Engineering Management

Final Term

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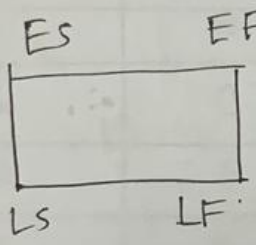
Network diagram

AON → Activity of Node.
AOA → Activity of Arrows.



Es → Earliest start
EF → Earliest Finish
LS → Latest start
LF → Latest Finish

slack:

slack = LF − EF
or slack = LS − ES

} যেকোন একটা দিয়ে বের করলেই হবে।

Activity	Immediate Predecessor	Duration weeks
A		4
B		10
C		7
D	A	5
E	B	3
F	B	6
G	C	2
H	F	8
I	F, G	11
J	D, E	8

(a) Draw AON. Find critical path, completion time, slack and also find All posible path.

(b) If $1000 can be saved for each delayed day of activity H, the how much dollar can be saved keeping the project completion time unchanged?

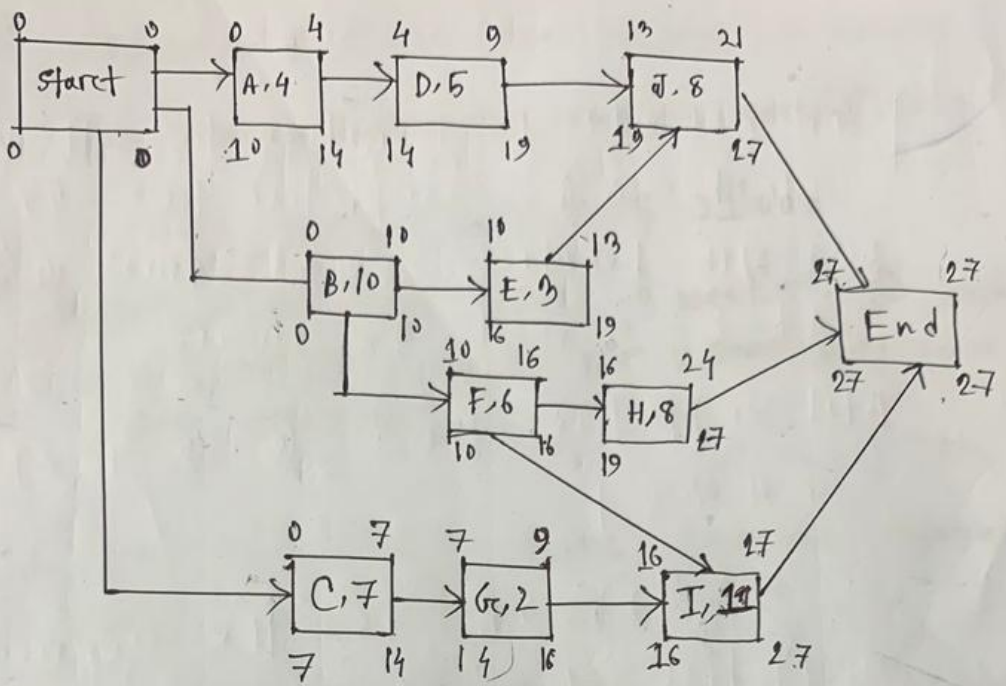
(a)

(c) Activity Gc needs a delayed time of 2 weeks and extra time of 5 weeks, is it possible by keeping the project completion time unchanged? Explain.

(d) The PM wants to shorten the duration of the activity I from 11 weeks to 9 weeks what will be the impact of these change on project completion time.

(e) prepare Gantt chart.

(a)



Slack:

A = 10	F = 0
B = 0	G = 7
C = 7	H = 3
D = 10	I = 0
E = 6	J = 6

যেগুলোর slack এর value 0 সেগুলো নিয়ে সঠিক path টা হলো critical path.

