Applied Mathematics and Computational Intelligence
Volume 11, No.1, Dec 2022 [73-87]

Application of Mahalanobis-Taguchi System in the Down-Up Case of Methadone Flexi Dispensing Program

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Received: 4 December 2021; Accepted: 21 January 2022; Available online (in press): 25 February 2022

ABSTRACT

Patients under methadone flexi dispensing (MFlex) program are required to do methadone dosages trends for down-up case since no parameters were employed to identify the patient who has potential rate of recovery. So that, the existing system need further enhancement towards classification and optimization. The objective is to determine the Mahalanobis distance (MD), evaluate the degree of contribution, and diagnose the unknown data in the MFlex program using Mahalanobis-Taguchi system (MTS). The data is obtained at the Bandar Pekan clinic that includes 16 parameters. Two types of MTS methods are used for classification and optimization using RT-Method and T-Method respectively. As a result, the RT-Method is able to classify between healthy and unhealthy samples, while the T-Method is able to evaluate the significant parameters in terms of degree of contribution. 4 unknown samples have been diagnosed with different number of positive and negative degree of contribution to achieve lower MD. The best-proposed solution is type 3 of 4 modifications because it shows the lowest MD value than others. In conclusion, a Bandar Pekan clinic pharmacist confirmed that MTS can solve a classification and optimization problems in the MFlex program.

Keywords: Mahalanobis-Taguchi system, methadone flexi dispensing program, RT method, T method

1 INTRODUCTION

In the United States, 49 860 people died from opioid overdoses in 2019 [1]. Serious and frequently fatal diseases are more common among drug users, especially those who inject drugs, and many of them have HIV or Hepatitis C [2]. Drug addiction is a complicated subject that has been a major public health concern in Malaysia. Until 2008, the total number of registered drug users was projected to be 250 000, with a half-million predicted by 2015 [3]. Patients under MFlex program are required to do methadone dosages trends for down-up case involving 16 parameters to determine whether the patient has better recovery process or vice versa. To identify patient with the potential rate to recover, no specific parameters have been used. This proves that the existing system does not have an accurate method of measurement and lack of justification on the recovery rate. The objective of this research work is to determine the value of MD, evaluate the degree of contribution, and to diagnose the unknown data of the MFlex program. Literature review describes related studies on MTS, where the research gap is the most significant. Research methodology explains the methods and strategies used to meet the objective of the research. Results and discussions elaborate all the evidence that has been possessed during data collection using the MTS method for classification and optimization. Lastly, the conclusion concludes the final findings after the measurements have been handled and provides some recommendations for the subsequent work.

2 LITERATURE REVIEW

In 2018, an estimated 0.3% of the world population injected drugs, and improper injection can transmit blood-borne illnesses like HIV and hepatitis C [1]. Their medical burdens are accompanied by large financial consequences, such as health-care and legislation costs, productivity losses, as well as other related costs, such as harm to everyone else [4]. In October 2005, the Malaysian government launched the MFlex program, which is one of the components of harm reduction, as part of the country's attempts to combat HIV/AIDS among injecting drug users while also addressing the problem of opiate addiction, particularly heroin [5].

MTS by Genichi Taguchi is the implementation of the Taguchi Methods are multivariate principles that aid quantitative strategic planning by establishing a multivariate scale of measurements through a data-analytical process [6]. In MTS, by computing uniform variables of normal or healthy data, Mahalanobis space (MS) is created. The MS has the potential to differentiate between healthy and unhealthy items. When the MS is defined, the set of features is decreased by measuring the input of each attribute using an orthogonal array (OA) and the signal-to-noise ratio (SNR) [7]. P.C. Mahalanobis presented the MD for the first time in 1936 as an effective tool for determining the similarity between known and unknown data set. The distance between the MD and the Euclidian distance (ED) has significant changes, as shown in Figure 1 [8]. Observation is divided into a category from the middle of which the distance is the least. ED also indicates the distance between the "unknown" point and the group mean point, and the limitation of the technique is ED does not have a mathematical calculation of how closely the unknown fits the reference range [9].

