A Modified ACO for Classification on different Data Set

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ABSTRACT

Ant colony optimization algorithms have been applied to many combinatorial optimization problems, ranging from quadratic assignment to protein folding or routing vehicles and a lot of derived methods have been adapted to dynamic problems in real variables, stochastic problems, multi-targets and parallel implementations. It has also been used to classification of the data set based on the attribute. It has been observed that construct solution and pheromone update play an important role in the ACO algorithm. The selection of the pheromone update is based on the construct solution which is further base on the probability function and initial selection. So if the selection of the pheromone done properly then ACO algorithm will terminate in less number of the iteration and it will be produce the good result. It has further observed that difference result have been possible for the different selection of the construct and pheromone on the same data set. Therefore, in this paper an effort has been made to suggest the techniques to select the initial construct and pheromone update for data set and the classification has to be done using the concept of clustering.

Keywords

Data mining, soft computing, Ant colony optimization, Particle swarm optimization, fuzzy, neural network, data mining preprocessing.

1. INTRODUCTION

Ants live together in colonies and they use chemical cues called pheromones to provide a sophisticated communication system. An isolated ant moves essentially at random but an ant encountering a previously laid pheromone will detect it and decide to follow it with high probability and thereby reinforce it with a further quantity of pheromone. The repetition of the above mechanism represents the collective behaviour of a real ant colony which is a form of autocatalytic behaviour where the more the ants follow a trail, the more attractive that trail becomes. The above behaviour of real ants has inspired ACO which has proved to be an effective metaheuristic technique for solving many complex problems. This technique uses a colony of artificial ants that behaves as cooperative agents in a mathematical space where they are allowed to search and reinforce pathways (solutions) in order to find the optimal ones. The features of artificial ants are: having some memory, not being completely blind and the process time is discrete. In the ACO technique an initialisation phase takes place during which ants are positioned on different nodes (sessions) with empty tabu lists and initial pheromone distributed equally on paths connecting these sessions. Ants update the level of pheromone while they are

constructing their schedules by iteratively adding new sessions to the current partial schedule. At each time step, ants compute a set of feasible moves and select the best one according to some probabilistic rules based on the heuristic information and pheromone level. The higher value of the pheromone and the heuristic information, the more profitable is to select this move and resume the search. The selected node is putted in the tabu list related to the ant to prevent to be chosen again. Heuristic information represents the nearer sessions around the current session, while pheromone level "memory" of each path represents the usability of this path in the past to find good schedules. At the end of each iteration. the tabu list for each ant will be full and the obtained cheapest schedule is computed and memorized. For the following iteration, tabu lists will be emptied ready for use and the pheromone level will be updated. This process is repeated till the number of iterations (stopping criteria) has been reached.

1.1 ACO algorithm

A general outline of the ACO algorithm is furnished below.

Algorithm ACO meta heuristic(); while (termination criterion not satisfied) ant generation and activity(); pheromone evaporation(); daemon actions(); "optional" end while end Algorithm

2. RELATED WORK AND LITERATURE SURVEY

Thomas Stutzle and Marco Dorigo[1], have tried to solve the travelling salesman problem with an ant colony optimization and authors have given an overview on the available ACO algorithms for the TSP. Thereafter authors have outlined how ACO algorithms can be applied to TSP problem and presented the available ACO algorithms for the TSP. In section 1.4, they have briefly discusses local search for the TSP, while Section 1.5 presented experimental results which have been obtained with MAX -MIN Ant System. The authors have further opined that they have been applied to several other combinatorial optimization problems because it was the first application of ACO algorithms to the TSP. Furthermore, the authors opined that ACO algorithms have proved to be among the best available algorithms and in section 1.6 they have given a concise overview of these other applications of ACO algorithms.

Wei Zhao et al.[2] have tried to solve combination optimization problems using ant colony optimization. The authors have presented revised pheromones in local and global update mode for solving TSP. The authors have proposed a pheromone increment model called ant constant and a pheromone diffusion model and shown that proposed model given better optimal solutions on different benchmark data sets.

Héctor D. Menéndez, et al. [3] have presented an ACObased clustering algorithm inspired by the ACO Clustering (ACOC) algorithm and authors have restructures ACOC from a centroid-based technique to a medoid-based technique, where the properties of the search space are not necessarily known. The authors have compared proposed algorithm with ACO Clustering (ACOC) algorithm on both synthetic datasets and real-world datasets extracted from the UCI Machine Learning Repository. The authors have opined that proposed algorithm outperformed the early algorithm based on its accuracy.

Xiaoyong Liu [4] has presented an improved clustering algorithm with Ant Colony optimization (ACO) based on dynamical pheromones. The author has proposed two strategies to improve the performance of the proposed algorithm. The author has adjusted the rate of pheromone evaporation dynamically, and the other has to adjust the strength of pheromone dynamically. The author has compared the proposed method based on the two indices named as Precision and Recall. The author has opined that it has given the best result as compared to the other algorithm.

R. F. Tavares Neto and M. Godinho Filho [13] have presented a literature survey on the uses of ACO approach to solve scheduling problems. The authors have opined that it will not only able to derive certain guidelines for the implementation of ACO algorithms but also to determine possible directions for future research.

Though the ant colony algorithms can resolve several optimization problems successfully, but it cannot establish its convergence. The many limitations have been observed from various survey paper which has been furnished below.

1) ACO has slow convergence speed and low efficiency [7, 8, 10, 11, and 12].

2) It is likely to fall in the local optimal solution [7, 8, 10, 11, and 12]. The main cause of this premature convergence is that the ant colony algorithms update the pheromone corresponding to the current better path, and after certain iterations, the pheromone on the best path becomes very strong, while the pheromone on the worthy path remains very weak. All the ants stick on the best path and it becomes very difficult to jump out from this best path. This raises the likelihood that the obtained optimal solution is only a local optimal solution.

3) Limited domain of inputs can be explored by using ACO [5, 10, and 12]. The studies also reported that in those cases ACO could be applied only to integral input domain.

4) Some studies also stated that redundant paths could not be deleted by using the ACO technique [6, 9]. This implies that various ants can find the test cases that meet the same test adequacy criterion and hence become redundant, whereas ants should be able to explore new paths without taking into account the redundant test cases.

5) Restricted applications of ACO were also spotted by a couple of studies [10, 12]. According to these, their developed

systems could not be useful for Object Oriented Programming. The reason behind this could be that the initial approach followed by them did not include the concept of object-oriented programming.

Several authors have used the ACO algorithm for the solving of TSP problem [1], combination optimization problems [2] and Clustering [3, 4]. Moreover authors have also pointed out the problem of ACO in slow convergence speed and low efficiency [7, 8, 10, 11, and 12], fall in the local optimal solution [7, 8, 10, 11, and 12], limited domain of inputs can [5, 10, and 12], redundant paths could not be deleted by using the ACO technique [6, 9] and restricted applications of ACO [10, 12]. It has been observed that construct solution and pheromone update play an important role in the ACO algorithm. The selection of the pheromone update is based on the construct solution which is further base on the probability function and initial selection. So if the selection of the pheromone done properly then ACO algorithm will terminate in less number of the iteration and it will be produce the good result. It has further observed that difference result have been possible for the different selection of the construct and pheromone on the same data set. Therefore, in this paper an effort has been made to suggest the techniques to select the initial construct and pheromone update for data set such that it will produce same result for different data set. Here modified form of the ACO algorithm has also been proposed.

In first section, abstract and introduction have been furnished. In second section, related work and literature survey of the models have been furnished. In third section, implementation has been furnished in detail. In fourth section, result and conclusion have been furnished

3. METHODOLOGY AND IMPLEMENTATION

The concept of data mining [14], association rule [15], factor analysis [15], fuzzy logic (14,15 16) neural network [14], PSO [14] and ABC [17] have been elaborated in the mentioned paper. Therefore, due to size of paper only detail explanation of ACO has been furnished in section 3.1.

3.1 Data cleaning and formation of association rule

3.1.1 Purpose of work

The available data contains the information of Iris flowers with various items. The data related to iris flower containing 150 data values. It is to note that the quality of flower depends on the sepal length of the flower. If the sepal length of a particular flower is known, the quality of flower can be ascertained. Therefore the sepal length of flower (D) has been chosen as the objective item (consequent item) of the flowers. The other parameters i.e. sepal width (A), petal length (B) and petal width (C) have been chosen as the depending items (antecedent items).

The purpose of this work is to correlate the items A, B and C with D, so that based on any value of A, B and C, the value of D can be estimated. From the value of D the quality of that type of flower can be ascertained.

3.1.2 Data mining Preprocessing

Now it is necessary to check whether the data items are proper or not. If the data items are proper, extraction of information is possible otherwise the data items are not suitable for the extraction of knowledge. In that case preprocessing of data is necessary for getting the proper data. Therefore, the data mining preprocessing techniques like data cleansing, data integration, data transformation and data reduction have to be applied on the available data as follows:

Data Cleansing

The data cleansing techniques include the filling in the missing value, correct or rectify the inconsistent data and identify the outlier in the available data.

It has been observed that all the data sets which have been considered do not contain any missing value. The said data sets do not contain any inconsistent data i.e. any abnormally low or any abnormally high value. All the data values are regularly distributed within the range of that data items. Therefore the data cleansing techniques are not applicable for the available data.

Data Integration

The data integration technique has to be applied if data has been collected from different sources. The available data have been taken from a single source therefore the said technique is not applicable here.

Data Transformation

To make the data within specific range smoothing and normalization techniques have to be applied. Decimal scaling technique has to be applied to move the decimal point to particular position of all data values. Out of these data transformation, smoothing and decimal scaling (multiply by 1000) techniques have been applied on the set.

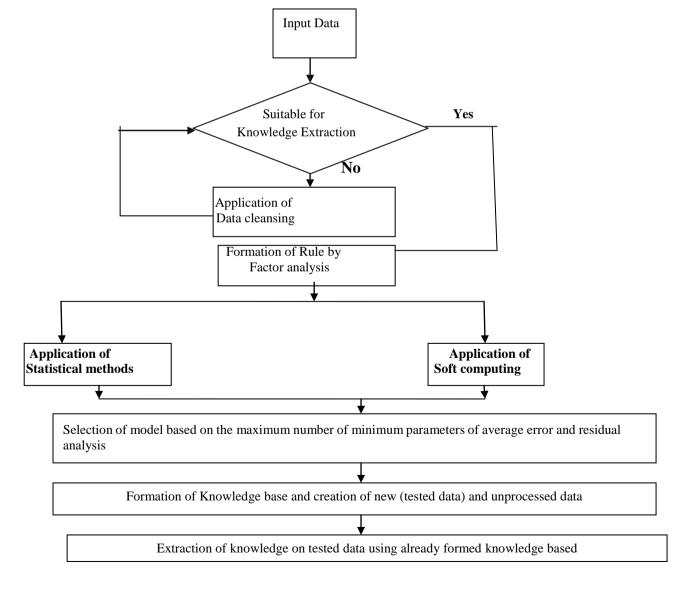
Data Reduction

The data reduction method has to be applied on huge amount of data (tetra byte) to get the certain portion of data. Since here the amount of data is not large, said technique has not been applied.

The data set has been taken from well know web site where it have been stored in well from Therefore, in this paper only data scaling has been applied on the said data set

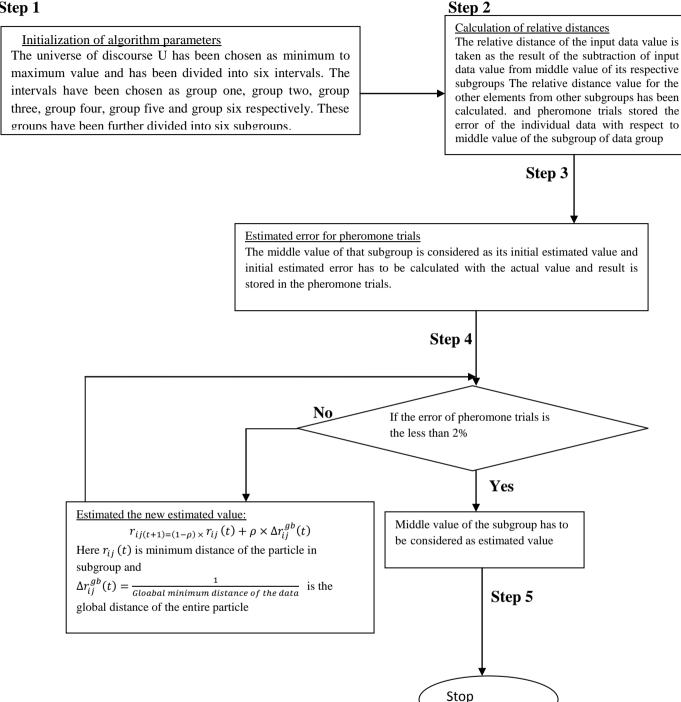
3.2 Implementation

The details of the formation of association rule and application of the factor analysis and principal component analysis has been discussed in the paper [18]. The concept of data mining [14], association rule[15], factor analysis [15], fuzzy logic (14,15 16) neural network [14], PSO [14] and ABC [17] have been elaborated in the mentioned paper. Due to size of the paper, only details procedure of ACO is discussed in this paper.



