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Linear Programming To FindThe Critical Path Using Spreadsheet Methodology

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Abstract:*In a business organization, management has to make decisions on how to allocate their resources to achieve its organization's goal. Each organization wants to achieve some objective with constrained resources. To be able to find the best uses of an organization's resources using spreadsheet model, a mathematical technique called Linear Programming can be used. Linear Programming (LP) is a mathematical optimization technique. By optimization technique, it refers to a method which attempts to maximize or minimize some objective, for example, maximize profits or minimize costs. The adjective linear is used to describe a relationship between two or more variables, a relationship which is directly and precisely proportional. The basic structure of an LP problem is either to maximize or minimize an objective function, while satisfying a set of constraining conditions called constraints. Therefore, this paper demonstrates the application of a method named Spreadsheet methodology, which is capable of solving linear programming problems and illustrate how this approach could be used in handling maximization and minimization problems and addressing suitable critical path for building a textile industry by taking account of large number of activity, where there exist predecessors and duration.*

Keywords:*Linear Programming (LP), Spreadsheet Methodology and Optimization.*

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I. Case Study

1.1 Solution to Building a Textile Industry

Consider the list of activities and predecessors that are involved in building a Textile Industry, as listed in Table 1.

Activity	Description	Predecessors	Duration (days)
Activity A	Build foundation	—	5
Activity B	Build walls and ceilings	A	8
Activity C	Build roof	B	10
Activity D	Do electrical wiring	B	5
Activity E	Put in windows	B	4
Activity F	Put on siding	E	6
Activity G	Paint house	C, F	3

Table 1: Textile Industry-Building Activities

1.2 Objectives: To Draw a project network and use LP to find the critical path and the minimum number of days needed to build the textile industry.

1.3 Managerial Formulation

Decision Variables: We are trying to decide when to begin and end each of the activities [1,2].
Objective: Minimize the total time to complete the project.
Constraints: Each activity has a fixed duration.
There are precedence relationships among the activities. We cannot go backwards in time.

1.4 Mathematical Formulation

Decision Variables: Define the nodes to be discrete events. In other words, they occur at one exact point in time. Our decision variables will be these points in time.[1,2,3,4]

Define t_i to be the time at which node i occurs, and at which time all activities preceding node i have been completed.
Define t_0 to be zero.
Objective: Minimize t_5.
Constraints: There is really one basic type of constraint. For each activity x, let the time of its starting node be represented by t_{jx} and the time of its ending node be represented by t_{kx}. Let the duration of activity x be represented as d_x.
For every activity x, $t_{kx} - t_{jx} \geq d_x$
For every node i, $t_i \geq 0$

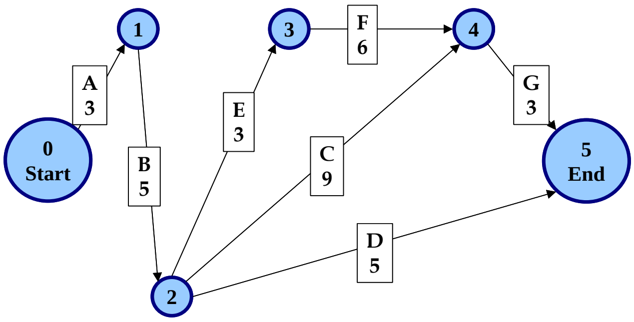
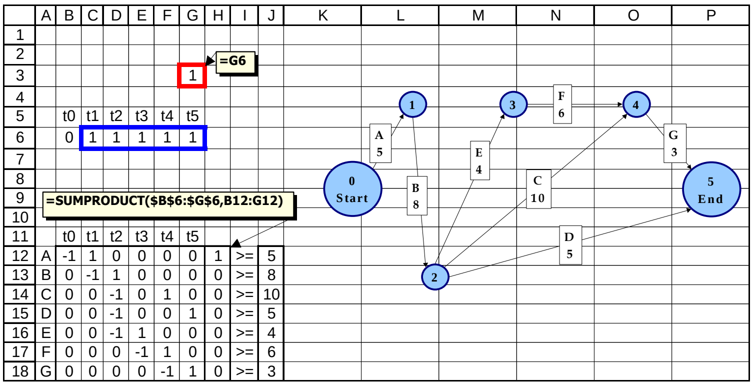


Fig: Project Network

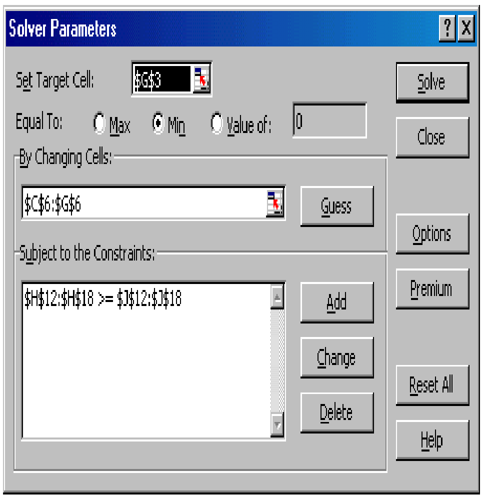
II. Solution Methodology

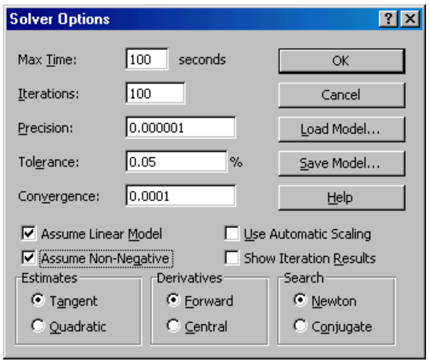
Here's the spreadsheet model:



