



Diagnosing Hyperthyroidism in Women Using the Concepts of Nano Topology

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ABSTRACT:

In this paper, we propose a novel diagnostic approach utilizing Nano topological space. Also, we examine the impact factors of hyperthyroidism in women through the concepts of Nanotopology

Keywords: Nano topological space, basis, attributes, lower approximation, upper approximation, boundary region, core.

1. Introduction:

Hyperthyroidism is known as overactive thyroid. It occurs when your thyroid gland makes and releases too much thyroid hormone. The thyroid gland is shaped like a butterfly. It is in the front of your neck, below your Adam's apple. The thyroid makes hormones that control your body's metabolism. The common causes for hyperthyroidism are

- Hyperfunctioning (overactive) thyroid nodules. One or more nodules or lumps in the thyroid grow. This increases the production of the thyroid hormone.
- It is also caused by Graves' disease, in which the immune system stimulates the thyroid, making it produce too much hormone.
- Consuming foods or medicines that contain high levels of iodine can also lead to hyperthyroidism.

The symptoms of the diseases are Heart palpitation, Weight loss, Brain fog, Swelling in neck, Hair loss, Menstrual cycle changes, Fatigue. L. Thivagar and Carmel Richard introduced the concept of Nano topological spaces with respect to a subset X of a universe U . The topology introduced here is named Nano topology because of its size, since it has at most 5 elements. In this paper we identify the impact factor of Hyperthyroidism in Women via Nano topology.

2. Preliminaries.

Definition: 2.1

Let U be a non-empty finite set of subject called the "universe" and \mathfrak{R} be an equivalence relation on U named as the indisceribility relation elements belonging to the same equivalence class are said to be indiscernible with one another. The pair (U, \mathfrak{R}) is said to be approximate space. Let $X \subseteq U$.

I. Lower approximation :

The lower approximation of X with respect to \mathfrak{R} is the set of all objects which can for certain classified as X with respect to \mathfrak{R} and it is denoted by $\underline{L}_{\mathfrak{R}}(X)$.

$$(i.e.) \underline{L}_{\mathfrak{R}}(X) = \bigcup_{x \in U} \{\mathfrak{R}(x) : \mathfrak{R}(x) \subseteq X\}$$

Where $\mathfrak{R}(x)$ denotes the equivalence class determined by x .

I. Upper approximation :

The upper approximation of X with respect to \mathfrak{R} is the set of all objects

which can be possibly classified as X with respect to \mathfrak{R} and it is denoted by $\overline{U}_{\mathfrak{R}}(X)$.

$$\overline{U}_{\mathfrak{R}}(X) = \bigcup_{x \in U} \{\mathfrak{R}(X) : \mathfrak{R}(X) \cap X \neq \emptyset\}$$

II. Boundary region :

The boundary region of X with respect to \mathfrak{R} is the set of all objects which can

classified neither as X nor as not X with respect to \mathfrak{R} and it is denoted by $B_{\mathfrak{R}}(X)$.

$$B_{\mathfrak{R}}(X) = \overline{U}_{\mathfrak{R}}(X) - \underline{L}_{\mathfrak{R}}(X)$$

IV. Nanotopology:

Let U be a non-empty, finite universe of objects and \mathfrak{R} be an equivalence

relation on U . Let $X \subseteq U$. Let $\tau_{\mathfrak{R}}(X) = \{U, \emptyset, \underline{L}_{\mathfrak{R}}(X), \overline{U}_{\mathfrak{R}}(X), B_{\mathfrak{R}}(X)\}$.

Then $\tau_{\mathfrak{R}}(X)$ is a topology on U , called as the Nano topology with respect to X .

Elements of the Nano topology are known as the Nano open sets in U and $(U, \tau_{\mathfrak{R}}(X))$ is called the Nano topological space.

Definition:2.2

Let U be a finite set and $X \subseteq U$ then the basis of Nano topology $\tau(X)$ is given by, $\beta_{\mathfrak{R}}(X) = \{U, \underline{L}_{\mathfrak{R}}(X), B_{\mathfrak{R}}(X)\}$.