3.3 Modified Ant Colony algorithm

Step 1



The value encoding has to be considered as the data encoding and the (1/ estimated error) of the estimated data with the actual data has to be considered as a fitness function of the estimated data.

The universe of discourse U has been chosen as 3330 to 9816 and has been divided into several intervals. The intervals have been chosen as A_1 , A_2 , A_3 , A_4 , A_5 and A_6 which are termed as group one, group two, group three, group four, group five and group six respectively. These groups have been further divided into six subgroups. The ranges of groups and subgroups have been furnished in table 1. Fuzzy sets have been defined on the universe and some linguistic values have also been determined. Let, $A_1 = (many)$, $A_2 = (many, many)$, $A_3 = (very many, A_4 = (too many) be the possible values.$

Table 1. Group and Subgroup Range

Group/Subgro up			Sut	group		
Group One (A ₁)	A ₁₁	A ₁₂	A ₁₃	A ₁₄	A ₁₅	A ₁₆
(3300-4386)	(3300- 3481)	(3481- 3662)	(3662- 3843)	(3843- 4024)	(4024- 4205)	(4205- 4386)
Group Two (A ₂)	A ₂₁	A ₂₂	A ₂₃	A ₂₄	A ₂₅	A ₂₆
(4386-5475))	(4386- 4567)	(4567- 4748)	(4748- 4929)	(4929- 5110)	(5110- 5291)	(5291- 5472)
Group Three(A ₃)	A ₃₁	A ₃₂	A ₃₃	A ₃₄	A ₃₅	A ₃₆
(5472-6588)	(5472- 5653)	(5653- 5834)	(5834- 6015)	(6015- 6196)	(6196- 6377)	(6377- 6558)
Group Four (A ₄)	A ₄₁	A ₄₂	A ₄₃	A44	A45	A ₄₆
(6588-7644)	(6558- 6739)	(6739- 6920)	(6920- 7101)	(7101- 7282)	(7282- 7463)	(7463- 7644)
Group Five(A ₅)	A ₅₁	A ₅₂	A ₅₃	A ₅₄	A ₅₅	A ₅₆
(7644-8730)	(7463- 7825)	(7825- 8006)	(8006- 8187)	(8187- 8386)	(8386- 8549)	(8549- 8730)
Group Six (A ₆)	A ₆₁	A ₆₂	A ₆₃	A ₆₄	A ₆₅	A ₆₆
(8730-9816)	(8730- 8911)	(8911- 9092)	(9092- 9273)	(9273- 9454)	(9454- 9635)	(9635- 9816)

Step 1

The relative distances of the data value from each subgroup of that group have been calculated. The relative distance of the input data value is taken as the result of the subtraction of input data value from middle value of its respective subgroups as shown in step 2 of table 2 of particle swarm optimization. The relative distance value for the other elements from other subgroups has been calculated and pheromone trials stored the error of the individual data with respect to middle value of the subgroup of data group.

As for example, the minimum distance of data element (3331.597) of serial number 1 of the of table2 is 58.903 (minimum distance of serial number one of group one is denoted by $r_{ij}(t)$). The middle value of that subgroup is considered as its initial estimated value and initial estimated error has to be calculated with the actual value and result is stored in the pheromone trials.

 Table 2

 Distance of each Element from Respective Group

Serial	Available Data	Range of Data										
No.	Group One(A ₁)	A ₁₁ (3300- 3481)	A ₁₂ (3481- 3662)	A ₁₃ (3662- 3843)	A ₁₄ (3843- 4024)	A ₁₅ (4024- 4205)	A ₁₆ (4205- 4386)					
1	3331.597	58.903	239.903	420.903	601.903	782.903	963.903					
2	3734.387	343.887	162.887	18.113	199.113	380.113	561.113					
3	3912.366	521.866	340.866	159.866	21.134	202.134	383.134					
4	3939.355	548.855	367.855	186.855	5.855	175.145	356.145					
5	3941.134	550.634	369.634	188.634	7.634	173.366	354.366					
6	4009.457	618.957	437.957	256.957	75.957	105.043	286.043					
7	4066.994	676.494	495.494	314.494	133.494	47.506	228.506					
8	4079.558	689.058	508.058	327.058	146.058	34.942	215.942					

