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Using the Minimize Distance Method to Find the Best Compromise Solution of Multi-objective Transportation Problem with Case Study

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Abstract The classical transportation problem aims at finding the optimal distribution of a certain product from different sources to different destinations. The objective of this optimal distribution could be minimizing the total transportation cost, time, distance or any other related single objective. In real world applications there are more than one objective function to be studied while transporting products for companies. Therefore, the multi-objective techniques should be implemented on such problems. The minimize distance method is a proofed method to find the best compromise solution of multi-objective linear programming problems. In this paper we applied the minimize distance method on a real two objective transportation problem. Two LINGO codes are prepared to find the best compromise solution and more other efficient solutions to be ready for the decision maker to choose from. The model, the solution algorithm, the collected data and the output results are included in this paper as a case study.

Keywords Transportation problem, an actual case study, Multi-objective linear programming, LINGO

1. Introduction

The French mathematician Gaspard Monge prepared the first transportation problem (T.P.) formula, Abdelwali et al [1]. Then on in the 1920s, Tolstoi, A.N. was one of the first to study the transportation problem mathematically. On 1930, on the collection Transportation Planning Volume number 1, for the National Commissariat of Transportation for the Soviet Union, he published a paper Methods of Finding the Minimal Kilometers in Cargo-transportation in space. Once again, Tolstoi (1939) illuminated his approach by applications to the transportation of cement, salt, and other cargo between different sources and destinations along the railway network of the Soviet Union. On 1941, F.L. Hitchcock worked on the distribution of some products from several sources to numerous localities. Koopman also worked on the optimum utilization of the transportation system and used a model of transportation, in activity analysis of production and allocation. It is known as the Hitchcock Koopman transportation problem [2]. More other papers were published on this topic with more features and methods of solution.

T.P. is a special nature of linear programming. It can be solved by the linear programming simplex method. But due to its special nature, T.P. can be solved easily through its table. To solve any T.P., three steps are needed. These steps are: Finding the initial basic feasible solution, test of optimality and moving towards optimality. There are some packages and software were prepared to find the optimal solution of any T.P. directly, like Tora by Hamdy Taha [3], Manager by Sang. M. Lee [4], and more other packages. Excel solver [5] and Lingo [1] can be used, too, to solve T.P. According to the total availabilities of problem sources and total requirements of destinations, the T.P. could be balanced or unbalanced. Unbalanced problems need to be changed into balanced T.P. by adding a dummy source or a dummy destination. The T.P. data should include more than one source with known availabilities of each source, more than one destination with known requirements of each destination, and the unit cost between each source and each destination. The optimal solution of a classical T.P. generates the distribution of a single product from all sources to all destinations, while this distribution gives the minimum transportation cost. More advanced researches on transportation problem had been introduced to study multi-objective T.P., multilevel T.P., multi-stage, fuzzy T.P., fuzzy multi-objective T.P., interactive fuzzy multi-objective T.P. and more other related advanced researches.

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The classical T.P.s are solved to achieve just a single objective function. This objective could be minimizing the total transportation distances, time, or cost. In real world applications, more objectives should be considered while solving a T.P. In general, the T.P. objectives are conflicting in nature, as a result the simultaneous optimization of objectives is impossible. Multi-objective programming deals with trying to obtain a set of efficient or Pareto optimal solutions. This leads the decision makers (DMs) to seek a most preferred compromise solution rather than optimal one [6]. There are many different methods that are used to solve Multi-objective Transportation Problems (MOTPs). From these methods, goal programming, the weighting method, multiple criteria decision-making procedures, the decomposition approach, the interactive method, the minimize distance method, and many other different methods. Some of these methods are illustrated and implemented in these research papers [2,7,8,9,10,11,12, 13,14]. In this paper, the minimize distance method strategy is applied to find the efficient solutions of a real multi-objective transportation problem.

2. The Minimize Distance Method

Kamal et al [6] introduced a distance-based method for solving multi-objective optimization problems. It is a new model which depends on the goal programming weighted method. The method is proposed based on minimizing the distances between the ideal objectives to the feasible objective space. This method provides the best compromised solution for Multi Objective Linear Programming Problems (MOLPP). The proposed model tackles MOLPP by solving a series of single objective subproblems, where the objectives are transformed into constraints. The generated compromise solution may be improved by defining priorities in terms of the weight. A criterion is also proposed for deciding the best compromise solution. The main advantage of the proposed approach over other approaches is that it can obtain the compromise solution without any preference and for different preferences.

