

TORA SOFTWARE REPORT

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TORA

TORA (Tools for Operations Research and Analysis) software is a popular software package used in Operations Research and Decision Analysis. It contains a wide variety of algorithms and programs that help solve various operational models. In this report, we will discuss the different programs and algorithms that TORA software contains, along with the operational steps involved in the solution of various operational models.

1)Linear Programming (LP):

Linear Programming is a mathematical optimization technique used to find the best possible solution to a problem with linear constraints. TORA software has an LP module that contains programs and algorithms to solve LP problems. The operational steps involved in solving LP problems using TORA software are as follows:

- 1)Formulate the LP problem in the form of an objective function and constraints.
- 2)Enter the LP problem into TORA software using the LP module.
- 3)Solve the LP problem using the Simplex algorithm, which is one of the algorithms contained in the LP module.
- 4)Interpret the results obtained from the LP problem.

2)Network Analysis:

Network Analysis is a mathematical technique used to study the flow of resources or information through a network. TORA software has a Network Analysis module that contains programs and algorithms to solve network problems. The operational steps involved in solving network problems using TORA software are as follows:

- 1)Draw the network diagram.
- 2)Define the activities and their durations.
- 3)Define the dependencies between the activities.
- 4)Enter the network problem into TORA software using the Network Analysis module.
- 5)Solve the network problem using the CPM algorithm, which is one of the algorithms contained in the Network Analysis module.
- 6)Interpret the results obtained from the network problem.

3)Integer Programming (IP):

Integer Programming is a mathematical optimization technique used to find the best possible solution to a problem with integer constraints. TORA software has an IP module that contains programs and algorithms to solve IP problems. The operational steps involved in solving IP problems using TORA software are as follows:

- 1)Formulate the IP problem in the form of an objective function and constraints.
- 2)Enter the IP problem into TORA software using the IP module.
- 3)Solve the IP problem using the Branch and Bound algorithm, which is one of the algorithms contained in the IP module.
- 4)Interpret the results obtained from the IP problem.

4)Decision Analysis:

Decision Analysis is a mathematical technique used to evaluate different alternatives and make the best possible decision. TORA software has a Decision Analysis module that contains programs and algorithms to solve decision problems. The operational steps involved in solving decision problems using TORA software are as follows:

- 1)Define the decision problem.
- 2)Identify the alternatives and their consequences.
- 3)Assign probabilities to the different outcomes.
- 4)Enter the decision problem into TORA software using the Decision Analysis module.
- 5)Solve the decision problem using the Expected Value algorithm, which is one of the algorithms contained in the Decision Analysis module.
- 6)Interpret the results obtained from the decision problem.

5)Queuing Theory:

Queuing Theory is a mathematical technique used to study the flow of customers through a system. TORA software has a Queuing Theory module that contains programs and algorithms to solve queuing problems. The operational steps involved in solving queuing problems using TORA software are as follows:

- 1)Define the queuing problem.
- 2)Define the arrival rate and service rate.
- 3)Enter the queuing problem into TORA software using the Queuing Theory module.
- 4)Solve the queuing problem using the M/M/1 algorithm, which is one of the algorithms contained in the Queuing Theory module.
- 5)Interpret the results obtained from the queuing problem.

LPP PROBLEM SOLVED BY USING SIMPLEX PROBLEM

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LINEAR PROGRAMMING

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SIMPLEX TABLEAU - (Starting All-Slack Method)

Title: (Maximize)

Steps for generating NEXT tableau from CURRENT one:

1. ENTERING variable: Click a NONBASIC variable (if correct, column turns green)
2. LEAVING variable: Click a BASIC variable (if correct, row turns red)
3. Click command button NEXT ITERATION (or ALL ITERATIONS) – This step may be executed without Steps 1 and/or 2.