9 10							
	4104.769	714.269	533.269	352.269	171.269	9.731	190.731
10	4104.769 4104.769	714.269 714.269	533.269 533.269	352.269 352.269	171.269 171.269	9.731 9.731	190.731 190.731
12	4135.317	744.817	563.817	382.817	201.817	20.817	160.183
13	4135.317 4146.102	744.817 755.602	563.817 574.602	382.817 393.602	201.817 212.602	20.817 31.602	160.183 149.398
15	4174.871	784.371	603.371	422.371	241.371	60.371	120.629
16	4203.639 4243.193	813.139 852.693	632.139 671.693	451.139 490.693	270.139 309.693	89.139 128.693	91.861 52.307
18	4300.73	910.23	729.23	548.23	367.23	186.23	5.23
19 20	4318.713	928.213	747.213	566.213	385.213	204.213	23.213
	4340.285	949.785 A ₂₁	768.785 A ₂₂	587.785 A ₂₃	406.785 A ₂₄	225.785 A ₂₅	44.785 A ₂₆
	Group wo (A2)	(4386- 4567)	(4567- 4748)	(4748- 4929)	(4929- 5110)	(5110- 5291)	(5291- 5472)
21	4397.822	78.678	259.678	440.678	621.678	802.678	983.678
22 23	4426.59	49.91 10.356	230.91	411.91 372.356	592.91	773.91	954.91
23	4466.144 4466.144	10.356	191.356 191.356	372.356	553.356 553.356	734.356 734.356	915.356 915.356
25	4467.923	8.577	189.577	370.577	551.577	732.577	913.577
26	4494.913 4496.692	18.413 20.192	162.587 160.808	343.587 341.808	524.587 522.808	705.587 703.808	886.587 884.808
28	4534.467	57.967	123.033	304.033	485.033	666.033	847.033
29 30	4563.236 4565.014	86.736 88.514	94.264 92.486	275.264 273.486	456.264 454.486	637.264 635.486	818.264 816.486
31	4592.004	115.504	65.496	246.496	427.496	608.496	789.496
32 33	4602.79 4606.347	126.29 129.847	54.71	235.71 232.153	416.71	597.71 594.153	778.71
33	4674.67	129.847	51.153 17.17	163.83	413.153 344.83	525.83	775.153 706.83
35	4716.003	239.503	58.503	122.497	303.497	484.497	665.497
36 37	4739.435 4757.418	262.935 280.918	81.935 99.918	99.065 81.082	280.065 262.082	461.065 443.082	642.065 624.082
38	4757.418	280.918	99.918	81.082	262.082	443.082	624.082
39 40	4843.723 4897.621	367.223 421.121	186.223 240.121	5.223 59.121	175.777 121.879	356.777 302.879	537.777 483.879
41	4911.964	435.464	254.464	73.464	107.536	288.536	469.536
42 43	4922.832 4924.611	446.332 448.111	265.332 267.111	84.332 86.111	96.668 94.889	277.668 275.889	458.668 456.889
44	4955.158	478.658	297.658	116.658	64.342	245.342	426.342
45 46	5034.134 5061.256	557.634 584.756	376.634 403.756	195.634 222.756	14.634 41.756	166.366 139.244	347.366 320.244
47	5075.681	599.181	418.181	237.181	56.181	124.819	305.819
48 49	5174.551 5188.762	698.051 712.262	517.051 531.262	336.051 350.262	155.051 169.262	25.949 11.738	206.949 192.738
50	5228.449	751.949	570.949	389.949	208.949	27.949	153.051
51 52	5248.078 5268.003	771.578 791.503	590.578 610.503	409.578 429.503	228.578 248.503	47.578 67.503	133.422 113.497
53	5285.853	809.353	628.353	447.353	266.353	85.353	95.647
	Group	A ₃₁ (5472-	A ₃₂ (5653-	A ₃₃ (5834-	A ₃₄ (6015-	A ₃₅ (6196-	A ₃₆ (6377-
Fo	our (A ₃)	5653)	5834)	6015)	6196)	6377)	6558)
54 55	5559.144 5569.929	3.356 7.429	184.356 173.571	365.356 354.571	546.356 535.571	727.356 716.571	908.356 897.571
56	5577.259	14.759	166.241	347.241	528.241	709.241	890.241
57	5616.681	54.181	126.819	307.819	488.819 407.932	669.819	850.819 769.932
58 59	5697.568 5862.982	135.068 300.482	45.932 119.482	226.932 61.518	242.518	588.932 423.518	604.518
60	5877.325	214 926	122.925	47.175			
61		314.825	133.825	47.175	228.175	409.175	590.175
61 62	6071.508 6098.497	509.008 535.997	133.825 328.008 354.997	147.008 173.997	228.175 33.992 7.003	214.992 188.003	590.175 395.992 369.003
62 63	6071.508 6098.497 6123.708	509.008 535.997 561.208	328.008 354.997 380.208	147.008 173.997 199.208	33.992 7.003 18.208	214.992 188.003 162.792	395.992 369.003 343.792
62	6071.508 6098.497	509.008 535.997	328.008 354.997	147.008 173.997	33.992 7.003	214.992 188.003 162.792 159.234 135.884	395.992 369.003
62 63 64 65 66	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582	509.008 535.997 561.208 564.766 588.116 624.082	328.008 354.997 380.208 383.766 407.116 443.082	147.008 173.997 199.208 202.766 226.116 262.082	33.992 7.003 18.208 21.766 45.116 81.082	214.992 188.003 162.792 159.234 135.884 99.918	395.992 369.003 343.792 340.234 316.884 280.918
62 63 64 65 66 67 68	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969	328.008 354.997 380.208 383.766 407.116 443.082 518.55 523.969	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031
62 63 64 65 66 67 68 69	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469 6362.781	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281	328.008 354.997 380.208 383.766 407.116 443.082 518.55 523.969 619.281	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969 438.281	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031 104.719
62 63 64 65 66 67 68	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969	328.008 354.997 380.208 383.766 407.116 443.082 518.55 523.969	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031
62 63 64 65 66 67 68 69 70	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469 6362.781 6371.788	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604	328.008 354.997 380.208 383.766 407.116 443.082 518.55 523.969 619.281 628.288 658.835 687.604	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969 438.281 447.288 4477.835 506.604	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.288 296.835 325.604	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 76.281 85.288 115.835 144.604	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396
62 63 64 65 66 67 68 69 70 71 72	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469 6362.781 6371.788 6402.335 6431.104 Group	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558-	328.008 354.997 380.208 383.766 407.116 443.082 518.55 523.969 619.281 628.288 658.835 687.604 A ₁₂ (6739-	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969 438.281 447.288 477.835 506.604 A ₄₃ (6920-	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.288 296.835 325.604 A ₄₁ (7101-	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 85.288 115.835 144.604 A ₄₅ (7282-	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463-
62 63 64 65 66 67 68 69 70 71 72 72 Fi	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469 6362.781 6371.788 6471.788 6402.335 6431.104 Group Vie (A ₄)	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739)	328.008 354.997 380.208 383.766 407.116 443.082 518.55 523.969 619.281 628.288 658.835 687.604 A ₄₂ (6739- 6920)	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969 438.281 447.288 4477.835 506.604 A ₃ (6920- 7101)	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.288 296.835 325.604 A ₄₄ (7101- 7282)	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 85.288 115.835 144.604 A ₄₅ (7282- 7463)	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644)
62 63 64 65 66 67 68 69 70 71 72 Fi 73 74	6071.508 6098.497 6123.708 6127.266 6186.582 6267.469 6362.781 6371.788 6402.335 6431.104 Group ve (A ₄) 6596.518 6603.664	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836	328.008 354.997 380.208 383.766 407.116 443.082 518.55 523.969 619.281 628.288 658.835 658.835 658.835 658.835 658.835 6739. 6920) 232.982 225.836	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969 438.281 447.288 477.835 506.604 A ₄₃ (6920- 7101) 413.982 406.836	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.288 296.835 325.604 A ₄₄ (7101- 7282) 594.982 587.836	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 76.281 144.604 A ₄₅ (7282- 7463) 775.982 768.836	395.992 369.003 343.709 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644) 956.982 949.836
62 63 64 65 66 67 68 69 70 71 72 Fi 73 74 75	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469 6362.781 6371.788 6402.335 6431.104 3roup ve (A ₄) 6596.518 6603.664 6623.507	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993	328.008 334.997 380.208 383.766 407.116 443.082 518.55 523.969 619.281 628.288 658.835 687.604 A ₁₂ (6739. 6920) 232.982 225.836 205.993	147.008 173.997 199.208 202.766 226.116 262.082 337.55 342.969 438.281 447.288 477.835 506.604 A ₄₃ (6920- 7101) 413.982 406.836 386.993	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.288 296.835 325.604 A ₄ (7101- 7282) 594.982 587.836 567.993	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 85.288 115.835 144.604 A ₄₈ (7282- 7463) 775.982 768.836 748.993	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644) 956.982 949.836
62 63 64 65 66 67 70 71 72 Fi 73 74 75 76 77	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6403.104 G596.518 6603.664 6623.507 6625.286 6664.84	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34	328,008 354,997 380,208 383,766 407,116 443,082 518,55 523,969 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,292 920 222,982 225,836 205,993 204,214 164,66	147.008 173.997 199.208 202.766 226.116 226.2082 337.55 342.969 438.281 447.288 447.288 447.288 447.288 506.604 506.604 438.281 (6920- 7101) 413.982 406.835 386.993 385.214 345.66	33,992 7,003 18,208 21,766 45,116 81,082 156,55 161,969 257,281 266,288 296,835 235,604 A ₄₁ (7101- 7282) 594,982 557,993 566,214 526,66	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 145.604 A ₄₅ (7282- 746.3) 775.982 768.836 748.993 747.214 707.66	395.992 369.003 343.792 340.234 316.884 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644) 956.982 949.836 929.993 928.214 888.66
62 63 64 65 66 67 70 71 72 Fi 73 74 75 76 77 77 78	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6431.104 3roup ve (A ₄) 6596.518 6603.664 6662.360 6662.84 6664.84	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34	328.008 354.997 380.208 383.766 407.116 407.116 433.082 518.85 523.969 619.281 658.835 658.835 658.835 658.835 658.835 658.835 658.835 232.982 225.982 225.982 225.982 225.982	147.008 173.997 199.208 202.766 226.116 226.116 226.116 226.116 226.116 226.116 226.128 337.55 332.969 438.281 447.283 506.604 439.282 406.836 336.993 385.214 335.66	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.283 325.604 Au (7101- 7282) 594.982 587.933 566.214 526.666 526.666	$\begin{array}{c} 214.992\\ 188.003\\ 162.792\\ 159.234\\ 155.884\\ 155.884\\ 99.918\\ 24.45\\ 19.031\\ 76.281\\ 158.835\\ 144.604\\ \mathbf{A_{45}}\\ (282\\ 746.3)\\ 775.982\\ 775.982\\ 775.982\\ 748.993\\ 747.214\\ 707.66\\ 707.66\\ 707.66\\ \end{array}$	395.992 369.003 343.792 340.234 340.234 280.918 205.45 200.031 104.719 95.712 200.031 104.719 95.712 36.366 4 ₄₆ (7463- 7644) 956.982 949.836 929.993 928.214 888.66
62 63 64 65 66 67 70 71 72 Fi 73 74 75 76 77	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6403.104 G596.518 6603.664 6623.507 6625.286 6664.84	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34	328,008 354,997 380,208 383,766 407,116 443,082 518,55 523,969 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,281 619,292 920 222,982 225,836 205,993 204,214 164,66	147.008 173.997 199.208 202.766 226.116 226.2082 337.55 342.969 438.281 447.288 447.288 447.288 447.288 506.604 506.604 438.281 (6920- 7101) 413.982 406.835 386.993 385.214 345.66	33,992 7,003 18,208 21,766 45,116 81,082 156,55 161,969 257,281 266,288 296,835 235,604 A ₄₁ (7101- 7282) 594,982 557,993 566,214 526,66	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 145.604 A ₄₅ (7282- 746.3) 775.982 768.836 748.993 747.214 707.66	395.992 369.003 343.792 340.234 316.884 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644) 956.982 949.836 929.993 928.214 888.66
62 63 64 65 66 67 68 69 70 71 72 Fi 73 74 75 76 77 77 78 79 80 81	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6431.104 Fromp vec (A ₄) 6596.518 6603.664 6662.367 6664.84 6693.527 670.039	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 17.58	328.008 354.997 380.208 383.766 407.116 443.082 518.85 523.969 619.281 628.288 667.604 A ₂₁ 6739. 6749. 6	147.008 173.997 199.208 202.766 226.116 226.116 226.082 337.55 342.969 438.281 447.288 447.288 447.288 447.288 447.288 455.06.604 413.982 406.836 385.214 345.66 316.973 306.105 239.561	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 226.283 235.604 A ₄₁ (7101- 7282) 594.982 587.836 566.214 526.666 526.666 497.973 3487.105	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 158.835 144.604 As 158.835 144.604 As 775.982 775.982 775.982 745.993 747.214 707.66 678.973 668.105 161.561 501.551 5	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A _M (7463- 7644) 956.982 949.836 949.836 888.66 888.66 888.66 888.66 888.65 885.55 849.105 8
62 63 64 65 66 67 70 71 72 Fi 73 74 75 76 77 78 79 80	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6402.335 6402.335 6603.644 6603.654 6604.84 6604.84 6604.84 6604.84 6604.3527 6704.395 6770.939 6826.615	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34 16.34 16.34 16.34 1.6.34	328.008 354.997 380.208 383.766 4470.116 443.082 523.969 518.523.969 619.281 628.288 658.835 687.604 Au (6739) 620.093 204.214 164.66 164.66 164.66 1635.973 125.105 58.561 2.888	$\begin{array}{c} 147.008\\ 173.907\\ 199.208\\ 202.766\\ 226.116\\ 226.116\\ 342.969\\ 438.281\\ 447.288\\ 477.833\\ 506.604\\ 438.281\\ 447.288\\ 477.833\\ 506.604\\ A_{43}\\ 847.833\\ 506.604\\ A_{43}\\ 847.83\\ 386.993\\ 385.214\\ 345.66\\ 336.993\\ 345.561\\ 345.561\\ 345.561\\ 336.105\\ 239.561\\ 183.885\\ \end{array}$	33.992 7.003 18.208 21.766 45.16 81.082 156.55 161.969 257.281 266.288 296.833 255.604 A4 (7101- 7282) 594.982 587.836 566.214 526.666 526.666 497.973 487.105 420.561 364.885	$\begin{array}{c} 2 4.992\\ 188.003\\ 162.792\\ 159.234\\ 153.884\\ 99.918\\ 24.45\\ 19.031\\ 19.$	$\begin{array}{r} 395.992\\ 369.003\\ 343.792\\ 340.234\\ 316.884\\ 280.918\\ 205.45\\ 200.031\\ 104.719\\ 95.712\\ 65.165\\ 36.396\\ \mathbf{A_{46}}\\ 956.982\\ 949.836\\ 929.993\\ 928.214\\ 888.66\\ 888.66\\ 888.66\\ 888.67\\ 859.973\\ 849.105\\ $
62 63 64 65 66 67 70 71 72 Fi 73 74 75 76 77 78 79 80 81 82 83 84	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6262.05 6267.469 6362.781 6371.788 6402.335 6431.104 Sroup ve (A ₄) 6596.518 6603.664 6664.84 6669.327 6770.939 6826.615 683.812 6869.809	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558 6739) 51.982 44.836 24.993 23.214 16.34 16.34 45.027 55.895 122.439 178.115 185.312 221.309	328.008 354.997 380.208 407.116 443.082 523.969 619.281 628.288 687.604 A ₄₂ 6658.835 687.604 A ₄₂ 66739- 66739- 66739- 773- 775-775- 775-775- 775-775-775- 775-775-	147.008 173.997 199.208 202.766 226.116 2226.116 2226.116 242.902 438.281 447.288 447.288 447.288 447.288 447.288 447.288 447.288 447.288 447.835 506.604 413.982 406.836 386.293 385.214 345.66 316.973 306.105 239.561 183.885 176.688 140.668	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.288 296.835 325.604 Au (7101- 7282) 554.982 554.982 554.982 556.214 556.214 556.214 556.214 556.213 356.688 357.688 357.688	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 158.835 144.604 As (7282- 765.982 768.836 775.982 768.836 747.214 707.66 678.973 668.105 661.561 545.885 538.688 538.688	395.992 369.003 343.792 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.306 A ₄₆ (7463- 7644) 956.982 949.836 888.66 886.68 886.65 886.68 886.68 884.05 726.885 719.686 868.683.691 726.885 719.6868 719.6868 719.6868 719.6868 719.6858 719.6868 719.6858 710.6858 7
62 63 64 65 66 67 68 69 70 71 71 72 72 72 Fi 73 74 75 76 77 77 78 79 80 81 82 83	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 63267.469 6327.1788 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6403.664 6603.664 6664.84 6664.84 6664.84 6664.84 6664.83 6670.395 6770.399 6826.615 6833.812	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34 16.34 16.34 16.34 16.34 15.895 122.439 178.115 185.312	328.008 354.997 380.208 383.766 443.082 518.55 523.969 619.281 658.835 658.835 658.835 658.835 658.835 658.835 658.835 658.835 658.835 658.835 658.835 205.993 204.214 164.66 164.66 164.66 164.66 164.66 165.973 125.105 58.8561 28.8	147.008 173.997 199.208 202.766 226.116 226.116 226.082 337.35 342.969 438.281 447.288 506.604 477.835 506.604 477.835 506.604 477.835 506.604 413.982 440.836 336.993 338.214 335.66 345.66345.66 345.66 345.6635.66 345.66 345.6636 345.66 345.66 345.6636 345.66 345.66 345.6636 345.66 345.66 345.6636 345.6	33.992 7.003 18.208 21.766 45.161 81.082 156.55 161.969 257.281 266.835 235.604 A4 (101- 7282) 594.982 556.266 526.666 526.666 526.666 420.561 364.887 357.688	$\begin{array}{c} 2 4.992\\ 188.003\\ 162.792\\ 159.234\\ 199.918\\ 24.45\\ 199.918\\ 24.45\\ 190.91\\ 76.281\\ 158.884\\ 115.835\\ 115.835\\ 114.604\\ \mathbf{A_8}\\ (282.\\ 7463)\\ 775.982\\ 747.214\\ 707.66\\ 707.66\\ 707.66\\ 707.66\\ 678.973\\ 668.105\\ 601.561\\ 545.885\\ 538.688\\ \end{array}$	395.992 369.003 343.792 340.234 340.234 316.884 280.918 205.45 200.031 104.719 95.712 45.165 36.396 A ₄₆ (7463- 7644) 956.982 949.836 828.66 888.66 888.66 888.67 782.561 782.561 719.6885 719.6885
62 63 64 65 66 67 70 71 72 Fi 73 74 75 73 74 75 77 76 77 78 78 80 81 82 83 84 85 86 87	6071.508 6098.497 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6402.335 6402.335 6402.335 6603.644 6603.664 6662.3286 6664.84 6664.84 6663.527 6704.395 6770.939 6828.6615 6889.809 6900.356 6912.92 6941.689	509.008 535.997 561.208 564.766 588.116 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34 16.34 16.34 16.34 16.34 1.8.512 2.2.1309 2.51.856 2.64.42 2.31.89 2.31.89 2.3.18	328.008 354.997 380.208 383.766 443.082 523.969 523.962 524.968 525.993 525.995 525	$\begin{array}{c} 147.008\\ 173.097\\ 179.208\\ 199.208\\ 202.766\\ 226.116\\ 226.116\\ 226.116\\ 342.969\\ 438.281\\ 447.288\\ 477.833\\ 506.604\\ 447.288\\ 477.833\\ 506.604\\ 447.288\\ 477.833\\ 200.288\\ 477.833\\ 477.8$	33.992 7.003 18.208 21.766 43.082 21.766 81.082 21.766 31.082 156.55 161.969 257.281 266.288 296.833 295.833 255.498 587.836 567.993 566.214 526.666 526.666 526.661 526.663 537.836 357.688 357.688 352.691 291.144 278.581 249.811	$\begin{array}{c} 2 4.992\\ 188.003\\ 162.792\\ 159.234\\ 153.884\\ 99.918\\ 24.45\\ 19.031\\ 76.281\\ 19.031\\ 85.288\\ 115.833\\ 144.60\\ 785.288\\ 115.833\\ 144.60\\ 765.982\\ 775.982\\ 765.836\\ 748.993\\ 747.214\\ 707.66\\ 601.561\\ 558.688\\ 538.688\\ 558.688\\ 558.688\\ 502.691\\ 472.144\\ 459.58\\ 10.561\\ 502.691\\ 430.811\\ 502.691\\ 10.561\\ 558.688\\ 10.561\\ 502.691\\ 430.811\\ 430.812\\ 4$	$\begin{array}{r} 395992\\ 369003\\ 369003\\ 343,792\\ 340,234\\ 316,884\\ 280,918\\ 20545\\ 205,45\\ 200,031\\ 104,719\\ 95,712\\ 65,165\\ 36,396\\ 945,712\\ 65,165\\ 36,396\\ 949,836\\ 956,982\\ 949,836\\ 949,836\\ 949,838,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 888,66\\ 818,81\\ 949,836\\ 819,973\\ 849,105\\ 712,688\\ 719,688\\ 859,973\\ 849,105\\ 712,688\\ 719,688\\ 653,144\\ 640,58\\ 611,811\\ 818,66\\ 611,811\\ 818,66\\ 818,81$
62 63 64 65 66 67 70 71 72 Fi 73 74 75 76 77 78 79 80 81 82 83 84 85 86	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6371.788 6402.335 6431.104 3roup ve (A ₄) 6596.518 6603.664 6662.307 6625.286 6664.84 6664.84 6664.83 6664.83 6664.83 6664.83 6664.84 6669.3527 6770.939 6826.615 6833.812 6869.809 690.356 691.292	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₀ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 23.214 16.34 23.21309 23.214 23.214 23.214 23.214 23.214 23.214 23.214 23.214 23.21309 251.856 264.42 264.42	328.008 354.997 380.208 383.766 443.082 513.8766 443.082 513.8766 513.969 619.281 658.835 658.835 658.835 658.835 658.835 658.835 658.835 658.836 658.835 658.835 658.836 205.993 204.214 164.66 164.66 164.66 164.66 164.66 164.66 164.66 164.66 164.66 164.66 164.66 164.66 164.66 165.8856 125.105 88.8561 28.8561	147.008 173.997 199.208 199.202.766 226.116 226.116 262.082 337.35 342.969 438.281 447.288 477.835 506.604 A ₄ 470.283 506.604 A ₄ 406.836 386.993 385.214 345.66 345.66 345.66 176.688 400.691 101.144 97.58 68.811 31.035	33.992 7.003 18.208 21.766 45.161 81.082 21.766 45.161 81.082 2156.55 161.969 257.281 266.835 235.604 A4 (7101- 7283) 594.982 587.836 556.206 226.666 526.666 526.666 420.561 357.688 321.691 291.144 278.58 249.811 212.035	$\begin{array}{c} 2 4.992\\ 188.003\\ 162.792\\ 159.234\\ 159.234\\ 199.918\\ 24.45\\ 199.918\\ 24.45\\ 190.31\\ 176.281\\ 158.884\\ 115.835\\ 115.835\\ 114.604\\ \mathbf{A_8}\\ (282.\\7463)\\ 775.982\\ 7463)\\ 775.982\\ 747.214\\ 707.66\\ 707.66\\ 707.66\\ 105.61\\ 545.885\\ 502.691\\ 472.144\\ 459.58\\ 430.811\\ 393.035\\ 102.081\\ 102.0$	395.992 369.003 343.792 340.234 340.234 280.918 205.45 200.031 104.719 95.712 200.031 104.719 95.712 30.396 Au (7463- 7644) 956.982 949.836 929.993 928.214 888.66 885.973 849.105 782.561 772.6.885 7719.688 683.691 653.144 640.58
62 63 64 65 66 67 68 69 70 71 72 72 72 73 74 75 76 77 77 78 80 81 80 81 82 83 84 85 86 87 88 88 89 90	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6402.335 6431.104 6596.518 6603.664 6663.864 6663.864 6663.527 6770.339 6826.615 6833.812 6833.812 6999.464 6997.9464 6997.447 6997.447 7008.23.3	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 15.895 122.439 178.115 185.312 221.309 231.856 264.42 233.189 330.964 348.947 359.733	328.008 354.997 380.208 383.766 443.082 518.55 523.969 619.281 628.288 658.835 667.604 Au (6739- 6920) 232.982 225.836 205.993 204.214 164.66 164.66 164.66 164.66 164.66 164.66 164.68 83.42 125.103 88.342 125.103 88.342 121.189 149.964 167.947 178.733 178.737 179.757 179.757 179.757 179.757 179.757 179.757 179.7577 179.7577 179.7577 179.7577 179.7577 179.7577 179.7577	147.008 173.997 199.208 202.766 226.116 226.116 26.02766 226.116 26.016 337.55 342.969 438.281 447.288 477.835 506.604 Au (6920- 7101) 413.982 406.836 345.66 345.66 345.66 345.66 345.66 336.103 183.885 176.688 140.691 101.144 97.58 68.811 31.036 2.267	33.992 7.003 18.208 21.766 45.161 81.082 21.766 41.161 81.082 2156.55 161.969 257.281 266.288 296.835 235.604 A4 (101- 7282) 594.982 567.993 566.214 526.666 526.666 526.666 321.691 291.144 278.58 232.911 212.036 183.267	214.992 188.003 162.792 159.234 159.234 153.884 99.918 24.45 19.031 76.281 85.288 115.835 144.604 A ₈ (282- 746.3) 775.982 748.993 748.993 748.993 747.214 707.66 707.66 707.66 707.66 707.66 707.66 545.885 538.688 538.688 538.548 538.535 538.688 538.535 538.688 538.535 538.688 538.5355 538.535 538.55555 538.5555 538.55555 538.555555 538.55555 538.55555 538.55555 538.5555555 538.555555 538.55555 538.555555555 538.555555555555	$\begin{array}{r} 395.992\\ 369.003\\ 343.792\\ 340.234\\ 316.884\\ 280.918\\ 205.45\\ 200.031\\ 104.719\\ 95.712\\ 65.165\\ 36.396\\ 95.712\\ 65.165\\ 36.396\\ 95.712\\ 65.165\\ 929.993\\ 928.214\\ 888.66\\ 888.66\\ 888.66\\ 888.66\\ 888.65\\ 782.561\\ 7726.885\\ 719.688\\ 663.849.105\\ 553.144\\ 640.58\\ 611.811\\ 574.036\\ 556.053\\ 556.05$
62 63 64 65 66 67 70 72 72 Fi 73 74 73 74 75 76 77 78 79 80 81 82 83 84 83 84 85 83 84 85 89 90	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6371.788 6402.335 6431.104 Fromp ve (A ₄) 6596.518 6664.84 6664.84 6664.84 6664.84 6664.83.812 6883.812 6883.812 6997.41.689 6997.441.689 6997.441 6997.441 6997.401	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 886.604 A ₄₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 13.312 221.309 178.115 188.512 221.309 251.856 264.42 293.189 330.964 348.947 359.733 388.501	328.008 354.997 380.208 380	147.008 173.997 199.208 202.766 226.116 226.116 226.116 226.116 242.082 337.55 342.969 438.281 447.288 506.604 447.288 506.604 447.288 506.604 413.982 440.6836 3365.903 385.214 413.982 440.6836 3365.903 385.214 413.982 440.691 415.666 345.6666 345.6666 345.6666 345.6666 345.6666 345.6666 345.6666 345.66666 345.666666666666666666666666666666666666	33.992 7.003 18.208 21.766 45.116 81.082 156.55 161.969 257.281 266.835 325.604 A4 (7101- 7283) 556.214 526.666 526.666 526.661 47.973 357.688 321.691 291.144 278.58 249.811 291.648 323.667 194.053 183.267 154.499	214.992 188.003 162.792 159.234 159.234 153.884 19.031 76.281 76.281 154.604 As (282- 768.835 775.982 775.982 775.982 775.982 775.982 775.982 775.982 775.982 775.982 775.982 775.982 768.973 668.105 601.561 545.885 538.688 502.091 472.144 459.58 430.811 393.035 375.053 354.267 355.493 354.267 355.493 354.267 355.493 354.267 355.495 355.4	395.992 369.003 343.792 340.0234 340.0234 316.884 280.918 205.45 200.031 104.719 95.712 45.165 36.396 Aut (7463- 7644) 956.982 949.836 929.993 928.214 888.66 859.973 849.105 782.561 772.6.885 772.6.6.85 772.6.855 772.6.75 774.0
62 63 64 65 66 67 68 69 70 Fi 73 74 73 74 75 76 77 78 79 80 81 82 84 87 85 86 87 88 89 90 91 92 93 93	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 664.84 6664.84 6664.84 6664.84 6664.84 6693.527 6770.395 6826.615 6833.812 6869.809 6900.356 6912.92 6941.689 6979.464 6997.477 7008.23.78 7038.78 7038.78	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 723.214 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 15.895 122.439 178.115 185.312 221.309 231.856 264.42 293.189 330.964 348.947 359.733 388.501 390.28 390.28	328.008 354.997 380.208 383.766 443.082 523.969 523	147.008 173.997 199.208 202.766 226.116 226.018 337.55 342.969 438.281 447.288 506.604 A 477.835 506.604 A 477.835 506.604 A 477.835 506.604 A 477.835 506.604 A 477.835 506.604 A 506.604 A 5020- 7101) 413.982 386.993 385.214 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 316.973 39.511 10.144 97.58 68.811 0.363 2.2657 2.26.501 3.026 5.012 2.26.501 2.28.28 2.8.28	33.992 7.003 18.208 21.766 43.161 156.55 161.969 257.281 262.282 296.835 235.604 A4 (101- 7282) 594.982 567.993 566.214 526.666 526.666 526.666 526.666 526.668 364.883 321.691 212.036 194.053 183.267 154.499 152.72 154.499 152.72	$\begin{array}{c} 2 4.992\\ 188.003\\ 162.792\\ 159.234\\ 153.884\\ 99.918\\ 24.45\\ 19.031\\ 76.281\\ 78.288\\ 153.884\\ 19.031\\ 76.281\\ 78.288\\ 154.604\\ 78.288\\ 154.835\\ 144.604\\ 78.288\\ 745.288\\ 745.288\\ 745.288\\ 745.288\\ 745.288\\ 745.298\\ 747.2144\\ 777.66\\ 707.66\\$	395.992 369.003 343.792 340.234 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644) 956.982 949.836 929.993 928.214 888.66 888.66 888.69 782.561 772.6885 633.691 653.144 640.58 611.811 574.036 556.053 556.053 556.053 556.053 554.222 514.72 514.72
62 63 64 65 66 67 70 72 72 Fi 73 74 75 76 77 78 79 80 81 82 83 84 85 83 84 85 85 88 88 88 88 89 90 91 92 92 93	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6371.788 6402.335 6431.104 3ropp ve (A ₄) 6596.518 6603.664 6662.307 6625.286 6664.84 6664.84 6664.84 6664.83 6664.84 6669.3527 670.039 6869.809 900.356 6912.92 6997.447 7008.233 7038.78 7038.78 7038.78 7038.78	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₁₁ (6558- 6739) 51.982 44.836 24.993 23.214 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 221.309 251.856 122.439 178.115 122.1309 251.856 264.42 293.189 330.964 348.947 359.733 388.501 390.28	328.008 354.997 380.208 380.208 380.208 380.208 380.208 380.208 380.208 380.208 380.208 380.208 380.208 380.208 380.208 383	147.008 173.997 199.208 202.766 226.116 226.116 226.116 226.116 226.116 226.116 242.969 438.281 447.288 447.288 447.288 447.288 447.288 447.835 506.604 413.982 413.985 413.982 413.082 413.08	33.992 7.003 18.208 18.208 21.766 318.208 18.082 116.1969 257.281 266.288 296.835 295.604 A44 (7101- 7282) 594.982 594.983 566.214 526.666 526.666 420.561 420.561 344.885 357.688 321.691 249.811 249.811 210.35 194.033 183.267 154.499 152.72 152.72	214.992 188.003 162.792 159.234 135.884 99.918 24.45 19.031 76.281 158.834 148.604 Ag (282- 765.982 775.982 775.982 775.982 775.982 775.982 775.982 775.982 768.836 745.973 668.105 601.561 553.885 502.691 439.538 502.691 439.533 353.499 333.72 333.72 333.72 333.72 197.155	395.992 369.003 343.792 340.234 340.234 316.884 280.918 205.45 200.031 104.719 95.712 36.306 A ₄₆ (7463- 7644) 956.982 949.933 928.214 988.66 888.66 888.69 1726.885 719.688 683.691 782.561 726.885 574.036 556.053 545.267 516.479 514.72 51
62 63 64 65 66 67 68 69 70 71 72 6 73 74 75 76 77 78 79 80 81 82 84 85 87 89 90 91 92 93 94 95	6071.508 6098.497 6123.708 6123.708 6127.266 6150.616 6186.582 6267.469 6362.781 6371.788 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 6402.335 664.84 6664.84 6664.84 6664.84 6664.84 6693.527 6770.395 6826.615 6833.812 6869.809 6900.356 6912.92 6941.689 6979.464 6997.477 7008.23.78 7038.78 7038.78	509.008 535.997 561.208 564.766 624.082 699.55 704.969 800.281 809.288 839.835 868.604 A ₄₁ (6558- 6739) 51.982 44.836 723.214 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 16.34 15.895 122.439 178.115 185.312 221.309 231.856 264.42 293.189 330.964 348.947 359.733 388.501 390.28 390.28	328.008 354.997 380.208 383.766 443.082 523.969 523	147.008 173.997 199.208 202.766 226.116 226.018 337.55 342.969 438.281 447.288 506.604 A 477.835 506.604 A 477.835 506.604 A 477.835 506.604 A 477.835 506.604 A 477.835 506.604 A 506.604 A 5020- 7101) 413.982 386.993 385.214 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 345.66 316.973 39.511 10.144 97.58 68.811 0.363 2.2657 2.26.501 3.026 5.012 2.26.501 2.28.28 2.8.28	33.992 7.003 18.208 21.766 43.161 156.55 161.969 257.281 266.288 296.835 235.604 A4 (101- 7282) 594.982 567.993 566.214 526.666 526.666 526.666 526.666 526.668 364.885 321.691 212.036 194.053 183.267 154.499 152.72 154.499 152.72	$\begin{array}{c} 2 4.992\\ 188.003\\ 162.792\\ 159.234\\ 153.884\\ 99.918\\ 24.45\\ 19.031\\ 76.281\\ 78.288\\ 153.884\\ 19.031\\ 76.281\\ 78.288\\ 154.604\\ 78.288\\ 154.835\\ 144.604\\ 78.288\\ 745.288\\ 745.288\\ 745.288\\ 745.288\\ 745.288\\ 745.298\\ 747.2144\\ 777.66\\ 707.66\\$	395.992 369.003 343.792 340.234 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644) 956.982 949.836 929.993 928.214 888.66 888.66 888.69 782.561 772.6885 633.691 653.144 640.58 611.811 574.036 556.053 556.053 556.053 556.053 554.222 514.72 514.72
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127.955	395.992 369.003 343.792 340.234 340.234 316.884 280.918 205.45 200.031 104.719 95.712 65.165 36.396 A ₄₆ (7463- 7644) 95.6.982 949.836 929.993 928.214 888.66 888.66 888.66 888.66 888.691 653.144 640.58 7719.688 653.144 640.58 7719.688 663.5973 574.036 556.053 557.054 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 556.053 557.054 556.053 557.054 556.053 557.054 5