Now, Critical path = B — F — I

All possible path:

B - F - I
A - D - J
B - E - J
B - F - H
C - G - I

critical path এর length সাধারণত সবচেয়ে বড় হয়।
এখানে সবগুলো path এর length ই সমান।
[critical path is also a possible path]

(b) Activity "H" can be delayed 3 weeks.

For every ~~week~~ day can be saved $1000

So, $3 \times 7 \times 1000 = \$\ 21000$

[এখানে H এর slack value 3 weeks, প্রতিদিন $1000 করে। মোট 3×7×1000 saving price হবে Ans পাওয়া যাবে]

(c) At Activity "G" there can be delayed 7 weeks driven from AON.

So, It is possible to delay 2 weeks and it can be take extra 5 weeks.

[G এর slack = 7 week, so 2 week delay করা যাবে। কারণ 7 week পর্যন্ত delay valid। তার extra থাকবে 7 − 2 = 5 weeks]

(d) If, 11 − 9 = 2 weeks is shorten on Activity "I"

I is a part of critical path, so the completion time will be shorten by 2 weeks

So, 27 − 2 = 25 week.

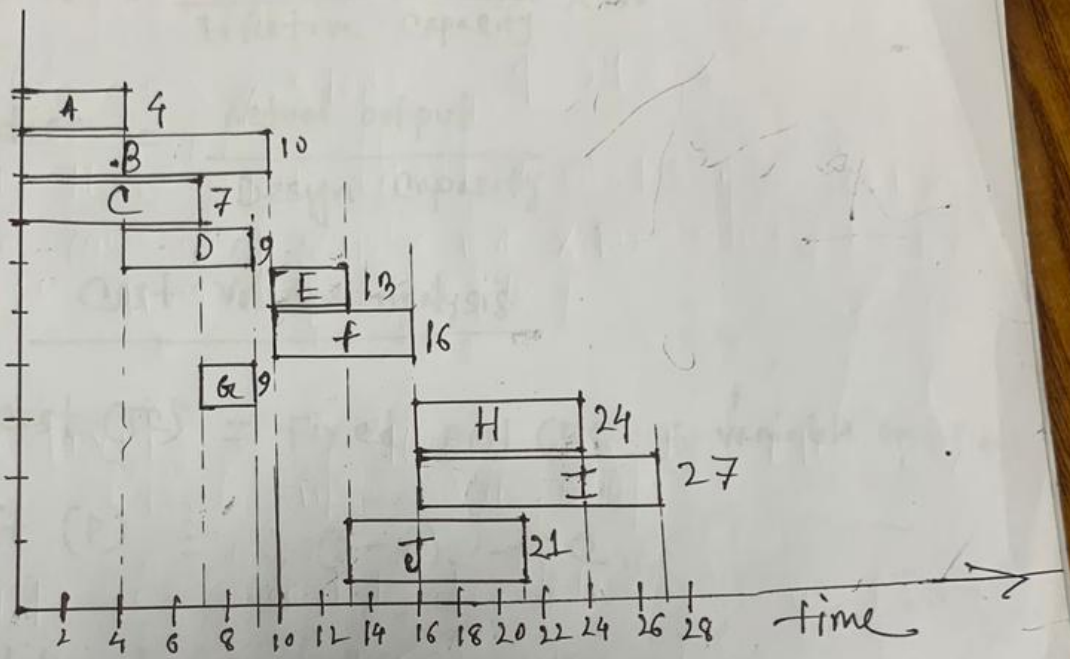
[In Activity I, Duration time 11 week
Slack = 0], completion time 27 week
এখন যদি Duration 2 week কমানো যায়
$11 - 2 = 9$ week হয়ে যাবে
Total completion time ও 2 weeks
কমে যাবে।

∴ $27 - 2 = 25$ is the current
completion time]

[Slack is the delay path of activity &
Critical path is the Longest path of
activity]

(e)