Next Iteration All Iterations Write to Printer

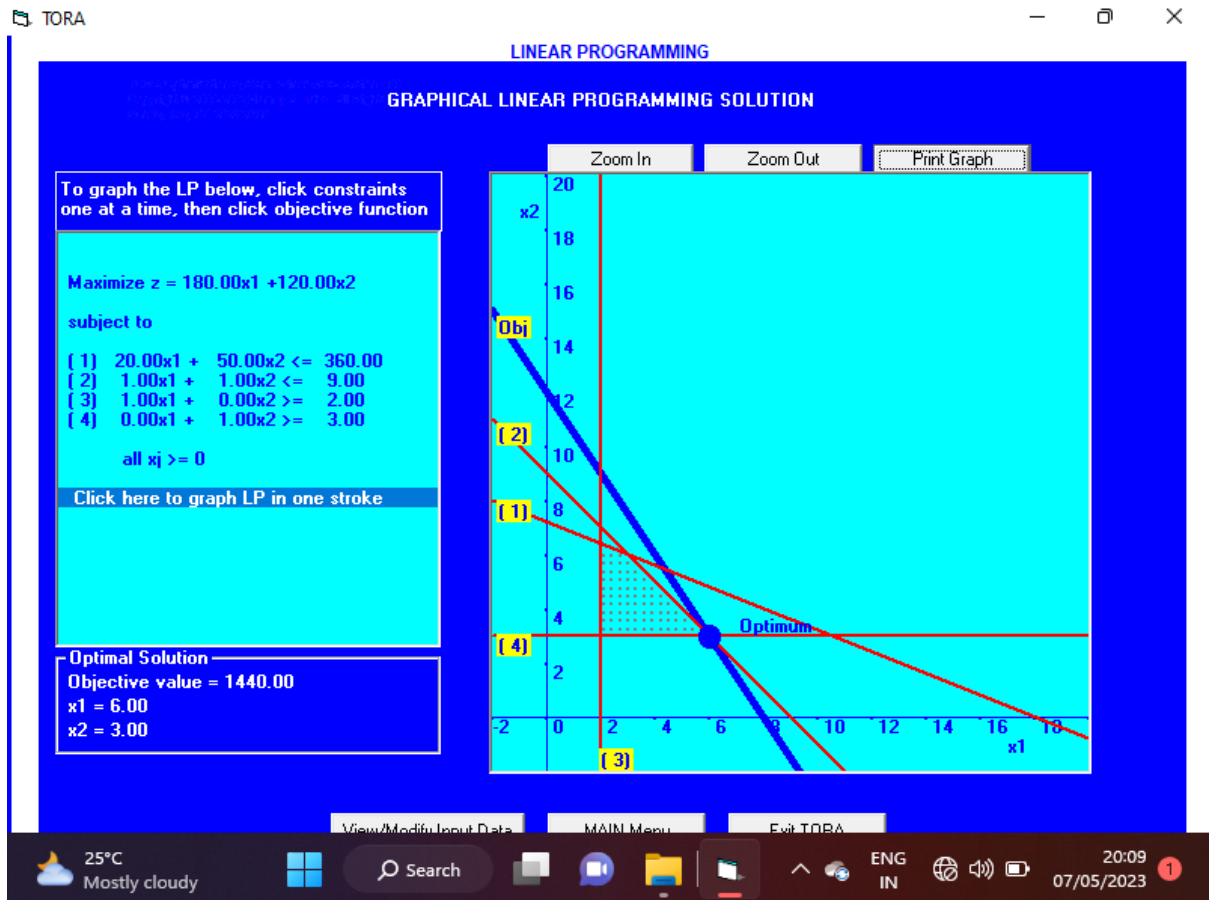
Iteration 1	x1	x2	sx3	sx4	Solution
Basic					
z (max)	-7.00	-5.00	0.00	0.00	0.00
sx3	1.00	2.00	1.00	0.00	6.00
sx4	4.00	3.00	0.00	1.00	12.00
Lower Bound	0.00	0.00			
Upper Bound	infinity	infinity			
Unrestr'd (y/n)?	n	n			

Iteration 2	x1	x2	sx3	sx4	Solution
Basic					
z (max)	0.00	0.25	0.00	1.75	21.00
sx3	0.00	1.25	1.00	-0.25	3.00
x1	1.00	0.75	0.00	0.25	3.00
Lower Bound	0.00	0.00			
Upper Bound	infinity	infinity			
Unrestr'd (y/n)?	n	n			

View/Modify Input Data MAIN Menu Exit TORA

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LPP PROBLEM SOLVED BY USING GRAPHICAL PROBLEM



TRANSPORTATION PROBLEM

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TRANSPORTATION MODEL

TRANSPORTATION TABLEAU - (Vogel's Method)

Title: --(minimum cost)

Steps for generating transportation tableaus:

1. (Optional step) Initialize ONE of the simplex multiplier ($u_1, u_2, \dots, v_1, v_2, \dots$) to zero value (default $u_1 = 0$)
2. Click (in any order) the cells defining the change-of-basis loop (if correct, cell changes color)
3. Click command button NEXT ITERATION (or ALL ITERATIONS) -- This step may be executed without Step 2