3. Problem Formulation

The multi-objective linear programming (MOLP) formulation based on the minimize distance method is presented in [6]. Based on this method and its formula, the multi-objective transportation problem, with two objective functions, can be derived as follows [6]:

$$Minimize\, F = (f_1 - f_1^*)(1 - w_1)d + \ (f_2 - f_2^*)(1 - w_2)d$$

Subject to:

$$\sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}^1\ x_{ij}^1\ \le\ f_1^* + d(1 - w_1)$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}^2\ x_{ij}^2\ \le\ f_2^* + d(1 - w_2)$$

$$\sum_{i=1}^{m} x_{ij}\ = a_i, \qquad j = 1,2,3,\dots,n.$$

$$\sum_{j=1}^{n} x_{ij}\ = b_i, \qquad i = 1,2,3,\dots,m.$$

$$w_1 + w_2 = 1\ and\ w_l \ge 0; and\ l = 1,2.$$

$$x_{ij} \ge 0, i = 1,2,3,\dots,m\ and\ j = 1,2,3,\dots n.$$

Where:

f^*_1, f^*_2: the obtained ideal objective values by solving single objective T.P.s.

w_1, w_2: weights for objective 1 and objective 2 respectively.

f1, f2: the objective values for the other efficient solutions.

d: the general deviational variable for all objectives.

c_{ij}^1, c_{ij}^2: the unit cost for objectives 1 and 2 from source i to destination j.

x_{ij}^1, x_{ij}^2: the amount to be shipped when optimizing for objectives 1 and 2 from source i to destination j.

4. Solution Algorithm

The solution algorithm as well as a flow-chart for the minimize distance method for solving MOLP problem are introduced in Kama et al [6]. Here is the derived solution algorithm steps for a multi-objective transportation problem.

Step 1. Consider the first objective function only. Solve the transportation problem as a single objective problem ignoring all other objectives subject to the constraints. Then consider the second objective function only and solve the transportation problem as a single objective problem ignoring all other objectives subject to the constraints. If there is more than two objectives, do the same for the other objective functions one by one.

Step 2. Based on the solutions of (Step 1), obtain the Ideal objective values (f^*_1, f^*_2). Then formulate the multi-objective optimization model as a single objective optimization model using the above model.

Step 3. Solve the prepared model (in Step 2) using any of the available solvers such as LINGO (a modelling language and optimizer) or any other solver.

Step 4. If the decision maker is satisfied with the solution so obtained then the process terminates, otherwise proceed to next step.

Step 5. Ask the decision maker to define weights (w_1, w_2) for each objective and repeat from Step 3 to Step 5 until the process terminates.

Table 1. MOTP collected data source capacities, destination demands, and distances and time between them