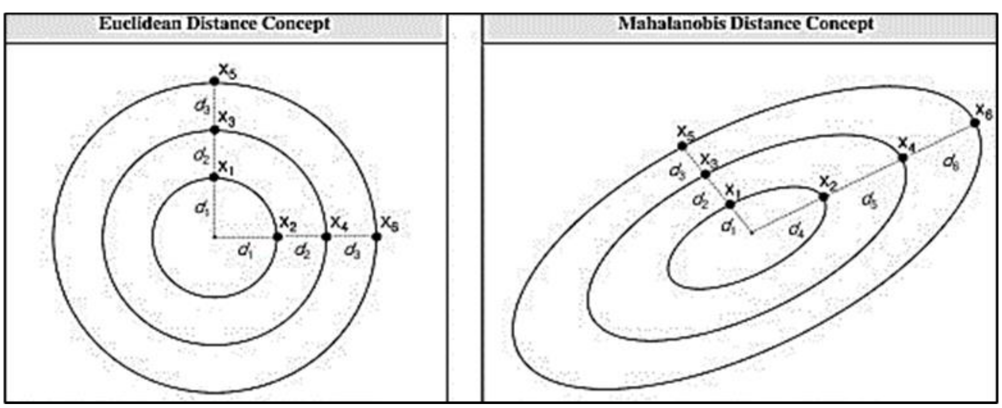

Figure 1: Comparison between MD and ED

The MTS is able to classify normal and abnormal findings and optimize different criteria for the development of a higher-performing product at the workstation [11], it can define critical and non-critical variables [12], and it is used to create a continuous scale of measurement and to calculate the abnormality degree [13]. In contrast, MTS has a poorer statistical base relative to the classic multivariate processes [13], it can decide imperative features, but employments the difficult threshold to choose the attributes [14], and it lacks a strategy for evaluating an appropriate binary classification threshold [15]. According to [16], the research of MTS is qualified into 7 categories which are, introduction to the method, comparison with other methods, case of study/application, integration and development with other methods, construction of MS, threshold establishment, and dimensional reduction. This work is used these categories to summarize the research gap of the published work from the year 2011 to 2020. In comparison with other methods, the enhanced model is contrasted with the standard model based on the outdated MTS [17]. MTS decode the purpose of the subject for the benefit from the online classification [18]. The MTS and Component Search (CS) comparison can quickly solve product parameter selection issues [19].

To discriminate between two separate ranges within the remanufacturability process spectrum, [20] used MTS on the big-end diameter of connecting rods. [21] analysed the data on the main journal diameter of the crankshaft in a systematic manner. [22] offered systematic pattern identification using MTS by creating a scatter diagram that might facilitate decision making in a specific industry on 14 main journals of crankshaft belonging to 7 engine models with various amounts of samples. [23] categorised the end of life of crankshafts into recovery operations using the MTS. Based on the MTS, [24] generated a distinct pattern of crankshaft and identified the important and unimportant parameters of crankshaft, then used Activity Based Costing (ABC) as a technique of prediction for the crankshaft remanufacturing cost. [25] used MTS to determine the important and unimportant variables during the remanufacturing process, and the ABC approach to estimate the cost. On the basis of Taguchi's orthogonal array, [12] assessed the criticality of parameters on the end-of-life crankshaft. Then, by examining the important characteristics, estimate the cost using classic cost accounting. [26] used MTS to assess the degree of anomaly and evaluate the system's influencing factors. In the electric and electronic industries, [27] proposed MTS and Time-Driven Activity-Based Costing (TDABC) to assess critical parameters and generate time equation and capacity cost rate, respectively. Using MTS, [28] discovered 4 insignificant and 11 significant factors in the visual mechanical inspection workstation. After removing unimportant variables using MTS, [11] discovered that positive gain through SNR shows that the performance of the system is still good from February with 0.1244 to December with 0.4432. According to [29], MTS is a useful tool for classification and optimization in the sector. [30] concluded that MTS and TDABC are excellent tools that can be used in the electronics business. [31] developed MTS based graphical user interface for analyzing and classifying the normal and abnormal patient under MFlex service for better monitoring system. [32] concluded none of the four thresholding strategies beat the others in most datasets (if not all). [33] demonstrated how Taguchi’s T-Method methodology might be improved by using Bitwise Artificial Bee Colony (BitABC) methodologies.

3 RESEARCH METHODOLOGY

This research work focused on MFlex program under Ministry of Health Malaysia in the methadone dosages. The 16 parameters of methadone dosages are created into four types of cases which are ascending, descending, up-down, and down-up cases. Thus, the classification of data and optimization of parameters can be analyzed between those types. To classify whether the patient tend to be healthy or require attention to restore the level of addiction, the methadone dosages contain 16 parameters where it is taken for four years start from 2017 until 2020. Each year are divided into four classes of methadone dosages. Table 1 shows the parameters of methadone dosages with reference range for each class.

