

How to Cite:

Kafaji, S. M. H. A., & Shiker, M. A. K. (2022). Improvement time estimate of network optimization. *International Journal of Health Sciences*, 6(S6), 9361–9375.

<https://doi.org/10.53730/ijhs.v6nS6.12437>

Improvement time estimate of network optimization

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Abstract---It's known that the network is a graph that connects activities to points, as in every project the representation of activities and points varies, where the researchers previously assumed a weighted estimate of the time through a law in which they put the optimistic time estimate with the pessimistic time estimate with a weight of 1 and decided to give a greater weight to the weighted time estimate of 4, while in our current research it was proposed to improve the time estimate more likely and make it closer to reality with the achievement of the required results without any negative impact on the project, where the cost and time are reduced while the results are satisfactory, as we can give less weight to the weighted time estimate of 3 instead of 4 to estimate the potential time for distributors, while the pessimistic and optimistic time estimates remain the same with a weight of 1 for each of them. This change gives reasonable and close to reality results, and it's leads to reduce the time to complete the project completely, as the results have been achieved in less time than the estimate of the usual time by less than estimate the optimistic time in a small percentage as well, that it takes the medium term between them, which helps not only to exceed the project schedule, but rather the project will be completed in less time than the usual time.

Keywords---time estimate, pessimistic time estimate, optimistic time estimate, most likely time estimate, predecessor event, successor event, critical path, critical activity.

Introduction

The network term is constituted by a certain set of points where linking their own links and is also a series of relationships, activities, and events associated with each other as exemplified by a series of actions [1, 2]. For example, the manufacturer of a product after complement their production process must by transfer of manufactured goods to the stores or shops consuming business to be the executive director of the company determine the path shortest distance to reduce the cost of transport. The common examples of networks is upon receipt of a company for a project must complete projects in their estimated time or less than the agreed time and can't be exceeded that time in order to maintain the company and its reputation in the commercial market [3, 4]. Project network is a diagram linking the activities and duration allocated to complete this project by the activities of this project and to identify the network plan for the project.

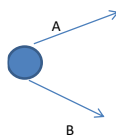
Importance of the project network

The importance of the project network is the main importance of creating a schedule and an arrow chart for a particular project is not only to organize the tasks and know when they must be implemented, but also to know which of the tasks must be completed and which of them can be overcome while maintaining the achievement of the goals and objectives of the project [5, 6].

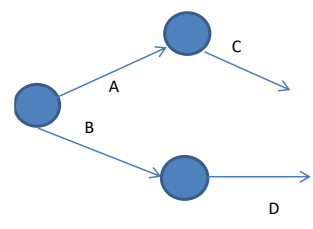
Example 1 7 Use the data below to construct network diagram.

Activity	Immediate predecessor activity
A	-
B	-
C	A
D	B
E	A
F	C,D
G	E
H	E
I	F,G
J	H,I

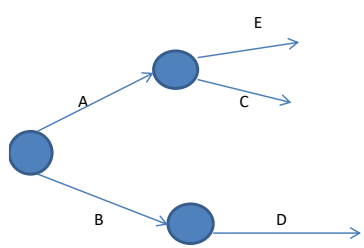
Solution: The two activities A and B do not have a previous event, that is, they are the first in the network.



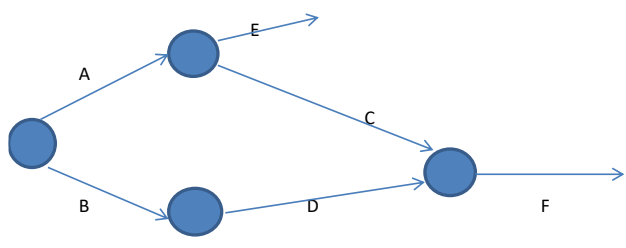
An activity A is an event that precedes the activity C.
An activity B is an event that precedes the activity D.