Initialize u or v
u1=0

Next Iteration All Iterations Write to Printer

Iter 1	ObjVal = 199500.00	D1	D2	D3	D4	Supply
	Name					
		$v_1=30.00$	$v_2=40.00$	$v_3=75.00$	$v_4=35.00$	
		25.00	40.00	75.00	20.00	
S1	$u_1=0.00$		1200	800		2000
		5.00	0.00	0.00	15.00	
S2	$u_2=-10.00$	50.00	40.00	65.00	25.00	1500
		-30.00	-10.00	0.00	0.00	
S3	$u_3=-5.00$	25.00	50.00	70.00	40.00	1000
		800		200		
		0.00	-15.00	0.00	-10.00	
	Demand	800	1200	1500	1000	
Iter 2	ObjVal = 187500.00	D1	D2	D3	D4	Supply
	Name					

View/Modify Input Data MAIN Menu Exit TORA

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TORA

TRANSPORTATION MODEL

Initialize u or v
u1=0

Next Iteration All Iterations Write to Printer

S3	Demand	$u_3=-5.00$	0.00	15.00	0.00	-10.00	1000
Iter 2	ObjVal = 187500.00	D1	D2	D3	D4	Supply	
	Name						
		$v_1=15.00$	$v_2=40.00$	$v_3=60.00$	$v_4=20.00$		
		25.00	40.00	75.00	20.00		
S1	$u_1=0.00$		1200		800	2000	
		-10.00	0.00	-15.00	0.00		
S2	$u_2=5.00$	50.00	40.00	65.00	25.00	1500	
		-30.00	5.00	0.00	0.00		
S3	$u_3=10.00$	25.00	50.00	70.00	40.00	1000	
		800		200			
		0.00	0.00	0.00	-10.00		
	Demand	800	1200	1500	1000		

View/Modify Input Data MAIN Menu Exit TORA

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TRANSPORTATION MODEL

Initialize u or v

u1=0

Next Iteration

All Iterations

Write to Printer

	Demand		800	1200	1500	1000	
Iter 3	ObjVal =	186500.00	D1	D2	D3	D4	Supply
	Name						
S1			v1=20.00	v2=40.00	v3=65.00	v4=20.00	
			25.00	40.00	75.00	20.00	
		u1=0.00		1000		1000	2000
S2			-5.00	0.00	-10.00	0.00	
			50.00	40.00	65.00	25.00	
		u2=0.00		200	1300		1500
S3			-30.00	0.00	0.00	-5.00	
			25.00	50.00	70.00	40.00	
		u3=5.00	800		200		1000
			0.00	-5.00	0.00	-15.00	
	Demand		800	1200	1500	1000	

View/Modify Input Data

MAIN Menu

Exit TORA

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Search

ENG
IN19:52
07/05/2023

CRITICAL PATH METHOD PROBLEM

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PROJECT PLANNING -- PERT/CPM

PROJECT PLANNING - CPM

Select Output Option
CPM Calculations

Next Step All Steps Write to Printer

Title: CPM

SOLUTION STEPS

Forward Pass			Backward Pass		
Step	Node	Earliest Time	Step	Node	Latest Time
1	1	0.00	11	10	25.00
2	2	6.00	12	7	20.00
3	3	10.00	13	4	17.00
4	4	17.00	14	3	10.00
5	5	2.00	15	6	14.00
6	6	13.00	16	5	4.00
7	7	20.00	17	9	15.00
8	8	8.00	18	8	11.00
9	9	12.00	19	2	6.00
10	10	25.00	20	1	0.00

Forward pass completed Backward pass completed

Activity	Duration	Earliest Start	Latest Completion	Total Float	Free Float
A	6.00	0.00	6.00	0.00	0.00
G	2.00	0.00	4.00	2.00	0.00
I	13.00	0.00	13.00	1.00	0.00

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PROJECT PLANNING -- PERT/CPM