Table 1 : Parameters in methadone dosages

Parameters	Dosage duration	Unit	Reference range
1	Jan-Mar 2017	mg	(160-151)
2	Apr-Jun 2017	mg	(150-141)
3	Jul-Sep 2017	mg	(140-131)
4	Oct-Dec 2017	mg	(130-121)
5	Jan-Mar 2018	mg	(120-111)
6	Apr-Jun 2018	mg	(110-101)
7	Jul-Sep 2018	mg	(100-91)
8	Oct-Dec 2018	mg	(90-81)
9	Jan-Mar 2019	mg	(80-71)
10	Apr-Jun 2019	mg	(70-61)
11	Jul-Sep 2019	mg	(60-51)
12	Oct-Dec 2019	mg	(50-41)
13	Jan-Mar 2020	mg	(40-31)
14	Apr-Jun 2020	mg	(30-21)
15	Jul-Sep 2020	mg	(20-11)
16	Oct-Dec 2020	mg	(10-1)

The RT-Method could classify items into two categories which are within and outside the unit space. Unit data was chosen on the basis of the largest number of samples, among other samples. The RT-Method measured value of the output, but the category is clear when more than one unit spaces exist. The average value for each parameter is calculated as shown in equation (1), from n number of samples in healthy group.

$$\bar{x}_j = \frac{1}{n}\left(x_{1j} + x_{2j} + \cdots + x_{nj}\right) \;\; (j = 1, 2, \ldots k) \tag{1}$$

The sensitivity β, the linear formula L, and the effective divider r, are shown in equation (2), equation (3), and equation (4) respectively.

$$\text{Sensitivity}, \beta_1 = \frac{L_1}{r} \tag{2}$$

$$\text{Linear equation}, L_1 = \bar{x}_1 x_{11} + \bar{x}_2 x_{12} + \cdots + \bar{x}_k x_{1k} \tag{3}$$

$$\text{Effective divider}, r = \bar{x}_1^2 + \bar{x}_2^2 + \cdots + \bar{x}_k^2 \tag{4}$$

The total variations S_T, variation of proportional term S_β, error variation S_e, and error variance V_e, are shown in equation (5), equation (6), equation (7), and equation (8) respectively.

$$\text{Total variation}, S_{T1} = x_{11}^2 + x_{12}^2 + \cdots + x_{1k}^2 \tag{5}$$

$$\text{Variation of proportional term}, S_{\beta 1} = \frac{L_1^2}{r} \tag{6}$$

Error variation, $S_{e1} = S_{T1} - S_{\beta 1}$ (7)

Error variance, $V_{e1} = \frac{S_{e1}}{k-1}$ (8)

The standard SN ratio η is then calculated as stated in the equation (9). The greater the value of η, the stronger the relationship between the input and output.

SN ratio, $\eta_1 = \frac{1}{V_{e1}}$ (9)

The sensitivity β, and the standard SN ratio η, are then calculated in the healthy group, and the two variables Y_1 and Y_2 are calculated to generate a scatter diagram. The equation (10) and equation (11) show the value of Y_1 and Y_2 respectively.

$$Y_{i1} = \beta_i \quad (10)$$

$$Y_{i2} = \frac{1}{\sqrt{\eta_i}} = \sqrt{V_{ei}} \quad (11)$$

The prediction of origin is referred to the calculation of average for Y_1 and Y_2 in equation (12) and equation (13) respectively.

$$\bar{Y}_1 = \frac{1}{n}(Y_{11} + Y_{21} + \cdots + Y_{n1}) \quad (12)$$

$$\bar{Y}_2 = \frac{1}{n}(Y_{12} + Y_{22} + \cdots + Y_{n2}) \quad (13)$$

Finally, MD is calculated through equation 14.

Mahalanobis distance, $D^2 = \frac{YA^{-1}Y^T}{k}$ (14)

The methadone patients who are under monitoring was classified as unhealthy group. To calculate unhealthy group, the similar equation as healthy group is repeated, but the different between two groups is in normalization of unhealthy group. The linear equation *L'*, and the effective divider *r'*, are calculated as the same equation in healthy group which are equation (3) and equation (4) respectively. Note that the average values of samples and parameters $\bar{x}$, and the effective divider *r'*, are the same values of the healthy group. Next, the value sensitivity β, for each unhealthy group can be calculated as stated in the equation (2).

