -0.05 \rangle \\ \langle x_2, 0.3, 0.2, 0.7, -0.02, -0.3, -0.02 \rangle \\ \langle x_3, 0.8, 0.05, 0.4, -0.6, -0.6, -0.03 \rangle$$

Is a bipolar neutrosophic subset of X .

Definition 2.7. Let

$$A_1 = \{ \langle x, T_1^P(x), I_1^P(x), F_1^P(x), T_1^N(x), I_1^N(x), F_1^N(x) \rangle \}$$

and $A_2 = \{ \langle x, T_2^P(x), I_2^P(x), F_2^P(x), T_2^N(x), I_2^N(x), F_2^N(x) \rangle \}$ be two bipolar neutrosophic sets then $A_1 \subseteq A_2$ if and only if $T_1^P(x) \leq T_2^P(x), I_1^P(x) \leq I_2^P(x), F_1^P(x) \leq F_2^P(x)$ and $T_1^N(x) \geq T_2^N(x), I_1^N(x) \geq I_2^N(x), F_1^N(x) \geq F_2^N(x)$ for all $x \in X$.



Definition 2.8. Let

$$A_1 = \{ \langle x, T_1^P(x), I_1^P(x), F_1^P(x), T_1^N(x), I_1^N(x), F_1^N(x) \rangle \}$$

and $A_2 = \{ \langle x, T_2^P(x), I_2^P(x), F_2^P(x), T_2^N(x), I_2^N(x), F_2^N(x) \rangle \}$ be two bipolar neutrosophic sets then $A_1 = A_2$ if and only if $T_1^P(x) = T_2^P(x), I_1^P(x) = I_2^P(x), F_1^P(x) = F_2^P(x)$ and $T_1^N(x) = T_2^N(x), I_1^N(x) = I_2^N(x), F_1^N(x) = F_2^N(x)$ for all $x \in X$.

Definition 2.9. Let

$$A_1 = \{ \langle x, T_1^P(x), I_1^P(x), F_1^P(x), T_1^N(x), I_1^N(x), F_1^N(x) \rangle \}$$

and $A_2 = \{ \langle x, T_2^P(x), I_2^P(x), F_2^P(x), T_2^N(x), I_2^N(x), F_2^N(x) \rangle \}$ be two bipolar neutrosophic sets then their union is defined as

$$\begin{aligned} (A_1 \cup A_2)(x) &= \max(T_1^P(x), T_2^P(x)), \frac{I_1^P(x) + I_2^P(x)}{2}, \\ &\quad \min(T_1^P(x), T_2^P(x)) \\ &= \max(T_1^N(x), T_2^N(x)), \frac{I_1^N(x) + I_2^N(x)}{2}, \\ &\quad \min(T_1^N(x), T_2^N(x)) \end{aligned}$$

for all $x \in X$.

Definition 2.10. Let

$$A_1 = \{ \langle x, T_1^P(x), I_1^P(x), F_1^P(x), T_1^N(x), I_1^N(x), F_1^N(x) \rangle \}$$

and $A_2 = \{ \langle x, T_2^P(x), I_2^P(x), F_2^P(x), T_2^N(x), I_2^N(x), F_2^N(x) \rangle \}$ be two bipolar neutrosophic sets then their intersection is defined as

$$\begin{aligned} (A_1 \cap A_2)(x) &= \min(T_1^P(x), T_2^P(x)), \frac{I_1^P(x) + I_2^P(x)}{2}, \\ &\quad \max(T_1^P(x), T_2^P(x)) \\ &= \max(T_1^N(x), T_2^N(x)), \frac{I_1^N(x) + I_2^N(x)}{2}, \\ &\quad \min(T_1^N(x), T_2^N(x)) \end{aligned}$$

for all $x \in X$.

Definition 2.11. Let

$$A_1 = \{ \langle x, T_1^P(x), I_1^P(x), F_1^P(x), T_1^N(x), I_1^N(x), F_1^N(x) \rangle : x \in X \}$$

be a bipolar neutrosophic set in X then the complement of A is denoted by A^c and is defined by $T_A^P c(x) = \{1^P\} - T_A^P(x), I_A^P c(x) = \{1^P\} - I_A^P(x), F_A^P c(x) = \{1^P\} - F_A^P(x)$ and $T_A^N c(x) = \{1^N\} - T_A^N(x), I_A^N c(x) = \{1^N\} - I_A^N(x), F_A^N c(x) = \{1^N\} - F_A^N(x)$.

Definition 2.12. Let $G = (A, B)$ be a single valued neutrosophic graph. Then the degree p of any vertex V is sum of degree of truth-membership. Sum of degree of indeterminacy-membership and sum of degree of falsity-membership of all

those edges which are incident on vertex V denoted by $d(v) = (d_T(v), d_I(v), d_F(v))$ Where

$$d_T(v) = \sum_{u \neq v} T_{B(u,v)} \text{ denotes degree of truth-membership vertex}$$

$$d_I(v) = \sum_{u \neq v} I_{B(u,v)} \text{ denotes degree of Interminary -membership vertex}$$

$$d_F(v) = \sum_{u \neq v} F_{B(u,v)} \text{ denotes degree of Falsity -membership vertex}$$

Definition 2.13. Let X be a space of points (objects) with generic elements in X denoted by X . An interval valued neutrosophic set (IVNSA) A in X is characterized by truth-membership function $T_A(x)$, indeterminacy-membership function $I_A(x)$ and falsity-membership function $F_A(x)$. For each point X in X we have that $T_A(x) = [T_{AL}(x)T_{AU}(x)], I_A(x) = [I_{AL}(x)I_{AU}(x)], F_A(x) = [F_{AL}(x)F_{AU}(x)] \leq [0, 1]$ and $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

Definition 2.14. Let X and Y be two non-empty crisp sets. An interval valued neutrosophic relation $R(x, y)$ is a subset of product space $x \times y$, and is characterized by the truth membership function $T_R(x, y)$, the indeterminacy membership function $I_R(x, y)$, and the falsity membership function $F_R(x, y)$, where $T_R(x, y), I_R(x, y), F_R(x, y) \leq [0, 1]$.

3. Bipolar Interval Valued Neutrosophic Graphs

Definition 3.1. A BIVNG can be defined as $G = (A, B)$, here

$$A = \langle x, [T_{AL}^P T_{AU}^P][I_{AL}^P I_{AU}^P][F_{AL}^P F_{AU}^P][T_{AL}^N T_{AU}^N][I_{AL}^N I_{AU}^N][F_{AL}^N F_{AU}^N] \rangle.$$

is an BIVN set on vertices V and

$$B = \langle x, [T_{BL}^P T_{BU}^P][I_{BL}^P I_{BU}^P][F_{BL}^P F_{BU}^P][T_{BL}^N T_{BU}^N][I_{BL}^N I_{BU}^N][F_{BL}^N F_{BU}^N] \rangle.$$

is an BIVN set on edges, proves the following condition

1. $Y = \{v_1, v_2, \dots, v_n\}$ then $T_{AL}^P : v \rightarrow [0, 1], T_{AU}^P : v \rightarrow [0, 1], I_{AL}^P : v \rightarrow [0, 1], I_{AU}^P : v \rightarrow [0, 1], F_{AL}^P : v \rightarrow [0, 1], F_{AU}^P : v \rightarrow [0, 1], T_{AL}^N : v \rightarrow [-1, 0], T_{AU}^N : v \rightarrow [-1, 0], I_{AL}^N : v \rightarrow [-1, 0], I_{AU}^N : v \rightarrow [-1, 0], F_{AL}^N : v \rightarrow [-1, 0], F_{AU}^N : v \rightarrow [-1, 0]$.

Denotes the degree of truth-membership, indeterminacy-membership and falsity-membership respectively

$$-0 \leq T_A^P(v_i) + I_A^P(v_i) + F_A^P(v_i) \leq 3 \forall v_i \in v (i = 1, \dots, n)$$

$$-3 \leq T_A^P(v_i) + I_A^P(v_i) + F_A^P(v_i) \leq 0$$

2. If $T_{BL}^P : V \times V \rightarrow [0, 1], T_{BU}^P : V \times V \rightarrow [0, 1], I_{BL}^P : V \times V \rightarrow [0, 1], I_{BU}^P : V \times V \rightarrow [0, 1], F_{BL}^P : V \times V \rightarrow [0, 1], F_{BU}^P : V \times V \rightarrow [0, 1]$

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[0, 1] then

$$\begin{aligned} \Rightarrow T_{BL}^P(\{v_i, v_j\}) &\leq \min[T_{AL}^P(v_i), T_{AL}^P(v_j)] \\ T_{BU}^P(\{v_i, v_j\}) &\leq \min[T_{AU}^P(v_i), T_{AU}^P(v_j)] \\ I_{BL}^P(\{v_i, v_j\}) &\geq \max[I_{AL}^P(v_i), I_{AL}^P(v_j)] \\ I_{BU}^P(\{v_i, v_j\}) &\geq \max[I_{AU}^P(v_i), I_{AU}^P(v_j)] \text{ and} \\ F_{BL}^P(\{v_i, v_j\}) &\geq \max[F_{AL}^P(v_i), F_{AL}^P(v_j)] \\ F_{BU}^P(\{v_i, v_j\}) &\geq \max[F_{AU}^P(v_i), F_{AU}^P(v_j)] \end{aligned}$$

If $T_{BL}^N : V \times V \rightarrow [-1, 0]$, $T_{BU}^N : V \times V \rightarrow [-1, 0]$, $I_{BL}^N : V \times V \rightarrow [-1, 0]$, $I_{BU}^N : V \times V \rightarrow [-1, 0]$, $F_{BL}^N : V \times V \rightarrow [-1, 0]$, $F_{BU}^N : V \times V \rightarrow [-1, 0]$, then

$$\begin{aligned} T_{BL}^N(\{v_i, v_j\}) &\leq \max[T_{AL}^N(v_i), T_{AL}^N(v_j)] \\ T_{BU}^N(\{v_i, v_j\}) &\leq \max[T_{AU}^N(v_i), T_{AU}^N(v_j)] \\ I_{BL}^N(\{v_i, v_j\}) &\geq \min[I_{AL}^N(v_i), I_{AL}^N(v_j)] \\ I_{BU}^N(\{v_i, v_j\}) &\geq \min[I_{AU}^N(v_i), I_{AU}^N(v_j)] \text{ and} \\ F_{BL}^N(\{v_i, v_j\}) &\geq \min[F_{AL}^N(v_i), F_{AL}^N(v_j)] \\ F_{BU}^N(\{v_i, v_j\}) &\geq \min[F_{AU}^N(v_i), F_{AU}^N(v_j)] \forall v_i, v_j \in E \end{aligned}$$

(0.3, 0.5) (0.2, 0.3) (0.3, 0.4) (0.1, 0.2) (0.3, 0.4) (0.4, 0.5) (0.2, 0.3) (0.2, 0.3) (0.1, 0.4)
(-0.3, -0.2) (-0.3, -0.1) (-0.3, -0.2) (-0.2, -0.1) (0.3, 0.1) (-0.3, -0.2) (-0.2, -0.1) (-0.3, -0.1) (-0.3, -0.2)