112	7536.801	888.301	707.301	526.301	345.301	164.301	16.699
113	7574.494	925.994	744.994	563.994	382.994	201.994	20.994
(Group	A51 (7463-	A ₅₂ (7825-	A ₅₃ (8006-	A54 (8187-	A55 (8366-	A56 (8549-
Fi	ive (A ₅)	7825)	8006)	8187)	8368)	8549)	(8349- 8730)
114	7648.235	86.265	267.265	448.265	629.265	810.265	991.265
115	7651.824	82.676	263.676	444.676	625.676	806.676	987.676
115	7659.021	75.479	256.479	437.479	618.479	799.479	980.479
117	7867.546	133.046	47.954	228.954	409.954	590.954	771.954
118	7885.447	150.947	30.053	211.053	392.053	573.053	754.053
119	7903.543	169.043	11.957	192.957	373.957	554.957	735.957
120	7932.312	197.812	16.812	164.188	345.188	526,188	707.188
120	7993.406	258,906	77.906	103.094	284.094	465.094	646.094
121	7997.077	262.577	81.577	99.423	280.423	461.423	642.423
122	8016.756	282.256	101.256	79.744	260.744	441.744	622.744
123	8029.403	294,903	113.903	67.097	248.097	429.097	610.097
124	8077.851	343.351	162.351	18.649	199.649	380.649	561.649
125	8086.858	352.358	171.358	9.642	190.642	371.642	552.642
120	8106.619	372.119	191.119	10.119	170.881	351.881	532.881
127	8142.616	408.116	227.116	46.116	134.884	315.884	496.884
120	8171.385	436.885	255.885	74.885	106.115	287.115	468.115
130	8218.167	483.667	302.667	121.667	59.333	240.333	421.333
130	8340.356	605.856	424.856	243.856	62.856	118.144	299.144
132	8381.802	647.302	466.302	285.302	104.302	76.698	257.698
132	8415.907	681.407	500.407	319.407	138.407	42.593	223,593
134	8417.686	683.186	502.186	321.186	140.186	40.814	221.814
135	8468.107	733.607	552.607	371.607	190.607	9.607	171.393
135	8518.334	783.834	602.834	421.834	240.834	59.834	121.166
137	8570.535	836.035	655.035	474.035	293.035	112.035	68.965
138	8602.861	868.361	687.361	506.361	325.361	144.361	36.639
139	8613.647	879.147	698,147	517.147	336.147	155.147	25.853
140	8692.755	958.255	777.255	596.255	415.255	234.255	53.255
141	8698.205	963.705	782.705	601,705	420.705	239,705	58.705
		A ₆₁		A63	A ₆₄	A65	A66
	Group	(8730-	(8911-	(9092-	(9273-	(9454-	(9635-
3	Six(A ₆)	8911)	9092)	9273)	9454)	9635)	9816)
142	8750.292	70.208	251.208	432.208	613.208	794.208	975.208
143	8809.608	10.892	191.892	372.892	553.892	734.892	915.892
144	8850.941	30.441	150.559	331.559	512.559	693.559	874.559
145	8850.972	30.472	150.528	331.528	512.528	693.528	874.528
146	8894.166	73.666	107.334	288.334	469.334	650.334	831.334
147	9055.909	235.409	54.409	126.591	307.591	488.591	669.591
148	9415.505	595.005	414.005	233.005	52.005	128.995	309.995
149	9464.148	643.648	462.648	281.648	100.648	80.352	261.352
150	9809.32	988.82	807.82	626.82	445.82	264.82	83.82