After that, the total variations S_T, variation of proportional term S_β, error variation S_e, and error variance V_e, are calculated through equation (5), equation (6), equation (7), and equation (8) respectively. The value of sensitivity β, and the standard SN ratio η, from unhealthy group are used for the calculation of variables Y_1 and Y_2 as well. The value of sensitivity β is used for Y_1 as stated in equation (10), meanwhile the variable Y_2 is converted first as stated in the equation (11) for allowing the evaluation of any scattering from the normal conditions. The average value for Y_1 and Y_2 are same as shown in the equation (12) and equation (13) respectively for the prediction of healthy group origin. Lastly, the MD value can be found based on the equation (14).

The T-Method is utilized as evaluation to the parameters towards the output. The highest sample will be defined as a healthy group while remaining number of samples will be defined as unhealthy group. The average values for every parameter and the output average value from the number of samples in the healthy group are found as shown in equation (15) and equation (16) respectively.

$$\bar{x}_j = \frac{1}{n}\left(x_{1j} + x_{2j} + \cdots + x_{nj}\right) \tag{15}$$

$$\bar{y} = m_0 = \frac{1}{n}\left(y_1 + y_2 + \cdots + y_n\right) \tag{16}$$

The balance samples that belong to healthy group are defined as unhealthy group. After that, the unhealthy group has been normalized using the average value of every parameter and output that belong to healthy group. The goal of normalisation is to remove redundancy from data to make it more adaptable. The calculation of normalized data for input and output are shown in the equation (17) and equation (18) respectively.

$$X_{ij} = \acute{x}_{ij} - \bar{x}_j \tag{17}$$

$$M_i = \acute{y}_i - m_0 \tag{18}$$

Proportional coefficient β and SN ratio η for each parameter are calculated as shown in equation (19), equation (20), equation (21), equation (22), equation (23), equation (24), and equation (25).

$$\text{Effective divider}, r = M_1^2 + M_2^2 + \cdots + M_l^2 \tag{19}$$

$$\text{Total variation}, S_{T1} = X_{11}^2 + X_{21}^2 + \cdots X_{l1}^2 \tag{20}$$

$$\text{Variation of proportional term}, S_{\beta 1} = \frac{(M_1X_{11} + M_2X_{21} + \cdots + M_lX_{l1})^2}{r} \tag{21}$$

$$\text{Error variation}, S_{e1} = S_{T1} - S_{\beta 1} \tag{22}$$

$$\text{Error variance}, V_{e1} = \frac{S_{e1}}{l-1} \tag{23}$$

$$\text{Proportional Coefficint}, \beta_1 = \frac{M_1X_{11} + M_2X_{21} + \cdots + M_lX_{l1}}{r} \tag{24}$$

$$\text{SN ratio}, \eta_1 = \begin{cases} \frac{\frac{1}{r}(S_{\beta 1} - V_{el})}{V_{el}} \\ 0 \end{cases} \left(when\ S_{\beta 1} > V_{el}\right)\left(when\ S_{\beta 1} \leq V_{el}\right) \tag{25}$$

A positive value of β means that the steepness is ascending to the right, while a negative value of β means that the steepness is descending to the right. The value of η should be in positive value, but if it turns out to be in negative value, it will be considered zero which means there is no longer a significant relationship between input and output.

The integrated estimate value of unhealthy group is computed by using the proportional coefficient β and SN ratio η for each parameter. The calculation of integrated estimate value is shown in equation (26). Note that, x_{j1}, x_{j2}, …, x_{j6} are the normalized value of each parameter.

Integrated estimate value, $\widehat{M}_i = \frac{\eta_1 \times \frac{X_{i1}}{\beta_1} + \eta_2 \times \frac{X_{i2}}{\beta_2} + \ldots + \eta_k \times \frac{X_{i6}}{\beta_6}}{\eta_1 + \eta_2 + \cdots + \eta_6}$ (26)

The step by step for calculating estimated SN ratio η are using the following equation (27), equation (28), equation (29), equation (30), equation (31), equation (32), and equation (33). In fact, the estimated SN ratio η is based on the suitability of OA.