Gantt chart :-



Capacity Planning

$$\text{Efficiency} = \frac{\text{Actual output}}{\text{Effective capacity}} \times 100$$

$$\text{Utilization} = \frac{\text{Actual output}}{\text{Design capacity}}$$

Cost Volume Analysis

1. Total cost (TC) = Fixed cost (FC) + variable cost (vc)
2. Profit (P) = Q (R - V) - FC
3. Quantity to generate specific profit,

$$Q = \frac{P + FC}{R - V}$$

4. Quantity at Break even point,

$$Q_{BEP} = \frac{FC}{R - V}$$

Profit = Total Revenue − Total cost

Example: The owners of old fashion berrey pies. Mrs. Dipto, is planning a new lines of pies. which will require leasing new equipments for a monthly payment of $ 6000, variable cost would be $ 2.00 per pie, and pies retail for $ 7.00 each.

(a) How many pies must be sold in order to Break even point?

$$Q = \frac{FC}{R-V} = \frac{6000}{7-2} = 1200 \text{ pies}$$

Fixed cost (FC) = $6000
VC = $ 2 per pie
R = $ 7 per pie

(b) what would be profit or loss if 1000 pies sold in a month?

$$P = Q(R-V) - FC$$
$$= 1000(7-2) - 6000$$
$$= -\$1000 \text{ (loss)}$$

(c) How many pies must be sold to realize a profit of $4000?

$P = \$4000$

$$Q = \frac{P + FC}{R - V} = \frac{4000 + 6000}{7 - 2}$$

$$= 2000 \text{ pies}$$

(d) If 2000 can be sold, And profit target is $5000, what price should be charged per pie?

$$\text{profit } (P) = Q(R - V) - FC$$

$$\Rightarrow 5000 = 2000(R - 2) - 6000$$

$$\Rightarrow R = \$7.50$$

Location planning

Fixed and variable cost for four potential plant location are shown below

Location	Fixed cost per year	variable cost per unit
A	$ 259000	$ 11
B	$ 100,000	$ 30
C	$ 150,000	$ 20
D	$ 200,000	$ 35

(a) Plot the total cost lines for these location on a single graph.

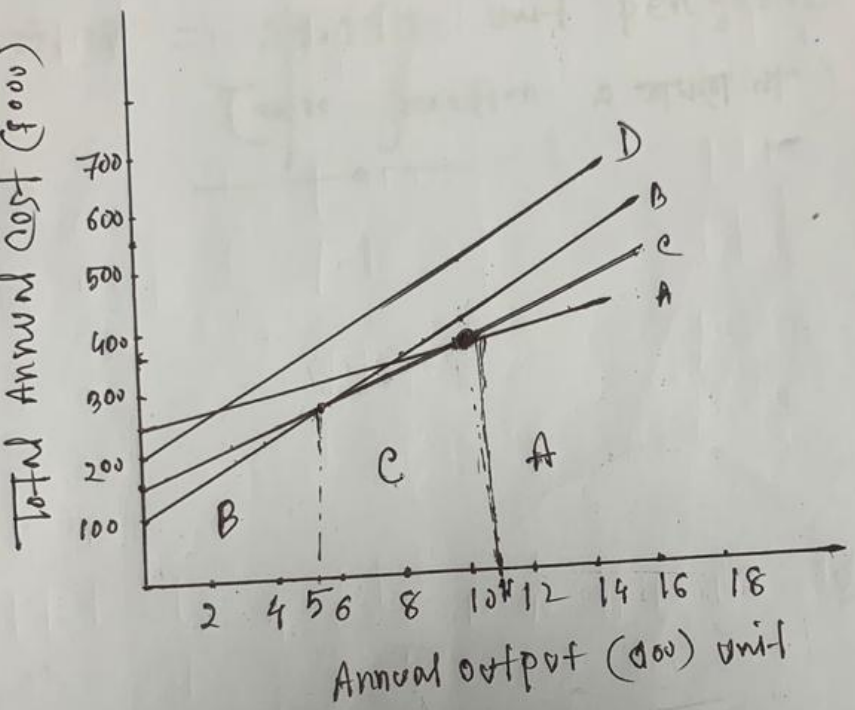
Fixed cost + variable cost = Total cost

A. $ 250,000 + $ 11 (10000) = $ 360,000

B 200,000 + 30 (10000) = 400,000

C 150,000 + 20 (10000) = 350,000

D 200,000 + 35 (10000) = 550,000



(b) In break even output level,

(B)