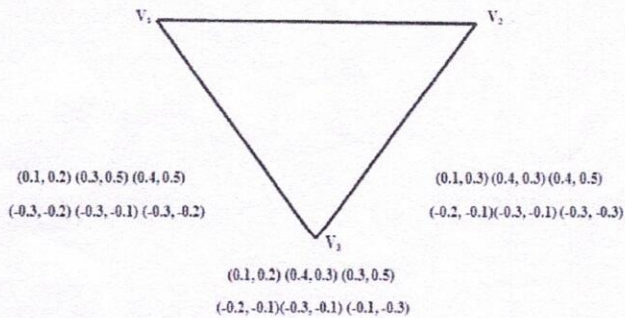


Figure 1. BIVNG

The following adjacency matrix M_G^P is representing the BIVNG diagram G

$$\begin{bmatrix} \langle [0.30.5][0.20.3][0.30.4] \rangle & \langle [0.10.2][0.30.4][0.40.5] \rangle \\ \langle [0.10.2][0.30.5][0.40.6] \rangle & \\ \langle [0.10.2][0.30.4][0.40.5] \rangle & \langle [0.20.3][0.20.3][0.10.4] \rangle \\ \langle [0.10.3][0.40.5][0.40.5] \rangle & \\ \langle [0.10.2][0.30.5][0.40.6] \rangle & \langle [0.10.3][0.40.5][0.40.5] \rangle \\ \langle [0.10.3][0.20.4][0.30.5] \rangle & \end{bmatrix}$$

And M_G^N is

$$\begin{bmatrix} \langle (-0.3, -0.2)(-0.3, -0.1)(-0.3, -0.2) \rangle \\ \langle (-0.2, -0.1)(+0.3, +0.1)(-0.3, 0.2) \rangle \\ \langle (-0.3, -0.2)(-0.3, -0.1)(-0.3, -0.2) \rangle \\ \langle (-0.2, -0.1)(-0.3, -0.1)(-0.3, -0.2) \rangle \\ \langle (-0.2, -0.1)(-0.3, -0.1)(-0.3, -0.2) \rangle \\ \langle (-0.2, -0.1)(-0.3, -0.1)(-0.3, -0.3) \rangle \\ \langle (-0.3, -0.2)(-0.3, -0.1)(-0.3, -0.2) \rangle \\ \langle (-0.2, -0.1)(-0.3, -0.1)(-0.2, -0.1) \rangle \\ \langle (-0.3, -0.1)(-0.3, -0.1)(-0.3, -0.3) \rangle \end{bmatrix}$$

Definition 3.2. If $G = (A, B)$ be an BIVNG. Then the degree of the vertex V is summation of degree of truth membership. Summation of degree of the indeterminacy membership and summation of degree of the falsity membership of all those edges which are incident on vertex V denoted by

$$\begin{aligned} d^N(v) &= [d_{TL}^N(v), d_{TU}^N(v)][d_{IL}^N(v), d_{IU}^N(v)][d_{FL}^N(v), d_{FU}^N(v)] \\ d^P(v) &= [d_{TL}^P(v), d_{TU}^P(v)][d_{IL}^P(v), d_{IU}^P(v)][d_{FL}^P(v), d_{FU}^P(v)] \end{aligned}$$

$$d_{TL}^P(v) = \sum_{u \neq v} T_{BL}^P(u, v)$$

\Rightarrow degree of lower truth positive membership vertex

$$d_{TU}^P(v) = \sum_{u \neq v} T_{BU}^P(u, v)$$

\Rightarrow degree of upper truth positive membership vertex

$$d_{IL}^P(v) = \sum_{u \neq v} I_{BL}^P(u, v)$$

\Rightarrow degree of lower indeterminacy positive membership vertex

$$d_{IU}^P(v) = \sum_{u \neq v} I_{BU}^P(u, v)$$

\Rightarrow degree of upper indeterminacy positive membership vertex

$$d_{FL}^P(v) = \sum_{u \neq v} F_{BL}^P(u, v)$$

\Rightarrow degree of lower falsity positive membership vertex

$$d_{FU}^P(v) = \sum_{u \neq v} F_{BU}^P(u, v)$$

\Rightarrow degree of upper falsity positive membership vertex

Similarly we can define for negative

$$d_{TL}^N(v) = \sum_{u \neq v} T_{BL}^N(u, v)$$

\Rightarrow degree of lower truth negative membership vertex

$$d_{TU}^N(v) = \sum_{u \neq v} T_{BU}^N(u, v)$$

\Rightarrow degree of upper truth negative membership vertex

$$d_{IL}^N(v) = \sum_{u \neq v} I_{BL}^N(u, v)$$

\Rightarrow degree of lower indeterminacy negative membership vertex

$$d_{IU}^N(v) = \sum_{u \neq v} I_{BU}^N(u, v)$$

\Rightarrow degree of upper indeterminacy negative membership vertex

$$d_{FL}^N(v) = \sum_{u \neq v} F_{BL}^N(u, v)$$

\Rightarrow degree of lower falsity negative membership vertex

$$d_{FU}^N(v) = \sum_{u \neq v} F_{BU}^N(u, v)$$

\Rightarrow degree of upper falsity negative membership vertex

Definition 3.3. If $G = (A, B)$ is called strong BIVNG. Then

$$\begin{aligned} T_{BL}^P(\{v_i, v_j\}) &= \min[T_{AL}^P(v_i), T_{AL}^P(v_j)] \\ T_{BU}^P(\{v_i, v_j\}) &= \min[T_{AU}^P(v_i), T_{AU}^P(v_j)] \\ I_{BL}^P(\{v_i, v_j\}) &= \max[I_{AL}^P(v_i), I_{AL}^P(v_j)] \\ I_{BU}^P(\{v_i, v_j\}) &= \max[I_{AU}^P(v_i), I_{AU}^P(v_j)] \\ F_{BL}^P(\{v_i, v_j\}) &= \max[F_{AL}^P(v_i), F_{AL}^P(v_j)] \\ F_{BU}^P(\{v_i, v_j\}) &= \max[F_{AU}^P(v_i), F_{AU}^P(v_j)] \end{aligned}$$

Similarly

$$\begin{aligned} T_{BL}^N(\{v_i, v_j\}) &= \max[T_{AL}^N(v_i), T_{AL}^N(v_j)] \\ T_{BU}^N(\{v_i, v_j\}) &= \max[T_{AU}^N(v_i), T_{AU}^N(v_j)] \\ I_{BL}^N(\{v_i, v_j\}) &= \min[I_{AL}^N(v_i), I_{AL}^N(v_j)] \\ I_{BU}^N(\{v_i, v_j\}) &= \min[I_{AU}^N(v_i), I_{AU}^N(v_j)] \\ F_{BL}^N(\{v_i, v_j\}) &= \min[F_{AL}^N(v_i), F_{AL}^N(v_j)] \\ F_{BU}^N(\{v_i, v_j\}) &= \min[F_{AU}^N(v_i), F_{AU}^N(v_j)] \end{aligned}$$

4. Bipolar Interval Valued Signed Neutrosophic Graphs

Definition 4.1. A BIVNG G^S is said to be signed BIVNG.

If $\sigma : E(G^S) \rightarrow \{3, -3\}$ this function associate from $E(G)^S$ of G^S such that each edges signed to $\{+, -\}$ or all the edges and the nodes are signed to $\{+, -\}$.

Assign $E(G^S) \rightarrow \{3, -3\}$ based on its truth, indeterminacy, falsity membership values. If Truth =

$$\begin{cases} > \text{Indeterminacy \& Falsity values; Positive (+)} \\ < \text{Indeterminacy \& Falsity values; Negative (-)} \\ = \text{Indeterminacy \& Falsity values; Unsigned} \end{cases}$$

Bipolar interval valued signed Neutrosophic graph is said to be negative signed if odd numbers of edges of Bipolar interval valued signed Neutrosophic are negative.

Lemma 4.2. A BIVSNG is a Bipolar interval valued positive signed Neutrosophic graph if all the even length cycles are having all the negative signed nodes.

Proof. In the following diagram, if all the edges contain negative sign is always positive. Hence it is always a positive signed graph.

In case all the edges contains negative sign is always positive.

So this graph is always a positive signed graph.

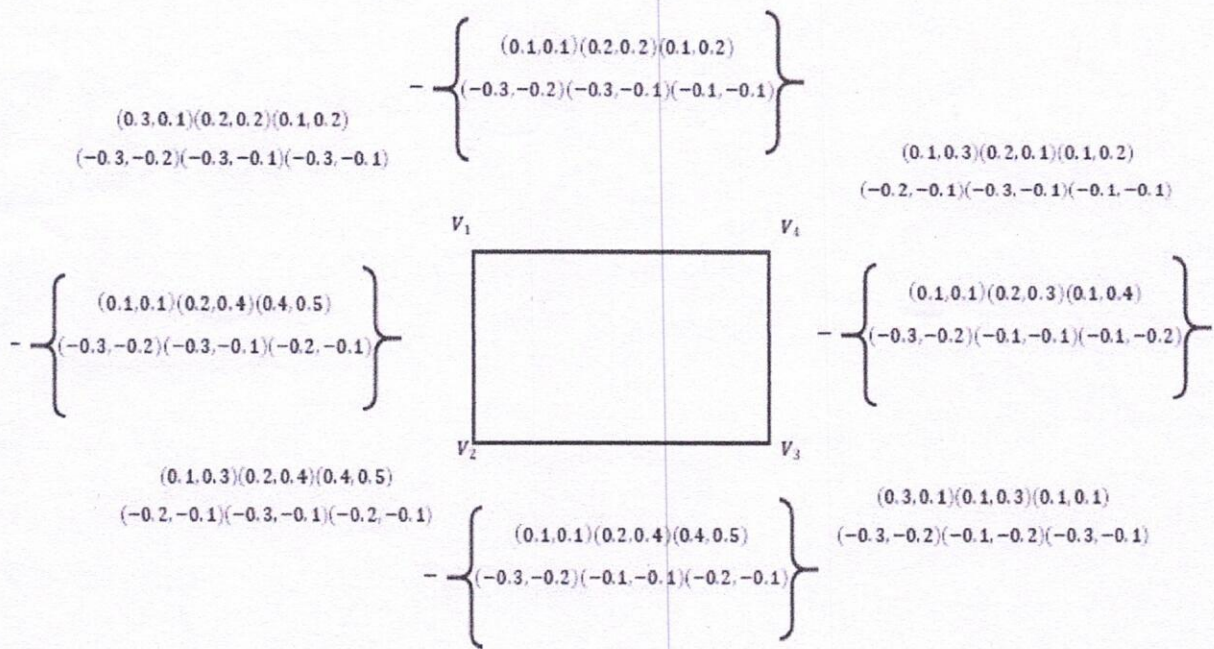


Figure 2. BIV Positive signed N.G

Corollary 4.3. If a graph with odd length cycle is having all negative signed nodes is always negative signed graph.

Definition 4.4. A Bipolar interval valued signed neutrosophic graph is balanced. Then the graph have even number of neg-

ative signed edges or all positive signed edges. The Bipolar interval valued signed neutrosophic graph is completely balanced if,

$$\sum_{i=1}^n T_i^P \& \sum_{i=1}^n T_i^N = \sum_{i=1}^n I_i^P \& \sum_{i=1}^n I_i^N = \sum_{i=1}^n F_i^P \& \sum_{i=1}^n F_i^N$$

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for all edges of G .

