

* Trade off : تعني أن نتنازل عن شيء من أجل شيء آخر

* إذا بتنازل عن الجودة زح يقل عذدي السعر

* في بعض الاحيان يكون بدنا نقتل المشروع او نسرعه

* ما نيجي نقتل وقت المشروع اننا بنعمل على تقليل بنقل critical activities

* Activity cost theory *

* مودن بيكولنا انو كل يوم الا تكلفه

* hyperbolic curve ، بنلاحظ انو activity كل ما قلنا وقتها بتزيد الكلفه

* عشان نقدر نستقرم هذا الكيرف زح نحول ل Linear ، عشان يسهل

علينا حساب $\text{slope} = \frac{\Delta C}{\Delta T}$ حيث ΔT وقت

* الان لما بدني اعني الجدول الجدول لما اتحرك من $C_1 \rightarrow C_2$ زح تكون

والكل نفس الشيء

Ex:

تابع لرسمه باخر صفة بالسلايدان (time and cost chart)

To From	C 4	PT1 5	PT2 7	N 9	
C 4	0	-1600	-966.7	-670	
PT1 5	1600	0	-650	-437.5	
PT2 7	966.7	650	0	-225	
N 9	670	437.5	225	0	

* عشان نتحول من نقطه PT1 (5) الى C (4) بنسب الـ slope

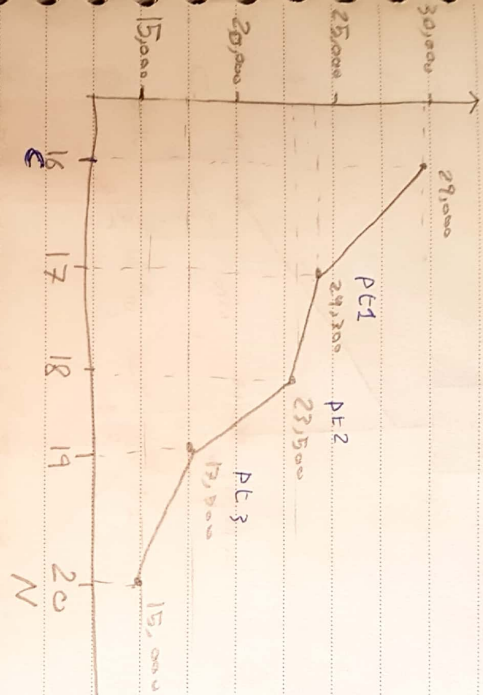
$$\frac{\Delta C}{\Delta t} = \frac{15600 - 14000}{14 - 5} = \$1600/\text{day}$$

From PT2 (7) → C (4)

$$\frac{\Delta C}{\Delta T} = \frac{15600 - 12700}{14 - 7} = \$966.7/\text{day}$$

