K. J. Somaiya College of Engineering, Mumbai-77
(Autonomous College Affiliated to University of Mumbai)

Batch: A2	**Roll No.: 1911027**
Experiment / assignment / tutorial No. 6	
Grade: AA / AB / BB / BC / CC / CD /DD	
Signature of the Staff In-charge with date	

Title: Resource utilization and smoothing with Gantt Chart.

Objective: To Identify resource utilization and demonstrate resource smoothing

Expected Outcome of Experiment:

Course Outcome	After successful completion of the course students should be able to
CO4	Monitor the progress of projects and to assess the risk of slippage so that project's requirements can be controlled.

Books/ Journals/ Websites referred:

1. *Bob Hughes, Mike cotterell, Rajib Mall"Software Project Management", fifth Edition, Tata McGraw Hill, Special Indian Edition*
2. *Royce, "Software Project Management", Pearson Education, 1999.*
3. *Project Management Institute: "A Guide to the Project Management Body of Knowledge (PMBOK Guide)" 5th Edition Project Management Institute.*
4. *John Nicholas, Herman Steyn, "Project Management for Business Engineering and Technology" 4th Edition.*

Pre Lab/ Prior Concepts:

- Representation of project activities with Gnatt chart.
- Understand the need of Resource Smoothing

New Concepts to be learned

- Effective utilization of resources.
- Resource Optimization

Work-out :

Students are needed to represent the resources utilized in their project in Resource histogram and perform the activity of Resource smoothing.

Particulars	Activity Code	Duration in Days	Predecessor(s)	Labour Weeks Required
Server and database procurement	A	14	-	2
Data Collection of existing EV infrastructure	B	28	A	12
Geospatial Analysis and site selection for public and semi public charging stations.	C	21	B	3
Tie Ups with electricity provider.	D	14	C	2
Charging station planning and pricing for private charging infrastructure.	E	7	D	5
Pricing calculations for charging EV at public and semi public charging stations.	F	21	D	2
Land Acquisition and permissions for installing charging stations.	G	56	F	7

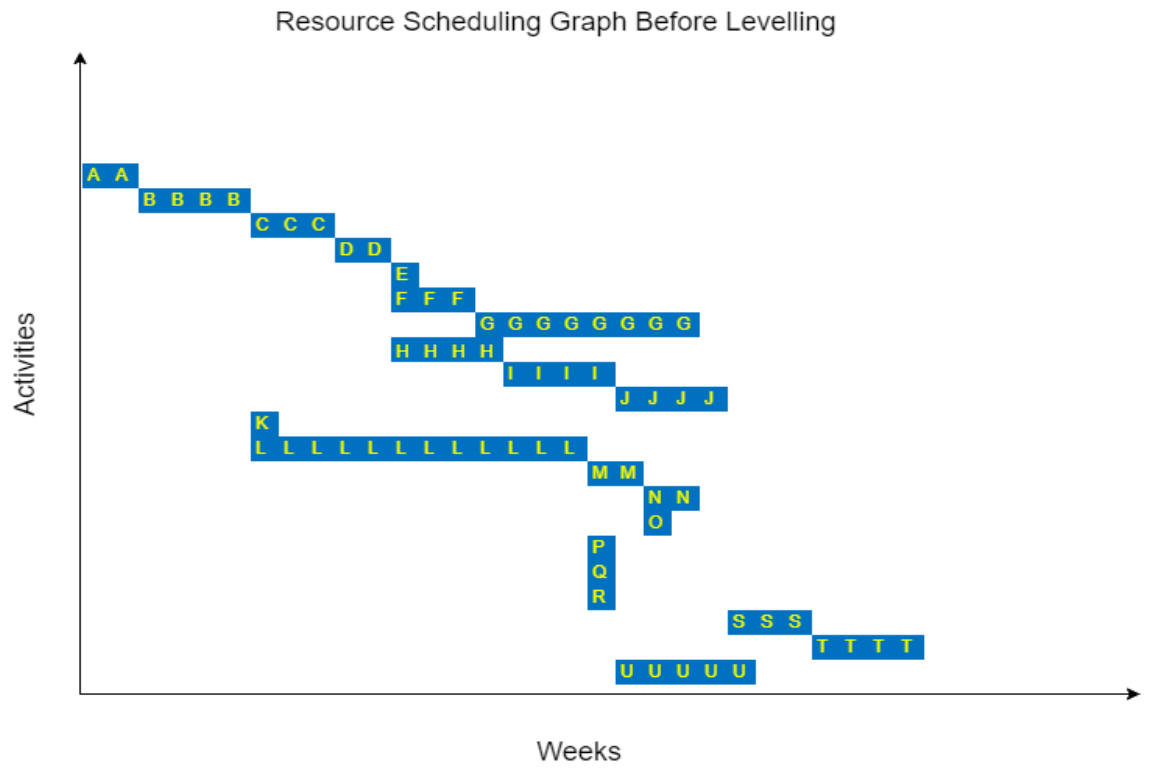
Charging stations logistics, delivery and tracking.	H	28	C	8
Connecting EV charging stations to electricity grids.	I	28	H, D	3
Installation of EV charging stations.	J	28	I	25
Hardware facility for diverse Electric vehicles	K	7	B	2
Mobile application Development and Deployment.	L	84	B	15
Searching for nearest EV charging points along with availability status.	M	14	L	2
Electric Vehicle bookings.	N	14	M	1
Reservation and pricing for charging slots at public charging stations.	O	7	F, M	3
Renting private and semi-public EV charging stations.	P	7	E, L	2
Requests for new construction of EV charging stations.	Q	7	L	3
Feedback Collection.	R	7	L	1
Calculation of daily energy requirements for EV charging stations.	S	21	J	4
Analysis for the removal of Redundant EV charging stations.	T	28	S	1