Linear equation, $L = M_1\widehat{M}_1 + M_2\widehat{M}_2 + \cdots + M_l\widehat{M}_l$ (27)

Effective divider, $r = M_1^2 + M_2^2 + \cdots + M_l^2$ (28)

Total variation, $S_T = \widehat{M}_1^2 + \widehat{M}_2^2 + \cdots + \widehat{M}_l^2$ (29)

Variation of proportional term, $S_\beta = \frac{L^2}{r}$ (30)

Error variation, $S_e = S_T - S_\beta$ (31)

Error variance, $V_e = \frac{S_e}{l-1}$ (32)

Estimated SN ratio, $\eta = 10 \log \left[\frac{\frac{1}{r}(S_\beta - V_e)}{V_e} \right]$ (33)

The relative relevance of a parameter is determined by how much the estimated SN ratio degrades when the parameter is not employed. Two-level OA which is level 1 and level 2 is used for an evaluation. The use of OA enables measurements to be made of the estimated SN ratio under various conditions. The two-level of OA means that level 1 is parameter will be used and level 2 is parameter will not be used. With respect to the estimated SN ratio, the difference between the averages of SN ratio for level 1 and level 2 for each parameter and on that basis determine the relative importance of the parameters. The degree of contribution is positive when the parameter is utilised with bigger SN ratios and negative when the parameter is not used with smaller SN ratios. Otherwise, the degree of contribution becomes negative when the parameter is utilised with lower SN ratios and positive when the parameter is not used with higher SN ratios.

4 RESULTS AND DISCUSSION

The scatter diagram of the methadone dosages between healthy groups and unhealthy groups are created. The samples of healthy and unhealthy groups are computed into two variables of Y_1 and Y_2. The horizontal line represents Y_1 and vertical line represents Y_2. The healthy group (blue dotted) has 50 samples while the unhealthy group (orange dotted) has 7 samples. The scatter diagrams consist of 16 parameters which have four years start from 2017 until 2020 with 4 classes of months for each of the year. Figure 2 shows a scatter diagram of down-up case between healthy and unhealthy samples. Both samples are not overlapped with each other because the different range of MD values and form an aggregation of their own. The maximum value of MD for healthy is 5.7535 and the minimum value of MD for healthy is 0.0212. Meanwhile, the maximum value of MD for unhealthy is

4562.4958 and the minimum value of MD is 2183.8824. It is clear that both samples are not identical because the average value of MD for healthy and unhealthy are 1.0000 and 3363.5596 respectively.

The correlation coefficient r value for unhealthy samples (orange dotted) and healthy samples (blue dotted) are -0.2519 and -0.2901 respectively. It shows that both data are technically a negative correlation and the relationship between Y_1 and Y_2 variables is only weak.

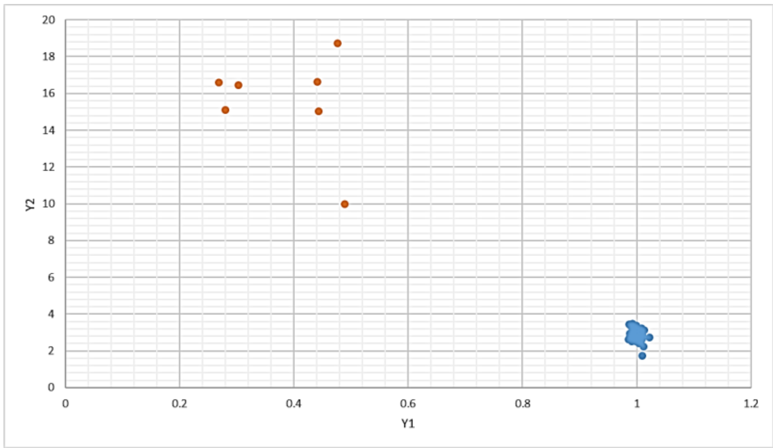

Figure 2: Scatter diagram of down-up case between healthy and unhealthy

In the down-up case of methadone dosages, the number of healthy and unhealthy samples are 5 and 52 respectively with 16 parameters. The data is organized in the ascending order of output value, as shown in Figure 3. Sample number 4 turns out to be the smallest with 0.021 while sample number 57 turns out to be the largest with 4562.496. This means sample number 49, 6, 1, 30, and 16 are set to be the center point in blue and red dotted.