$100,000 + 30Q = $150,000 + $20Q

$\Rightarrow 10Q = 50000$

$\Rightarrow Q = 5000$ units per year

Total cost (TC) = FC + VQ

For C And A

$\$ 150,000 + 20Q = \$ 250,000 + \$ 11Q$

$\Rightarrow 9Q = 100000$

$\Rightarrow Q = 11111$ units per year

[value fraction এ রাখলো না]

Quality control

control chart

SAMPLE

	1	2	3	4	5
1	12.11	12.15	12.09	12.12	12.09
2	12.10	12.12	12.09	12.10	12.14
3	12.11	12.10	12.12	12.08	12.13
4	12.08	12.11	12.15	12.10	12.12
$\bar{x}$	12.10	12.12	12.11	12.10	12.12

$$\bar{\bar{x}} = \frac{12.10 + 12.12 + 12.11 + 12.10 + 12.12}{5}$$

$$= 12.11$$

$$UCL = \bar{\bar{x}} + Z\sigma_{\bar{x}}$$

$$LCL = \bar{\bar{x}} - Z\sigma_{\bar{x}}$$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

$Z = 3$, $n = 4$ $\sigma = .02$

Z এবং σ এর value দেওয়া থাকবে।

UCL = Upper control Limit

LCL = Lower control Limit

$$UCL = 12.11 + 3\left(\frac{.02}{\sqrt{4}}\right) = 12.14$$

$$LCL = 12.11 - 3\left(\frac{.02}{\sqrt{4}}\right) = 12.08$$

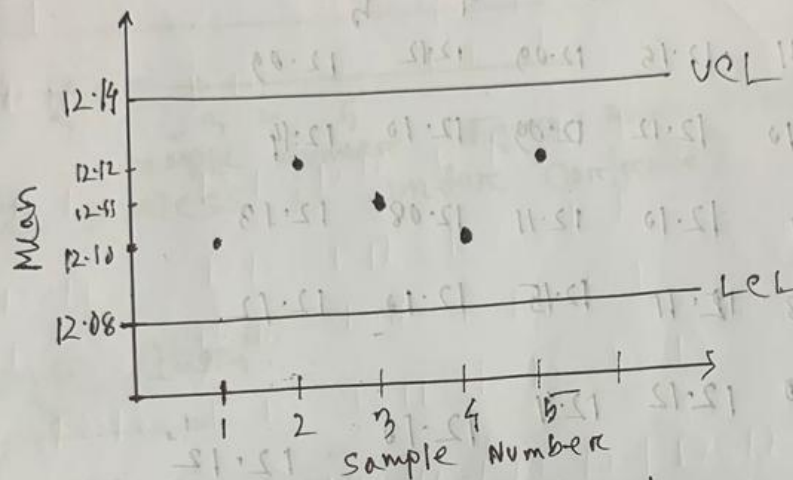


Figure: Mean chart

This process is under controlled.

[যেহেতু sample 1, 2, 3, 4, 5 এর সবগুলো mean value এগুলো $\bar{x}$ এর value LCL এবং UCL এর মধ্যে অবস্থান করছে এই কারণে process under controlled]

এবার r এর value দেওয়া না থাকলে এবং A_2 এর value এর টেবিল উধিনা দেওয়া থাকলে Mean chart দ্বারা process under control কিনা সেটা কের বলতে।

Sample:	1	2	3	4	5
1	12.11	12.15	12.09	12.12	12.09
2	12.10	12.12	12.09	12.10	12.14
3	12.11	12.10	12.11	12.08	12.13
4	12.08	12.11	12.15	12.10	12.12
$\bar{x}$ =	12.10	12.12	12.11	12.10	12.12