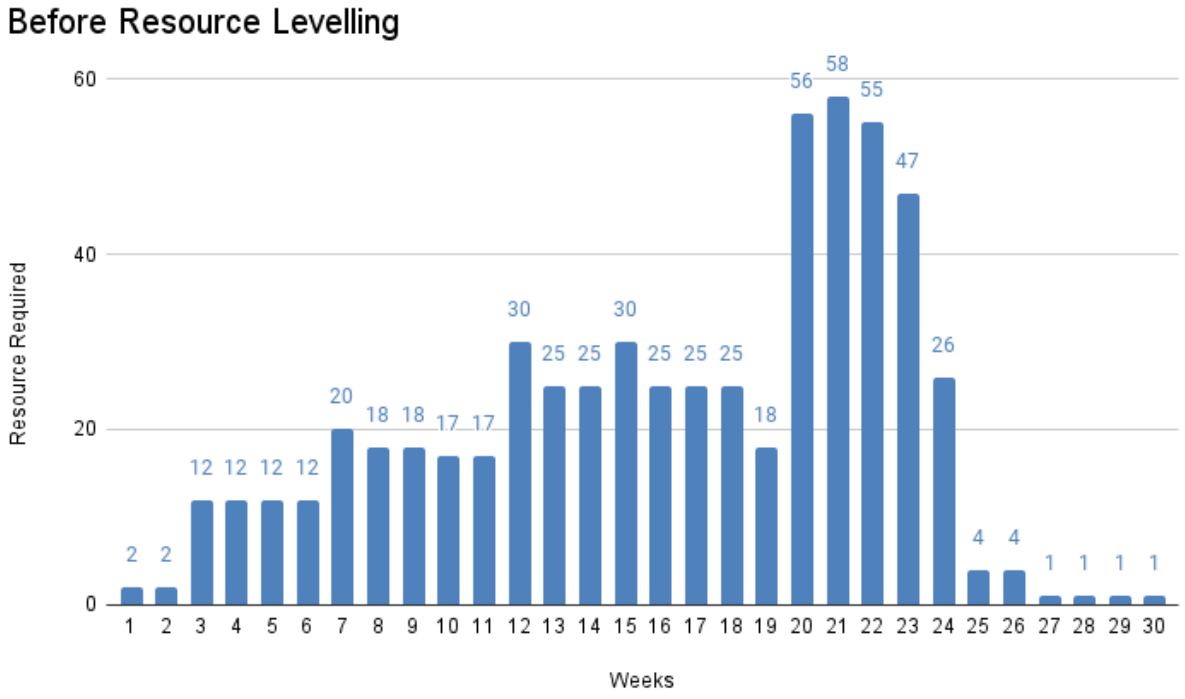
Maintenance of the charging station and Customer complaints resolution.	U	35	R	22