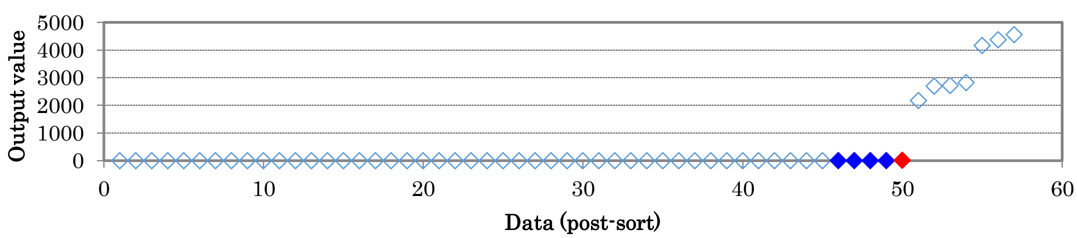

Figure 3: Data (post-sort) for down-up case in methadone dosages

The relationship between parameters and their output values is shown in Figure 4. The x-axis represents the normalized output values and the y-axis represents the normalized parameters values. To determine which of the parameters would be useful for evaluation, parameter by parameter computation of the proportional coefficient β and SN ratio ŋ were carried out. The T-Method calculates SN ratios ŋ and proportional coefficients β based on the relationship between the normalized output value and the normalized parameter value. According to [34], the greater the SN ratios ŋ produces a stronger relationship or in the other words the distribution is closer to a blue line. Since Figure 4 (i), Figure 4 (ii), and Figure 4 (iii) which represents the parameter 1, 2, and 3 has

4x10-5 SN ratio ŋ, so the distribution is approaching to the blue line whereas Figure 4 (xiii) which represent the parameter 13 has 1x10-7 SN ratio ŋ, so the distribution is far away from a blue line.

Furthermore, [34] also stated that ascending the line from left to the right indicates the parameter has a positive value of proportional coefficients β whereas the descending the line indicates the parameter has a negative value of proportional coefficients β. This has been proven through Figure 4 (i) until Figure 4 (xiii) have negative value of proportional coefficient β. As a result, those parameters are well suited to the purpose of calculating integrated estimate value. This study would derive the value of integrated estimate value by using those proportional coefficient β and SN ratios ŋ values. Therefore, the higher the SN ratios ŋ, the greater the degree to which it contributes to the integrated estimates of MD value which is closer to the actual normalized MD value. Since none of those parameters has a negative SN ratio ŋ value, subsequently all those parameters are considered in integrated estimate value.