$\bar{\bar{x}} = 12.11$

R = 0.03 0.05 0.06 0.04 0.05

$\bar{R} = 0.046$ | $\bar{R} = \frac{0.03+0.05+0.06+0.04+0.05}{5} = 0.046$

Range.
R = sample এর Highest value — Lowest value

$UCL = \bar{\bar{x}} + A_2\bar{R}$
$= 12.11 + 0.73 \times 0.046$
$= 12.14$

A_2 এর value টেবিল এ দেওয়া থাকবে।

$LCL = \bar{\bar{x}} - A_2\bar{R}$
$= 12.11 - 0.73 \times 0.046$
$= 12.08$

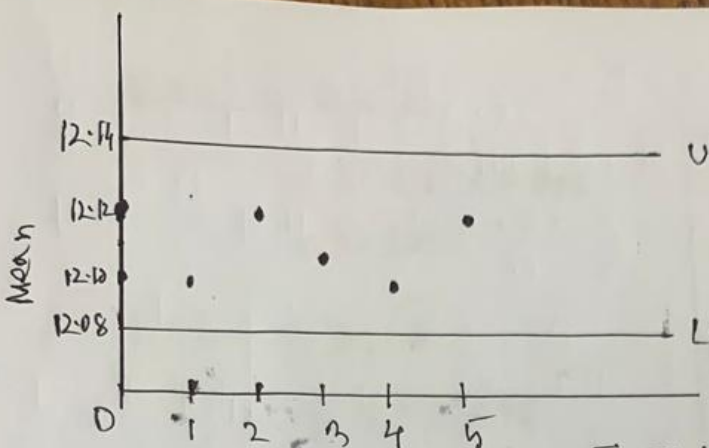


Figure: Mean chart

The process is under controlled

Range chart:

$$UCL = D_4 \bar{R}$$

$$LCL = D_3 \bar{R}$$

Sample:

	1	2	3	4	5
1	12.11	12.15	12.09	12.12	12.09
2	12.10	12.12	12.09	12.10	12.14
3	12.11	12.10	12.11	12.08	12.13
4	12.08	12.11	12.15	12.10	12.12
R	0.03	0.05	0.06	0.04	0.05

$\bar{R} = 0.046$

$UCL = D_4 \bar{R}$

$= 2.28 \times 0.046$

$= 0.105$

$LCL = D_3 \bar{R}$

$= 0 \times 0.046$

$= 0$

D3 এবং D4 এর value Question এ দেওয়া থাকবে।

Here,

$D_4 = 2.28$

$D_3 = 0$

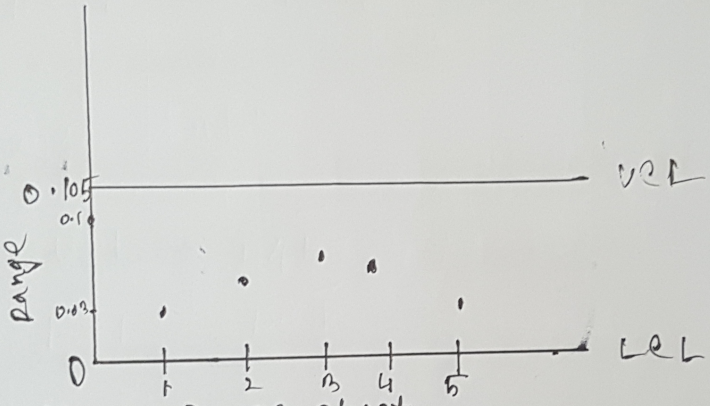


Figure Range chart

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To construct a Frequency distribution from this data we proceed as follows.

1. Determine the largest and smallest number in the raw data
2. Find the range (difference between largest and smallest number)
3. Determine the number of classes
4. Calculate class interval
5. Determine class frequencies.
6. All the bottom of the frequency column record the total frequency.