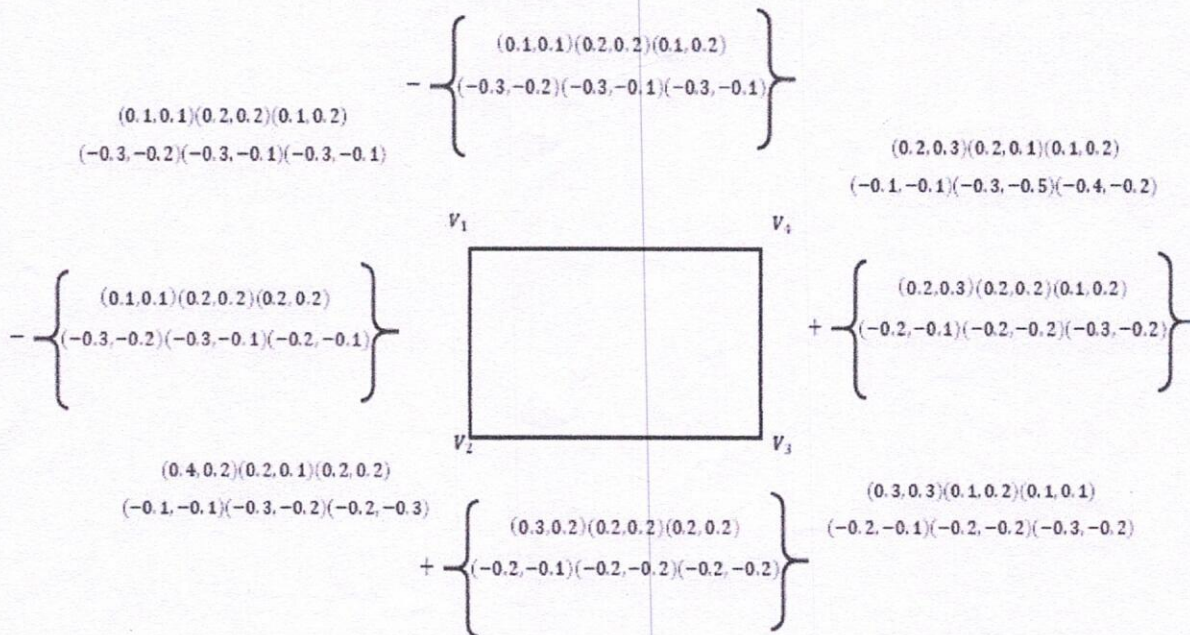


Figure 3. Balanced BIVSNG

Definition 4.5. The complement of a Bipolar interval valued signed neutrosophic graph $G = (A, B)$ on G^* is a bipolar interval valued signed neutrosophic graph \bar{G} , where

$$\begin{aligned} \bar{T}_A^P(v_i) &= T_A^P(v_i) & \bar{T}_A^N(v_i) &= T_A^N(v_i) \\ \bar{I}_A^P(v_i) &= I_A^P(v_i) & \bar{I}_A^N(v_i) &= I_A^N(v_i) \\ \bar{F}_A^P(v_i) &= F_A^P(v_i) & \bar{F}_A^N(v_i) &= F_A^N(v_i) \end{aligned}$$

Example 4.6. An example of complement of BIVSNG.

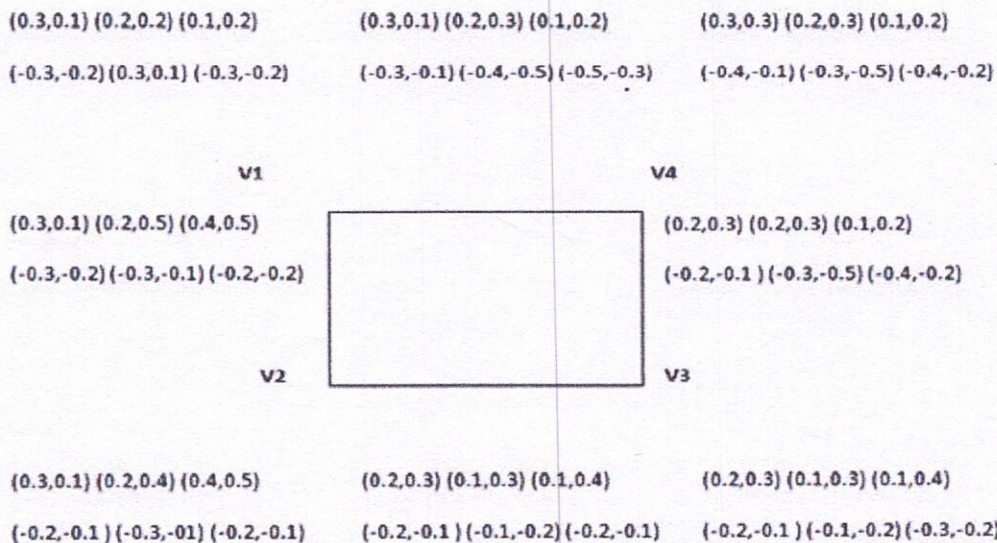


Figure 4.

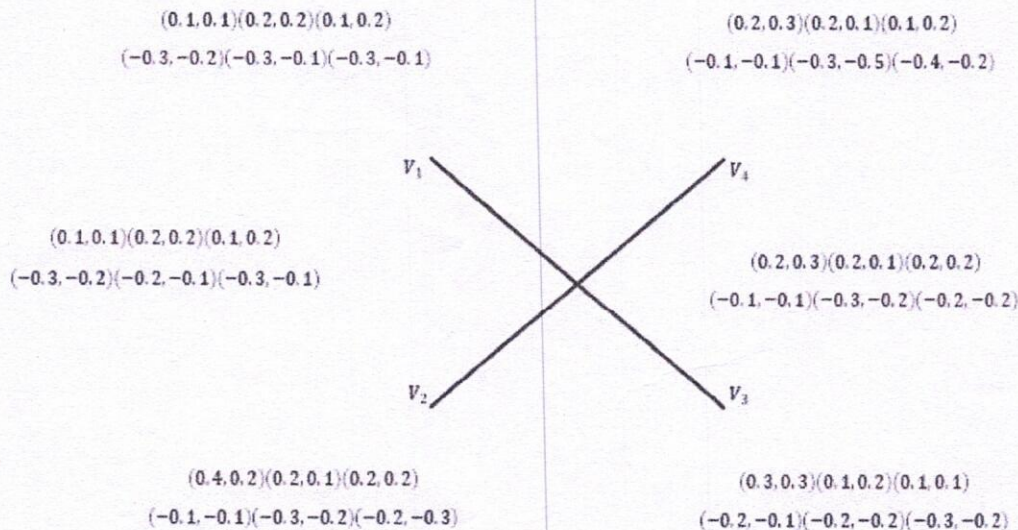


Figure 5.

Proposition 4.7. An odd length Bipolar interval valued signed neutrosophic cycle is balanced iff it contains at least one positive edge or odd number of positive edges

Proposition 4.8. If G is a strong BIVNG then $\bar{\bar{G}} = G$.

Proof. By the definition,

$$\begin{aligned} T_{BL}^P(u, v) &= \min(T_{AL}^P(u), T_{AL}^P(v)) \\ T_{BU}^P(u, v) &= \min(T_{AU}^P(u), T_{AU}^P(v)) \\ T_{BL}^N(u, v) &= \max(T_{AL}^N(u), T_{AL}^N(v)) \\ T_{BU}^N(u, v) &= \max(T_{AU}^N(u), T_{AU}^N(v)) \\ I_{BL}^P(u, v) &= \max(I_{AL}^P(u), I_{AL}^P(v)) \\ I_{BU}^P(u, v) &= \max(I_{AU}^P(u), I_{AU}^P(v)) \\ I_{BL}^N(u, v) &= \min(I_{AL}^N(u), I_{AL}^N(v)) \\ I_{BU}^N(u, v) &= \min(I_{AU}^N(u), I_{AU}^N(v)) \\ F_{BL}^P(u, v) &= \max(F_{AL}^P(u), F_{AL}^P(v)) \\ F_{BU}^P(u, v) &= \max(F_{AU}^P(u), F_{AU}^P(v)) \\ F_{BL}^N(u, v) &= \min(F_{AL}^N(u), F_{AL}^N(v)) \\ F_{BU}^N(u, v) &= \min(F_{AU}^N(u), F_{AU}^N(v)) \end{aligned}$$

Let

$$\begin{aligned} \bar{\bar{T}}_{BL}^P(u, v) &= \min(T_{AL}^P(u), T_{AL}^P(v)) - \bar{T}_{BL}^P(u, v) \\ &= \min(T_{AL}^P(u), T_{AL}^P(v)) - [\min(T_{AL}^P(u), T_{AL}^P(v)) - T_{BL}^P(u, v)] \\ &= \min(T_{AL}^P(u), T_{AL}^P(v)) - \min(T_{AL}^P(u), T_{AL}^P(v)) + T_{BL}^P(u, v) \\ &= T_{BL}^P(u, v) \\ \bar{\bar{T}}_{BU}^P(u, v) &= \min(T_{AU}^P(u), T_{AU}^P(v)) - \bar{T}_{BU}^P(u, v) \end{aligned}$$

$$\begin{aligned} &= \min(T_{AU}^P(u), T_{AU}^P(v)) - [\min(T_{AU}^P(u), T_{AU}^P(v)) - T_{BU}^P(u, v)] \\ &= \min(T_{AU}^P(u), T_{AU}^P(v)) - \min(T_{AU}^P(u), T_{AU}^P(v)) + T_{BU}^P(u, v) \\ &= T_{BU}^P(u, v) \\ \bar{\bar{T}}_{BL}^N(u, v) &= \max(T_{AL}^N(u), T_{AL}^N(v)) - \bar{T}_{BL}^N(u, v) \\ &= \max(T_{AL}^N(u), T_{AL}^N(v)) - [\max(T_{AL}^N(u), T_{AL}^N(v)) - T_{BL}^N(u, v)] \\ &= \max(T_{AL}^N(u), T_{AL}^N(v)) - \max(T_{AL}^N(u), T_{AL}^N(v)) + T_{BL}^N(u, v) \\ &= T_{BL}^N(u, v) \\ \bar{\bar{T}}_{BU}^N(u, v) &= \max(T_{AU}^N(u), T_{AU}^N(v)) - \bar{T}_{BU}^N(u, v) \\ &= \max(T_{AU}^N(u), T_{AU}^N(v)) - [\max(T_{AU}^N(u), T_{AU}^N(v)) - T_{BU}^N(u, v)] \\ &= \max(T_{AU}^N(u), T_{AU}^N(v)) - \max(T_{AU}^N(u), T_{AU}^N(v)) + T_{BU}^N(u, v) \\ &= T_{BU}^N(u, v) \\ \bar{\bar{I}}_{BL}^P(u, v) &= \max(I_{AL}^P(u), I_{AL}^P(v)) - \bar{I}_{BL}^P(u, v) \\ &= \max(I_{AL}^P(u), I_{AL}^P(v)) - [\max(I_{AL}^P(u), I_{AL}^P(v)) - I_{BL}^P(u, v)] \\ &= \max(I_{AL}^P(u), I_{AL}^P(v)) - \max(I_{AL}^P(u), I_{AL}^P(v)) + I_{BL}^P(u, v) \\ &= I_{BL}^P(u, v) \\ \bar{\bar{I}}_{BU}^P(u, v) &= \max(I_{AU}^P(u), I_{AU}^P(v)) - \bar{I}_{BU}^P(u, v) \\ &= \max(I_{AU}^P(u), I_{AU}^P(v)) - [\max(I_{AU}^P(u), I_{AU}^P(v)) - I_{BU}^P(u, v)] \\ &= \max(I_{AU}^P(u), I_{AU}^P(v)) - \max(I_{AU}^P(u), I_{AU}^P(v)) + I_{BU}^P(u, v) \\ &= I_{BU}^P(u, v) \end{aligned}$$