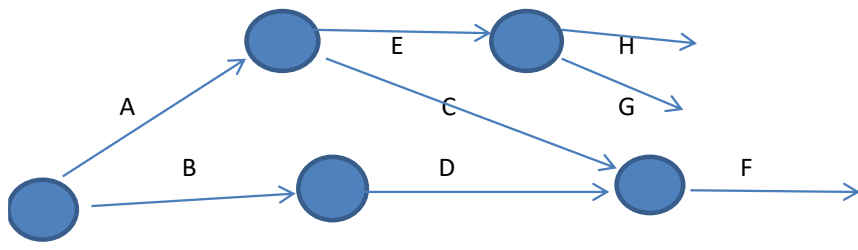
An activity A is an event that precedes the activity E



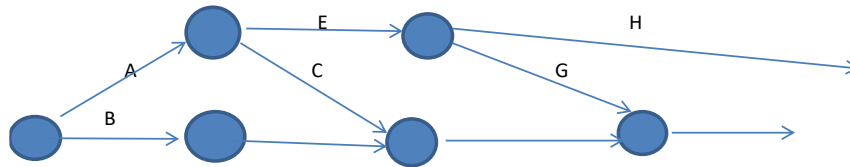
The two activities C, D are preceding the activity F



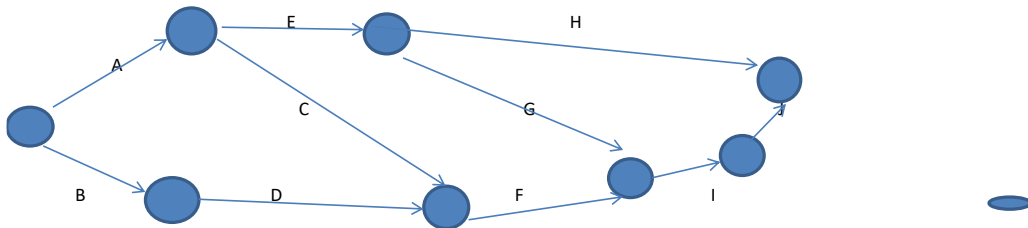
An activity E is an event that precedes the activity H, G



The two activities F and G are preceding the activity I



The two activities I and H are preceding the activity J



Time Estimate

Basic preparations to start the work on any project should be an estimate of the time of termination this project. It is by the administrators of recipients of the project, where one of them is a short time of optimism is assumed on the assumption that there will be no problems during the work and then another pessimistic time suggests assuming that there is a non- problems unexpected as possible to occur during the period of work and thus will consume a lot of time [8, 9]. In fact, what utter the mind is the estimated time between optimistic and pessimistic, it is called time- usual is likely and obviously that estimate the time optimistic less than the estimated time normal and is, in turn, less than the estimated time pessimistic and former researchers have an estimate of the most likely time estimated for any project where they assumed in practice it is likely not withstand appreciation of the pessimistic or optimistic so they decided to give more weight to estimate the time likely of 4 to estimate the likely time for distributors while time estimates pessimistic and optimistic weight of 1 for each one [10, 11]. Therefore, there are three types of time estimation:

- Pessimistic time estimate ,
- Most likely time estimate,
- Optimistic time estimate

The mathematical law is

$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

Where: t_e : Time estimate, t_o : Optimistic time estimate, t_m : Most likely time estimate, t_p : Pessimistic time estimate

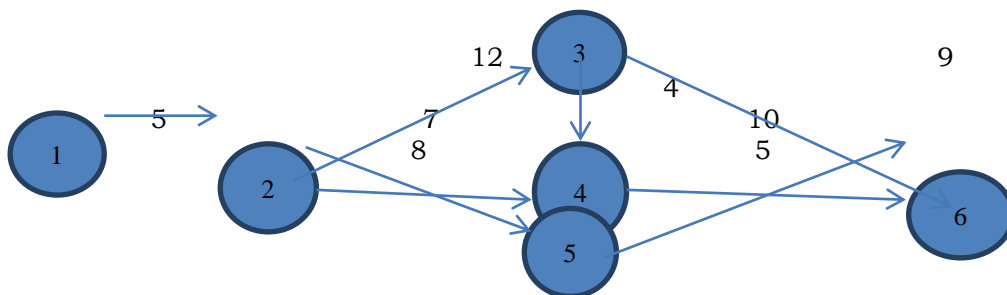
Example 2 [12]: Find the time required to complete the next project and then find the critical path and critical activities.