This method has been applied to every data set for calculating distance value of the all groups. Based on the minimum distance value, the group has been selected and the error with respect to that group has been calculated and stored in memory of pheromone trials and have been furnished in table 3 (column 4 and 10 respectively)

Step 2

If the error of pheromone trials is the less than 2% then middle value of the subgroup has to be considered as estimated value of data otherwise if the estimated error is not less than 2% and positive then error as calculated has to be subtracted from the earlier estimated value. If the estimated error is not less than 2% and negative then error as calculated has to be added with estimated value. The Global parameter is furnished below.

$$r_{ij(t+1)=(1-\rho)\times}r_{ij}(t) + \rho \times \Delta r_{ij}^{gb}(t)$$

Here $r_{ij}(t)$ is minimum distance of the particle in subgroup and $\Delta r_{ij}^{gb}(t) = \frac{1}{Gloabal minimum distance of the data}$ is the global distance of the entire particle in that group.

As for an example, as the estimated error of data element (3331.597) of serial number 1 of the group one of table 3 (third column) is 1.77% (positive), the value of $r_{ij}(t+1)$ will be

$$r_{ij^{(t+1)}} = (1-0.5) \times 58.903 + 0.5(1/5.23) = 29.5471$$

Here 3331.597 belongs to serial number one and lies in group one which contains the minimum distance value as 5.23 in the group one (according to table 2 serial no. 18 of column A₁₆). Therefore the value of $\Delta r_{ij}^{gb}(t)$ is taken as 1/5.23. The estimated value has been calculated as (available data – the value of $r_{ij^{(t+1)}}$). Therefore the estimated value = 3331.597-29.5471= 3302.05 for serial no 1. The value of ρ is taken as 0.5. The estimated error is -0.89%. This step has to be repeated until the estimated error is less than 2% or number of iteration has been reached as 50 whichever is less.

The instructions as narrated in step 2 has been repeated for other data elements of other groups to calculate the estimated value based on ant colony optimization algorithm. The error analysis has been made to produce estimated error as furnished in table 3 (6 and 12 column). The average error has been found as 0.73%.

SI. No	Available Data	Estimated Data(initial)	Estimated Error (initial) (%)	Estimated data(Final)	Estimated Error (%)	Sl. No.	Available Data	Estimated Data (initial)	Estimated Error (initial) (%)	Estimated data(Final)	Estimated Error (%)
1	3331.597	3390.5	1.77	3302.05	-0.89	76	6625.286	6648.5	0.35	6648.5	0.35
2	3734.387	3752.5	0.49	3752.5	0.49	77	6664.84	6648.5	-0.25	6648.5	-0.25
3	3912.366	3933.5	0.54	3933.5	0.54	78	6664.84	6648.5	-0.25	6648.5	-0.25
4	3939.355	3933.5	-0.15	3933.5	-0.15	79	6693.527	6648.5	-0.67	6648.5	-0.67
5	3941.134	3933.5	-0.19	3933.5	-0.19	80	6704.395	6648.5	-0.83	6648.5	-0.83
6	4009.457	3933.5	-1.89	3933.5	-1.89	81	6770.939	6829.5	0.86	6829.5	0.86
7	4066.994	4114.5	1.17	4114.5	1.17	82	6826.615	6829.5	0.04	6829.5	0.04
8	4079.558	4114.5	0.86	4114.5	0.86	83	6833.812	6829.5	-0.06	6829.5	-0.06
9	4104.769	4114.5	0.24	4114.5	0.24	84	6869.809	6829.5	-0.59	6829.5	-0.59
10	4104.769	4114.5	0.24	4114.5	0.24	85	6900.356	6829.5	-1.03	6829.5	-1.03
11	4104.769	4114.5	0.24	4114.5	0.24	86	6912.92	6829.5	-1.21	6829.5	-1.21
12	4135.317	4114.5	-0.50	4114.5	-0.50	87	6941.689	7010.5	0.99	7010.5	0.99
13	4135.317	4114.5	-0.50	4114.5	-0.50	88	6979.464	7010.5	0.44	7010.5	0.44
14	4146.102	4114.5	-0.76	4114.5	-0.76	89	6997.447	7010.5	0.19	7010.5	0.19
15	4174.871	4114.5	-1.45	4114.5	-1.45	90	7008.233	7010.5	0.03	7010.5	0.03
16	4203.639	4114.5	-2.12	4143.55	-1.43	91	7037.001	7010.5	-0.38	7010.5	-0.38
17	4243.193	4295.5	1.23	4295.5	1.23	92	7038.78	7010.5	-0.40	7010.5	-0.40
18	4300.73	4295.5	-0.12	4295.5	-0.12	93	7038.78	7010.5	-0.40	7010.5	-0.40
19	4318.713	4295.5	-0.54	4295.5	-0.54	94	7175.344	7191.5	0.23	7191.5	0.23
20	4340.285	4295.5	-1.03	4295.5	-1.03	95	7227.544	7191.5	-0.50	7191.5	-0.50
21	4397.822	4476.5	1.79	4476.5	1.79	96	7231.102	7191.5	-0.55	7191.5	-0.55
22	4426.59	4476.5	1.13	4476.5	1.13	97	7232.962	7191.5	-0.57	7191.5	-0.57
23	4466.144	4476.5	0.23	4476.5	0.23	98	7245.445	7191.5	-0.74	7191.5	-0.74
24	4466.144	4476.5	0.23	4476.5	0.23	99	7254.534	7191.5	-0.87	7191.5	-0.87
25	4467.923	4476.5	0.19	4476.5	0.19	100	7259.87	7191.5	-0.94	7191.5	-0.94