Before Resource levelling:

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Resources	2	2	12	12	12	12	20	18	18	17	17	30	25	25	30	25

Weeks	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Resources	25	25	18	56	58	55	47	26	4	4	1	1	1	1

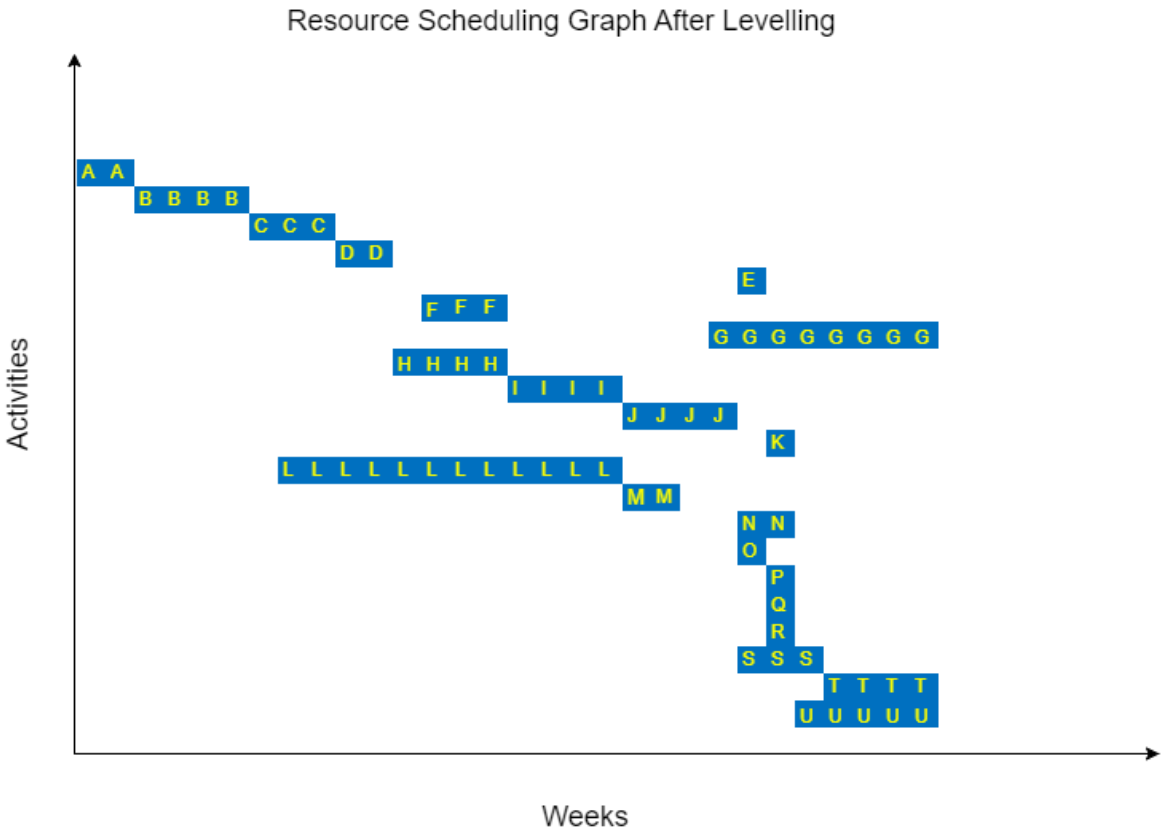


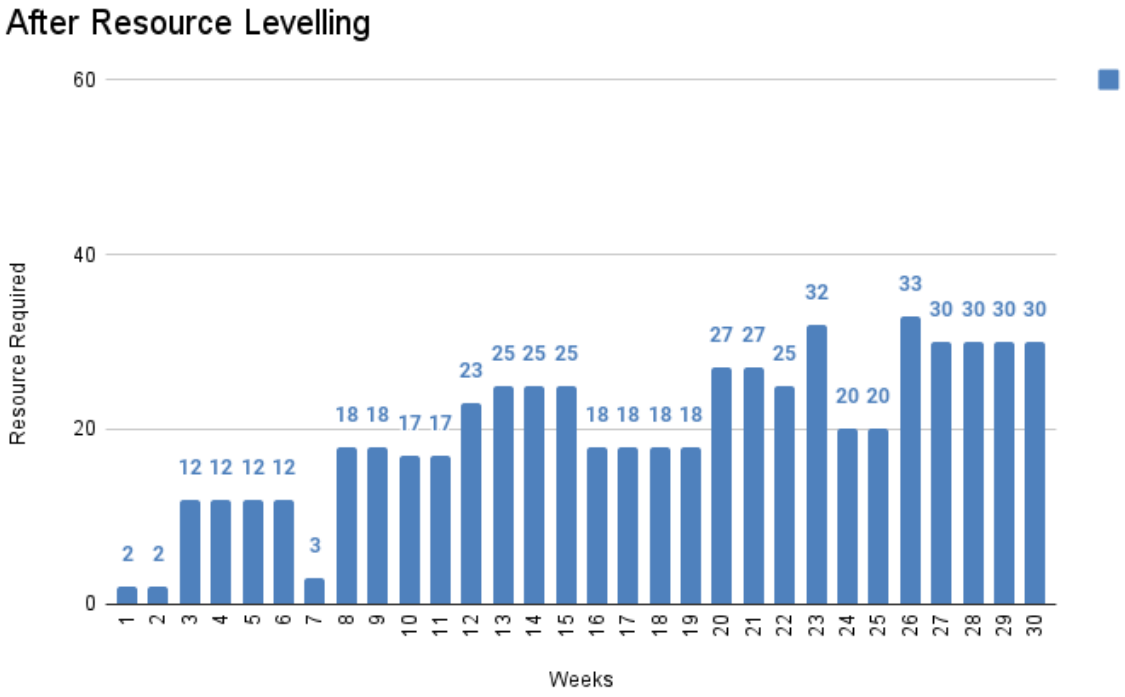


After Resource Levelling:

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Resources	2	2	12	12	12	12	3	18	18	17	17	23	25	25	25	18

Weeks	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Resources	18	18	18	27	27	25	32	20	20	33	30	30	30	30


Resource Scheduling Graph After Levelling
Activities
A A
B B B B
C C C
D D
E
F F F
G G G G G G G G
H H H H
I I I I
J J J J
K
L L L L L L L L L L L
M M
N N
O
P
Q
R
S S S
T T T T
U U U U U
Weeks


After Resource Levelling
60
40
20
0
Resource Required
2 2
12 12 12 12
3
18 18
17 17
23
25 25 25
18 18 18 18
27 27
25
32
20 20
33
30 30 30 30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Weeks

Post Lab Questions:

1) What is the difference between Resource Smoothing and Resource Levelling?

Q-1) Ans	Resource smoothing	Resource Leveling.
	1) Aims to achieve optimal resource usage by avoiding peaks and valleys in the resources usage profile. Hence the name smoothing.	1) Aim is to adjust start and end dates of a project with resource constraints while balancing resource requirements and availability.
	2) Used in time-constrained scheduling.	2) Used in resource constraint scheduling.
	3) Critical path of the project won't change.	3) Critical path of the project will be affected and usually the length of critical path will increase.
	4) Doesn't apply to resources on critical path.	4) Can be applied to resources on critical path.
	5) Free and total float (or slack) are used.	5) Free and total float (or slack) may be used.
	6) May not be able to optimize all the resources if sufficient slack (or float) isn't available, but does not change the duration of the project.	6) Will optimize all the resources and may change the duration of the project.

2) Does critical path changes with resource smoothing. Justify your answer.