Activity	t_o	t_m	t_p
1-2	2	5	8
2-3	8	11	20
3-4	2	4	6
2-4	4	7	10
2-5	4	8	12
4-6	6	10	14
5-6	3	5	7
3-6	4	9	14

Solution: From the three time estimate t_p , t_m and t_o calculate t_e we get:

Activity	t_o	$4*t_m$	t_p	t_e
1-2	2	5(4)	8	5
2-3	8	11(4)	20	12
3-4	2	4(4)	6	4
2-4	4	7(4)	10	7
2-5	4	8(4)	12	8
4-6	6	10(4)	14	10
5-6	3	5(4)	7	5
3-6	4	9(4)	14	9

By using the single time estimate we get:



Consider the path starting at the starting point and stopping at the end point.

- Path 1: 1- 2- 3- 6, Time of the path $5+12+9=26$
 Path 2: 1- 2- 3- 4- 6, Time of the path $5+12+4+10=31$
 Path 3: 1- 2- 4- 6, Time of the path $5+7+10=22$
 Path 4: 1- 2- 5- 6, Time of the path $5+8+5=18$
 Max of {26, 31, 22, 18}= 31

The path 2 has the max time, so it is the critical path and 1-2, 2-3, 3-4, 4-6 are the critical activities.

The rest of the edges are non-critical activities, such that project time 31 weeks.

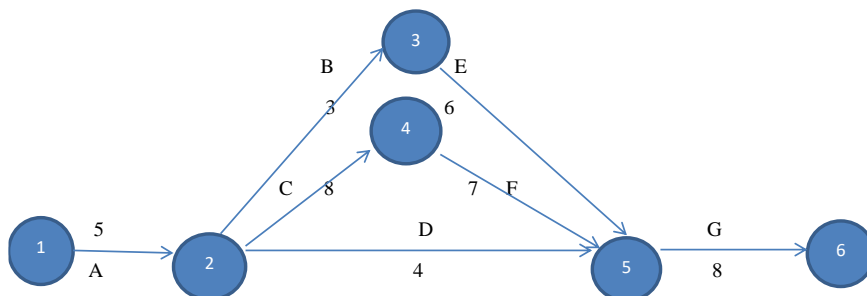
Example 3 [13]: For the following data, find the probability that the project will be completed in 30 weeks or less.

Activity	Predecessor activity	t_o day	t_m day	t_p day
A	-	2	5	8
B	A	2	3	4
C	A	6	8	10
D	A	2	4	6
E	B	2	6	10
F	C	6	7	8
G	D,E,F	6	8	10

Solution: From the estimates t_p, t_m and t_o compute t_e we get:

Activity	t_o	$4*t_m$	t_p	t_e
A	2	20	8	5
B	2	12	4	3
C	6	32	10	8
D	2	16	6	4
E	2	24	10	6
F	6	28	8	7
G	6	32	10	8

We get:



Consider the path starting at the starting point and stopping at the end point

PATH 1: A- B- E- G

Time = 5+3+6+8=22

PATH 2: A- C- F- G

Time = 5+8+7+8=28

PATH 3: A- D- G
 Time = 5+4+8=17
 Max {22, 28, 17}= 28

So path 2 is the critical path and A, C, F, G are the critical activities. The project time = 28 Weeks.

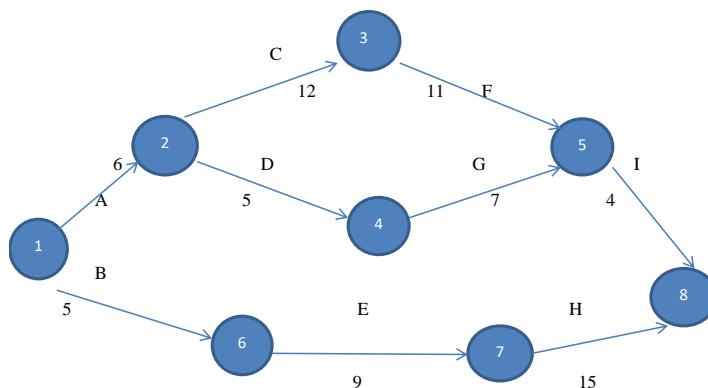
Example 4: Find the required time and the critical path and critical activities.