$$\begin{aligned} \bar{I}_{BL}^N(u, v) &= \min(I_{AL}^N(u), I_{AL}^N(v)) - \bar{I}_{BL}^N(u, v) \\ &= \min(I_{AL}^N(u), I_{AL}^N(v)) - [\min(I_{AL}^N(u), I_{AL}^N(v)) - I_{BL}^N(u, v)] \\ &= \min(I_{AL}^N(u), I_{AL}^N(v)) - \min(I_{AL}^N(u), I_{AL}^N(v)) + I_{BL}^N(u, v) \\ &= I_{BL}^N(u, v) \end{aligned}$$

$$\begin{aligned} \bar{I}_{BU}^N(u, v) &= \min(I_{AU}^N(u), I_{AU}^N(v)) - \bar{I}_{BU}^N(u, v) \\ &= \min(I_{AU}^N(u), I_{AU}^N(v)) - [\min(I_{AU}^N(u), I_{AU}^N(v)) - I_{BU}^N(u, v)] \\ &= \min(I_{AU}^N(u), I_{AU}^N(v)) - \min(I_{AU}^N(u), I_{AU}^N(v)) + I_{BU}^N(u, v) \\ &= I_{BU}^N(u, v) \end{aligned}$$

$$\begin{aligned} \bar{F}_{BL}^P(u, v) &= \max(F_{AL}^P(u), F_{AL}^P(v)) - \bar{F}_{BL}^P(u, v) \\ &= \max(F_{AL}^P(u), F_{AL}^P(v)) - [\max(F_{AL}^P(u), F_{AL}^P(v)) - F_{AL}^P(u, v)] \\ &= \max(F_{AL}^P(u), F_{AL}^P(v)) - \max(F_{AL}^P(u), F_{AL}^P(v)) + F_{AL}^P(u, v) \\ &= F_{AL}^P(u, v) \end{aligned}$$

$$\begin{aligned} \bar{F}_{BU}^P(u, v) &= \max(F_{AU}^P(u), F_{AU}^P(v)) - \bar{F}_{BU}^P(u, v) \\ &= \max(F_{AU}^P(u), F_{AU}^P(v)) - [\max(F_{AU}^P(u), F_{AU}^P(v)) - F_{AU}^P(u, v)] \\ &= \max(F_{AU}^P(u), F_{AU}^P(v)) - \max(F_{AU}^P(u), F_{AU}^P(v)) + F_{AU}^P(u, v) \\ &= F_{AU}^P(u, v) \end{aligned}$$

$$\begin{aligned} \bar{F}_{BL}^N(u, v) &= \min(F_{AL}^N(u), F_{AL}^N(v)) - \bar{F}_{BL}^N(u, v) \\ &= \min(F_{AL}^N(u), F_{AL}^N(v)) - [\min(F_{AL}^N(u), F_{AL}^N(v)) - F_{AL}^N(u, v)] \\ &= \min(F_{AL}^N(u), F_{AL}^N(v)) - \min(F_{AL}^N(u), F_{AL}^N(v)) + F_{AL}^N(u, v) \\ &= F_{AL}^N(u, v) \end{aligned}$$

$$\begin{aligned} \bar{F}_{BU}^N(u, v) &= \min(F_{AU}^N(u), F_{AU}^N(v)) - \bar{F}_{BU}^N(u, v) \\ &= \min(F_{AU}^N(u), F_{AU}^N(v)) - [\min(F_{AU}^N(u), F_{AU}^N(v)) - F_{AU}^N(u, v)] \\ &= \min(F_{AU}^N(u), F_{AU}^N(v)) - \min(F_{AU}^N(u), F_{AU}^N(v)) + F_{AU}^N(u, v) \\ &= F_{AU}^N(u, v) \end{aligned}$$

∴ The theorem proved. □

Proposition 4.9. *If G is a complete BIVNG then the complement of complete BIVNG has no edges.*

Proof.

$$T_{BL}^P(u, v) = \min(T_{AL}^P(u), T_{AL}^P(v))$$

$$T_{BU}^P(u, v) = \min(T_{AU}^P(u), T_{AU}^P(v))$$

$$T_{BL}^N(u, v) = \max(T_{AL}^N(u), T_{AL}^N(v))$$

$$T_{BU}^N(u, v) = \max(T_{AU}^N(u), T_{AU}^N(v))$$

$$I_{BL}^P(u, v) = \max(I_{AL}^P(u), I_{AL}^P(v))$$

$$I_{BU}^P(u, v) = \max(I_{AU}^P(u), I_{AU}^P(v))$$

$$I_{BL}^N(u, v) = \min(I_{AL}^N(u), I_{AL}^N(v))$$

$$I_{BU}^N(u, v) = \min(I_{AU}^N(u), I_{AU}^N(v))$$

$$F_{BL}^P(u, v) = \max(F_{AL}^P(u), F_{AL}^P(v))$$

$$F_{BU}^P(u, v) = \max(F_{AU}^P(u), F_{AU}^P(v))$$

$$F_{BL}^N(u, v) = \min(F_{AL}^N(u), F_{AL}^N(v))$$

$$F_{BU}^N(u, v) = \min(F_{AU}^N(u), F_{AU}^N(v))$$

Now \bar{G}

$$\begin{aligned} \bar{T}_{BL}^P &= \min(T_{AL}^P(u), T_{AL}^P(v)) - T_{BL}^P(u, v) \quad \forall u, v \in V \\ &= \min(T_{AL}^P(u), T_{AL}^P(v)) - \min(T_{AL}^P(u), T_{AL}^P(v)) \\ &= 0 \quad \forall u, v \in V \end{aligned}$$

$$\begin{aligned} \bar{T}_{BU}^P &= \min(T_{AU}^P(u), T_{AU}^P(v)) - T_{BU}^P(u, v) \quad \forall u, v \in V \\ &= \min(T_{AU}^P(u), T_{AU}^P(v)) - \min(T_{AU}^P(u), T_{AU}^P(v)) \\ &= 0 \quad \forall u, v \in V \end{aligned}$$

$$\begin{aligned} \bar{T}_{BL}^N &= \max(T_{AL}^N(u), T_{AL}^N(v)) - T_{BL}^N(u, v) \quad \forall u, v \in V \\ &= \max(T_{AL}^N(u), T_{AL}^N(v)) - \max(T_{AL}^N(u), T_{AL}^N(v)) \\ &= 0 \end{aligned}$$

$$\begin{aligned} \bar{T}_{BU}^N &= \max(T_{AU}^N(u), T_{AU}^N(v)) - T_{BU}^N(u, v) \quad \forall u, v \in V \\ &= \max(T_{AU}^N(u), T_{AU}^N(v)) - \max(T_{AU}^N(u), T_{AU}^N(v)) \\ &= 0 \end{aligned}$$

$$\begin{aligned} \bar{I}_{BL}^P &= \max(I_{AL}^P(u), I_{AL}^P(v)) - I_{BL}^P(u, v) \\ &= \max(I_{AL}^P(u), I_{AL}^P(v)) - \max(I_{AL}^P(u), I_{AL}^P(v)) \\ &= 0 \end{aligned}$$

$$\begin{aligned} \bar{I}_{BU}^P &= \max(I_{AU}^P(u), I_{AU}^P(v)) - I_{BU}^P(u, v) \\ &= \max(I_{AU}^P(u), I_{AU}^P(v)) - \max(I_{AU}^P(u), I_{AU}^P(v)) \\ &= 0 \end{aligned}$$

and

$$\begin{aligned} \bar{I}_{BL}^N &= \min(I_{AL}^N(u), I_{AL}^N(v)) - I_{BL}^N(u, v) \\ &= \min(I_{AL}^N(u), I_{AL}^N(v)) - \min(I_{AL}^N(u), I_{AL}^N(v)) \\ &= 0 \end{aligned}$$

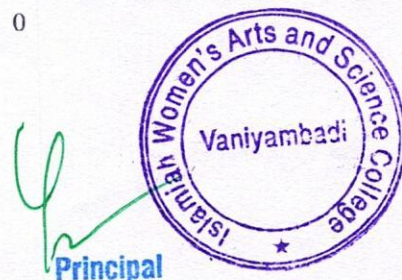
$$\begin{aligned} \bar{I}_{BU}^N &= \min(I_{AU}^N(u), I_{AU}^N(v)) - I_{BU}^N(u, v) \\ &= \min(I_{AU}^N(u), I_{AU}^N(v)) - \min(I_{AU}^N(u), I_{AU}^N(v)) \\ &= 0 \end{aligned}$$

Similarly,

$$\begin{aligned} \bar{F}_{BL}^P(u, v) &= \max(F_{AL}^P(u), F_{AL}^P(v)) - F_{BL}^P(u, v) \\ &= \max(F_{AL}^P(u), F_{AL}^P(v)) - \max(F_{AL}^P(u), F_{AL}^P(v)) \\ &= 0 \end{aligned}$$

$$\begin{aligned} \bar{F}_{BU}^P(u, v) &= \max(F_{AU}^P(u), F_{AU}^P(v)) - F_{BU}^P(u, v) \\ &= \max(F_{AU}^P(u), F_{AU}^P(v)) - \max(F_{AU}^P(u), F_{AU}^P(v)) \\ &= 0 \end{aligned}$$

and



$$\begin{aligned} \overline{F}_{BL}^N(u, v) &= \min(F_{AL}^N(u), F_{AL}^N(v)) - F_{BL}^N(u, v) \\ &= \min(F_{AL}^N(u), F_{AL}^N(v)) - \min(F_{AL}^N(u), F_{AL}^N(v)) \\ &= 0 \\ \overline{F}_{BU}^N(u, v) &= \min(F_{AU}^N(u), F_{AU}^N(v)) - F_{BU}^N(u, v) \\ &= \min(F_{AU}^N(u), F_{AU}^N(v)) - \min(F_{AU}^N(u), F_{AU}^N(v)) \\ &= 0 \end{aligned}$$

$\overline{T}_{BL}^P, \overline{T}_{BU}^P, \overline{T}_{BL}^N, \overline{T}_{BU}^N, \overline{T}_{BL}^P, \overline{T}_{BU}^P, \overline{T}_{BL}^N, \overline{T}_{BU}^N, \overline{F}_{BL}^P, \overline{F}_{BU}^P, \overline{F}_{BL}^N, \overline{F}_{BU}^N = (0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)$. Hence the edge set of \overline{G} is empty if G is complete Bipolar interval valued neutrosophic graph. \square

5. Conclusion

In this paper, we have defined for the Bipolar interval valued signed neutrosophic graphs, Strong bipolar interval valued neutrosophic graphs and Degree of bipolar interval valued neutrosophic graphs with examples. In future study, we plan to extend our research work to regular bipolar interval valued neutrosophic graphs and irregular bipolar interval valued neutrosophic graphs.