3. Applications of Nano topology.

3.1 Algorithm:

Step:1 For a limited universe U , a limited set of attributes A which is partitioned in to two class S and D and an equivalence relation \mathfrak{R} on U corresponding to S .

Step: 2 Find the lower boundary, upper boundary and boundary region with respect to \mathfrak{R} .

Step: 3 Generate the Nano topology $\tau_S(X)$ and its basis $\beta_S(X)$.

Step: 4 Eliminate an attributes Y from S and determine lower boundary, upper boundary and boundary region for $S-Y$.

Step: 5 Generate the Nano topology $\tau_{S-Y}(X)$ and its basis $\beta_{S-Y}(X)$.

Step: 6 Repeat steps 4 and 5 for each attribute.

Step: 7 The CORE attributes are those for which $\beta_S(X) = \beta_{S-Y}(X)$.

Step: 8 Eliminate an attribute not CORE. Repeat steps 4 and 7 and determine the CORE in all the cases

Step: 9 The attributes in CORE are the risk factors that cause the disease.

INFORMATION TABLE

Women	Heart Palpitation	Weight Loss	Brain Fog	Swelling in Neck	Hair Loss	Menstrual cycle Changes	Fatigue	Decision
W_1	✓	✓	○	○	✓	✓	○	✓
W_2	✓	1.	2.	✓	○	✓	✓	✓
W_3	✓	✓	○	○	✓	✓	○	○
W_4	✓	○	✓	○	○	✓	○	✓
W_5	✓	○	✓	○	○	○	○	○
W_6	✓	✓	✓	✓	○	✓	✓	✓
W_7	✓	✓	○	○	✓	✓	○	○
W_8	✓	○	✓	○	○	✓	○	○
W_9	✓	○	✓	○	○	○	○	○
W_{10}	✓	✓	✓	✓	○	✓	✓	✓
W_{11}	○	✓	✓	○	✓	○	○	○
W_{12}	○	✓	○	○	✓	✓	○	○
W_{13}	✓	○	✓	○	○	○	○	○
W_{14}	○	✓	✓	○	✓	○	○	○
W_{15}	✓	○	○	✓	○	✓	✓	✓
W_{16}	✓	○	✓	○	○	✓	○	○
W_{17}	✓	✓	○	○	✓	✓	○	○
W_{18}	✓	✓	○	○	✓	✓	○	○
W_{19}	✓	✓	✓	✓	○	✓	✓	✓

W_{20}	✓	✓	✓	○	✓	○	○	○
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$$U = \bigcup_{i=1}^{20} W_i$$

Here U is the Women with the disease.

$U = \{W_1, W_2, W_3, W_4, W_5, W_6, W_7, W_8, W_9, W_{10}, W_{11}, W_{12}, W_{13}, W_{14}, W_{15}, W_{16}, W_{17}, W_{18}, W_{19}, W_{20}\}$ and $A = \{\text{Heart palpitation, Weight loss, Brain fog, Swelling in neck, Hair loss, Menstrual cycle Changes, Fatigue}\}$.

A is classified into two classes $S = \{\text{HP, WL, BF, SN, HL, MC, F}\}$ and $D = \{\text{Hyperthyroidism}\}$. The family of equivalence classes U/S corresponding to S is given by

$$U / \mathfrak{R}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

CASE I: WOMEN WITH HYPERTHYROIDISM

Here the set of Women with Hyperthyroidism is $X = \{W_1, W_2, W_4, W_{15}, W_6, W_{10}, W_{19}\}$.