Activity	t_o day	t_m day	t_p day
1-2	3	6	9
1-6	2	5	8
2-3	6	12	18
2-4	4	5	6
3-5	8	11	14
4-5	3	7	11
6-7	3	9	15
5-8	2	4	6
7-8	8	16	18

Solution: From the estimates t_p , t_m and t_o compute t_e we get:

Activity	t_o	$4 * t_m$	t_p	t_e
1-2	3	24	9	6
1-6	2	20	8	5
2-3	6	48	18	12
2-4	4	20	6	5
3-5	8	44	14	11
4-5	3	28	11	7
6-7	3	36	15	9
5-8	2	16	6	4
7-8	8	64	18	15

We get:



Consider the path starting at the starting point and stopping at the end point

PATH 1: A- C- F- I

Time = 6+12+11+4=33

PATH 2: A- D- G- I

Time = 6+5+7+4=22

PATH 3: B- E- H

Time = 5+9+15=29

Max {22, 33, 29} = 33

So, path 1 is the critical path and A, C, F, I are the critical activities.

The rest of the edges are non-critical activities, such that project time 33 weeks

Improvement time estimate

The authors introduced many papers in various types of sciences such as optimization [14- 24], operation research [25- 33], and reliability [34- 43], but in this work we propose a technique to improve the most likely estimate time for any project where we get less weight to estimate the time weighted of 2 instead of 4 for distributors while estimates of time pessimistic and optimistic weight of 1 because we see that giving weight 2 instead of 4 gives reasonable results, closer to reality, and appropriate degree of reliability. As well as to reduce the complete time of the project with achieve the desired goals and achieve results less than the estimated time obtained by the classic methods. It takes the medium term between them and this leads to reduce the time and cost without causing a negative impact on the project in general, and this leads not to schedule exceeded the project and that exceeded the time for any reason, whether an event was possible or potential problems do not take a large socket of time, but rather more than a little thing and due to the application of existing controls within the scheme of the project to coincide with the time of each paragraph as it is the law would be as follows called this improvement (SA_2). The mathematical law is

$$t_e = \frac{t_o + 3t_m + t_p}{5} - 1$$

Such that:

We will demonstrate this by applying the idea of optimization to the previous examples.

Example 5: For the following data, use (SA_2) to find the time and the critical path and critical activities.

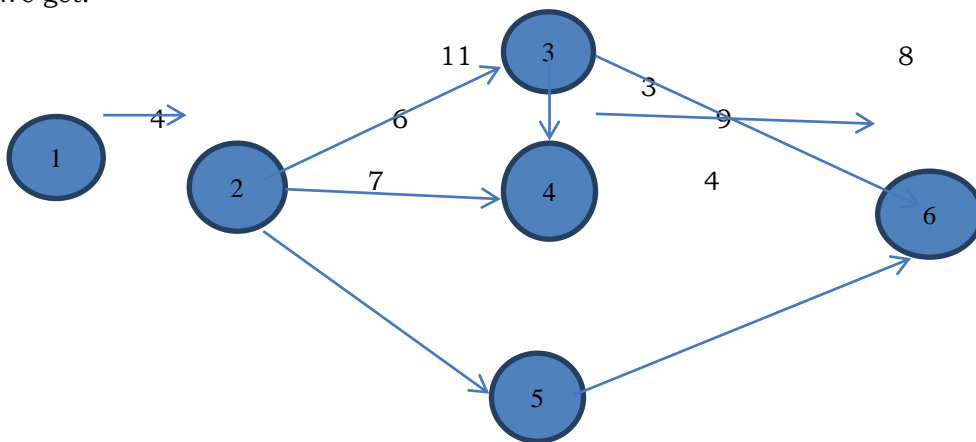
Activity	Optimistic estimate t_o	Most likely time estimate t_m	Pessimistic time Estimate t_p
1-2	2	5	8
2-3	8	11	20
3-4	2	4	6
2-4	4	7	10
2-5	4	8	12
4-6	6	10	14
5-6	3	5	7