* والباقي بنفس الشيء

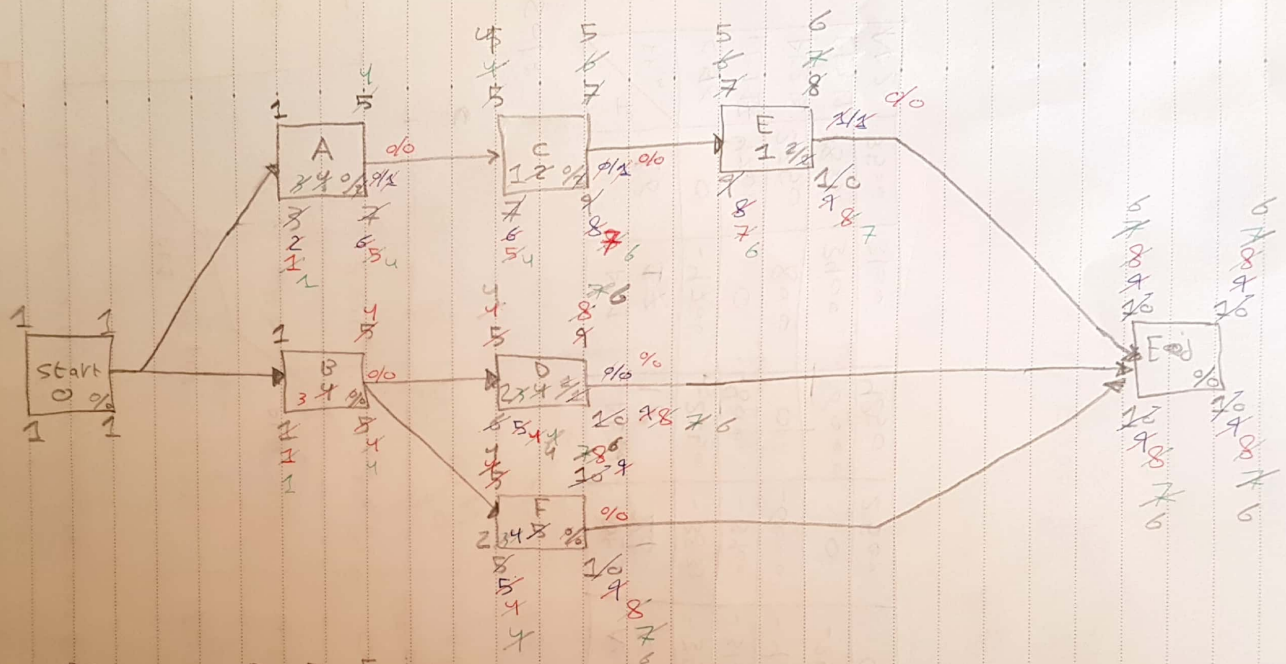
EX 2°



Sols

T_0	C	$PT1$	$PT2$	$PT3$	N
F_{0n}	16	17	18	19	20
C_{96}	0	-4700	-2750	-3833	-3500
$PT1_{18}$	4700	0	-800	-3400	-3100
$PT2_{18}$	2750	800	0	-6000	-4250
$PT3_{19}$	3833	3400	6000	0	-2500
AV_{20}	3500	3100	4250	2500	0

EX: Time cost tradeoff.



- *CP1: start - B - F, End
- *CP2: start - B - D - End
- *CP3: start - A - C - E - End

<u>Act</u>	<u>Normal Dur</u>	<u>Exp Dur</u>	<u>Exp cost Per day</u>
A	4	3	250
B	4	3	1,500
C	2	1	1,500
D	4	1	1,500
F	5	2	500