Source	Objective	St1	St2	St3	St4	St5	St6	St7	St8	St9	St10	St11	St12	St13	St14	St15	St16	St17	St18	St19	St20	St21	St22	St23	St24	St25	St26	Availabilites
W1	Distance	219	419	28	218	0	151	135	18	120	138	629	84	87	39	514	53	207	193	64	10	182	252	154	247	25	106	382
	Time	164	314	33	163	0	140	101	23	90	103	471	63	80	29	385	45	155	144	55	14	136	189	115	185	18	79	
W2	Distance	123	373	124	122	96	248	39	114	24	235	533	180	183	135	418	149	111	97	160	86	86	126	58	151	71	10	1536
	Time	92	279	98	91	72	225	40	85	18	176	399	135	137	101	313	111	83	72	120	64	64	94	43	113	53	17	
W3	Distance	272	522	45	271	53	98	188	35	173	85	682	31	34	14	517	0	260	246	15	63	235	275	257	300	88	159	1011
	Time	204	391	33	203	39	86	141	35	129	70	511	23	25	15	387	0	195	184	18	47	185	206	192	225	66	119	
W4	Distance	169	419	78	168	50	202	85	680	70	189	579	134	137	89	464	103	157	143	114	40	132	172	104	197	25	56	3580
	Time	126	314	65	126	37	180	75	51	52	120	434	100	80	66	348	60	117	107	76	30	99	129	78	147	18	42	
W5	Distance	372	622	144	371	152	53	288	134	273	40	782	86	97	113	667	99	360	346	114	162	335	375	307	40	177	259	1048
	Time	279	466	108	278	114	45	216	100	204	35	586	64	72	90	500	80	270	259	90	121	200	281	230	300	132	194	
W6	Distance	279	45	452	278	424	571	289	442	304	563	205	508	511	463	90	477	267	253	488	414	242	282	270	307	399	318	281
	Time	209	33	339	208	318	428	216	331	228	422	153	381	383	347	67	357	200	189	366	310	181	211	202	230	299	238	
W7	Distance	345	595	117	344	125	26	261	107	246	13	755	59	70	86	640	72	33	319	87	135	308	348	280	373	150	232	1490
	Time	258	446	90	258	93	25	195	80	184	9	566	44	52	64	480	60	249	239	70	101	190	261	210	279	112	174	
W8	Distance	37	287	210	36	182	334	47	200	62	321	447	266	269	221	321	235	25	11	246	172	0	40	28	65	157	76	2012
	Time	27	215	157	37	136	200	35	150	46	180	335	199	185	165	240	155	23	16	170	129	0	30	21	48	117	57	
W9	Distance	294	544	67	293	75	76	210	57	195	63	704	9	20	36	589	22	282	218	37	85	257	297	229	322	100	181	615
	Time	220	408	65	219	56	70	157	42	146	40	528	6	15	35	441	16	211	163	32	63	180	222	171	241	75	135	
W10	Distance	77	303	194	71	166	318	31	184	46	305	463	250	253	205	337	219	65	51	230	156	40	80	12	105	141	60	3140
	Time	57	227	145	53	124	253	23	138	34	228	347	187	189	153	252	164	48	45	172	117	30	60	13	78	105	45	
W11	Distance	327	577	100	321	108	109	243	90	228	96	737	24	53	69	622	55	315	301	70	118	290	330	262	355	133	214	2297
	Time	245	432	80	240	81	95	182	67	171	87	552	18	39	60	466	41	236	225	60	88	217	247	196	266	99	160	
W12	Distance	148	398	99	147	71	223	64	89	49	210	558	155	158	110	443	124	136	122	135	61	111	151	83	176	46	35	1877
	Time	111	298	80	110	53	200	60	66	36	157	418	116	100	82	332	75	102	91	95	45	83	113	62	132	34	35	
W13	Distance	194	444	53	193	25	176	110	43	95	163	604	109	112	74	489	88	182	168	99	15	157	197	129	22	0	81	156
	Time	145	333	45	144	18	160	82	45	71	122	453	81	95	55	366	66	136	126	83	16	117	147	96	166	0	60	
W14	Distance	237	487	10	231	18	133	153	0	138	120	647	61	69	21	532	35	225	211	46	28	200	240	172	215	43	124	104
	Time	177	365	15	173	24	120	114	0	103	90	485	45	60	15	399	30	168	158	40	21	150	180	129	161	32	93	
W15	Distance	99	349	148	98	120	272	15	138	0	259	509	204	207	159	394	173	87	73	184	11	62	102	34	127	95	14	154
	Time	74	261	111	73	90	240	20	103	0	194	381	153	155	119	295	129	65	54	138	83	46	76	30	95	71	16	
W16	Distance	61	311	234	12	206	358	71	224	86	345	471	290	293	245	345	259	49	32	270	196	24	64	52	41	181	100	2910
	Time	45	233	175	18	154	254	53	168	64	258	353	217	219	183	258	194	36	34	202	147	25	48	39	30	135	75	
Requirements		643	32	797	1123	1809	1744	1505	89	745	1295	171	210	979	897	313	27	1108	1294	774	1307	156	413	1449	460	2234	1019	