Q-2 Ans) 1) Resource smoothing will not change the critical path; it tries to make the best use of slack.
2) We apply resource smoothing after doing resource leveling. since we need to first accomodate accommodate the resource constraints before we can optimize it.
3) Here we make use of slack, and will not result in a change of project duration. As duration is not hampered critical path won't change.
4) It is because the total allocation of a certain resource remains the same.
5) As the desired limit identified in resource smoothing may not be be applied in some cases; if we do not have slack. It is optimized within the float boundaries.
6) Critical path will be affected only by the changing the activity duration which doesn't have slack, overall project will not be delayed. but activities may only be delayed within their free or float total float.
7) A technique that adjusts the activities of a schedule model such that the requirements for resource on the project do not exceed certain predefined resource limits.
8) In resource smoothing, as opposed to resource leveling, the project's critical path is not changed and the completion date may not be delayed. in other words activities may not only be delayed within their free and total float.

3) For a Project, following information is made available. Apply Resource Smoothing/Levelling methodology for the same. Assume that only a single type resource is used for the project. Apply it for Early start and Late Start approach.

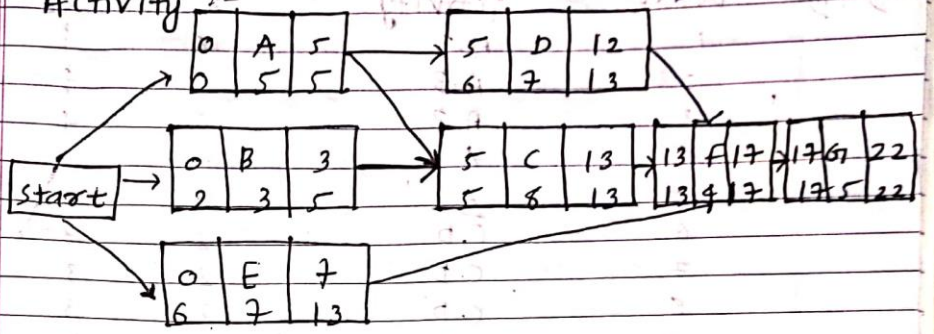
Activity	Immediate Predecessor	Duration(weeks)	Required Labour days/week	Total labour
A	-	5	8	40
B	-	3	4	12
C	A,B	8	3	24
D	A	7	2	14
E	-	7	5	35
F	C,D,E	4	9	36
G	F	5	7	35

Q-3) Ans)

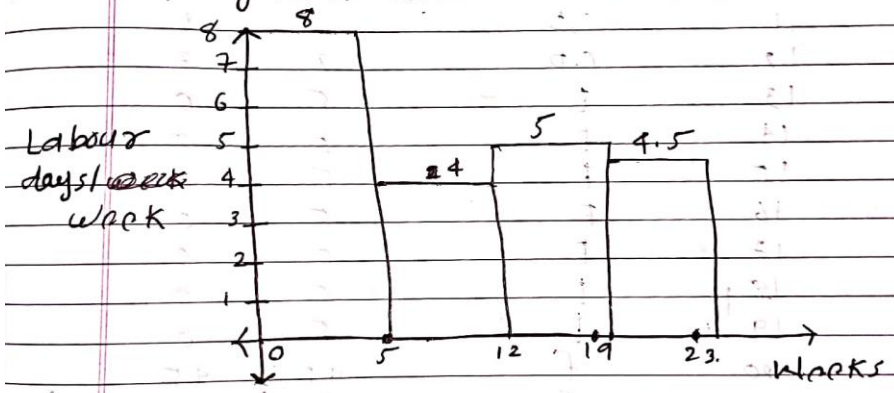
Week	Activity	R_1	R_2
1	A, B	8	4
2	A, B	8	4
3	A, B	8	4
4	A	8	0
5	A	8	0
6	C, D	2	3
7	C, D	2	3
8	C, D	2	3
9	C, D	2	3
10	C, D	2	3
11	C, D	2	3
12	C, D	2	3
13	E	5	0
14	E	5	0
15	E	5	0
16	E	5	0
17	E	5	0
18	E	5	0
19	E	5	0
20	f	4.5	4.5
21	f	4.5	4.5
22	f	4.5	4.5
23	f	4.5	4.5