Q) crash the net work from its normal
to its crashed duration

Iteration

crashing
pass/cost

Proj
Dur

Inc
cost

Cum
Cost

1

B/\$ 1,500 X
F/\$ 500 ✓

10 → 9

500

500

الشرط لانها
اقل كلمة

2

CP1: B/\$ 1,500

F/\$ 500

X

CP2: B/\$ 1,500

D/\$ 1,500

X

or joint CP1 & CP2 9 → 8

1500

2000

B/\$ 1,500 ✓

* انما 2 نولة يوم من كل CP

فـ F و D بطول 2000 \$

فيكون الان من اوفر

3

CP1: F/\$ 500 ✓

CP2: D/\$ 1,500 ✓

8 → 7

2250

4250

CP3: A/\$ 250 ✓

or
C/\$ 1,500 X

1 1

ite

crashing
Poss/Cost

Prod
Dur

Inc
cost

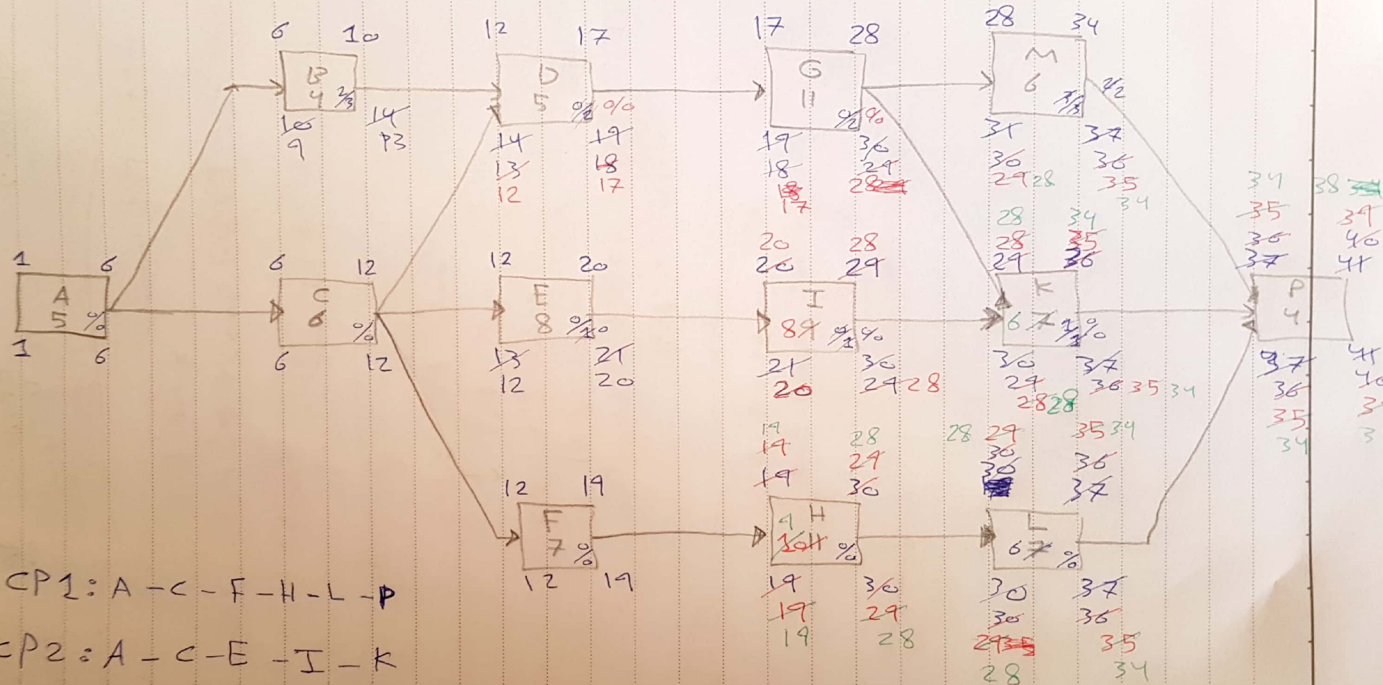
Can
cost

4

CP1: F/\$ 500 ✓

CP2: D/\$ 1,500 ✓ 7 → 6 3,500 7,750

CP3: C/\$ 1,500 ✓



<u>Act</u>	<u>Dur</u>	<u>Crashed Dur</u>	<u>Cost of Crash Per day</u>
D	5	4	3,100
E	8	7	2,900
F	7	6	2,500
G	11	8	3,200
H	11	9	2,500
I	9	6	2,900
K	7	6	5,900
L	7	6	2,300

Q) Based on the Shown information
Crash the project by 3 days.

Sol:

1 1

<u>Iter</u>	<u>Crashing Poss/cost</u>	<u>Proj Dur</u>	<u>Inc Cost</u>	<u>Cum Cost</u>
1	F/\$ 2,500 x H/\$ 2,500 x L/\$ 2,300 ✓	41 → 40	2,300	2,300

2	CP1: F/\$ 2,500 x H/\$ 2,500 ✓ 40 → 39 2500 CP2: E/\$ 2,900 x I/\$ 2,900 ✓ K/\$ 5,900		2,900	7,700
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3	CP1: F/\$ 2,500 x H/\$ 2,500 ✓ } anyone 2,500 CP2: E/\$ 2,900 x I/\$ 2,900 ✓ } \$6000 CP3: D/\$ 3,100 ✓ } G/\$ 3,200 x			16,100
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don't CP2 & CP3
K/\$ 5,900 → 5,900