3-6	4	9	14
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Solution: From the estimates t_p , t_m and t_o compute t_e we get:

Activity	t_o	$3*t_m$	t_p	t_e
1-2	2	5(3)	8	4
2-3	8	11(3)	20	11.2=11
3-4	2	4(3)	6	3
2-4	4	7(3)	10	6
2-5	4	8(3)	12	7
4-6	6	10(3)	14	9
5-6	3	5(3)	7	4
3-6	4	9(3)	14	8

We get:



Consider the path starting at the starting point and stopping at the end point

Path 1: 1- 2- 3- 6

Time of the path $4+11+8=23$

Path 2: 1- 2- 3- 4- 6

Time of the path $4+11+3+9=27$

Path 3: 1- 2- 4- 6

Time of the path $4+6+9=19$

Path 4: 1- 2- 5- 6

Time of the path $4+7+4=15$

$\text{Max}\{27, 19, 23, 15\} = 27$

So, path 2 is the critical path and 1- 2, 2- 3, 3- 4, 4- 6 are the critical activities.

The rest of the edges are non-critical activities, such that project time 27 weeks.

Example 6: For the following data, use (**SA₂**) to find the probability that the project will be completed in 30 weeks or less.

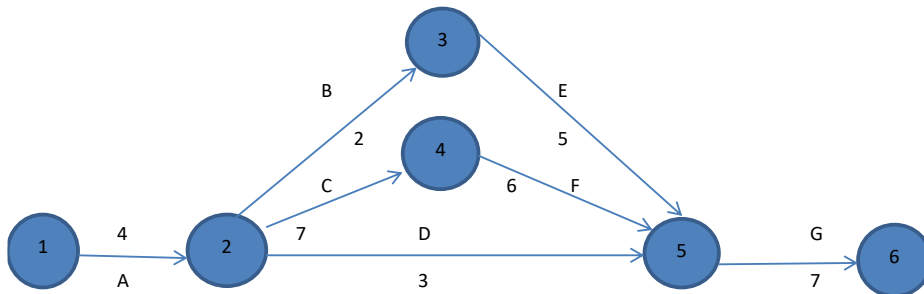
Activity	Predecessor activity	t_o day	t_m day	t_p day
A	-	2	5	8

B	A	2	3	4
C	A	6	8	10
D	A	2	4	6
E	B	2	6	10
F	C	6	7	8
G	D,E,F	6	8	10

Solution: By using the estimates t_p , t_m and t_o compute t_e we get:

Activity	t_o	$3*t_m$	t_p	t_e
A	2	15	8	4
B	2	9	4	2
C	6	24	10	7
D	2	12	6	3
E	2	18	10	5
F	6	21	8	6
G	6	24	10	7

We get:



So,

Path 1: A- B- E- G

Time of the path $4+2+5+7=18$

Path 2: A- C- F- G

Time of the path $4+7+6+7=24$

Path 3: A- D- G

Time of the path $4+2+7=13$

$\text{Max}\{13, 24, 18\} = 24$

So, path 2 is the critical paths and A, C, F, G are the critical activities. The time = 24 weeks.

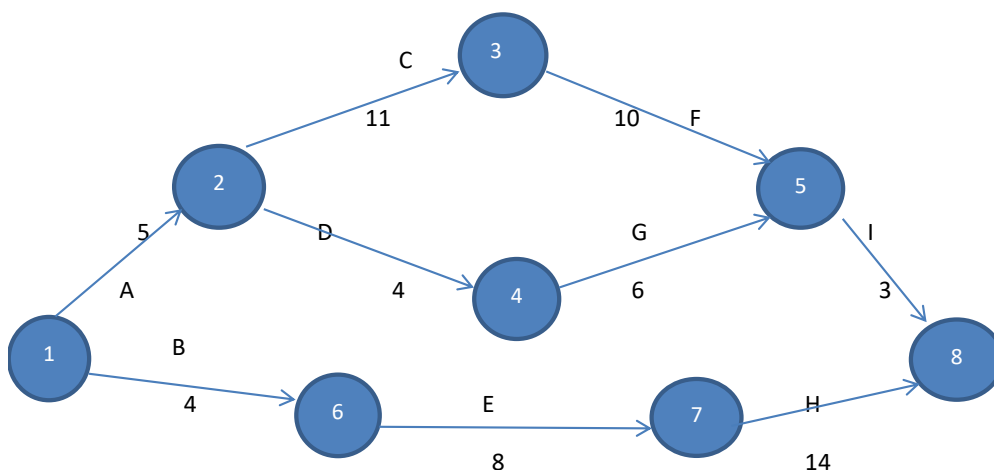
Example 7: For the following data, use (SA_2) to find the time and critical path and critical activities.