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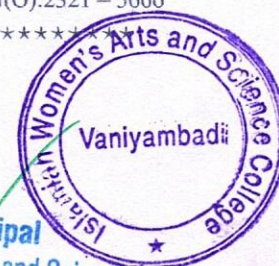
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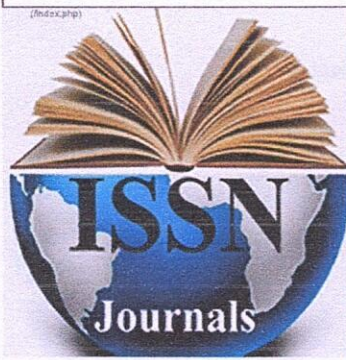
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MR M. Reni and Deepa. C Updated December 23, 2020

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Volume: 7 & Issue: 26 (April – June 2020) PP: 01 - 05 Date: 25-06-2020

THE STRANGLED WOMEN – A SOCIAL REALITY IN ARUNDHATI ROY'S PERIOD

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Abstract:

This paper depicts the mentality of the Indian people towards women who are always anticipated to be a stick to them to make use for all the purpose. They are even expected to be an acquiescent, docile, sheepish and even cringing housewife. Women are still reckoned to be the property of their men, if married, and of fathers, if unmarried. There is no talking about the way in which women are manipulated and controlled by men and by male-oriented society. One of our favorite views is that woman is an embodiment of sexual pleasure. It also expresses the feelings, thoughts, experiences and the struggles and sufferings of the Indian women. It also limns the incessant battle of women and invulnerable for scratching their identity in this vicious, blimpish, fusty and male-dominating society. It means to create a modern-day environment and to face demanding situations as a woman.

Keywords: Indian people, cringing housewife, male-oriented society, male-dominating society, modern-day environment etc.

Arundhati Roy says- "fiction has always been a means of making sense of the world, to connect the smallest things to the biggest things." in her interviews. But the fact remains that the small things are no match or the big ones and get crushed by them. The small things like love and warmth, yearning and affection get trampled by the big things

like blatant gender and caste prejudice, patriarchy.

Women in the Vedic age were treated not only with grace but also with courtesy and consideration and they enjoyed almost an equal status with men in the family, society and the state. Their attitude was responsible for the high status of women during that time. There was no seclusion of women, and hence women moved freely in the society. They remained unmarried if they wanted to, and had a right to the paternal property. Thus, on the whole women enjoyed comparatively a greater freedom in society and commanded a much greater authority.

But the status of woman in India began to decline around 300BC. There was a slow but steady eclipse in the status accorded to women both at home and in society. Several formidable challenges are faced by women in the tradition bound society of India. From centuries to century, women are being made to be exploited and

diddled by the male-dominated society not only in India but all over the world. Women have been made to serve the interests of man at all costs, dispossessed of her soul and mind. They are simply running the household and bringing up children. Men play a vital role in the Indian household as bosses and masters. Women are never allowed to fight their oppressors and even never treated to quench about their afflictions.

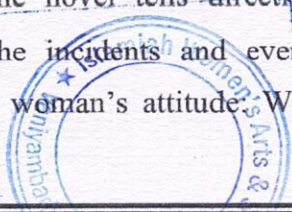
In this society, men moderate over women, the rich over the poor, upper caste over the lower caste, touchable over the impure, the educated over the illiterate, capitalist over the proletariat. The individual aspirations are crushed under the heavy feet of powerful hierarchy of caste and class. It is difficult to protest the traditional, conventional, religious and social laws. The problems of social inequality, patriarchy, castism, conservatism cannot be resolved by Marxism.

The women characters of Arunthathi Roy are brawny. They always try to dispute for their rights and make themselves to confront the consequences. All her novels imply the question that the author of the novel tells directly when indicating the incidents and events that defined one woman's attitude. Was it "a

Small Price to Pay? (336) Women are addressed as secondary in this society.

A critic Anita Loomba argues that: "Traditionally the arguments for women's education in the colonies rely on the logic that educated women will make better wives and mothers. At the same time, educated women have to be taught not to overstep their bounds and usurp authority from men". (2005: 182)

Roy brings her women characters that are used for one's advantage. They are torn between their identity and social responsibilities. One of her heroines, Ammu sacrifices her life to search for identity. She defies stepping a path where she can find an identity of her own. There is inoffensive way of evincing the general belief that she has no rights whatsoever in the society. The only resort that she has is her home where her parents live. It is undoable to get over the infamy. Ammu becomes very cognizant after break up with her husband "for her, her life had been lived. She had one chance. She made a mistake. She married a wrong man". (38) Women who get divorce are never handled well by the society and are excoriated even by their families itself. She examines this social phenomenon with all the technical tools at her disposal.



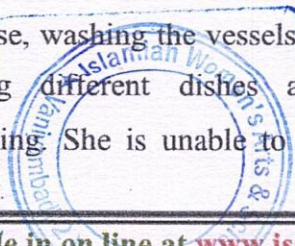
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Our society has bound its people with limitations on social interaction with the caste system deeply in India's legacy, men and women here have always left love the heat of it in the matter of falling in love. Women on the other hand craving for fulfillment in life cross the barriers of piety motivated by benevolence or passion of the underdog and break the fence of regulated love. Arunthathi Roy, here has depicted a very realistic picture of the contemporary society where women are supposed to be of secondary sex, meant only for mating, procreating and tending the family.

Talking of woman M. Kumaraswamy Raju says, "designed 'weaker sex' hypocritically 'fair sex' she is pilloried on the Alta of marriage and family and this predicament of hers has not changed" (78). Men go out for not only doing work but do many things every day. They often get chance to see many people from all sorts of life and develop relationship among them where they meet but a women's life are not much better, especially that of the housewives. The whole day they keep out themselves in their house or where their men tell to stay. She does all sorts of homework like cleaning the house, washing the vessels or dresses, cooking different dishes and scouring everything. She is unable to go

out and meet anybody whom she likes because she is bound to be at her home for others. Her house is her world. In the evening she will be on the lookout for her husband only. If he is not ready to talk to her, she keeps quiet and starts doing her routine. She cannot express her feelings over husband. Therefore her loneliness may make cause to die.

Women are constitutional part of human culture. No society or county can ever shape up without an active involvement of women in its overall development. The place of women in society has differed from culture to culture from age to age. One common fact shows that two men have never been treated as equal to men. Ironically, women are held in great esteem in India. Women are regarded subordinate to men because it is believed that she was made out of man. The process of women being made a possession of man is a gradual one. Thus, in India, girl children are being exploited as the food of many men even today. As we often come across that no woman is allowed alone at her home, office or anywhere. They are not acknowledged as persons or independent beings. They have to face lots of obstacles in the educational circuit, which symbolizes the possessions of an enlightening civilization that utterly



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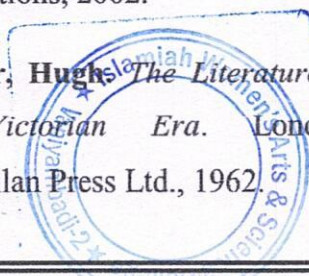
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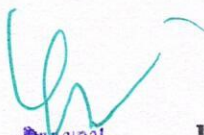
restricts the capacity of women's rational exposure.

To conclude, Arunthathi Roy makes her readers to think that Women are to be seen as being domestic, godly, chaste, pristine, soft, gracious, elegant, simple, merciful, sympathetic and beautiful; which are nature's separate spheres. Therefore, nature is viewed as the embodiment of all the characteristics that ladies possess.

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IMPACT OF COVID 19 ON CONSUMER BUYING BEHAVIOUR IN TIRUPATTUR DISTRICT

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Title of the Paper: **IMPACT OF COVID 19 ON CONSUMER BUYING BEHAVIOUR IN TIRUPATTUR
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Abstract:

People find difficult in coping with COVID 19 Pandemic both physically, psychologically and financially. Monetary facilities have been reduced due to complete lockdown. Though lockdown people cannot survive without food and other essential items. During lockdown many shops are voluntarily offering door delivery system on the purchases made by the consumers. Government also provides basic necessities at least level. Hence, this made the researcher to find how people are adjusting with their earning and spending. Percentage analysis, Freidman Rank Test are applied to find the factors for difficulty to buy, hindering factors and to know the benefits obtained during lockdown. Path analysis is made with the help of regression analysis to identify impact factors. The results show that people find more difficulty in buying fruits, vegetables and non-vegetable items, transportation and additional cost are their major problem in buying essential items. The paramount benefits received are spending time with family members and work from home offers.

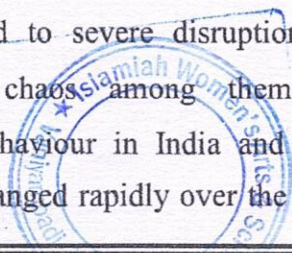
Keywords: Spending pattern, Earning, Lockdown, COVID 19, Monetary, Consumer Behaviour etc.

Introduction:

The coronavirus pandemic has taken the whole world by storm. People find difficult of contracting the virus led to severe disruptions and widespread chaos among them. The consumer behaviour in India and across the world changed rapidly over the course

of COVID 19 crisis. The lockdown resulted in panic buying and hoarding essential items. The COVID 19 pandemic also known as the Corona virus pandemic, is an ongoing global pandemic of Corona virus disease 2019, caused by severe acute respiratory syndrome Corona virus 2. The outbreak was first identified in Wuhan, China in December 2019. The World Health Organisation (WHO) declared the outbreak a Public Health Emergency of International Concern on January 2020 and a pandemic on March 2020. As of July 2020, more than 12.9 million cases of COVID 19 have been reported in more than 188 countries and territories, resulting in more than 5,71,000 deaths, more than 7 million people have recovered.

The virus is primarily spread between people during close contact, most often via small droplets produced by coughing, sneezing and talking. Common symptoms include fever, cough, fatigue, shortness of breath and loss of sense of smell. There is no vaccine (or) specific antiviral treatment. These results



authorities worldwide have responded by implementing lockdown.

The lockdown restricted people from stepping out of their homes. All transport services – road, rail and air were suspended with exceptions for transportation of essential goods, fire, police and emergency services. Educational institutions, industrial establishments and hospitality services were also suspended. Services such as food, shops, banks and ATMs, petrol pumps, other essentials and their manufacturing are exempted. However, people find difficult in consuming basic and essential items in some way (or) the other.

The present study aims at finding difficulties faced by people on consumption, factors hindering to buy and also any benefits they obtained during COVID 19 lockdown period.

Scope of the Study:

The scope of the study was to know whether the COVID 19 lockdown has any impact on consumer buying behaviour pattern in Tirupattur District. Problems faced and obstructs in buying the essential items during COVID 19 and benefits of lockdown are studied in the research work.

Objectives of the Study:

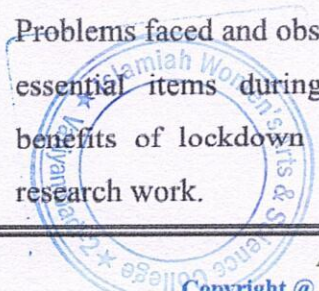
- To know the difficulties faced by consumers on buying the basic and essential items.
- To find the benefits received during COVID 19 lockdown period.
- To find the factors hindering to buy items during pandemic.

Research Methodology:

Research design applied for the study is Evaluation Study assessing the impact of COVID 19 on consumer buying behaviour. The sample size of the study was 81 respondents from Tirupattur District. Purposive and random sampling technique was used for the study to ensure that sample so obtained are consumers of basic and essential items and also from different backgrounds. Data have been collected with the help of a well structured questionnaire. The questionnaire is prepared and distributed with the help of Google Forms. The study was conducted for two months period May and June 2020.