PROJECT PLANNING - CPM

Select Output Option
CPM Calculations

Next Step All Steps Write to Printer

Title: CPM

SOLUTION STEPS

Forward pass completed			Backward pass completed		
Activity	Duration	Earliest Start	Latest Completion	Total Float	Free Float
A	6.00	0.00	6.00	0.00	0.00
G	2.00	0.00	4.00	2.00	0.00
J	13.00	0.00	14.00	1.00	0.00
B	4.00	6.00	10.00	0.00	0.00
K	9.00	6.00	17.00	2.00	2.00
D	2.00	6.00	11.00	3.00	0.00
C	7.00	10.00	17.00	0.00	0.00
L	3.00	17.00	20.00	0.00	0.00
H	10.00	2.00	14.00	2.00	1.00
I	6.00	13.00	20.00	1.00	1.00
M	5.00	20.00	25.00	0.00	0.00
E	4.00	8.00	15.00	3.00	0.00
F	10.00	12.00	25.00	3.00	3.00

Critical activities highlighted in red

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QUEUEING PROBLEM

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QUEUEING MODELS

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QUEUEING OUTPUT ANALYSIS

Select Output Option
Comparative Analysis

Next Iteration All Iterations Write to Printer

Title: QUEUEING PROBLEM

Comparative analysis

Scenario	c	Lambda	Mu	L'da eff	p0	Ls	Lq	Ws	Wq
1	1	24.00000	30.00000	24.00000	0.20000	4.00000	3.20000	0.16667	0.13333

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QUEUEING MODELS

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QUEUEING OUTPUT ANALYSIS

Select Output Option
Scenario1

Next Iteration All Iterations Write to Printer

Title: QUEUEING PROBLEM

Scenario 1:(M/M/1):(GD/infinity/infinity)

Lambda =	24.00000	Mu =	30.00000
L'da eff =	24.00000	Rho/c =	0.80000
Ls =	4.00000	Lq =	3.20000
Ws =	0.16667	Wq =	0.13333

n	Probability, pn	Cumulative, Pn	n	Probability, pn	Cumulative, Pn
0	0.20000	0.20000	23	0.00118	0.99528
1	0.16000	0.36000	24	0.00094	0.99622
2	0.12800	0.48800	25	0.00076	0.99698
3	0.10240	0.59040	26	0.00060	0.99758
4	0.08192	0.67232	27	0.00048	0.99807
5	0.06554	0.73786	28	0.00039	0.99845
6	0.05243	0.79028	29	0.00031	0.99876
7	0.04194	0.83223	30	0.00025	0.99901
8	0.03355	0.86578	31	0.00020	0.99921
9	0.02684	0.89263	32	0.00016	0.99937

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QUEUEING MODELS

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QUEUEING OUTPUT ANALYSIS

Select Output Option

Scenario1

Next Iteration

All Iterations

Write to Printer

Title: QUEUEING PROBLEM

Scenario 1:(M/M/1):(GD/infinity/infinity)

Lambda = 24.00000

Mu = 30.00000

L'da eff = 24.00000

Rho/c = 0.80000

Ls = 4.00000

Lq = 3.20000

Ws = 0.16667

Wq = 0.13333

9	0.02684	0.89263	32	0.00016	0.99937
10	0.02147	0.91410	33	0.00013	0.99949
11	0.01718	0.93128	34	0.00010	0.99959
12	0.01374	0.94502	35	0.00008	0.99968
13	0.01100	0.95602	36	0.00006	0.99974
14	0.00880	0.96482	37	0.00005	0.99979
15	0.00704	0.97185	38	0.00004	0.99983
16	0.00563	0.97748	39	0.00003	0.99987
17	0.00450	0.98199	40	0.00003	0.99989
18	0.00360	0.98559	41	0.00002	0.99991
19	0.00288	0.98847	42	0.00002	0.99993

View/Modify Input Data

MAIN Menu

Exit TORA

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Search

ENG IN

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QUEUEING MODELS

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QUEUEING OUTPUT ANALYSIS

Select Output Option

Scenario1

Next Iteration

All Iterations

Write to Printer

Title: QUEUEING PROBLEM

Scenario 1:(M/M/1):(GD/infinity/infinity)

Lambda = 24.00000

Mu = 30.00000

L'da eff = 24.00000

Rho/c = 0.80000

Ls = 4.00000

Lq = 3.20000

Ws = 0.16667

Wq = 0.13333

13	0.01100	0.95602	36	0.00006	0.99974
14	0.00880	0.96482	37	0.00005	0.99979
15	0.00704	0.97185	38	0.00004	0.99983
16	0.00563	0.97748	39	0.00003	0.99987
17	0.00450	0.98199	40	0.00003	0.99989
18	0.00360	0.98559	41	0.00002	0.99991
19	0.00288	0.98847	42	0.00002	0.99993
20	0.00231	0.99078	43	0.00001	0.99995
21	0.00184	0.99262	44	0.00001	0.99996
22	0.00148	0.99410			