Then,

$$\underline{L}_{\mathfrak{R}}(X) = \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \overline{U}_{\mathfrak{R}}(X) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\},$$

$$B_{\mathfrak{R}}(X) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}$$

Therefore the Nano topology is given by,

$$\tau_S(X) = \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\}$$

$$\beta_S(X) = \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\}$$

STEP I:

When the attribute ‘‘HP (Heart Palpitation)’’ is removed from S .

$$U / \mathfrak{R}_{(S-HP)}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}, W_{12}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\} \right\}$$

Then,

$$\underline{L}_{(S-HP)}(X) = \{W_2, W_{15}, W_6, W_{10}, W_{19}\}$$

$$\overline{U}_{(S-HP)}(X) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}, W_{12}\}$$

$$B_{(S-HP)}(X) = \{W_1, W_3, W_7, W_{18}, W_{12}, W_{17}, W_4, W_8, W_{16}\}$$

Then the Nano topology is given by,

$$\tau_{(S-HP)}(X) = \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}, W_{12}\}, \{W_1, W_3, W_7, W_{18}, W_{12}, W_{17}, W_4, W_8, W_{16}\} \right\}$$

$$\beta_{(S-HP)}(X) = \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{18}, W_{12}, W_{17}, W_4, W_8, W_{16}\}\}$$

Hence, $\tau_{(S-HP)}(X) \neq \tau_S(X)$ and $\beta_{(S-HP)}(X) \neq \beta_S(X)$.

STEP II:

When the attribute ‘‘WL (Weight Loss)’’ is removed from S .

$$U / \mathfrak{R}_{(S-WL)}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-WL)}(X) &= \{W_2, W_{15}, W_6, W_{10}, W_{19}\} \\ \overline{U}_{(S-WL)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\} \\ B_{(S-WL)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nan topology is given by,

$$\begin{aligned} \tau_{(S-WL)}(X) &= \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \\ \beta_{(S-WL)}(X) &= \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\} \end{aligned}$$

Hence, $\tau_{(S-WL)}(X) = \tau_S(X)$ and $\beta_{(S-WL)}(X) = \beta_S(X)$.

STEP III:

When the attribute “BF (Brain Fog)” is removed from S.

$$U / \mathfrak{R}_{(S-BF)}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-BF)}(X) &= \{W_2, W_{15}, W_6, W_{10}, W_{19}\} \\ U_{(S-BF)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\} \\ B_{(S-BF)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\begin{aligned} \tau_{(S-BF)}(X) &= \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \\ \beta_{(S-BF)}(X) &= \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\} \end{aligned}$$

Hence, $\tau_{(S-BF)}(X) = \tau_S(X)$ and $\beta_{(S-BF)}(X) = \beta_S(X)$.

STEP IV:

When the attribute “SN(Swelling in Neck)” is removed from S

$$U / \mathfrak{R}_{(S-SN)}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-SN)}(X) &= \{W_2, W_{15}, W_6, W_{10}, W_{19}\} \\ \overline{U}_{(S-SN)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\} \\ B_{(S-SN)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\tau_{(S-SN)}(X) = \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\}$$

$$\beta_{(S-SN)}(X) = \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\}$$

Hence, $\tau_{(S-SN)}(X) = \tau_S(X)$ and $\beta_{(S-SN)}(X) = \beta_S(X)$.

STEP V:

When the attribute “HL (Hair Loss)” is removed from S.

$$U / \mathfrak{R}_{(S-HL)}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\underline{L}_{(S-HL)}(X) = \{W_2, W_{15}, W_6, W_{10}, W_{19}\}$$

$$\overline{U}_{(S-HL)}(X) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\}$$

$$B_{(S-HL)}(X) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}$$

Then the Nano topology is given by,

$$\tau_{(S-HL)}(X) = \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\}$$

$$\beta_{(S-HL)}(X) = \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\}$$

Hence, $\tau_{(S-HL)}(X) = \tau_S(X)$ and $\beta_{(S-HL)}(X) = \beta_S(X)$.

STEP VI:

When the attribute “MC (Menstrual cycle Changes)” is removed from S.

$$U / \mathfrak{R}_{(S-MC)}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}, W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\underline{L}_{(S-MC)}(X) = \{W_2, W_{15}, W_6, W_{10}, W_{19}\}$$

$$\overline{U}_{(S-MC)}(X) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\}$$

$$B_{(S-MC)}(X) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\}$$

Then the Nano topology is given by,

$$\tau_{(S-MC)}(X) = \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\} \right\}$$

$$\beta_{(S-MC)}(X) = \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\}\}$$

Hence, $\tau_{(S-MC)}(X) \neq \tau_S(X)$ and $\beta_{(S-MC)}(X) \neq \beta_S(X)$.