Table 3. Estimated Output and Estimated Error Based on ACO

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26	4494.913	4476.5	-0.41	4476.5	-0.41	101	7272.517	7191.5	-1.11	7191.5	-1.11
27	4496.692	4476.5	-0.45	4476.5	-0.45	102	7299.506	7372.5	1.00	7372.5	1.00
28	4534.467	4476.5	-1.28	4476.5	-1.28	103	7331.863	7372.5	0.55	7372.5	0.55
29	4563.236	4476.5	-1.90	4476.5	-1.90	104	7409.162	7372.5	-0.49	7372.5	-0.49
30	4565.014	4476.5	-1.94	4476.5	-1.94	105	7437.849	7372.5	-0.88	7372.5	-0.88
31	4592.004	4657.5	1.43	4657.5	1.43	106	7437.849	7372.5	-0.88	7372.5	-0.88
32	4602.79	4657.5	1.19	4657.5	1.19	107	7454.053	7372.5	-1.09	7372.5	-1.09
33	4606.347	4657.5	1.11	4657.5	1.11	108	7468.396	7553.5	1.14	7553.5	1.14
34	4674.67	4657.5	-0.37	4657.5	-0.37	109	7497.246	7553.5	0.75	7553.5	0.75
35	4716.003	4657.5	-1.24	4657.5	-1.24	110	7520.597	7553.5	0.44	7553.5	0.44
36	4739.435	4657.5	-1.73	4657.5	-1.73	111	7522.375	7553.5	0.41	7553.5	0.41
37	4757.418	4838.5	1.70	4838.5	1.70	112	7536.801	7553.5	0.22	7553.5	0.22
38	4757.418	4838.5	1.70	4838.5	1.70	113	7574.494	7553.5	-0.28	7553.5	-0.28
39	4843.723	4838.5	-0.11	4838.5	-0.11	114	7648.235	7734.5	1.13	7734.5	1.13
40	4897.621	4838.5	-1.21	4838.5	-1.21	115	7651.824	7734.5	1.08	7734.5	1.08
41	4911.964	4838.5	-1.50	4838.5	-1.50	116	7659.021	7734.5	0.99	7734.5	0.99
42	4922.832	4838.5	-1.71	4838.5	-1.71	117	7867.546	7915.5	0.61	7915.5	0.61
43	4924.611	4838.5	-1.75	4838.5	-1.75	118	7885.447	7915.5	0.38	7915.5	0.38
44	4955.158	5019.5	1.30	5019.5	1.30	119	7903.543	7915.5	0.15	7915.5	0.15
45	5034.134	5019.5	-0.29	5019.5	-0.29	120	7932.312	7915.5	-0.21	7915.5	-0.21
46	5061.256	5019.5	-0.83	5019.5	-0.83	121	7993.406	7915.5	-0.97	7915.5	-0.97
47	5075.681	5019.5	-1.11	5019.5	-1.11	122	7997.077	7915.5	-1.02	7915.5	-1.02
48	5174.551	5200.5	0.50	5200.5	0.50	123	8016.756	8096.5	0.99	8096.5	0.99
49	5188.762	5200.5	0.23	5200.5	0.23	124	8029.403	8096.5	0.84	8096.5	0.84
50	5228.449	5200.5	-0.53	5200.5	-0.53	125	8077.851	8096.5	0.23	8096.5	0.23
51	5248.078	5200.5	-0.91	5200.5	-0.91	126	8086.858	8096.5	0.12	8096.5	0.12
52	5268.003	5200.5	-1.28	5200.5	-1.28	127	8106.619	8096.5	-0.12	8096.5	-0.12
53	5285.853	5200.5	-1.61	5200.5	-1.61	128	8142.616	8096.5	-0.57	8096.5	-0.57
54	5559.144	5562.5	0.06	5562.5	0.06	129	8171.385	8096.5	-0.92	8096.5	-0.92
55	5569.929	5562.5	-0.13	5562.5	-0.13	130	8218.167	8277.5	0.72	8277.5	0.72
56	5577.259	5562.5	-0.26	5562.5	-0.26	131	8340.356	8277.5	-0.75	8277.5	-0.75
57	5616.681	5562.5	-0.96	5562.5	-0.96	132	8381.802	8458.5	0.92	8458.5	0.92
58	5697.568	5743.5	0.81	5743.5	0.81	133	8415.907	8458.5	0.51	8458.5	0.51
59	5862.982	5924.5	1.05	5924.5	1.05	134	8417.686	8458.5	0.48	8458.5	0.48
60	5877.325	5924.5	0.80	5924.5	0.80	135	8468.107	8458.5	-0.11	8458.5	-0.11
61	6071.508	6105.5	0.56	6105.5	0.56	136	8518.334	8639.5	1.42	8639.5	1.42
62	6098.497	6105.5	0.11	6105.5	0.11	137	8570.535	8639.5	0.80	8639.5	0.80
63	6123.708	6105.5	-0.30	6105.5	-0.30	138	8602.861	8639.5	0.43	8639.5	0.43
64	6127.266	6105.5	-0.36	6105.5	-0.36	139	8613.647	8639.5	0.30	8639.5	0.30
65	6150.616	6105.5	-0.73	6105.5	-0.73	140	8692.755	8639.5	-0.61	8639.5	-0.61
66	6186.582	6105.5	-1.31	6105.5	-1.31	141	8698.205	8639.5	-0.67	8639.5	-0.67
67	6262.05	6286.5	0.39	6286.5	0.39	142	8750.292	8820.5	0.80	8820.5	0.80
68	6267.469	6286.5	0.30	6286.5	0.30	143	8809.608	8820.5	0.12	8820.5	0.12
69	6362.781	6286.5	-1.20	6286.5	-1.20	144	8850.941	8820.5	-0.34	8820.5	-0.34
70	6371.788	6286.5	-1.34	6286.5	-1.34	145	8850.972	8820.5	-0.34	8820.5	-0.34
71	6402.335	6467.5	1.02	6467.5	1.02	146	8894.166	8820.5	-0.83	8820.5	-0.83
72	6431.104	6467.5	0.57	6467.5	0.57	147	9055.909	9001.5	-0.60	9001.5	-0.60
73	6596.518	6648.5	0.79	6648.5	0.79	148	9415.505	9363.5	-0.55	9363.5	-0.55
74	6603.664	6648.5	0.68	6648.5	0.68	149	9464.148	9363.5	-1.06	9363.5	-1.06
75	6623.507	6648.5	0.38	6648.5	0.38	150	9809.32	9725.5	-0.85	9725.5	-0.85
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3.5 Statistical Methods and Soft computing models

The statistical method using least square technique (LSQ) based on linear, exponential, asymptotic, curvilinear and logarithmic equations have been applied on the cumulative antecedent item to produce estimated cumulative antecedent item. The error analysis has been made to compute estimated error and average error. The estimated data based on statistical methods and the estimated errors have been furnished in table 7. It has been observed that the least square technique based on logarithmic equation has given minimum error as compared to other statistical models. The problem of using this model is that if original data (actual data) is not stabilized, some noise may enter with the original data, and as a result that may generate some erroneous results. This sort of unstabilized data can be avoided by using soft computing models.

Under soft computing domain, the harmony search, fuzzy logic, neural network, particle swarm optimization, artificial bee colony algorithm have been used to produce estimated data based on that models.

3.6 Review of models

The statistical methods, fuzzy logic, neural network, particle swarm optimization, artificial bee colony algorithm have been used to produce estimated data based on those models. The error analysis and the parameters of residual analysis have been applied on the estimated data with respect to the available data. The error analysis includes the computation of average error and residual analysis includes the computation of sum of absolute residual, mean of absolute residual, mean of mean of absolute residual, median of absolute residual, maximum of absolute residual and standard deviation of absolute residual. The average error and the parameters of residual analysis have been furnished in table 4. The strength of each model can be ascertained by the error and residual analysis. The less value of the parameter for the error and residual analysis indicates more strength of the model (method) than others. From table 4 it has been observed that out of seven cases, ACO has been preferred by seven cases. Therefore the ACO has been selected as the preferable optimizing model for the estimation of data. Therefore, the estimated data based on ACO can be used for the extraction of knowledge. The estimated data based on the ACO has been named as intermediate data and that name will be used in further processing.

Table 4

Average Error and Residual Analysis of Applied Methods on Iris Flowers Data

Serial Number	Method Name	Sum of Absolute Residual	Maximum Absolute Residual	Mean Absolute Residual	Mean of Mean Absolute Residual	Median of Absolute Residual	Standard Deviation of Absolute residual	Average Error (%)		
1	Linear Equation	20090	710.349	3.375	0.023	286.376	94.90468	2.25		
2	Exponential equation	31627.33	618.573	4.907	0.033	495.577	144.1412	3.27		
3	Asymptotic Equation	80269.16	2191.526	15.404	0.103	309.903	459.805	10.27		
4	Curvilinear Equation	20066.95	716.8084	3.382	0.023	282.7374	95.0663	2.25		
5	Logarithm Equation	27677.26	998.64	4.762	0.032	71.827	143.9862	3.17		
6	Fuzzy Logic	14493.82	420.903	2.429	0.016	65.507	64.14068	1.62		
7	Neural Network	6811.231	191.861	1.104	0.007	24.993	28.12644	0.78		
8	PSO	8917.629	324.073	1.529	0.01	63.043	53.0546	1.02		
9	ACO	6728.986	121.166	1.098	0.007	24.993	26.82716	0.73		

3.7 Creation of Knowledge

Certain unknown data have been taken for the extraction of knowledge for that data item and that have been furnished in table 5. The preprocessing technique namely decimal scaling techniques have been applied on unknown data sets to convert it into proper format for the extraction of knowledge. The unknown data have been termed as tested data. The purpose of this work is to assess the quality of flowers (unknown data) based on the information A, B, C. The proposed work is to estimate the value D based on these primary values i.e. A, B, C using the proposed model. Thereafter an effort has to be made the quality of information which has been obtained (estimated value of D) by calculating the error of the estimated value of D with respect to actual value of D. The items sepal width, petal length petal width and sepal width have been termed as A, B, C and D respectively.

1	able	5
T Int Int		Dat

			U	nknov	vn Data				
Serial Number	Α	В	С	D	Serial Number	Α	В	С	D
1	2.65	1.2	0.2	4.4	31	3	4.55	1.45	5.85
2	2.95	1.25	0.15	4.35	32	2.6	5.05	1.75	6.15
3	3.45	1.55	0.2	5	33	2.7	5	1.7	6.15
4	3.4	1.6	0.3	5.4	34	2.95	4.75	1.65	6.45
5	3.35	1.65	0.45	5.05	35	3.15	4.7	1.45	6.85
6	3.35	1.8	0.35	4.95	36	2.9	5.15	1.4	6.55
7	1.9	3.35	1.1	3.85	37	2.85	5.25	1.45	6.5
8	3.85	1.4	0.35	5.25	38	3.1	4.7	1.8	5.8
9	2.95	2.4	0.7	5.2	39	3.2	4.75	1.65	6.35
10	4.15	1.45	0.15	5.35	40	3	5	1.75	6.35
11	3.25	2.35	0.6	5.25	41	2.95	5.05	1.85	6.15
12	3.15	2.45	0.75	5.1	42	2.95	5.55	1.8	6.4
13	3.1	2.6	0.7	5	43	3.1	5.3	1.9	6.5
14	2.4	3.5	1	5.2	44	3.1	5.45	1.8	6.85
15	2.3	3.85	1	5.75	45	2.9	5.7	1.85	6.8
16	3.3	2.75	0.7	5.85	46	2.95	5.55	1.95	6.4
17	3.5	2.5	0.7	5.7	47	3.05	5.35	2.05	6.55
18	2.5	3.65	1.05	5.6	48	2.9	5.4	2.25	6.55
19	2.7	4.2	1.25	5.8	49	2.95	5.35	2.25	6.65
20	2.65	4.3	1.25	5.55	50	3	5.7	2.1	6.9
21	2.55	4.6	1.4	5.85	51	3.05	5.8	2.05	6.85

22	2.6	4.6	1.35	5.85	52	2.95	6.1	1.95	7.2
23	3	4.15	1.25	5.65	53	3	5.85	2.15	6.8
24	2.95	4.2	1.3	6	54	3.35	5.55	2.2	6.45
25	2.9	4.3	1.3	6.3	55	3.3	5.55	2.3	6.55
26	2.7	4.4	1.5	5.55	56	3.1	5.9	2.3	7.3
27	2.65	4.5	1.5	5.3	57	3.15	6.3	2.3	6.95
28	2.75	4.55	1.5	6.1	58	3.45	6.05	2.5	6.75
29	2.95	4.4	1.4	6.25	59	3.7	6.25	2.25	7.55
30	2.95	4.65	1.4	6.1	60	3.8	6.55	2.1	7.8

Step 2

Now, it is necessary to calculate cumulative antecedent item using the relation as formed in section of factor analysis. The relation has been furnished as

Total effect value = (0.970912) \times A + (0.683227) \times B + (0.701015) \times C.