Activity	t_o day	t_m day	t_p day
1-2	3	6	9
1-6	2	5	8
2-3	6	12	18
2-4	4	5	6
3-5	8	11	14
4-5	3	7	11
6-7	3	9	15
5-8	2	4	6
7-8	8	16	18

Solution: By using the estimates t_p , t_m and t_o compute t_e we get:

Activity	t_o	$3*t_m$	t_p	t_e
1-2	3	18	9	5
1-6	2	15	8	4
2-3	6	36	18	11
2-4	4	15	6	4
3-5	8	33	14	10
4-5	3	21	11	6
6-7	3	27	15	8
5-8	2	12	6	3
7-8	8	48	18	13.8=14

We get:



Consider the path starting at the starting point and stopping at the end point

Path 1: A- C- F- I

Time of the path $5+11+10+3=29$

Path 2: A- D- G- I

Time of the path $5+4+6+3=18$

Path 3: B- E- H

Time of the path $4+8+14=26$

Max {29, 18, 26} = 29

So, path 1 is the critical path and A, C, F, I are the critical activities.

The rest of the edges are non-critical activities, such that project time 29 weeks.

Comparison

Comparison of example results for the estimated time before optimization and the estimated time after optimization:

Table 1
Comparison of example results

Examples	Results of time estimate	Examples	Results of improvement time estimate
Example 2	31	Example 5	27
Example 3	28	Example 6	24
Example 4	33	Example 7	29

Conclusion

It has been shown through the above explanation that time estimation has three types, they are optimistic time estimation, most likely time estimation, and pessimistic time estimation, and that there is a relationship between them called estimated time so that it gives results for time similar to the results of estimating most likely time often. In this work, an improvement has been suggested for estimating time that is, we obtain an estimated time close to reality, and its range between an optimistic estimate of time and an estimate of the most likely time, and its results are always close to the estimate of the most likely time than to the estimate of the optimistic time, which makes it more appropriate and slightly less than the results of the previous one, that is, it is a shortening of time without any negative impact on the project.

References

1. H. J. Kadhim and M. A. K. Shiker, Solving QAP with large size 10 facilities and 10 locations, Journal of Positive School Psychology, **6**: 2, p. 5465 – 5471. 2022.
2. A.,T. Hamdy, Operation Research An Introduction, Pearson Education, Inc., Prentice hall, 9 edition, Newjersey, USA, 2011.
3. F. H. Abd Alsharif, G.A. Mudhar, and Z. A. H. Hassan, A modified technique to compute the minimal path sets for the reliability of the complex network, Journal of Physics: Conference Series, 1999(1) 012083, 2021.