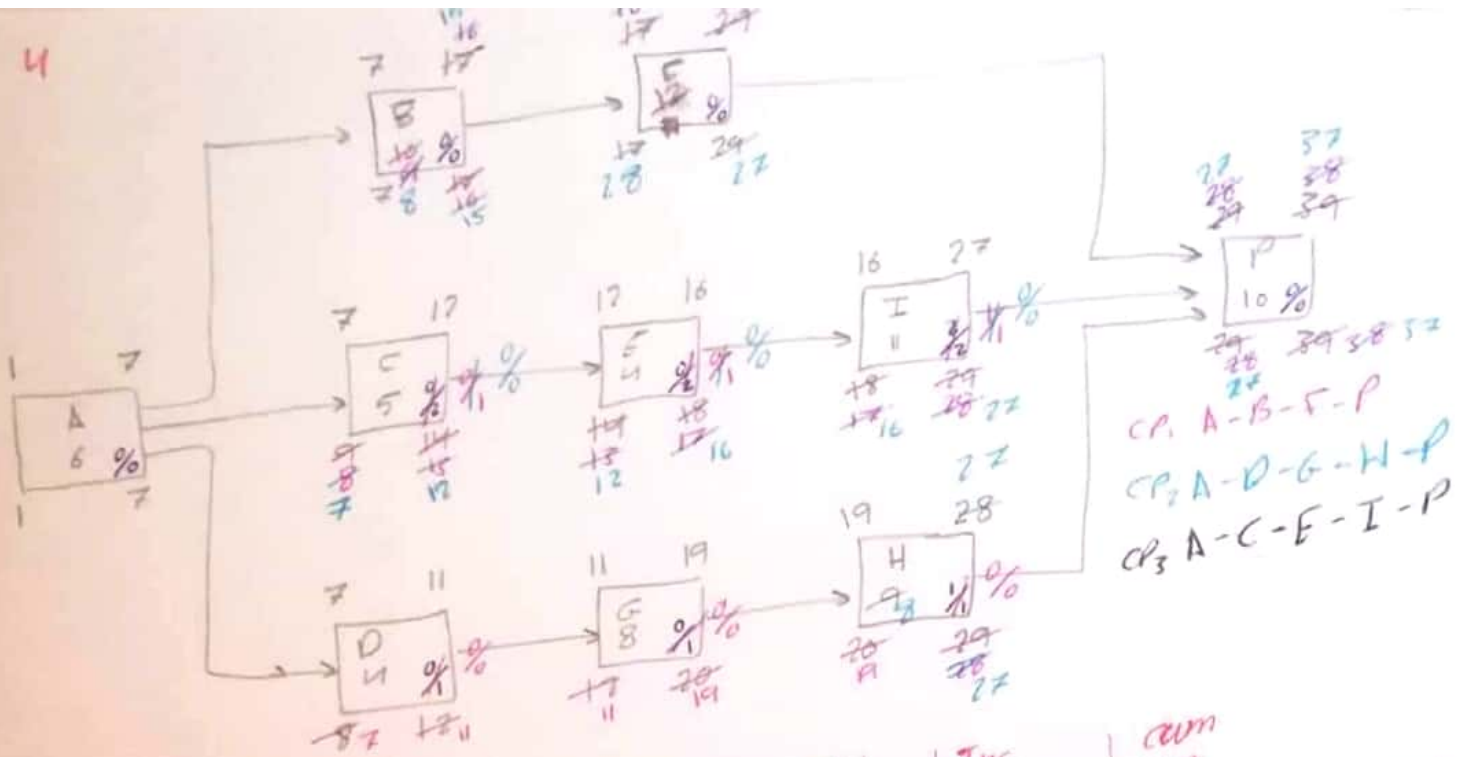
ملاحظات عن السؤال السابق:

١- إذا تساوى التكلفة يؤخذ إلى بقدر انزلة أيام أكثر.