STEP VII:

When the attribute “F (Fatigue)” is removed from S.

$$U / \mathfrak{R}_{(S-F)}(X) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-F)}(X) &= \{W_2, W_{15}, W_6, W_{10}, W_{19}\} \\ \overline{U}_{(S-F)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\} \\ B_{(S-F)}(X) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\begin{aligned} \tau_{(S-F)}(X) &= \left\{ \phi, U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_2, W_{15}, W_6, W_{10}, W_{19}, W_4, W_8, W_{16}\}, \right. \\ &\quad \left. \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \\ \beta_{(S-F)}(X) &= \{U, \{W_2, W_{15}, W_6, W_{10}, W_{19}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\} \\ \text{Hence, } \tau_{(S-F)}(X) &= \tau_S(X) \text{ and } \beta_{(S-F)}(X) = \beta_S(X). \end{aligned}$$

Therefore,

CORE (A) = {Heart Palpitation , Menstrual cycle Changes}

CASE II: WOMEN WITHOUT HYPERTHYROIDISM

The family of equivalence classes U/S corresponding to S is given by

$$\begin{aligned} U / \mathfrak{R}(Y) &= \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \right. \\ &\quad \left. \{W_{12}\} \right\} \\ \text{Assume the set of Women without Hyperthyroidism is } Y &= \{W_3, W_7, W_5, W_9, W_{13}\}. \end{aligned}$$

Then,

$$\begin{aligned} \underline{L}_{\mathfrak{R}}(Y) &= \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ \overline{U}_{\mathfrak{R}}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ B_{\mathfrak{R}}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\begin{aligned} \tau_S(Y) &= \left\{ U, \phi, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \right. \\ &\quad \left. \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \\ \beta_S(Y) &= \{U, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\} \end{aligned}$$

STEP I:

When the attribute ‘‘HP (Heart Palpitation)’’ is removed from S.

$$U / \mathfrak{R}_{(S-HP)}(Y) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}, W_{12}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \right. \\ \left. \{W_{11}, W_{14}, W_{20}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-HP)}(Y) &= \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}\} \\ \overline{U}_{(S-HP)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ B_{[S-HP]}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_{12}\} \end{aligned}$$

Then the Nano topology is given by,

$$\begin{aligned} \tau_{(S-HP)}(Y) &= \left\{ U, \phi, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \right. \\ &\quad \left. \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_{12}\} \right\} \\ \beta_{(S-HP)}(Y) &= \{U, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_{12}\}\} \end{aligned}$$

Hence, $\tau_{(S-HP)}(Y) \neq \tau_S(Y)$ and $\beta_{(S-HP)}(Y) \neq \beta_S(Y)$.

STEP II:

When the attribute “WL (Weight Loss)” is removed from S.

$$U / \mathfrak{R}_{(S-WL)}(Y) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-WL)}(Y) &= \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ \overline{U}_{(S-WL)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ B_{(S-WL)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\begin{aligned} \tau_{(S-WL)}(Y) &= \left\{ U, \phi, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \\ \beta_{(S-WL)}(Y) &= \{U, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\} \end{aligned}$$

Hence, $\tau_{(S-WL)}(Y) = \tau_S(Y)$ and $\beta_{(S-WL)}(Y) = \beta_S(Y)$.

STEP III:

When the attribute “BF (Brain Fog)” is removed from S.

$$U / \mathfrak{R}_{(S-BF)}(Y) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-BF)}(Y) &= \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ \overline{U}_{(S-BF)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ B_{(S-BF)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\begin{aligned} \tau_{(S-BF)}(Y) &= \left\{ U, \phi, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \\ \beta_{(S-BF)}(Y) &= \{U, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\} \end{aligned}$$

Hence, $\tau_{(S-BF)}(Y) = \tau_S(Y)$ and $\beta_{(S-BF)}(Y) = \beta_S(Y)$.