View/Modify Input Data

MAIN Menu

Exit TORA

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Search

ENG IN

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SHORTEST ROUTE PROBLEM BY USING DIJKSHTRA ALGORITHM

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NETWORK MODELS

DIJKSTRA'S SHORTEST ROUTE ALGORITHM

Select Output Option
Iterations

Next Iteration All Iterations Write to Printer

Title: SHORTEST PROBLEM

ITERATIONS

Node	Label	Status
Iteration 1		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	temporary
3-C	[2.00, 1]	temporary
4-D		
5-E		
6-F		
Iteration 2		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	temporary
3-C	[2.00, 1]	permanent
4-D		
5-E	[5.00, 3]	temporary
6-F		

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NETWORK MODELS

DIJKSTRA'S SHORTEST ROUTE ALGORITHM

Select Output Option
Iterations

Next Iteration All Iterations Write to Printer

Title: SHORTEST PROBLEM

ITERATIONS

Iteration 2		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	temporary
3-C	[2.00, 1]	permanent
4-D		
5-E	[5.00, 3]	temporary
6-F		
Iteration 3		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	permanent
3-C	[2.00, 1]	permanent
4-D	[14.00, 2]	temporary
5-E	[5.00, 3]	temporary
6-F		

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NETWORK MODELS

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DIJKSTRA'S SHORTEST ROUTE ALGORITHM

Select Output Option
Iterations

Next Iteration All Iterations Write to Printer

Title: SHORTEST PROBLEM

ITERATIONS

Iteration 3		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	permanent
3-C	[2.00, 1]	permanent
4-D	[14.00, 2]	temporary
5-E	[5.00, 3]	temporary
6-F		

Iteration 4		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	permanent
3-C	[2.00, 1]	permanent
4-D	[9.00, 5]	temporary
5-E	[5.00, 3]	permanent
6-F		

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NETWORK MODELS

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DIJKSTRA'S SHORTEST ROUTE ALGORITHM

Select Output Option
Iterations

Next Iteration All Iterations Write to Printer

Title: SHORTEST PROBLEM

ITERATIONS

Iteration 5		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	permanent
3-C	[2.00, 1]	permanent
4-D	[9.00, 5]	permanent
5-E	[5.00, 3]	permanent
6-F	[20.00, 4]	temporary

Iteration 6		
1-A	[0.00, -]	permanent
2-B	[4.00, 1]	permanent
3-C	[2.00, 1]	permanent
4-D	[9.00, 5]	permanent
5-E	[5.00, 3]	permanent
6-F	[20.00, 4]	permanent

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SHORTEST ROUTE PROBLEM BY USING FLOYDS ALGORITHM

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NETWORK MODELS

Next Iteration All Iterations Write to Printer

Title: floyds problem

SHORTEST ROUTES

Find shortest route

From node ? To node ?

[Click here to list ALL routes](#)

3-C	2-B	infinity	
3-C	4-D	7.00	3- 5- 4
3-C	5-E	3.00	3- 5
3-C	6-F	18.00	3- 5- 4- 6
4-D	1-A	infinity	
4-D	2-B	infinity	
4-D	3-C	infinity	
4-D	5-E	infinity	
4-D	6-F	11.00	4- 6
5-E	1-A	infinity	

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ENG IN 09:30 08/05/2023 2

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NETWORK MODELS

Next Iteration All Iterations Write to Printer

Title: floyds problem

SHORTEST ROUTES

Find shortest route

From node ? To node ?

[Click here to list ALL routes](#)

5-E	1-A	infinity	
5-E	2-B	infinity	
5-E	3-C	infinity	
5-E	4-D	4.00	5- 4
5-E	6-F	15.00	5- 4- 6
6-F	1-A	infinity	
6-F	2-B	infinity	
6-F	3-C	infinity	
6-F	4-D	infinity	
6-F	5-E	infinity	

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CONCLUSION

In conclusion, TORA software is a powerful tool for solving a wide variety of operational models in Operations Research and Decision Analysis. The software contains programs and algorithms for Linear Programming, Network Analysis, Integer Programming, Decision Analysis, and Queuing Theory. The operational steps involved in solving these problems.