٢- لفرنا المفضل بال (31٤) لانو كلفتها (\$5,900) وهي اقل

من (I, D) اي بطلع كلفتهم (\$6,000)

EX 4



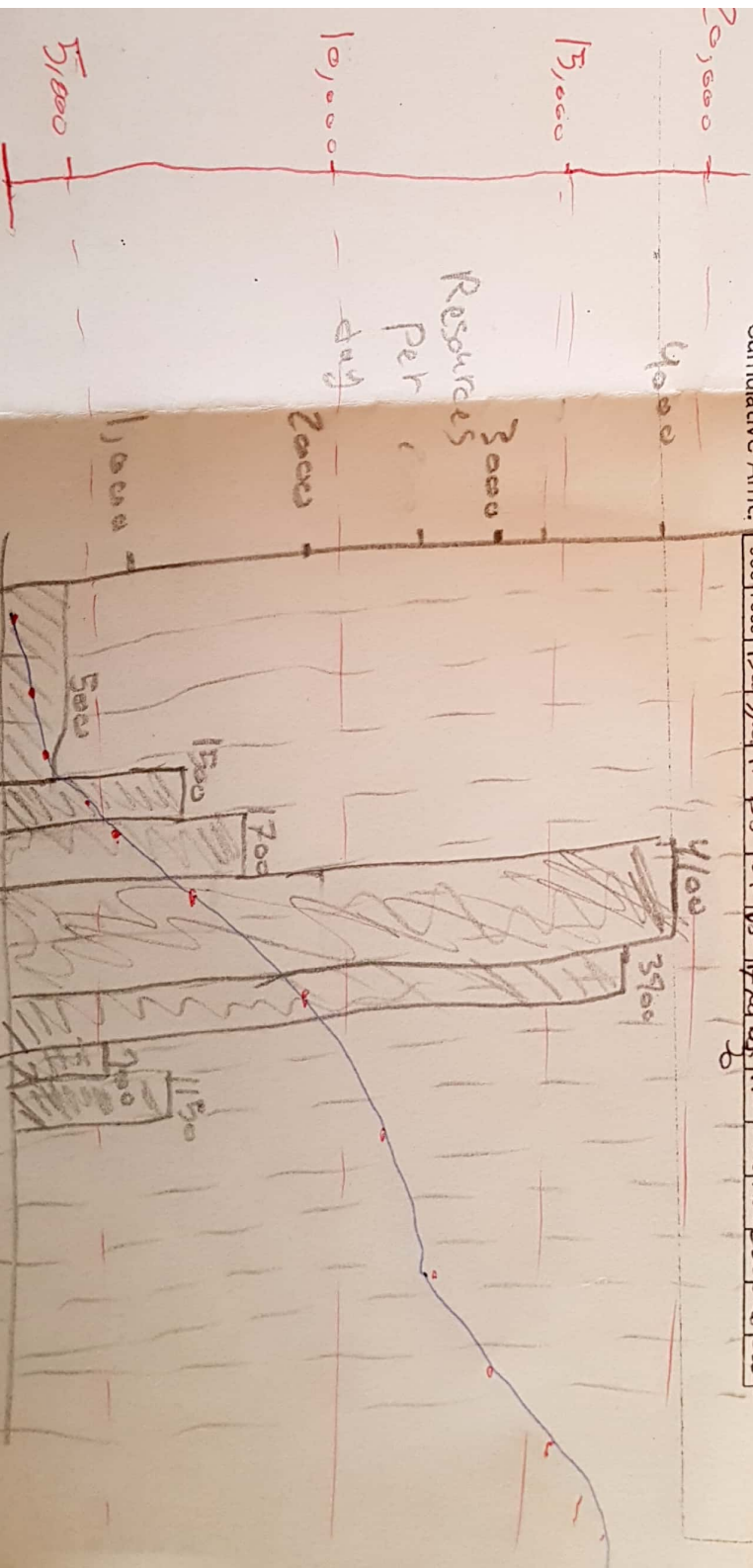
CP₁ A-B-E-P
 CP₂ A-D-G-H-P
 CP₃ A-C-F-I-P

