Time Estimates and Critical path in Network

An Activity time is a ~~forecased~~ forecast ~~terms~~ of the time An Activity is accepted to take ~~form its start ing point~~ from its starting pt to its comple-tion.

The main objective ~~on bes~~ of the time analy-sis is to prepare a planning schedule of the project.

Notation and their meaning

1. Activity (i-j) $i \longrightarrow j$

Activity (i-j) is tail event i and head event j

T_E or E_i

Earliest occurrence time of event i

T_L or E_j

Latest allowable occurence time of event j

D_{ij}

Estimated completion time of activity (i,j)

$(E_s)_{ij}$

Earliest starting time of activity (i,j)

$(E_F)_{ij}$
Earliest finishing time of activity (i,j)

$(L_S)_{ij}$
Latest starting time of activity (i,j)

$(L_F)_{ij}$
Latest finishing time of activity (i,j)

Farward past campeitatians (far earliest event time)
The farward path campeitatians yield the caliest start and earliest finish time far each activity (i,j)
Earliest starting time of activity i-j is the earliest event time of the tail end event i.e

$$(E_S)_{ij} = E_i$$

Earticest finish-time af activity (i,j) is the the earliest starting time pluse the activity time

$$(E_F)_{ij} = (E_S)_{ij} + D_{ij}$$
$$= E_i + D_{ij}$$

Earliest event time of the event J is the maximum of earliest finish time of all the activity ~~as~~ ending into that event

$$E_j = \max_i [(E_F)_{ij}$$

for all immediate predecessor of (i,j)]

$$= \max_i [E_i + D_{ij}]$$

Backward pass computations (for latest allowable time)

The latest event time L indicates the time by which all the activity entering into that event must be completed without delaying the completion of the project.

Latest finish time for activity (i-j) is equal to the latest event time for event j

$$(LF)_{ij} = L_j$$

Latest starting time of activity (i-j) is equal to the latest completion time of act. (i-j) minus the activity time i.e

$$(L_S)_{ij} = (L_F)_{ij} - D_{ij}$$

Latest event time for event i is the minimum of the latest start time of all activity originating from that event i.e

$$L_i = \min_j [(L_S)_{ij}]$$

Determination of float and slack time:

Their are mainly 3 kinds of float

1. Tatal flaat
2. Free flaat
3. Independent flaat

1. Tatal flaat

The amaunt af time by which the campletion af an act. cauld be delayed beyand the earliest enecpted campletian time withaut effecting the overall project duratian time mathematically the total float af an activity (i-j) is the difference between the latest start time and Earliest start time af the activity.

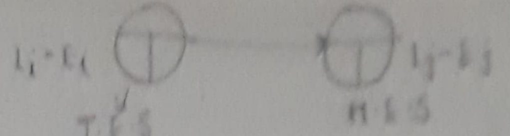
$$(T_F)_{ij} = (L_S)_{ij} - (E_S)_{ij}$$
$$= (L_j - D_{ij}) - E_i$$

2. Free flaat

The time by which the campletian af an activity can be delayed beyaand the earliest finish time withaut effecting the earliest start af the succeding activity, so the free float mathematically represented at

$$(F_F)_{ij} = (E_j - E_i) - D_{ij}$$
$$= \text{Total Float} - \text{head event slack}$$

free float can take value fram zero up to tatal float but it cannat enceed tatal flaat.



3. Independent float

The amount of time by which the start of an activity can be delayed without effecting the earliest start time of any immediately following activity, Assuming that the preceding activity has finish at its latest finish time, Mathematically represented by

$$(I_F)_{ij} = (E_j - L_i) - D_{ij}$$

Free Float - tail event slack

The Negative independent float is always taken zero

Independent float ≤ free float ≤ Total float

Interfering float:

Interfering float is that part of float which cause a reduction in the float of succesor activity, mathematically it is a difference between the latest finish time of an activity and the eartiest stating time of the fall" activity or zero which is larger

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Event Slack:

For any given event the event slack is defined as the difference between the latest event and earliest event time, mathematically for activity (i-j)