Table 2. MOTP ideal and efficient distribution between sources and destinations

Case	Weights Assigned	Z1 (Ton-Kilometers)	Z2 (Ton-Minutes)	Distance from Ideal Solution	Case Solution
1	w1=0.0, w2=1.0	890639	717480	6811	X15 = 382, X27 = 170, X29 = 389, X226 = 977, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 320, X611 = 171, X615 = 780, X76 = 696, X710 = 794, X81 = 643, X818 = 800, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1018 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 270, X1119 = 660, X1203 = 910, X1209 = 356, X1220 = 1307, X1225 = 810, X1226 = 420, X1303 = 156, X1403 = 150, X1408 = 890, X1507 = 154, X1604 = 1123, X1617 = 1108, X1618 = 219, X1624 = 460.
2	w1=0.1, w2=0.9	889595	718120	5802.403726	X15 = 382, X27 = 170, X29 = 741, X226 = 625, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 320, X611 = 171, X615 = 780, X76 = 696, X710 = 794, X81 = 643, X817 = 730, X818 = 727, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 270, X1119 = 660, X1203 = 910, X1209 = 400, X1220 = 1307, X1225 = 810, X1226 = 394, X1303 = 156, X1403 = 150, X1408 = 890, X1507 = 154, X1604 = 1123, X1617 = 760, X1618 = 567, X1624 = 460.
3	w1=0.2, w2=0.8	889178	718815	5514.047969	X15 = 382, X27 = 170X29 = 745, X226 = 621, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 320, X611 = 171, X615 = 780, X76 = 696, X710 = 794, X81 = 643, X817 = 212, X818 = 588, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 270, X1119 = 660, X1203 = 910, X1220 = 1307, X1225 = 810, X1226 = 398, X1303 = 156, X1403 = 150, X1408 = 890, X1507 = 154, X1604 = 1123, X1617 = 621, X1618 = 706, X1624 = 460.
4	w1=0.3, w2=0.7	888722	719575	5323.557175	X15 = 382X27 = 170, X29 = 745, X226 = 621, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X817 = 364, X818 = 436, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1220 = 1307, X1225 = 81, X1226 = 398, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 469, X1618 = 858, X1624 = 460.
5	w1=0.4, w2=0.6	888221	720409	5279.913825	X15 = 382, X27 = 170, X29 = 745, X226 = 621, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X817 = 531, X818 = 269, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1220 = 1307, X1225 = 81, X1226 = 398, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 302, X1618 = 1025, X1624 = 460.
6	w1=0.5, w2=0.5	887672	721324	5436.236934	X15 = 382, X27 = 170, X29 = 740, X226 = 626, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X817 = 714, X818 = 86, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1209 = 5, X1220 = 1307, X1225 = 81, X1226 = 393, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 119, X1624 = 460.
7	w1=0.6, w2=0.4	887414	721755	5579.876432	X15 = 382, X27 = 170, X29 = 730, X226 = 636, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X817 = 800, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1209 = 15, X1220 = 1307, X1225 = 81, X1226 = 383, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 33, X1618 = 1294, X1624 = 460.
8	w1=0.7, w2=0.3	887414	721755	5579.876432	X15 = 382, X27 = 170, X29 = 745, X226 = 621, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X817 = 800, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1220 = 1307, X1225 = 81, X1226 = 398, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 33, X1618 = 1294, X1624 = 460.