Act	Dur	Crash Dur	Cost of crash/day	Iter	Crash Poss/cost	Proj Dur	Inc. Cost	Crash Cost
B	10	8	1800	1	CPD	39 → 38	1800	1800
D	4	2	2500		B/\$1800 ✓			
E	4	1	3100		F/\$1900 X			
F	12	11	1900	2	CPD	38 → 37	1800 1900 2000 → 3800	5600
F	12	11	1900		B/\$1800 ✓			
G	8	5	2500		F/\$1900 X			
H	9	8	2000		D/\$2500 X			
I	11	9	3100		G/\$2500 X			
				3	H/\$2000 ✓	37 → 36	1900 2500 3100 → 7500	13100
					CPD			
					F/\$1900 ✓			
					CPD			
					D/\$2500 X			
					G/\$2500 ✓			
					CPD			
					E/\$3100 X			
					I/\$3100 ✓			

Question 3 Bar Chart
Use the data below to construct a Resource histogram and s-curve.

Activity	Dur (Days)	Total Resource	Workdays															
Move to Site	4	2,000	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Clear Site	5	5,000																
Survey Site	3	600																
Grade Site	6	3,000																
Exc. for Sewer	3	6,000																
Exc. for Electric	5	2,000																
Install Sewer	4	1,000																
Install Electric	3	3,000																
Total		22,600																

Period Amount	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Cumulative Amt.	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000