24	G	0	7
25	G	0	7
26	G	0	7
27	G	0	7
28	G	0	7

Activity :-

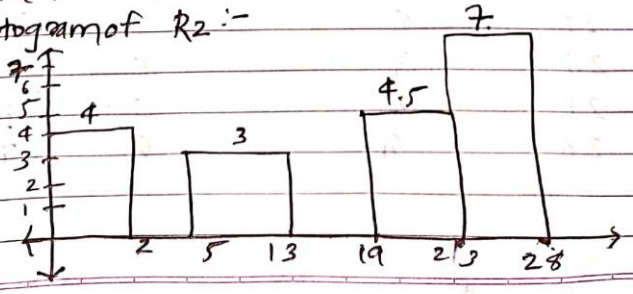


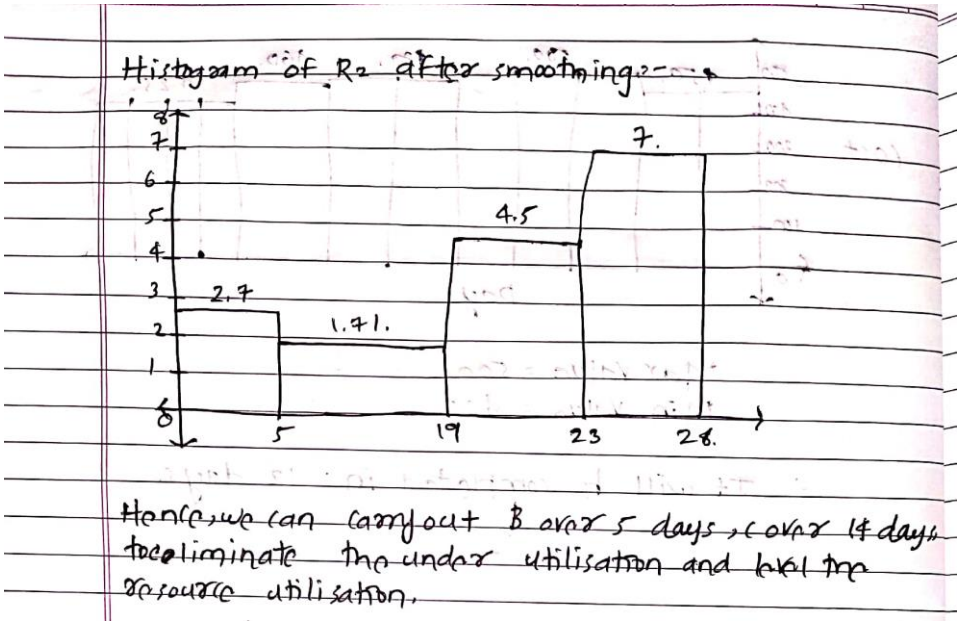
Histogram of R1 :-



Histogram of R1 cannot be smoothed because the activities cannot be spread due to the values of resources R1.