Step 3

Now using the relation, the total effect value has been computed and furnished in table 6.

Table 6

Total Effect Value

Serial No.	А	в	с	Total Effect Value	Serial No.	А	в	с	Total Effect Value
1	2650	1200	200	3532.992	31	3000	4550	1450	7037.891
2	2950	1250	150	3823.377	32	2600	5050	1750	7201.444
3	3450	1550	200	4548.852	33	2700	5000	1700	7229.323
4	3400	1600	300	4604.569	34	2950	4750	1650	7266.194
5	3350	1650	450	4695.337	35	3150	4700	1450	7286.012
6	3350	1800	350	4727.719	36	2900	5150	1400	7315.685
7	1900	3350	1100	4904.66	37	2850	5250	1450	7370.513
8	3850	1400	350	4939.885	38	3100	4700	1800	7482.821
9	2950	2400	700	4994.646	39	3200	4750	1650	7508.922
10	4150	1450	150	5125.116	40	3000	5000	1750	7555.648
11	3250	2350	600	5181.657	41	2950	5050	1850	7611.365
12	3150	2450	750	5258.041	42	2950	5550	1800	7917.928
13	3100	2600	700	5276.928	43	3100	5300	1900	7962.859
14	2400	3500	1000	5422.499	44	3100	5450	1800	7995.242
15	2300	3850	1000	5564.537	45	2900	5700	1850	8006.917
16	3300	2750	700	5573.594	46	2950	5550	1950	8023.08
17	3500	2500	700	5596.97	47	3050	5350	2050	8053.627
18	2500	3650	1050	5657.125	48	2900	5400	2250	8082.355
19	2700	4200	1250	6367.285	49	2950	5350	2250	8096.739
20	2650	4300	1250	6387.062	50	3000	5700	2100	8279.262
21	2550	4600	1400	6600.091	51	3050	5800	2050	8361.079
22	2600	4600	1350	6613.586	52	2950	6100	1950	8398.855
23	3000	4150	1250	6624.397	53	3000	5850	2150	8416.797
24	2950	4200	1300	6645.063	54	3350	5550	2200	8586.698
25	2900	4300	1300	6664.84	55	3300	5550	2300	8608.254
26	2700	4400	1500	6679.184	56	3100	5900	2300	8653.201
27	2650	4500	1500	6698.961	57	3150	6300	2300	8975.038
28	2750	4550	1500	6830.214	58	3450	6050	2500	9235.707
29	2950	4400	1400	6851.811	59	3700	6250	2250	9439.827
30	2950	4650	1400	7022.617	60	3800	6550	2100	9636.734

Step 4

The cumulative antecedent item for tested data has been furnished in table 6 which has to be processed in subsequent sections. The cumulative antecedent item has been termed as tested antecedent data. The tested antecedent data has been furnished in table 7.

Table 7

			Tested	l Data			
Serial Numbe r	Tested Antecede nt Data	Serial Numbe r	Tested Antecede nt Data	Serial Numbe r	Tested Antecede nt Data	Serial Numbe r	Tested Antecede nt Data
1	3532.992	16	5573.594	31	7037.891	46	8023.08
2	3823.377	17	5596.97	32	7201.444	47	8053.627
3	4548.852	18	5657.125	33	7229.323	48	8082.355
4	4604.569	19	6367.285	34	7266.194	49	8096.739
5	4695.337	20	6387.062	35	7286.012	50	8279.262
6	4727.719	21	6600.091	36	7315.685	51	8361.079
7	4904.66	22	6613.586	37	7370.513	52	8398.855
8	4939.885	23	6624.397	38	7482.821	53	8416.797
9	4994.646	24	6645.063	39	7508.922	54	8586.698
10	5125.116	25	6664.84	40	7555.648	55	8608.254
11	5181.657	26	6679.184	41	7611.365	56	8653.201
12	5258.041	27	6698.961	42	7917.928	57	8975.038
13	5276.928	28	6830.214	43	7962.859	58	9235.707
14	5422.499	29	6851.811	44	7995.242	59	9439.827
15	5564.537	30	7022.617	45	8006.917	60	9636.734

Step 5

The statistical methods and soft computing models have been applied on the tested antecedent data. The statistical methods include least square technique (LSQ) based on linear, exponential, asymptotic, curvilinear and logarithmic equations. The soft computing models include fuzzy logic (Fuzzy), neural network (NN), genetic algorithm(GA), particle swarm optimization (PSO), ant colony optimization(ACO. The average errors based on statistical and soft computing models have been furnished in tables 8.

Table 8

Average Error and Residual Analysis using Tested Data (Iris Flowers Data)

Serial Number	Method Name	Sum of Absolute Residual	Maximum Absolute Residual	Mean Absolute Residual	Mean of Mean Absolute Residual	Median of Absolute Residual	Standard Deviation of Absolute residual	Average Error (%)
1	Linear Equation	8978.615	555.933	1.41	0.02	85.876	100.0384	2.34
2	Exponential equation	13170.25	526.431	1.97	0.03	264.337	140.3142	3.29
3	Asymptotic Equation	26623.52	2161.037	4.46	0.07	517.588	346.7657	7.43
4	Curvilinear Equation	8970.36	562.254	1.41	0.02	82.555	100.4892	2.34
5	Logarithm Equation	11435.6	835.499	1.74	0.03	162.808	155.382	2.9
6	Fuzzy Logic	411009.6	9636.734	60	1	7022.617	1470.556	1.43
7	Neural Network	2928.87	180.785	0.63	0.01	12.317	28.8091	0.59
8	PSO	3380.681	253.008	0.54	0.01	4.237	50.62961	0.91
9	ACO	2081.524	92.234	0.32	0.01	<u>12.117</u>	26.11567	0.53

3.8 Extraction of Knowledge

The estimated ACO output of the tested data has been furnished in table 9. The data (serial number 1 of the table 9) is 3571.5 which lie between (serial number 1 and 2 of table 6). Therefore its estimated output of the consequent item will be the average of actual output of the consequent item of table 6(serial number 1 and 2). Similarly output (estimated consequent item) of the all the tested data has been calculated and furnished in table 12.

Table 9

	Teste	d with A	LCO ot	itput on "	tested	data	
Tested Antecedent Data	ACO	Tested Antecedent Data	ACO	Tested Antecedent Data	ACO	Tested Antecedent Data	ACO
3532.992	3571.5	5573.594	5562.5	7037.891	7191.5	8023.08	8096.5
3823.377	3843	5596.97	5653	7201.444	7191.5	8053.627	8096.5
4548.852	4476.5	5657.125	6286.5	7229.323	7191.5	8082.355	8096.5
4604.569	4657.5	6367.285	6377	7266.194	7282	8096.739	8277.5
4695.337	4657.5	6387.062	6648.5	7286.012	7372.5	8279.262	8368
4727.719	4862.75	6600.091	6648.5	7315.685	7372.5	8361.079	8458.5
4904.66	5019.5	6613.586	6648.5	7370.513	7553.5	8398.855	8458.5
4939.885	5110	6624.397	6648.5	7482.821	7553.5	8416.797	8639.5
4994.646	5200.5	6645.063	6648.5	7508.922	7553.5	8586.698	8639.5
5125.116	5200.5	6664.84	6648.5	7555.648	7644	8608.254	8639.5
5181.657	5200.5	6679.184	6648.5	7611.365	7915.5	8653.201	8911
5258.041	5381.5	6698.961	6829.5	7917.928	7915.5	8975.038	9182.5
5276.928	5562.5	6830.214	6829.5	7962.859	7915.5	9235.707	9363.5
5422.499	5562.5	6851.811	7010.5	7995.242	8006	9439.827	9544.5
5564 537	5569.5	7022 617	7010.5	8006 917	8096.5	9636 734	9594.5

 Table 10

 Estimated Error on Tested Data by ACO

Serial Number	Tested Data	Tested data (ACO)	Actual Consequent Item	Estimated Consequent Item	Estimated Error (%)
1	3532.992	3571.5	5573.594	4500	2.27
2	3823.377	3843	5596.97	4300	-1.15
3	4548.852	4476.5	5657.125	5150	3.00
4	4604.569	4657.5	6367.285	5150	-4.63
5	4695.337	4657.5	6387.062	4966.67	-1.65
6	4727.719	4862.75	6600.091	4966.67	0.34
7	4904.66	5019.5	6613.586	5150	33.77
8	4939.885	5110	6624.397	5150	-1.90
9	4994.646	5200.5	6645.063	5000	-3.85

10	5125.116	5200.5	6664.84	5000	-6.54
11	5181.657	5200.5	6679.184	5166.67	-1.59
12	5258.041	5381.5	6698.961	5166.67	1.31
13	5276.928	5562.5	6830.214	5166.67	3.33
14	5422.499	5562.5	6851.811	5166.67	-0.64
15	5564.537	5569.5	7022.617	5680	-1.22
16	5573.594	5562.5	7037.891	5680	-2.91
17	5596.97	5653	7201.444	5680	-0.35
18	5657.125	6286.5	7229.323	5680	1.43
19	6367.285	6377	7266.194	5716.67	-1.44
20	6387.062	6648.5	7286.012	5716.67	3.00
21	6600.091	6648.5	7315.685	5775	-1.28
22	6613.586	6648.5	7370.513	5775	-1.28
23	6624.397	6648.5	7482.821	5775	2.21
24	6645.063	6648.5	7508.922	5775	-3.75
25	6664.84	6648.5	7555.648	5775	-8.33
26	6679.184	6648.5	7611.365	5775	4.05
27	6698.961	6829.5	7917.928	5775	8.96
28	6830.214	6829.5	7962.859	6333.33	3.83
29	6851.811	7010.5	7995.242	6333.33	1.33
30	7022.617	7010.5	8006.917	6100	0.00
31	7037.891	7037.891	7191.5	6100	4.27
32	7201.444	7201.444	7191.5	6300	2.44
33	7229.323	7229.323	7191.5	6300	2.44
34	7266.194	7266.194	7282	6300	-2.33
35	7286.012	7286.012	7372.5	6300	-8.03
36	7315.685	7315.685	7372.5	6300	-3.82
37	7370.513	7370.513	7553.5	6300	-3.08
38	7482.821	7482.821	7553.5	6160	6.21
39	7508.922	7508.922	7553.5	6160	-2.99
40	7555.648	7555.648	7644	6160	-2.99
41	7611.365	7611.365	7915.5	6160	0.16
42	7917.928	7917.928	7915.5	6275	-1.95
43	7962.859	7962.859	7915.5	6275	-3.46
44	7995.242	7995.242	8006	6275	-8.39
45	8006.917	8006.917	8096.5	6625	-2.57
46	8023.08	8023.08	8096.5	6625	3.52
47	8053.627	8053.627	8096.5	6666.67	1.78
48	8082.355	8082.355	8096.5	6666.67	1.78
49	8096.739	8096.739	8277.5	6666.67	0.25
50	8279.262	8279.262	8368	7033.73	1.94
51	8361.079	8361.079	8458.5	6866.67	0.24
52	8398.855	8398.855	8458.5	6866.67	-4.63
53	8416.797	8416.797	8639.5	6866.67	0.98
54	8586.698	8586.698	8639.5	7040	9.15
55	8608.254	8608.254	8639.5	7040	7.48
56	8653.201	8653.201	8911	7040	-3.56
57	8975.038	8975.038	9182.5	6300	-9.35
58	9235.707	9235.707	9363.5	6300	-6.67
59	9439.827	9439.827	9544.5	7550	0.00
60	9636.734	9636.734	9594.5	7700	-1.28

The particular model has to be selected based on maximum number of minimum value of the parameters of residual analysis and average error. The estimated data based on the selected model has to be used to form a knowledge base. It has been observed that ACO has been preferred over all models (table 4) for initial data sets (training data set) using Iris data set. The said concept has also been tallied (table 8) using new data for Iris data set. The modified ACO and other algorithms have been applied on the other data sets like wine data set and Boston city data to produce the estimated data and estimated error. Using Wine data set, it has been observed that out of seven cases modified ACO has been preferred in seven cases (training data table 11) and seven cases in testing data (Table 12). It has been further observed that average error of modified ACO 0.97% (training data) and 0.55% (tested data) as compared to conventional ACO 2.33% (training data) and 2.67% (tested data). Therefore, modified ACO has been considered as preferable optimizer for tested data with an objective of knowledge extraction of tested antecedent data for Wine data. Using Boston city data set, it has been observed that out of seven cases, modified ACO has been preferred by seven cases in both training (Table 13) and testing data (Table 14) respectively. It has been further observed that average error of modified ACO 0.84% (training data) and 1.04% (tested data) as compared to conventional harmony search algorithm 1.97% (training data) and 1.56% (tested data). Therefore the modified ACO has been selected

as the preferable optimizing model for extraction of knowledge for Boston city data. Thereafter for any other new data set, the application of rules as decided by factor analysis and the algorithm of ACO can be applied to from the total effect value (antecedent item) for that.