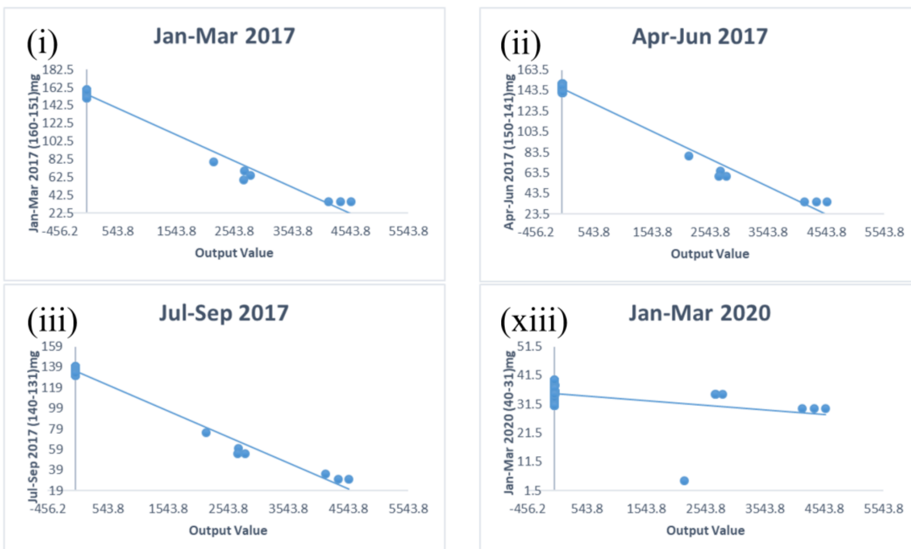

Figure 4: Scatter of normalized output and parameter values of down-up case

Nevertheless, some of those parameters are useful for integrated estimation, while others are not. Hence, parameters assessment is performed by utilizing L_{20} of OA with level 1 indicates the parameter will be utilized and level 2 indicates the parameter will not be utilized. The value -43.43 db of integrated estimate SN ratio ŋ refers to the first run in L_{20}. Subsequently, the degree of contribution is translated into a bar graph as shown in Figure 5. From that, it shows how the parameters are significant to the output. When the parameter 2 has been used (level 1) with a greater relationship (SN ratio = -43.48 db) to the output and when the parameter has not been used (level 2) with a smaller relationship (SN ratio = -44.66 db) to the output, the parameter would obtain a higher degree of contribution (1.18 db) which is a positive contribution to the output. On the other hand, when the parameter 10 has been used (level 1) with a smaller relationship (SN ratio = -44.41 db) to the output and when the parameter has not been used (level 2) with a greater relationship (SN ratio = -43.73 db) to the output, the parameter would obtain a lower degree of contribution (-0.68 db) which is a negative contribution to the output.

Positive degree of contribution means that the use of parameter produces the effect of elevating the output of MD whereas negative degree of contribution means that the use of parameter produces the effect of lowering the output of MD. Consequently, parameter 1, 2, 3, 4, 5, 6, 13, and 14 are positive degree of contribution whereas parameter 7, 8, 9, 10, 11, 12, 15, and 16 are negative degree of contribution. This research work is suggested that in order to obtain lower MD, positive degree of contribution should be increased while negative degree of contribution should be maintained.

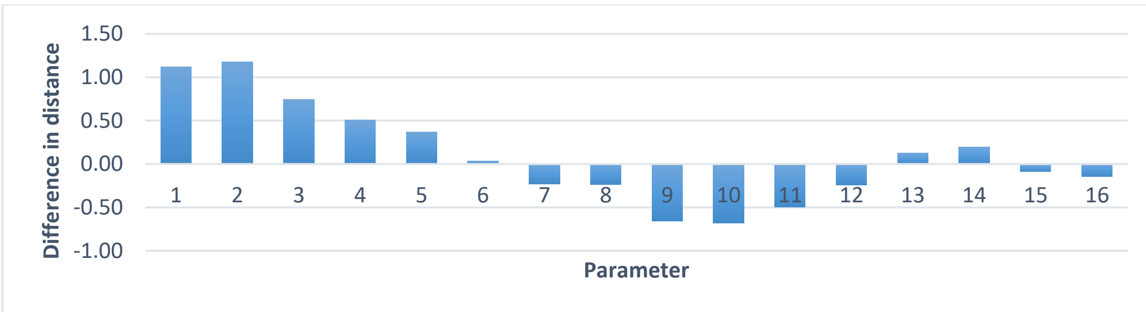

Figure 5: Degree of contribution of down-up case

The purpose of diagnosis of unknown data is to measure the MD and evaluate their parameters for each sample. The normalization is performed by subtracting from the average value of the parameters in the healthy group. The results of estimated value Mˆ or MD for unknown data are calculated through the equation (26) and subsequently, can be seen in Table 2.

Table 2: The estimated value Mˆ (MD) for unknown data in down-up case

No. of sample	Estimated value $M^{\wedge}$ (MD)
1	28.1092
2	66.2220
3	2916.7364
4	3607.2129
5	1936.9637
6	1111.1392

Figure 6 shows the degree of contribution in the first sample of unknown data in down-up case. Consequently, parameter 4, 5, 8, 9, 10, 11, and 15 are positive degree of contribution whereas parameter 1, 2, 3, 6, 7, 12, 13, 14, and 16 are negative degree of contribution. This research work is suggested that in order to obtain lower MD, positive degree of contribution should be increased while negative degree of contribution should be maintained.