Analytical Tools:

The collected data have been analyzed with the help of statistical techniques to understand the outcomes with reference to objectives and



hypothesis. Data processing was carried out with the help of MS Excel and SPSS 18. The analytical tools applied for the study are,

- Percentage analysis
- Friedman Rank Test
- Path analysis with the help of Regression analysis

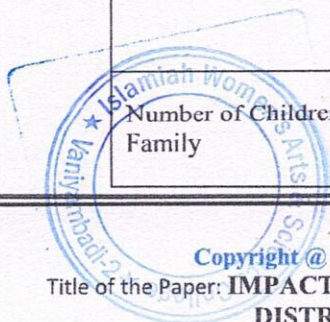
Analysis and Results:

Percentage analysis:

1. Demographic details of the respondents

Table 1 – Demographic Details

Demographic Details		Frequency	Percentage
Age (years)	Below 20	08	10
	20-30	25	31
	30-40	31	38
	40-50	12	15
	Above 50	05	06
	Total	81	100
Gender	Male	12	15
	Female	69	85
	Total	81	100
Qualification	Upto School	02	02
	Graduate	12	15
	Post Graduate	67	83
	Total	81	100
Family Income (per month in Rs.)	Below Rs.10,000	27	33
	Rs.10,000- Rs.15,000	16	20
	Rs.15,000- Rs.20,000	09	11
	Rs.20,000- Rs.25,000	12	15
	Above Rs.25,000	17	21
	Total	81	100
Type of Family	Nuclear Family	53	65
	Joint Family	28	35
	Total	81	100
Number of Members in the Family	2	03	04
	3	19	24
	4	27	33
	5	19	24
	Above 5	13	16
	Total	81	100
	Number of Children in the Family	0	20
1		23	28
2		28	35



	3	07	08
	4	03	04
	Total	81	100
Family Expenses (per month in Rs.)	Below Rs.10,000	20	25
	Rs.10,000- Rs.20,000	27	33
	Rs.20,000- Rs.30,000	16	20
	Rs.30,000- Rs.40,000	2	15
	Above Rs.40,000	06	07
	Total	81	100
Institution Provide Salary	Yes	58	72
	No	23	28
	Total	81	100
Basis of Providing Salary by the Institution	Monthly	52	90
	Fortnightly	00	00
	Once in Two Months	03	05
	Others	03	05
	Total	58	100.0

Table 1 shows the demographic details of respondents. Respondents have been classified based on age, gender, qualification, income, type of family, number of members and children in the family, family expenses and institution providing salary.

2. Coping with COVID 19 on Spending

Table 2 – Coping with COVID 19 on Spending

Level of Frequency	Frequency	Percentage
Very much	12	15
Somehow	39	48
Little bit	20	25
Cannot Say	08	10
Never	02	02
Total	81	100

Table 2 shows that nearly half of the respondents somehow cope up with the COVID 19 lockdown on spending their

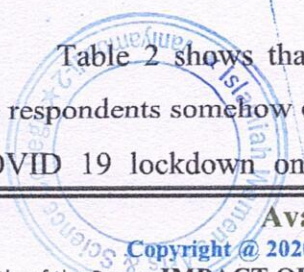
income. One-third of them are little bit deal with lockdown. Only 2% stated that they never handle with lockdown situation.

3. Income is being Saved during COVID 19

Table 3 – Saving Income during COVID 19

Level of Frequency	Frequency	Percentage
Very much saved	04	05
Moderately saved	08	10
Little bit saved	14	17
Cannot Say	08	10
Never saved	34	42
No changes in savings	13	16
Total	81	100

Table 3 shows that nearly half of the respondents stated that they never saved their income during lockdown period. 16% of them said that they do not have any changes in savings.



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Title of the Paper: **IMPACT OF COVID 19 ON CONSUMER BUYING BEHAVIOUR IN TIRUPATTUR**

DISTRICT / Authors: S. Deepalakshmi* and K. Antony Baskaran**

Pages: 42-54 / Date of Publication: 25/06/2020

4. *Spending Pattern is increased during COVID 19*

Table 4 – Spending Pattern during COVID 19

Level of Frequency	Frequency	Percentage
Highly increased	16	20
Moderately increased	20	25
Little bit increased	13	16
Cannot be determined	09	11
Never increased	11	14
No changes in spending	12	15
Total	81	100

Table 4 shows that one-fourth of the respondents stated that their spending is increased moderately. 15% of them said that there is no changes in their spending pattern during lockdown period.

5. *Benefits received during Lockdown*

Table 5 – Benefits received during lockdown

Benefits	Frequency	Percent	Rank
Stress Relief	21	11	III
Work from home	34	18	II
Door delivery system	14	7	V
Free Supply by Government (or) Politicians	8	4	VI
Spending time with family	60	31	I
Income factor	2	1	VIII
Time convenience	34	18	II
Savings	15	8	IV
Others	3	2	VII
	191	100	

The prime benefits received during COVID 19 lockdown are spending time with family members, work from home and time convenience. Hence, these are ranked one and two respectively.

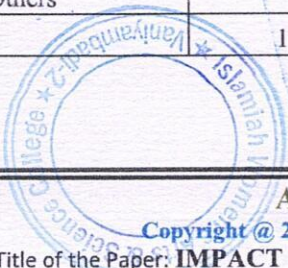
The sensible benefits are stress relief, savings and door delivery system. Hence, they are ranked three, four and five respectively.

The less benefits are free supply by Government, other factors and income factor. Hence, they are ranked six, seven and eight respectively.

Friedman Rank Test:

The Friedman test is a non-parametric statistical test developed by Milton Friedman. Similar to the parametric repeated measures ANOVA, it is used to detect differences in treatments across multiple test attempts. The procedure involves ranking each row (or block) together, then considering the values of ranks by columns.

Friedman Rank Test is applied to identify major factors on difficulties faced on buying and spending the items, factors hindering to buy the items during lockdown period.



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Difficulties faced on buying or spending on the household items

H₀: there is no difference between ranking of difficulties faced on buying or spending on basic and essential items

H₁: there is difference between ranking of difficulties faced on buying or spending on basic and essential items

Table 6 - Chi-square Test Statistics

N	81
Chi-square	20.407
Df	7
Asymp. Sig.	.005
a. Friedman Test	

The asymptotic significant value is less than 0.05, the null hypothesis is rejected. Hence, there is significant difference between ranking of difficulties faced by consumers on buying or spending on basic and essential items. The mean ranks are given in the following table.

Table 7 – Difficulties Faced during COVID 19

Households	Mean Rank	Rank
Buying baby care products(clothes, medicines, play items, cosmetics, etc.,	4.96	VIII
Payment of Electricity	4.48	IV
Recharges (mobile, TV)	4.85	VII
Payment of Insurance (health, life, general)	4.81	VI
Buying of Household appliances	4.53	V
Buying of fruits and vegetables, non-veg. items	3.93	I

Buying of clothes, cosmetics, luxury items	4.13	II
Education Purpose	4.31	III

Consumers find major difficulties on buying fruits, vegetables and non-vegetables, clothes, cosmetics and luxury items and for education purpose. Hence, these are ranked one, two and three respectively. They face moderate difficulties on payment electricity and buying household appliances. Hence, these are ranked four and five. The least difficulties are payment of insurance, doing recharges and buying baby care products. Hence, these have been ranked six, seven and eight.

Factors hindering to buy the household items

H₀: there is no difference between ranking of factors hindering to buy basic and essential items

H₁: there is difference between ranking of factors hindering to buy basic and essential items

Table 8 - Chi-square Test Statistics

N	81
Chi-square	20.774
Df	9
Asymp. Sig.	.014
a. Friedman Test	

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The asymptotic significant value is less than 0.05, the null hypothesis is rejected. Hence, there is significant difference between ranking of factors hindering to buy basic and essential items. The mean ranks are given in the following table.

Table 9 – Factors hindering to buy basic and essential items during COVID 19

Factors	Mean Rank	Rank
Reduced income	5.56	VI
Transportation problem	4.88	I
Poor supply in selected areas	5.63	VII
Non availability of essential items	6.22	X
Additional cost	5.07	II
Menace to buy certain items	5.84	VIII
No timely availability	5.85	IX
Inadequate stores (lock of certain shops/ stores)	5.21	III
No after sales service	5.23	IV
No return policy	5.50	V

The major hindering factors during lockdown are transportation problem, additional cost, inadequate stores and no after sales service. Hence, these are ranked one, two, three and four respectively.

The tolerable factors are no return policy, reduced income and poor supply in selected areas. Hence, these are ranked five, six and seven respectively.

The slightest amount of hindering factors are menace to buy certain items, no timely availability and non-availability of essential items. Hence, these are ranked eight, nine and ten respectively.

Path Analysis:

Path analysis is applied to know the impact of various factors on difficulties faced by consumers on buying the items and factors hindering to buy items during COVID 19 lockdown period. The analysis consists of two models – a full model with all of the possible paths included; a reduced model which has some of the paths deleted because they are not contributing to this model.

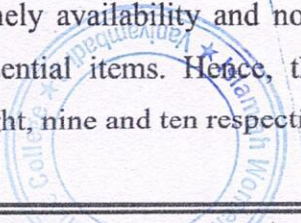
The following diagrams display the reduced model for impact of factors on difficulties faced by consumers on buying items and factors hindering to buy during lockdown. The values shown in the model are significant values of multiple regression analysis.

Lined arrows show significance of the factor and dotted arrows show the insignificance of the factors.

6. Impact of various factors on difficulties faced in buying basic and essential during COVID 19 lockdown

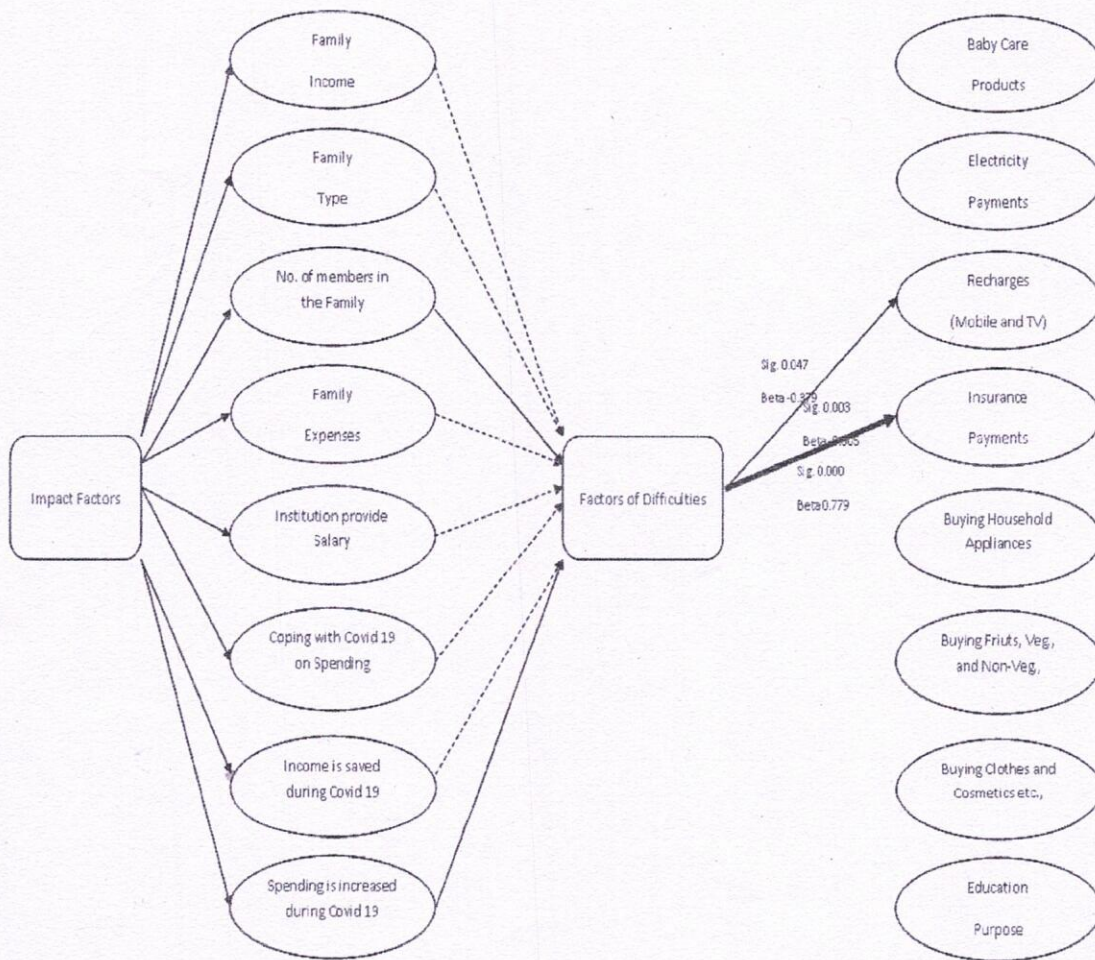
The criteria and predictors shown in the model are;

- (i) Various factors such as income, family type, family expenses etc., are taken as criteria and
- (ii) Factors for difficulties faced to buy are taken as predictors.