STEP IV:

When the attribute “SN (Swelling in Neck)” is removed from S.

$$U / \mathfrak{R}_{(S-SN)}(Y) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-SN)}(Y) &= \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ \overline{U}_{(S-SN)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ B_{(S-SN)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\tau_{(S-SN)}(Y) = \left\{ U, \phi, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\}$$

$$\beta_{(S-SN)}(Y) = \{U, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\}$$

Hence, $\tau_{(S-SN)}(Y) = \tau_S(Y)$ and $\beta_{(S-SN)}(Y) = \beta_S(Y)$.

STEP V:

When the attribute “HL (Hair Loss)” is removed from S.

$$U / \mathfrak{R}_{(S-HL)}(Y) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\underline{L}_{(S-HL)}(Y) = \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}$$

$$\overline{U}_{(S-HL)}(Y) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}$$

$$B_{(S-HL)}(Y) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}$$

Then the Nano topology is given by,

$$\tau_{(S-HL)}(Y) = \left\{ U, \phi, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\}$$

$$\beta_{(S-HL)}(Y) = \{U, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\}\}$$

Hence, $\tau_{(S-HL)}(Y) = \tau_S(Y)$ and $\beta_{(S-HL)}(Y) = \beta_S(Y)$.

STEP VI:

When the attribute “MC (Menstrual cycle Changes)” is removed from S.

$$U / \mathfrak{R}_{(S-MC)}(Y) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}, W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\underline{L}_{(S-MC)}(Y) = \{W_{11}, W_{14}, W_{20}, W_{12}\}$$

$$\overline{U}_{(S-MC)}(Y) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}$$

$$B_{(S-MC)}(Y) = \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\}$$

Then the Nano topology is given by,

$$\tau_{(S-MC)}(Y) = \left\{ U, \phi, \{W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\} \right\}$$

$$\beta_{(S-MC)}(Y) = \{U, \{W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}\}\}$$

Hence, $\tau_{(S-MC)}(Y) \neq \tau_S(Y)$ and $\beta_{(S-MC)}(Y) \neq \beta_S(Y)$.

STEP VII:

When the attribute “F (Fatigue)” is removed from S.

$$U / \mathfrak{R}_{(S-F)}(Y) = \left\{ \{W_1, W_3, W_7, W_{17}, W_{18}\}, \{W_2, W_{15}\}, \{W_4, W_8, W_{16}\}, \{W_5, W_9, W_{13}\}, \{W_6, W_{10}, W_{19}\}, \{W_{11}, W_{14}, W_{20}\}, \{W_{12}\} \right\}$$

Then,

$$\begin{aligned} \underline{L}_{(S-F)}(Y) &= \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ \overline{U}_{(S-F)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\} \\ \mathcal{B}_{(S-F)}(Y) &= \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \end{aligned}$$

Then the Nano topology is given by,

$$\begin{aligned} \tau_{(S-F)}(Y) &= \left\{ U, \phi, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}, W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \right. \\ &\quad \left. \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \\ \beta_{(S-F)}(Y) &= \left\{ U, \{W_5, W_9, W_{13}, W_{11}, W_{14}, W_{20}, W_{12}\}, \{W_1, W_3, W_7, W_{17}, W_{18}, W_4, W_8, W_{16}\} \right\} \end{aligned}$$

Hence, $\tau_{(S-F)}(Y) = \tau_S(Y)$ and $\beta_{(S-F)}(X) = \beta_S(X)$.

Therefore,

$$\text{CORE}(A) = \{\text{Heart Palpitation, Menstrual cycle changes}\}$$

4. Conclusion:

We conclude that, "Heart Palpitation ,Menstrual cycle Changes", are the most impact factors for "HYPERTHYROIDISM IN WOMEN". Also, The Concepts of Nano topology can be applied in various fields namely, Medical field, Academic related field, Marketing fields, Business sectors and so on.

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