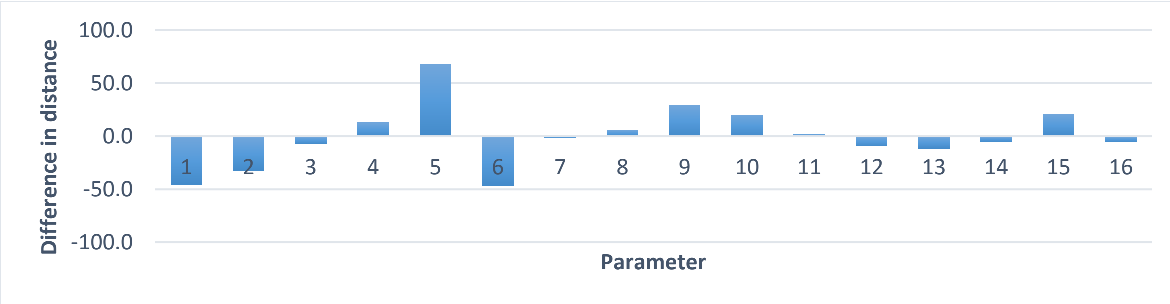

Figure 6: Degree of contribution in first sample of unknown data in down-up case

There are two types of degree of contribution. First is the positive degree of contribution indicating that the use of this parameter produces the effect of elevating the output. Second is the negative degree of contribution indicates that the use of this parameter produces the effect of lowering the output. The purpose of this section is to prove that the propose solution to the Bandar Pekan clinic which is lowering degree of contribution is the best solution. Thus, this research work has selected methadone dosages (down-up case) sample 1 as a subject matter as shown in Figure 6. The original output for sample 1 down-up case is 28.11 as shown in Table 3. The value is compared with 4 types of modification.

Table 3: Comparison between original and types of modification

Original	MD	Modification	MD
1	28.11	Type 1	44.43
		Type 2	11.79
		Type 3	3.22
		Type 4	69.32

The MD value for type 1 is 44.43 which is higher than the original sample. This modification means the higher positive degree of contribution is added with two points (parameter 5 and 9) while lower positive degree of contribution is added with one point (parameter 4, 8, 10, 11, and 15). On the other hand, the higher negative degree of contribution is subtracted with two points (parameter 1, 2, and 6) while the lower negative degree of contribution is subtracted with one point (parameter 3, 7, 12, 13, 14, and 16). Consequently, this modification as proposed solution has been rejected.

The MD value for type 2 is 11.79 which is smaller than original sample. This modification means the higher positive degree of contribution is subtracted with two points (parameter 5 and 9) while lower positive degree of contribution is subtracted with one point (parameter 4, 8, 10, 11, and 15). On the other hand, the higher negative degree of contribution is added with two points (parameter 1, 2, and 6) while the lower negative degree of contribution is added with one point (parameter 3, 7, 12, 13, 14, and 16). Consequently, this modification as proposed solution has been rejected.

The MD value for type 3 is 3.22 which is smaller than original sample. This modification means the higher positive degree of contribution is added with two points (parameter 5 and 9) while lower positive degree of contribution is added with one point (parameter 4, 8, 10, 11, and 15). On the other hand, the higher and lower negative degree of contribution is maintained their value. Consequently, this modification as proposed solution has been accepted.

The MD value for type 4 is 69.32 which is higher than original sample. This modification means the higher and lower positive degree of contribution is maintained their value. On the other hand, the higher negative degree of contribution is subtracted with two points (parameter 1, 2, and 6) while the lower negative degree of contribution is subtracted with one point (parameter 3, 7, 12, 13, 14, and 16). Consequently, this modification as proposed solution has been rejected.

Therefore, the best solution to the Bandar Pekan clinic is modification type 3 because it shows the lowest MD value compared to others. However, the proposed solution also might be influenced to the total number of positive and negative degree of contribution, and the total number of higher and lower degree of contribution. Also, the proposed solution might be different to the real practice.

5 CONCLUSION

From this research, MTS is able to classify between the healthy and unhealthy data. Besides, it can identify the significant parameters for the down-up case in the methadone dosages. In other words, it is proved that MTS can evaluate the significant factors in the methadone dosages of the MFlex program. The MD average of healthy is 1.0000 and for unhealthy is 3363.5596. The positive degree of contribution is parameter 1, 2, 3, 4, 5, 6, 13, and 14 whereas the negative degree of contribution is parameter 7, 8, 9, 10, 11, 12, 15, and 16. There are 6 unknown samples in down-up case of methadone dosages in MFlex program have been diagnosed using MTS. All of them have different number of positive and negative degree of contribution to achieve lower MD. There are 4 types of modification to prove the proposed solution and type 3 modification has been selected as the best solution. A Bandar Pekan clinic pharmacist confirmed that MTS can solve a classification and optimization problems in the MFlex program.

MTS is interesting if applied more in the healthcare sector such as classification of medications, the infection stage of Coronavirus (Covid-19) in Malaysia or worldwide, and the healthcare system updates.

ACKNOWLEDGEMENT

This research was fully supported by RDU220326 and the authors fully acknowledge Universiti Malaysia Pahang for the approved fund which makes this research effective.

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