4. F. H. Abd Alsharify, Z. A. H. Hassan, Computing the reliability of a complex network using two techniques, *Journal of Physics: Conference Series*, 1963(1) 012016, 2021.
5. F. L. Hitchcock, The distribution of a product from several sources to numerous localities. *Journal of mathematics and physics*, Vol. 20, no. 1, pp. 224- 230, 1941.
6. G. Abdullah and Z. A. H. Hassan, A Comparison Between Genetic Algorithm and Practical Swarm to Investigate the Reliability Allocation of Complex Network, *J. Phys.: Conf. Ser.* 1818 (1) 012163, 2021.
7. G. Abdullah and Z. A. H. Hassan, Use of Bees Colony algorithm to allocate and improve reliability of complex network, *Journal of Physics: Conference Series*, 1999(1) 012081, 2021.
8. G. Abdullah and Z. A. H. Hassan, Using of Genetic Algorithm to Evaluate Reliability Allocation and Optimization of Complex Network, *I.O.P. Conf. Ser.: Mater. Sci. Eng.* 928(4) 0420333, 2020.
9. G. Abdullah and Z. A. H. Hassan, Using of particle swarm optimization (PSO) to address reliability allocation of complex network, *J. Phys.: Conf. Ser.* 1664 (1) 012125, 2020.
10. H. A. Hussein and M. A. K. Shiker, A modification to Vogel's approximation method to solve transportation problems, *J. Phys.: Conf. Ser.* no. 1591, 012029, 2020.
11. H. A. Hussein and M. A. K. Shiker, Two new effective methods to find the optimal solution for the assignment problems, *Journal of Advanced Research in Dynamical and Control Systems*, vol.12, no. 7, pp. 49- 54, 2020.
12. H. A. Hussein, M. A. K. Shiker, and M. S. M. Zabiba, A new revised efficient of V.A.M. to find the initial solution for the transportation problem, *J. Phys.: Conf. Ser.* no. 1591, 012032, 2020.
13. H. A. Mueen and M. A. K. Shiker, A New projection technique with gradient property to solve optimization problems, *J. Phys.: Conf. Ser.* 1963, 012111, 2021.
14. H. A. Mueen and M. A. K. Shiker, Using a new modification of trust region spectral (T.R.S.) approach to solve optimization problems, *J. Phys.: Conf. Ser.* 1963, 012090, 2021.
15. H. A. Wasi and M. A. K. Shiker, A modified of F.R. method to solve unconstrained optimization, *J. Phys.: Conf. Ser.* 1804, 012023, 2021.
16. H. A. Wasi and M. A. K. Shiker, A new hybrid C.G.M. for unconstrained optimization problems, *J. Phys.: Conf. Ser.* no. 1664, 012077, 2020.
17. H. A. Wasi and M. A. K. Shiker, Nonlinear conjugate gradient method with modified Armijo condition to solve unconstrained optimization, *J. Phys.: Conf. Ser.* 1818, 012021, 2021.
18. H. A. Wasi and M. A. K. Shiker, Proposed C.G. method to solve unconstrained optimization problems, *J. Phys.: Conf. Ser.* 1804, 012024, 2021.
19. H. H. Dwail and M. A. K. Shiker Using a trust region method with non monotone technique to solve an unrestricted optimization problem, *J. Phys.: Conf. Ser.* 1664, 012128, 2020.
20. H. H. Dwail and M. A. K. Shiker, Reducing the time that T.R.M. requires to solve systems of nonlinear equations, *I.O.P. Conf. Ser.: Mater. Sci. Eng.* 928, 042043, 2020.