Case	Weights Assigned	Z1 (Ton-Kilometers)	Z2 (Ton-Minutes)	Distance from Ideal Solution	Case Solution
9	w1=0.8, w2=0.2	887414	721755	5579.876432	X15 = 382, X27 = 170, X29 = 741, X226 = 625, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X817 = 800, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1209 = 4, X1220 = 1307, X1225 = 81, X1226 = 394, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 33, X1618 = 1294, X1624 = 460.
10	w1=0.9, w2=0.1	890639	717480	6811	X15 = 382, X27 = 170, X29 = 745, X226 = 621, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X818 = 800, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1018 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1220 = 1307, X1225 = 81, X1226 = 398, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 1108, X1618 = 219, X1624 = 460.
11	w1=1.0, w2=0.0	883828	752803	35323	X15 = 382, X27 = 168, X29 = 617, X226 = 751, X33 = 535, X314 = 476, X45 = 1414, X425 = 2166, X56 = 1048, X62 = 320, X611 = 171, X615 = 780, X76 = 696, X710 = 794, X81 = 643, X817 = 800, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1337, X1015 = 235, X1017 = 119, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 270, X1119 = 660, X1203 = 247, X1205 = 130, X1209 = 128, X1220 = 1153, X1225 = 680, X1226 = 268, X1324 = 156, X1403 = 150, X1408 = 890, X1520 = 154, X1604 = 1123, X1617 = 189, X1618 = 1294, X1624 = 304.
12	Without Preference – Best Compromise Solution	888353	720190	5274.440729	X15 = 382, X27 = 170, X29 = 347, X226 = 1019, X33 = 535, X314 = 476, X45 = 1422, X425 = 2158, X56 = 1048, X62 = 320, X611 = 171, X615 = 780, X76 = 696, X710 = 794, X81 = 643, X817 = 487, X818 = 313, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 270, X1119 = 660, X1203 = 960, X1209 = 398, X1220 = 1307, X1225 = 760, X1303 = 151, X1305 = 500, X1403 = 150, X1408 = 890, X1507 = 154, X1604 = 1123, X1617 = 346, X1618 = 981, X1624 = 460.
13	w1=0.3745681, w2=0.6254319	888353	720190	5274.440729	X15 = 382, X27 = 170, X29 = 741, X226 = 625, X33 = 535, X314 = 476, X45 = 1427, X425 = 2153, X56 = 1048, X62 = 32, X611 = 171, X615 = 78, X76 = 696, X710 = 794, X81 = 643, X817 = 487, X818 = 313, X821 = 156, X822 = 413, X910 = 501, X919 = 114, X1007 = 1181, X1015 = 235, X1017 = 275, X1023 = 1449, X1112 = 210, X1113 = 979, X1114 = 421, X1116 = 27, X1119 = 660, X1203 = 91, X1209 = 4, X1220 = 1307, X1225 = 81, X1226 = 394, X1303 = 156, X1403 = 15, X1408 = 89, X1507 = 154, X1604 = 1123, X1617 = 346, X1618 = 981, X1624 = 460.

5. Case Study and Result Analysis

The minimize distance method formulation and solution algorithm are applied on the M.E.M.C. company. The M.E.M.C. is a big company that produces and distributes flour in 5 governorates in Egypt. Their mills exist in 16 cities while the company distributes flour to 26 major cities. The company produces several types of flour. We considered just one product in this paper. The data of the M.E.M.C. was introduced and solved as a single objective transportation problem by Abdelwali et al [1]. The data required for the multi-objective T.P. are prepared and illustrated in Table (1) below. Due to the road surface, number of lanes and the different speed limits from one road to the other in this transportation network, distance and time are independent of each other. So, these two objectives are conflicting. As a result, the ideal solution as well as the best compromise solution differ from each other.

A LINGO code is prepared to solve the M.E.M.C. transportation problem as a multi-objective problem. Table (2) above summarizes the output of the studied problem. This code could generate the best compromise solution of the studied problem which exists at the lowest distance from the ideal solution. The distances from each efficient solution from the ideal solution are calculated based on the distance formula that is prepared by El-Wahed et al [12]. Another LINGO code is prepared to validate the results of the first code and to be ready for the decision maker (DM) if s/he is not satisfied by the generated compromise solution. This second code is based on the weights of each objective (w_1, w_2) that the DM would like to choose or change.

The best compromise solution is illustrated in Table (2), row (12). The ideal solution for objective 1 is included in Table (2), row (11), while the ideal solution for objective 2 is included in Table (2), row (1). Rows (2) to (10) includes more efficient solutions to be ready for the D.M. to choose from based on different weights of both objectives. Finally, row (13) presented the results of the second LINGO code to validate the results of code 1.

From the results of Table (1,2), it is clear that the best compromise solution exists at the minimum distance of the generated solution from the ideal solutions. This reflects the power of the minimize distance method to find the best compromise solution of multi-objective transportation problems.

6. Conclusions

The minimize distance method by Kamal et al [6] is applied on a real two objective transportation problem. This methos is applied on a mills company called M.E.M.C. that exists in middle Egypt. Two LINGO codes are prepared to find the best compromise solution and more other efficient solutions to be ready for the decision maker to choose from if he is not satisfied with the generated best compromise solution. All the output results are included in this paper. It is found that the gives the minimum distance from the ideal solution of both objectives. This reflects the power of the minimize distance method. When compared by the actual distribution, there are huge savings of both distance and time with the best compromise solution, and all other efficient solutions.

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