Table 11

Average Error and Residual Analysis Using Wine Data Set (Training)

Serial Number	Method Name	Sum of Absolute Residual	Maximum Absolute Residual	Mean Absolute Residual	Mean of Mean Absolute Residual	Median of Absolute Residual	Standard Deviation of Absolute residual	Average Error (%)
1	Linear Equation	563239.8	20864.46	11.83	0.07	3715.2	2706.837	6.65
2	Exponential equation	263976.8	16307.86	4.99	0.03	1216.55	1906.527	2.8
3	Asymptotic Equation	916816.2	22028.48	23.31	0.13	6067.63	3349.786	13.1
4	Curvilinear Equation	272310	12907.52	5.82	0.03	363.57	1348.284	3.27
5	Logarithm Equation	500072.4	20067.69	9.84	0.06	3227.99	2545.412	5.53
6	Fuzzy Logic	191872.5	6591.45	3.89	0.02	1043.65	841.5369	2.19
7	Neural Network	90976.54	1019.61	1.97	0.01	17.65	298.4702	1.11
8	GA	77766.62	1019.61	1.6	0.01	17.65	288.5529	0.9
9	PSO	82189.65	1584.68	1.85	0.01	6.18	365.586	1.03
10	ACO	82429.31	1037.39	1.73	0.01	17.65	269.9827	0.97

 Table 12

 Average Error and Residual Analysis Using Wine Data

 Set(Tested)

Serial Number	Method Name	Sum of Absolute Residual	Maximum Absolute Residual	Mean Absolute Residual	Mean of Mean Absolute Residual	Median of Absolute Residual	Standard Deviation of Absolute residual	Average Error (%)
1	Linear Equation	242461.8	17217.92	4.764317	0.071109	4009.03	3294.108	7.11092
2	Exponential equation	121704.4	12757.49	2.082021	0.031075	1494.3	2341.779	3.107494
3	Asymptotic Equation	359025	18334.91	9.129402	0.13626	6385.15	3794.556	13.62597
4	Curvilinear Equation	100678.5	9395.47	2.079314	0.031035	69.74	1615.817	3.103454
5	Logarithm Equation	212114.9	16416.51	3.91513	0.058435	3535.42	3061.499	5.843478
6	Fuzzy Logic	79867.98	3048.42	1.541123	0.023002	1029.17	798.3215	2.300183
7	Neural Network	19454.74	996.42	0.386516	0.005769	<u>3.17</u>	233.6207	0.576889
8	GA	19068.94	996.42	0.372862	0.005565	3.17	234.3948	0.55651
9	PSO	35301.4	2398.57	0.7353	0.0110	8.3	526.5675	1.094
10	ACO	19056.6	<u>996.42</u>	0.372102	0.005554	<u>3.17</u>	234.1222	0.555375

 Table 13

 Average Error and Residual Analysis Using Boston City

 Data (Training)

	Data (Training)									
Serial Number	Method Name	Sum of Absolute Residual	Maximum Absolute Residual	Mean Absolute Residual	Mean of Mean Absolute Residual	Median of Absolute Residual	Standard Deviation of Absolute residual	Average Error (%)		
1	Linear Equation	2608225	30884.83	57.81	0.11	6071.3	4104.223	11.43		
2	Exponential equation	4386720	30783.82	78.66	0.16	10190.87	5003.399	15.55		
3	Asymptotic Equation	1034558	17429.51	24.25	0.05	674.99	2149.16	4.79		
4	Curvilinear Equation	1250565	18522.46	27.79	0.05	118.06	2495.727	5.49		

5	Logarithm Equation	1970980	26466.41	45.18	0.09	3671.98	3411.724	8.93
6	Fuzzy Logic	635987.1	2821.05	10.06	0.02	341.66	813.3729	1.99
7	Neural Network	365430.3	1408.05	6	0.01	1071.34	414.4377	1.18
8	GA	330512.2	1590.05	4.84	0.01	1071.34	411.074	0.96
9	PSO	526228.4	3402.18	6.8	0.01	101.41	976.207	1.35
10	ACO	<u>316549.6</u>	5652.02	<u>4.3</u>	0.01	<u>1071.34</u>	493.7084	0.85

Table 14 Average Error and Residual Analysis Using Tested Data on Boston City Data(Tested)

Serial Number	Method Name	Sum of Absolute Residual	Maximum Absolute Residual	Mean Absolute Residual	Mean of Mean Absolute Residual	Median of Absolute Residual	Standard Deviation of Absolute residual	Average Error (%)
1	Linear Equation	1116324	29669.76	36.8	0.24	5493.49	6083.05	24.37
2	Exponential equation	1591262	29546.42	42	0.28	9629.36	5755.885	27.81
3	Asymptotic Equation	404876.6	16309.43	15.18	0.1	3180.23	3246.44	10.06
4	Curvilinear Equation	458333.7	17380.78	16.63	0.11	3770.79	3551.805	11.02
5	Logarithm Equation	841487.6	25258.46	28.89	0.19	6333.96	5108.946	19.13
6	Fuzzy Logic	198607.2	2804.41	4.09	0.03	304.97	840.9338	2.71
7	Neural Network	114148.3	1391.41	2.26	0.01	1108.03	419.2308	1.5
8	GA	100868.2	1391.41	1.77	0.01	1108.03	414.0762	1.17
9	PSO	147805.6	1791.11	1.52	0.04	803.74	932.314	1.51
10	ACO	<u>99462.27</u>	2845.43	1.57	<u>0.01</u>	1108.03	527.8877	<u>1.04</u>

From previous knowledge, the necessary consequent item (output) may be decided, which is the predicted value or inference knowledge gathered from the applied early data set. In case of Iris flower data the quality of flower can be inference from the input of its attributes. The quality of wine and property tax rate to be pays by the customer can also be predicted based on the attribute of Wine and Boston city data sets. Thereafter, if the said knowledge is available in advance, necessary planning work can be decided by the Governments and various other agencies in the country.

4. CONCLUSION

The applications of rules as decided by factor analysis and principal component analysis have been applied to from the total effect value (antecedent) on the Iris flower data. The methods of statistical analysis and soft computing have been applied on the total effect value to select the preferable method. The decision of the preferable model has been decided by maximum number of minimum parameters of average error and the residual analysis. For checking the validity of model, an effort has been made to get relevant information (knowledge) using new data items (tested data). It has been mentioned that modified harmony search algorithm has been preferred over all models for initial data sets (training data set) using Iris data set. The said concept has been tallied using new data (tested data) for Iris data set.

For any new data set, the said models can be applied to from the cumulative antecedent item for that data set and accordingly a relation can be formed between antecedent item and consequent item for the formation of knowledge base. From previous knowledge, the necessary consequent item may be decided, which is the predicted or inference knowledge gathered from the applied new data set. Knowledge discovery (output extraction) can also be made for different new unknown data set.

Thereafter, if the said information is available in advance, necessary planning work can be decided by the Governments and various other agencies in the country

5. REFERENCES

- [1] Thomas STUTZLE and Marco DORIGO "ACO Algorithms for the Traveling Salesman Problem", *John Wiley & Sons*, 1999
- [2] Wei Zhao; Coll. of Inf. Technol., JiLin Agric. Univ., Changchun, China; Xingsheng Cai; Ying Lan, "A New Ant Colony Algorithm for Solving Traveling Salesman Problem", Computer Science and Electronics Engineering (ICCSEE), 2012 International Conference, Vol.3, pp. 530-533 23-25 March 2012
- [3] Héctor D. Menéndez, Fernando E. B. Otero, David Camacho, "MACOC: A Medoid-Based ACO Clustering Algorithm" 9th International Conference, ANTS 2014, Brussels, Belgium, September 10-12, 2014. Proceedings, pp. 122-133, 2014.
- [4] Xiaoyong Liu, "Ant Colony Optimization Algorithm Based on Dynamical Pheromones for Clustering Analysis", International Journal of Hybrid Information Technology, Vol.7, No.2 (2014), pp.29-38
- [5] K. Ayari, S. Bouktif, G. Antoniol," Automatic Mutation Test Input Data Generation via Ant Colony," In the Proceedings of the 9th annual conference on Genetic and evolutionary computation [GECCO], London, England, July 2007.
- [6] D.J. Mala and V. Mohan, "IntelligenTester Software Test Sequence Optimization Using Graph Based Intelligent Search Agent," In the Proceedings of International Conference on Computational Intelligence and Multimedia Applications [ICCIMA], 2007, pp. 2227.
- [7] K. Li, Z. Yang, "Generating Method of Pair-wise Covering Test Data Based on ACO," In the Proceedings of International Workshop on Educational Technology & International Workshop on Geoscience and Remote Sensing, 2008, pp. 776-779.
- [8] D.J. Mala, M. Kamalapriya, R. Shobhana, V.Mohan, "A NonPheromone based Intelligent Swarm Optimization Technique in Software Test Suite Optimization," In the *Proceedings of IAMA*, 2009.
- [9] P. R. Srivastava, K. Baby, and G Raghurama, "An Approach of Optimal Path Generation using Ant Colony Optimization," In the Proceedings of *TENCON 2009*, *IEEE Press*, 2009, pp. 1-6.
- [10] K. Li, Z. Zhang, and W. Liu, "Automatic Test Data Generation Based On Ant Colony Optimization," In the Proceedings of *Fifth International Conference on Natural Computation (ICNC)*, IEEE Press, 2009, pp. 216-219.
- [11] W. Ding, J. Kou, K. Li, Z. Yang, "An Optimization Method of Test Suite in Regression Test Model," In the Proceedings of the 2009 WRI World Congress on

Software Engineering (WCSE), IEEE Computer Society Washington, DC, USA, Vol. 4, 2009, pp. 180-183.

- [12] M. Chis, "A Survey of the Evolutionary Computation Techniques for Software Engineering," 1st Chapter In Chis, M. (Ed.), Evolutionary Computation and Optimization Algorithms in Software Engineering: Applications and Techniques, 2010, pp. 1-12.
- [13] R. F. Tavares Neto and M. Godinho Filho, "Literature review regarding Ant Colony Optimization applied to scheduling problems: Guidelines for implementation and directions for future research", Engineering Applications of Artificial Intelligence, Volume 26 Issue 1, pp 150-161. January, 2013
- [14] D. P. Singh, J. P. Choudhury and M. De, "A Comparative Study on the performance of Soft Computing models in the domain of Data Mining," *International Journal of Advancements in Computer Science and Information Technology*, Vol. 1, No. 1, pp. 35-49, September, 2011
- [15] D. P. Singh, J. P. Choudhury and M. De, "A Comparative Study to Select a Soft Computing Model for Developing the Knowledge Base of Data mining with Association Rule Formation by Factor Analysis", *International Journal of Artificial Intelligence and Knowledge Discovery*, Vol. 3, No. 3, October, 2013
- [16] D. P. Singh, J. P. Choudhury and M. De, "A comparative study on the performance of Fuzzy Logic, Bayesian Logic and neural network towards Decision Making"*International Journal of Data Analysis Techniques and Strategies (IJDATS)*, Vol. 4, No. 2, pp. 205-216, April, 2012
- [17] D. P. Singh, J. P. Choudhury and M. De, "A Comparative Study to Select a Soft Computing Model for Knowledge Discovery in Data Mining", *International Journal of Artificial Intelligence and Knowledge Discovery*, Vol. 2, No. 2, pp. 6-19, April, 2012.
- [18] D. P. Singh, J. P. Choudhury and M. De, "A comparative study on principal component analysis a nd factor analysis for the formation of association rule in datamining domain", *Proceedings of the* 2nd International Conference on Mathematical, Computational and Statistical Sciences (MCSS '14), Gdansk, Poland, ISBN: 978-960-474-380-3, pp.442-452, May 15-17, 2014, ISI Index

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