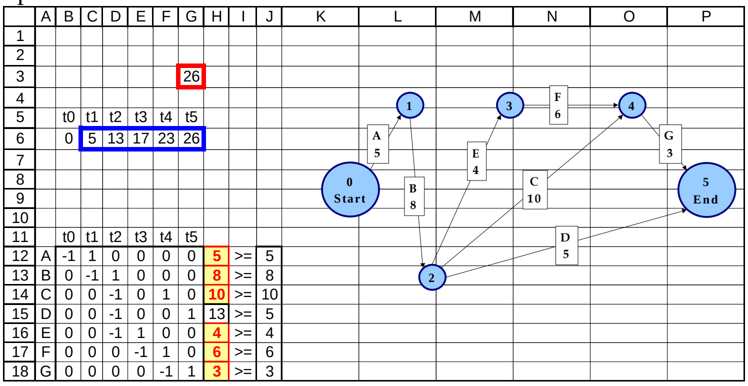
	A	B	C	D	E	F	G	H	I	J
3							1			
5		t0	t1	t2	t3	t4	t5			
6		0	1	1	1	1	1			
11		t0	t1	t2	t3	t4	t5			
12	A	-1	1	0	0	0	0	1	>=	5
13	B	0	-1	1	0	0	0	0	>=	8
14	C	0	0	-1	0	1	0	0	>=	10
15	D	0	0	-1	0	0	1	0	>=	5
16	E	0	0	-1	1	0	0	0	>=	4
17	F	0	0	0	-1	1	0	0	>=	6
18	G	0	0	0	0	-1	1	0	>=	3

The matrix of zeros, ones, and negative ones (B12:G18) is a means for setting up the constraints. The sumproduct functions in H12:H18 calculate the elapsed time between relevant pairs of nodes, corresponding to the various activities. The duration times of the activities are in J12:J18.



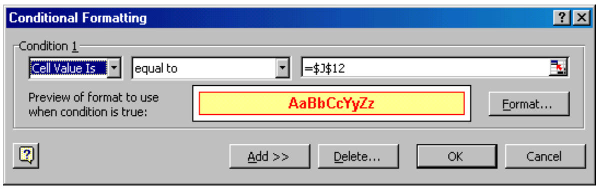


Here is the optimized spreadsheet:



	A	B	C	D	E	F	G	H	I	J
1										
2										
3							26			
4										
5		t0	t1	t2	t3	t4	t5			
6		0	5	13	17	23	26			
7										
8										
9										
10										
11		t0	t1	t2	t3	t4	t5			
12	A	-1	1	0	0	0	0	5	>=	5
13	B	0	-1	1	0	0	0	8	>=	8
14	C	0	0	-1	0	1	0	10	>=	10
15	D	0	0	-1	0	0	1	13	>=	5
16	E	0	0	-1	1	0	0	4	>=	4
17	F	0	0	0	-1	1	0	6	>=	6
18	G	0	0	0	0	-1	1	3	>=	3

We have used Excel's *conditional formatting* feature here to identify the activities on the critical path.



It is also possible to identify the critical path by looking at the Solver answer report:

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$H$12	A	5	$H$12>=$J$12	Binding	0
$H$13	B	8	$H$13>=$J$13	Binding	0
$H$14	C	10	$H$14>=$J$14	Binding	0
$H$15	D	13	$H$15>=$J$15	Not Binding	8
$H$16	E	4	$H$16>=$J$16	Binding	0
$H$17	F	6	$H$17>=$J$17	Binding	0
$H$18	G	3	$H$18>=$J$18	Binding	0

III. Conclusions

The project will take 26 days to complete.The only activity that is not critical is the electrical wiring.

References

[1]. Andersen, D.R., D.J. Sweeney, & T.A. Williams, An Introduction to Management Science: Quantitative Approaches to Decision Making

[2]. Andersen, D. R., Dennis J. Sweeny, and Thomas A. Williams. 2001. QuantitativeMethods for Business.Eighth edition. Cincinnati, Ohio: South-Western College Publishing.

[3]. Anderson, Michael Q. 1982. Quantitative Management Decision Making, Belmont,California: Brooks/ Cole Publishing Co.,

[4]. Dunn, Robert A. and K. D. Ramsing. 1981. Management Science: A Practical Approach to Decision Making. New York, New York: MacMillan Publishing Co.

[5]. Krajewski, Lee C. and H. E. Thompson. 1981. Management Science: Quantitative Methods in Context, New York: John Wiley & Sons.

* Juel Sikder. " Linear Programming To Find The Critical Path Using Spreadsheet Methodology." IOSR Journal of Computer Engineering (IOSR-JCE) 20.3 (2018): 48-50.