21. H. H. Dwail and M. A. K. Shiker, Using trust region method with BFGS technique for solving nonlinear systems of equations, J. Phys.: Conf. Ser. 1818, 012022, 2021.
22. H. H. Dwail et al., A new modified T.R. algorithm with adaptive radius to solve a nonlinear systems of equations, J. Phys.: Conf. Ser. 1804, 012108, 2021.
23. H. H. Dwail, M. M. Mahdi, and M. A. K. Shiker, CG method with modifying β_k for solving unconstrained optimization problems, Journal of Interdisciplinary Mathematics, DOI: 10.1080/09720502.2022.2040854. 2022.
24. H. J. Kadhim, M. A. K. Shiker and H. A. Hussein, A New technique for finding the optimal solution to assignment problems with maximization objective function, J. Phys.: Conf. Ser. 1963 012104, 2021.
25. H. J. Kadhim, M. A. K. Shiker and H. A. Hussein, New technique for finding the maximization to transportation problems J. Phys.: Conf. Ser. 1963, 012070, 2021.
26. Handayani, N. D., Mantra, I. B. N., & Suwandi, I. N. (2019). Integrating collaborative learning in cyclic learning sessions to promote students' reading comprehension and critical thinking. International Research Journal of Management, IT and Social Sciences, 6(5), 303-308. <https://doi.org/10.21744/irjmis.v6n5.777>
27. K. H. Hashim and M. A. K. Shiker, Using a new line search method with gradient direction to solve nonlinear systems of equations, J. Phys.: Conf. Ser. 1804, 012106, 2021.
28. K. H. Hashim et al., Solving the Nonlinear Monotone Equations by Using a New Line Search Technique, J. Phys.: Conf. Ser. 1818, 012099, 2021.
29. L. A. Issa, and Z. A. H. Hassan, Use of a modified Markov models for parallel reliability systems that are subject to maintenance, Journal of Physics: Conference Series, 1999(1) 012087, 2021.
30. L. H. Hashim et al., An application comparison of two negative binomial models on rainfall count data, J. Phys.: Conf. Ser. 1818, 012100, 2021.
31. L. H. Hashim et al., An application comparison of two Poisson models on zero count data, J. Phys.: Conf. Ser. 1818 012165, 2021.
32. M. A. K. Shiker and Z. Sahib A modified trust-region method for solving unconstrained optimization, Journal of Engineering and Applied Sciences, vol. 13, no. 22, pp. 9667– 9671, 2018.
33. M. M. Mahdi and M. A. K. Shiker, A New Class of Three-Term Double Projection Approach for Solving Nonlinear Monotone Equations J. Phys.: Conf. Ser. 1664, 012147, 2020.
34. M. M. Mahdi and M. A. K. Shiker, A new projection technique for developing a Liu-Storey method to solve nonlinear systems of monotone equations, J. Phys.: Conf. Ser. 1591, 012030, 2020.
35. M. M. Mahdi and M. A. K. Shiker, Solving systems of nonlinear monotone equations by using a new projection approach, J. Phys.: Conf. Ser. 1804, 012107, 2021.
36. M. M. Mahdi and M. A. K. Shiker, Three terms of derivative free projection technique for solving nonlinear monotone equations, J. Phys.: Conf. Ser. no. 1591, 012031, 2020.
37. M. M. Mahdi and M. A. K. Shiker, Three-Term of New Conjugate Gradient Projection Approach under Wolfe Condition to Solve Unconstrained

- Optimization Problems, Journal of Advanced Research in Dynamical and Control Systems, vol. 12, no. 7, pp. 788- 795, 2020.
38. M. M. Mahdi, H. H. Dwail, and M. A. K. Shiker, Hybrid spectral algorithm under a convex constrained to solve nonlinear equations, Journal of Interdisciplinary Mathematics, DOI: 10.1080/09720502.2022.2040851. 2022.
 39. M. S. A. Sahib M S A, and M. A. K. Shiker, Employing the golden ratio to reach the BFS for T.P. International Journal of Health Sciences, 6: 2, p. 14894–14901. 2022.
 40. N. K. Dreeb, et al., Using a New Projection Approach to Find the Optimal Solution for Nonlinear Systems of Monotone Equation, J. Phys.: Conf. Ser. 1818, 012101, 2021.
 41. S. A. K. Abbas, Z. A. H. Hassan, Increase the Reliability of Critical Units by Using Redundant Technologies, Journal of Physics: Conference Series, 1999(1) 012107, 2021.
 42. S. A.K. Abbas, Z. A. H. Hassan, Use of ARINC Approach method to evaluate the reliability assignment for mixed system, Journal of Physics: Conference Series, 1999(1) 012102, 2021.
 43. Simpen, I. N., Dewi, N. P. G. B., & Aribudiman, I. N. (2018). Relationship between resistivity and soil strength based on geoelectric data: Case study at Cassa Villa Jimbaran. International Journal of Life Sciences, 2(2), 22–29. <https://doi.org/10.29332/ijls.v2n2.126>
 44. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Get vaccinated when it is your turn and follow the local guidelines. *International Journal of Health Sciences*, 5(3), x-xv. <https://doi.org/10.53730/ijhs.v5n3.2938>
 45. T.C. Koopmans, Optimum utilization of the transportation system. *Econometrica: Journal of the Econometric Society*, vol. 17, pp. 136-146, 1949.
 46. Z. A. H. Hassan and E. K. Mutar, Geometry of reliability models of electrical system used inside spacecraft, 2017 Second Al-Sadiq International Conference on Multidisciplinary in I.T. and Communication Science and Applications (AIC-MITCSA), pp. 301-306. 2017.