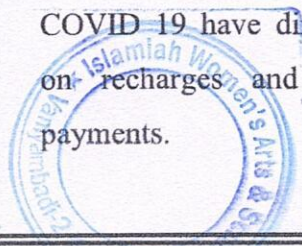
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Diagram 1 – Impact of factors on difficulties faced in buying households during COVID 19 lockdown



The results of the model are explained below:

- (i) Number of members in the family influence difficulties faced by consumers on doing recharges.
- (ii) Spending is increased during COVID-19 have direct impact on recharges and insurance payments.



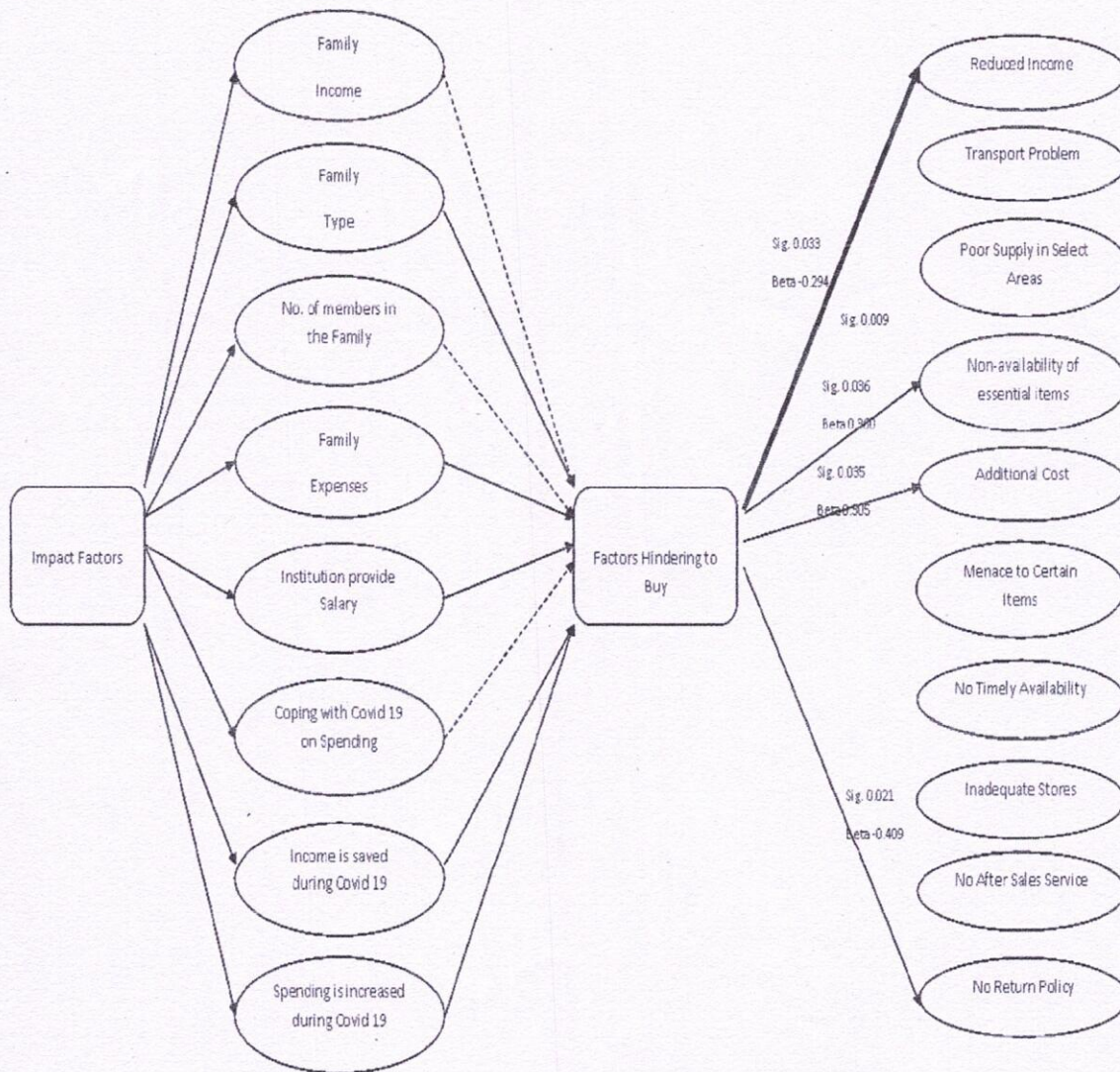
7. Impact of various factors on factors hindering to buy

The criteria and predictors shown in the model are;

- (iii) Various factors such as income, family type, family expenses etc., are taken as criteria
- (iv) Factors hindering to buy are taken as predictors.

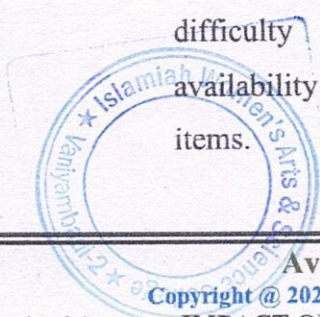
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Diagram 2 – Impact of various factors on factors hindering to buy



The results of the model are explained below:

- (i) Family type (nuclear and joint) have impact on reduced income.
- (ii) Family expenses per month have association with difficulty on non-availability of essential items.
- (iii) Institutions provide salary have impact on no return policy.
- (iv) Saving income during COVID 19 have significant relationship with reduced income.
- (v) Increase in spending during COVID 19 have considerable bond with additional cost.



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Findings and Results:

General:

- 38% of respondents are in the age group of 30-40 years.
- 85% of respondents are females.
- 83% of respondents are post graduates.
- One-third (33%) of respondents have income below Rs.10,000.
- 65% of respondents are in nuclear family.
- 33% of respondents have four members in their family.
- 35% of respondents have two children in their family.
- One-third (33%) of respondents spend between Rs.10,000 and Rs.20,000 for their family needs.
- 72% of respondents get their salary from the institution during COVID 19 lockdown period.
- 90% of institutions provide salary on monthly basis.

Specific:

- 48% of respondents somehow cope with their spending during COVID 19 lockdown.
- 17% of respondents stated that they could save little bit of their earnings during lockdown period.

- 16% of respondents stated that they do not have any changes in their savings before and during lockdown period.
- More than half of the respondents agreed that their spending pattern is increased during COVID 19 lockdown than before.
- Buying fruits, vegetables and non-vegetables are the prime difficulties faced by consumers during lockdown.
- Transportation is the major hindering factor to buy consumable items during COVID 19 pandemic.
- Number of members in the family have significant impact on doing recharges.
- Recharges and insurance payments are the main reasons for increase in spending pattern by consumers.
- The system of nuclear and joint family have direct impact on reduced income.
- Additional cost is the most hindering factor for increase in spending the amount during lockdown.

Suggestions:

Based on the study, researcher likes to bring the following suggestions:

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- People find difficult that their spending is increased compare to before lockdown. Hence, Government shall take initiatives on reducing the cost on basic and necessary items.
- More delivery methods shall be arranged for supply of necessities. Vendors can find the difficulty of supply and make ease of it.
- Consumers shall be informed of date and time of opening of stores so as to avoid intricacy of availability.

Conclusion:

COVID 19 is a life sucking virus kills the lives of many human and other living beings. The lockdown during this pandemic is another kind of life hack. People find hard to manage their day-to-day life. Day-by-day the situation is worsening all and sundry. The results show that people find more difficulty in buying fruits, vegetables and non-vegetable items, transportation and additional cost are their major problem in buying essential items. The paramount benefits received are spending time with family members and work from home offers. It is in the hands of nature to solve this problem. However, it is the responsibility of the public to safeguard

their life. If they obey the laws and orders passed by Government then sure the problem will be resolved in nearing future.

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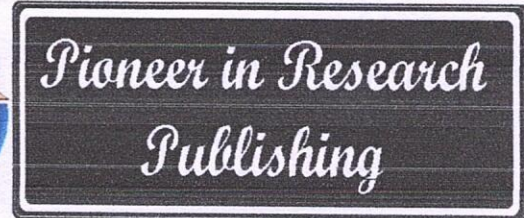
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CONSUMER PERCEPTION TOWARDS ONLINE SHOPPING DURING COVID 19 IN VANIYAMBADI TOWN

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Title of the Paper: CONSUMER PERCEPTION TOWARDS ONLINE SHOPPING DURING COVID 19
IN VANIYAMBADI TOWN / Authors: S. Deepalakshmi* and K. Antony Baskaran**

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Abstract:

Online shopping is the process whereby consumers directly buy goods and services from sellers in real time, without an intermediary service over the internet. It is form of E-Commerce. An online shop, e-shop, e-store, internet shop, web shop, web store, online store or virtual shop evokes the physical analogy of buying products or services in a shopping centre. Today the epoch of COVID 19 lockdown people prefer to online shopping than traditional shopping due to petrified of pandemic. Hence, online shopping might influence buyers in one way or the other. This paper attempts to analyze the perception about online shopping during COVID 19 lockdown. The study was made with a sample size of 150 and the respondents are chosen from Vaniyambadi town. Likert's five point scale was used to analyse the consumer perception towards online shopping.

Keywords: Online shopping, E-Commerce, e-shop, e-store, Internet shop, Web shop, Perception etc.

Introduction:

A consumer is no longer bound to a place for shopping. He can go to any corner of world for shopping virtually with the help of Internet. Internet is relatively a new medium for communication and information exchange that has become a part of everyday life. The number of Internet users are constantly increasing and also the online purchasers. This rapid increase is explained by the growth in the

use of broad band technology combined with a change in consumer behaviour. An online shop, e-shop, e-store, internet shop web shop, web store, online store or virtual shop evokes the physical analogy of buying products or services in a shopping centre.

During the initial 21-day lockdown period, e-commerce players like Amazon and Flipkart were allowed to sell only essential items and daily use products. However, even the sale of these were affected by delayed deliveries and supply only to selected areas. Red alert and hotspot vicinities are excluded from this supply chain. These lockdowns restrictions have been liberalised in the successive orders passed by the government. This made the researcher to study about consumers' perception towards online shopping during lockdown period.

Review of Literature:

Kushboo Makwana, globalisation of competition and development of information technology have enhanced

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consumer awareness and created a situation where people prefer shopping online rather than migrating as online shopping provides quality products as well as saves time. With the increasing Internet literacy, the prospects of online marketing in increasing in India. The largest of these online retailing corporations are Snapdeal, Amazon.com and e-bay. Retail success is no longer all about physical stores. This is evident because of the increase in retailers now offering online store interfaces for consumers.