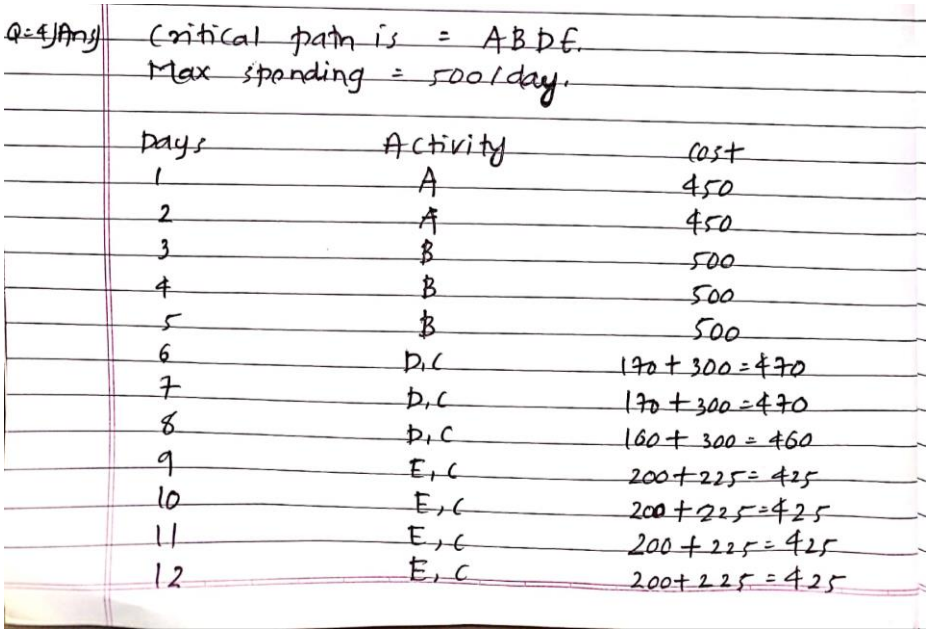
Histogram of R2 :-

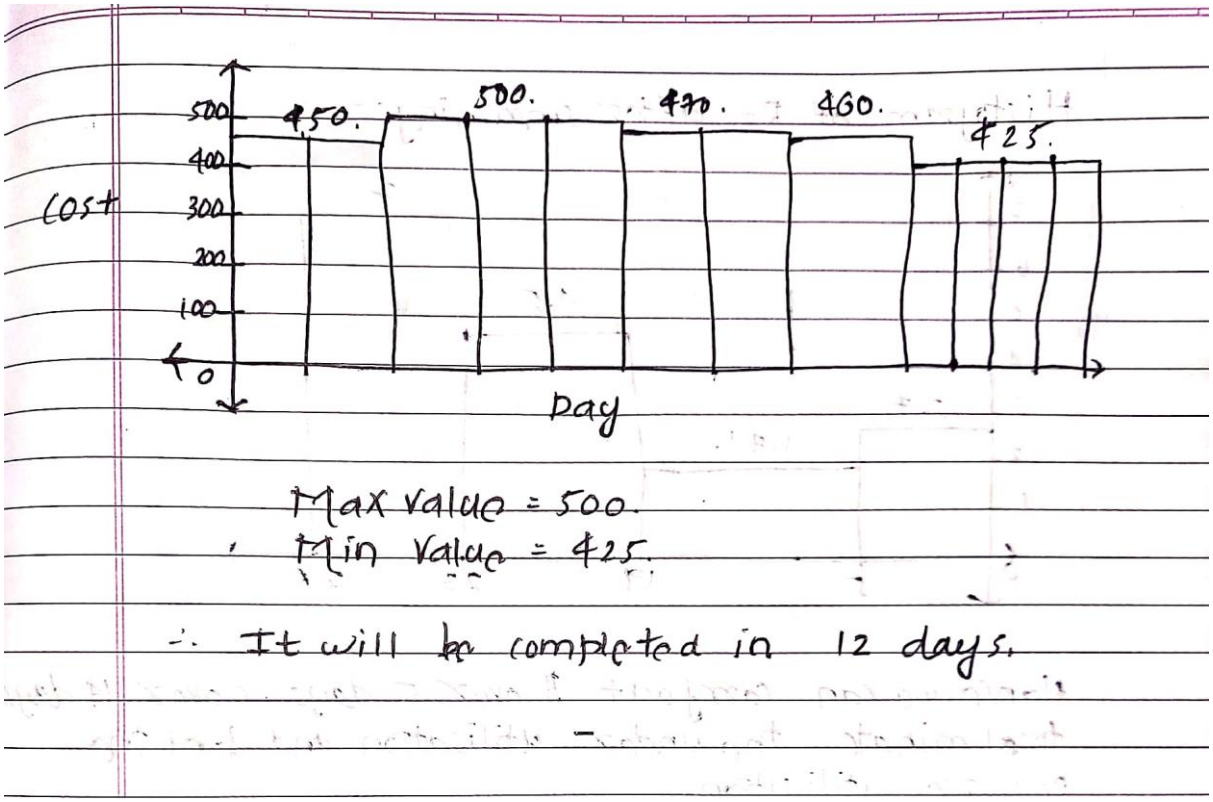




4) For the given project, the table represents Activity, duration, predecessors and cost/day. The constraint to spend is Max. 500/day. Plot a graph of Cost vs Time mentioning the activities to be carried out in such a way that fluctuation in the expenditure is minimum.

Activity	Predecessors	Duration (Days)	Cost
A	-	2	600
B	A	3	1200
C	B	3	1200
D	B	2	400
E	D	3	300





Max value = 500.
Min value = 425.

∴ It will be completed in 12 days.