Head event slack = $L_j - E_j$
Tail event slack = $L_i - E_i$

On the float can be represented in terms of Head and tail event slack

Total float = $L_j - E_i - D_{ij}$
Free float = $E_j - E_i - D_{ij}$
$= (L_j - E_i - D_{ij}) - (L_j - E_j)$
= Total float − Head event slack

Independent float = $E_j - L_i - D_{ij}$
$= (E_j - E_i - D_{ij}) - (L_i - E_i)$
= free float − Tail event Slack

Conclusion :
Total float value : If the total float value is negative then resources are not adequate and activity may not finish in time

2. Total float value zero ~~that~~ then the resources are Just sufficient to complete the activity

3. If the total float value are positive then their are extra resources

Fulkerson's rule for Numbering the events:

1. event number should be unique
2. event numbering should be carries out in a sequential basis from left to Right
3. The initially event which has all out going arraws with no incoming arraw is numbered zero or one.
4. The head of an arraw should always bear a number higher than the assigned at the tail of the arraw,

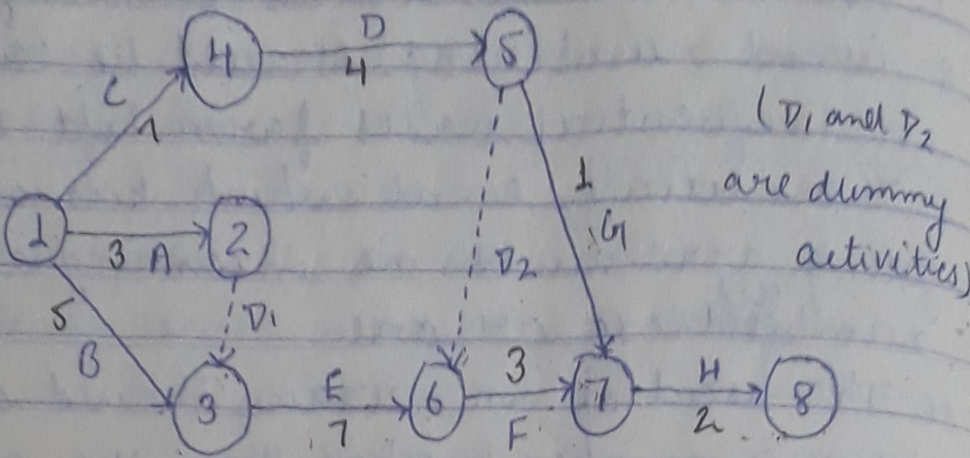
for example, 1-2, 2-3, 2-4, 3-7 except than not 8-7, 9-3

5. Gaps should be left ~~on~~ in the sequence of event numbering to accomoded subsequence inclusion of ~~on~~ activity if necessary

Q. Consider a project with the following precedence relationship.

Activity	Time duration	Immediate Predecessor
A	3	-
B	5	-
C	7	-
D	4	C
E	7	A, B
F	3	E, D
G	1	D
H	2	F, G

Canstruct a network diagram carrcspanding to abave project



Critical path:
A path in a netwark is a sequence af activity which have to be campleted sequenc-ally due to precedence requirment.

Time duratian:
time duratian af the path is the sum af activity times af activity farming af path
The path ar paths with the largest time duratian in the netwark is called critical paths
All the activities ~~ad~~ an the critical path ~~cal~~ are called critical activities

Referring to the abave netwark diagram path A D1 E F H will take

A D1 E F H = 3+7+3+2 = 15 units time

CDD_2FH = 7+4+3+2 = 16 unit time
CDGH = 7+4+1+2 = 14 unit time
BEFH = 5+7+3+2 = 17

path BEFH having lagest duration is called critical path, The second longest path is called subcritical path CDD_2FH is called subcritical path having next longest dur duration of 16 units

Critical path in terms of latest event time and earliest event time

Critical event:
The event with zero slack times all are called critical events

Critical Activity:
The activities with zero total float are known as critical activity in other words an activity is said to be critical if a delayed in its start will cause a further delayed in a completion date of entire project

Critical path:
The sequence of critical activity in a network is called a critical path.