Rawat, in the era of Internet technology, wifi services and Smartphone gadgets, the online promotions tools are very effective in reaching out to target audience. They are perceived to be effective, informative and credible. Online promotions have the potential to engage the audience in an impulsive behaviour. Although, users sometimes find the online promotions to cause irritability, yet they are convincing. The beauty of technology is in the usage of visuals and information. Companies must exploit this feature of Internet through the usage of colours pictures and images of the entire product. In addition to the visuals, online promotions can serve an excellent purpose in description of the entire product and service. All forms of products and services

have the potential to be promoted and to be sold over the Internet.

Kaushal, with Internet Penetration improving the country, smart phones becoming affordable and life styles becoming hectic, the way people used to shop are changing. Also with a huge chunk of young and working population, Indian demographics are a delight for e-commerce retailers. But to gain the trust and attention of Indian Consumers in this virtual shopping world there are many aspects of consumer behaviour which need to be explored. What exactly the Indian consumer thinking when he is buying online, what are his expectations, apprehensions, anxieties and phobias which retailers need to overcome. It is an Indian online consumer comfortable with the click of the mouse buying any improvements or areas which he thinks need to get addressed any specific part of online buying which delights him.

Kamalaveni, internet provides vital platform where sellers and buyers can come in contact for sale and purchase of goods and services. Since the internet, has the ability to reach the consumer's home, the distribution channels have started to assume new manning fo the B2C E-commerce. The physical delivery converted too electronic delivery; physical

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products are now electronic products displayed on a website. With options of paying online through debit and credit cards, the transaction is purely electronic. It offers a new environment distinguished from the traditional ways of doing business.

Objectives of the Study:

1. To find out the preferences of consumer regarding attributes of online shopping website.
2. To find out the factors that influences the consumers to online shopping.
3. To know the perceptions of the consumers towards online shopping.

Research Methodology:

Research design is used for this study is descriptive design. Descriptive design includes surveys and fact finding enquires of different kinds. The researcher has used simple random sampling for data collection. Among the total population of consumers, samples of 150 respondents were selected in order to relevant information for the study. Primary data were collected with the help of constructed questionnaire method and also used an interview schedule. The secondary data

collected from books, journals, and from websites. The study was conducted in the months of June and July 2020.

Analytical Tools:

Data have been analyzed with the help of statistical tools. The tools applied are;

- Percentage Analysis
- Mean and Standard Deviation

Limitations of the Study:

- The study was conducted only with the help of 150 respondents. The results would have been different if more samples are collected.
- Analysis was subject to response of online buyers only and not based on any other criterion.
- The survey was conducted in a part of Vaniyambadi Town only. Hence the results from this study may (or) may not be applied to other areas.

Data Analysis:

Demographic details:

The following table shows the demographic distribution of respondents. The respondents have been categorised on the basis of their gender, age, marital status, educational qualifications, occupation, and family income.

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Table 1: Demographic Distribution of Respondents

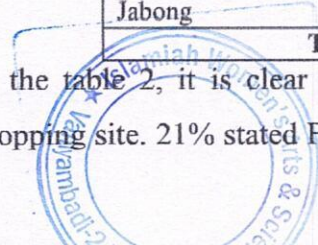
Demographic Details		Frequency	Percentage
Gender	Male	67	45
	Female	83	55
Total		150	100
Age	Below 20	35	23
	20-30	75	50
	30-40	37	25
	Above 40	03	02
Total		150	100
Marital Status	Married	62	41
	Unmarried	88	59
Total		150	100
Educational Qualification	Up to HSC	08	05
	UG	66	44
	PG	69	46
	Others	07	05
Total		150	100
Family Income	Below 10,000	28	19
	10,000 – 20,000	48	32
	20,000 – 30,000	34	23
	30,000 – 40,000	23	15
	Above 40,000	17	11
Total		150	100
Occupation	Salaried	66	44
	Business	22	15
	Self employed	18	12
	Students	44	29
Total		150	100

Preferable Online Shopping Site

Table 2: Preferable Online Shopping Site

Particulars	Frequency	Percentage
Flipkart	32	21
Snapdeal	28	19
Amazon	65	43
Shopclues	18	12
Jabong	07	05
Total	150	100

From the table 2, it is clear that 43% of respondents stated that Amazon is their preferable shopping site. 21% stated Flipkart. Only 5% of respondents prefer to shop through Jabong.



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Kind of Goods Purchased in Online Shopping:

Table 3: Kind of Goods Purchased in Online Shopping

Particulars	Frequency	Percentage
Books	22	14
Electronic Products (mobile, camera, computer)	55	37
Clothes	35	23
Music, Software	19	13
Food items	19	13
Total	150	100

The table 3 shows that more than one-third (37%) of respondents buy electronic items through online. 23% of respondents buy clothes, 15% of them buy books and equal

number of respondents buy music items, software and food items through online shopping.

Features of Online Shopping:

Table 4: Features of Online Shopping

Particulars	Frequency	Percentage	Rank
Design of website	11	07.33	V
Discount offered	35	23.33	II
Advertisements	24	16	IV
Variety	50	33.33	I
Value of money	30	20	III
Total	150	100	

The table 4 clears that variety is the main feature to go online shopping, hence it is ranked one. Followed by discount and value for money. Hence these are ranked two and three respectively. Advertisement and website design are the least concentrated features. Therefore these are ranked as four and five respectively.

various factors influencing online shopping and its mean values. Based on this ranks are assigned.

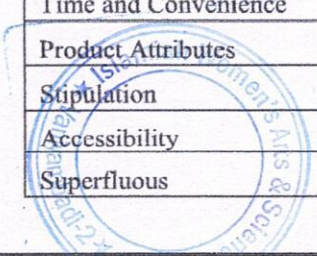
[Note: ranks are assigned based on mean values. Since, Likert's 5 point scale of strongly agree, agree, neutral, disagree and strongly disagree is assigned from 1-5 respondents, ranks are assigned from lowest mean values to highest.]

Factors Influencing Online Shopping:

The following table shows the

Table 5: Factors Influencing Online Shopping

Variables	Mean	Standard Deviation	Rank
Time and Convenience	1.87	0.99	I
Product Attributes	2.22	0.94	III
Stipulation	2.85	1.11	V
Accessibility	2.12	1.06	II
Superfluous	2.47	1.17	



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The mean score of time and convenience is found to be lower than the other factors. This indicates that time and convenience is the most influencing factor for shopping online. The mediocre factors are accessibility and product attributes. The least influencing factors are

superfluous and stipulation. The level of standard deviation is also upto acceptable limit.

The following table shows individual factors and its influencing variables.

1. Time and Convenience:

Table 6: Time and Convenience Factor Influencing Online Shopping

Variables	Mean	Standard Deviation
Variety of Brands available	1.79	0.97
Timely Delivery	2.13	1.07
Saves Time	1.71	0.97
Convenience to Shop	1.86	0.95
Privacy in Shopping	1.95	1.08
Easy to Shop	1.74	1.02
Product Information	1.94	0.95
Total	1.87	0.99

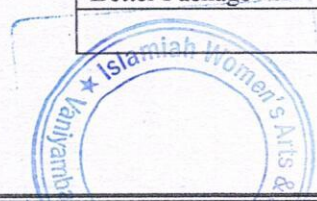
The mean value of time and convenience factor is 1.87. The variables in this factor are upto the average value. This indicates

that online shoppers are 'contentment and amenity seekers'. The main purpose of going online during lockdown is online shopping saves the time of consumers.

2. Product Attributes:

Table 7: Product Attributes Factor Influencing Online Shopping

Variables	Mean	Standard Deviation
Reasonable Price	2.06	0.76
Discounts & Offers	2.28	0.88
Review Options	2.52	1.03
Brand Images	2.13	0.87
Quality of Products	2.26	1.01
Product's Physical Appearance	2.29	0.97
Better Package	1.97	0.98
Total	2.22	0.94



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The mean value of product attributes is 2.22. The mean values of the variables in this factor are upto the overall mean. This shows that online shoppers are 'excellence

seekers' seeking quality and worth on their purchase. Consumers are highly influenced by the packaging system followed in online shopping.

3. Stipulation:

Table 8: Stipulation Factor Influencing Online Shopping

Variables	Mean	Standard Deviation
Customer Care Service	2.83	1.09
Easy Return Policy	3.12	1.15
Guarantee/ Warrantee	2.70	1.05
Insurance in Transit	3.14	1.13
Friends & Relatives Referral	2.44	0.99
Total	2.85	1.11

The mean value of stipulation factor is 2.85. The mean values of the variables in this factor are also in acceptable limit. This clears that online shoppers are 'value

seekers' looking for value added benefits from their shopping. Consumers prefer to shop online during lockdown by friends and relatives referral.

4. Accessibility:

Table 9: Accessibility Factor Influencing Online Shopping

Variables	Mean	Standard Deviation
Secured Payment	2.02	0.92
Any time Shopping (24x7)	1.74	0.96
Not available in Local Stores	2.30	1.17
Trust Worthiness	2.42	1.04
Total	2.12	1.06

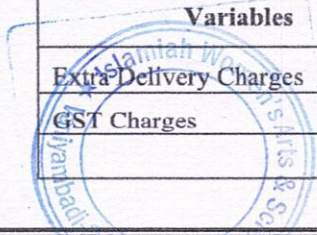
The mean value of this factor is 2.12. The mean values of all variables in this factor are upto the overall mean. This indicates

that online shoppers are 'reliable seekers' concentrating on security and trust worthy on their purchase during lockdown period.

5. Superfluous:

Table 10: Superfluous Factor Influencing Online Shopping

Variables	Mean	Standard Deviation
Extra Delivery Charges	2.43	1.22
GST Charges	2.50	1.12
Total	2.47	1.17



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The mean value of this factor is 2.47. The mean values of all variables are upto the overall mean value. This shows that online shoppers consider the amount of money spent on their purchase. Since, getting income is a difficulty during COVID 19 lockdown consumers think more to spend.

Findings:

- Nearly half (43%) of respondents prefer to shop online through Amazon shopping site.
- 37% of respondents buy electronic items through online shopping sites.
- Variety is the main feature to go online shopping.
- Time and convenience is the most influencing factor for shopping online.
- Time factor, easy to shop at global level, reasonable price, better package and any time shopping are the most influencing variables for preferring online shopping during lockdown period.

Suggestions:

- Since, safety is the main factor during COVID 19 lockdown online shopping sites should therefore continue to contribute meaningfully in this battle by bringing products that consumers need at their doorsteps in addition

to sustained, intense focus on ensuring safe supply chain to maximise resources on ground.

- Income is the limiting factor during lockdown, consequently spending may also be affected. Hence, online shopping sites may put forward offers and discounts on essential items to attract more consumers.

Conclusion:

The study was attempted to determine consumers' perception towards online shopping. It is concluded that consumers are more influenced by many factors regarding time and convenience, ease of accessibility and product attributes. This is really a good thing for business and has to be capitalized quickly as possible. Allowing e-commerce to fully resume operations is a proactive decision that the government has taken which helps consumers buying on non-essential goods that the merchants who suddenly stop their operations get back on track.

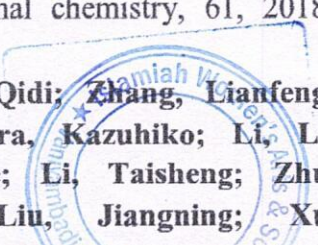
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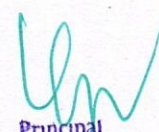
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