Data table:

3.67	10.94	5.47	8.64	2.84
3.183	4.80	5.42	1.97	2.09
6.72	4.95	4.55	3.32	2.78
3.34	6.45	5.11	7.20	3.53
5.10	9.15	3.89	3.65	4.10
2.75	1.93	4.15	4.85	3.21

Step-1:

largest value = 10.94
smallest value = 1.83

Step-2: Range = 10.94 − 1.83
= 9.11

Step-3: Classes In order to determine number of we will use

$2^k \geq n$

[k is smallest positive Number]

$e^k \geq 1$ [k is the smallest positive Number]

$e^k \geq 30$

when,

$k = 1$:

$2^1 = 2$

when $k = 2$

$2^2 = 4$

when $k = 3$

$2^3 = 8$

when $k = 4$

$2^4 = 16$

when $k = 5$

$2^5 = 32$

∴ For this example number of classs,

$k = 5$

Step4:

size of the class interval = $\frac{\text{Largest value} - \text{Smallest value}}{\text{Number of classes}}$

$= \frac{9.11}{5}$

$= 1.82 \simeq 2$

~~Step-4~~:

Class Interval
1.5 - 3.5
3.5 - 5.5
5.5 - 7.5
7.5 - 9.5
9.5 - 11.5

Step-5:

Class Interval	Tally	Frequency
1.5 - 3.5	𝍸 𝍸	10
3.5 - 5.5	𝍸 𝍸 𝍸 𝍸	14
5.5 - 7.5	𝍸	3
7.5 - 9.5	𝍸	2
9.5 - 11.5	𝍸	1

* Histrogram draw

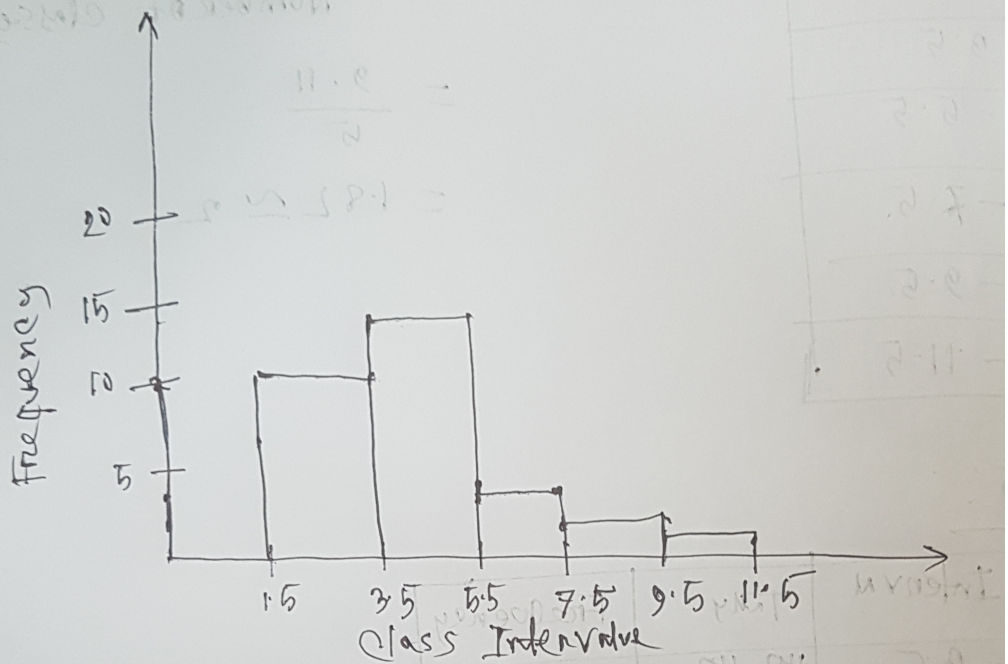

Figure : Histrogram