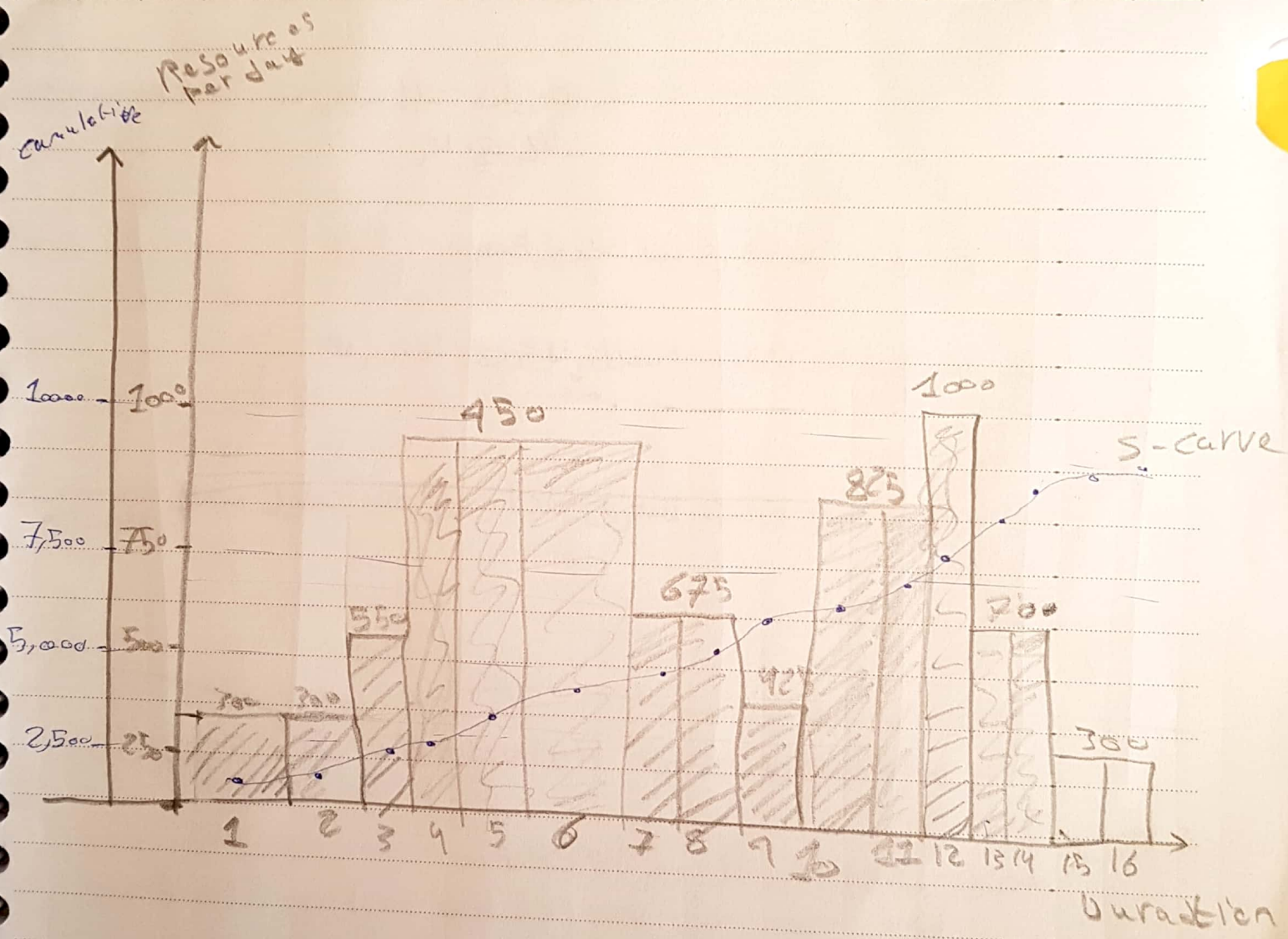
حلقة

* Histograms and S-curve

prob 8 (من الكتاب)

ID	Activity	Duration	Resources Per day	1	2	3	4	5	6	7	8	9	10
10	A	7	300	300	300	300	300	300	300	300			
20	B	6	250			250	250	250	250	250	250		
30	C	3	400				400	400	400				
60	D	5	125							125	125	125	125
40	E	5	300								300	300	300
50	F	5	400										400
70	G	5	300										
Period amount				300	300	550	950	950	950	675	675	475	825
Cumulative amount				300	600	1150	2100	3050	4000	4675	5350	5775	6600

11	12	13	14	15	16
125					
300	300				
400	400	400	400		
	300	300	300	300	300
825	1000	700	700	300	300
7425	8425	9125	9825	10125	10425



In-Class Resource Leveling Example

Minimum Moment Algorithm Approach

Activities are arranged according to their early start

Free float is indicated by -

Number of resources are shown in the table

Cycle 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	1	6	6	3	-	-	-	3	5	5	1	1	3	3	4	4	2
B	4	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2
C	4	4	4	-	-	-	-	4	5	5	1	1	3	3	4	4	2
D	3	3	3	-	-	-	-	3	5	5	1	1	3	3	4	4	2

Note that G depends on C&D

Resource	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sum	13	10	3	3	3	3	3	12	8	5	1	1	3	3	4	4	2

Cycle 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2
B	4	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2
C	4	4	4	-	-	-	-	4	5	5	1	1	3	3	4	4	2
D	3	3	3	-	-	-	-	3	5	5	1	1	3	3	4	4	2

Resource	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sum	13	10	3	3	3	3	3	12	8	5	1	1	3	3	4	4	2

Cycle 2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2
B	4	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2
C	4	4	4	-	-	-	-	4	5	5	1	1	3	3	4	4	2
D	3	3	3	-	-	-	-	3	5	5	1	1	3	3	4	4	2

Resource	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sum	13	10	3	3	3	3	3	12	8	5	1	1	3	3	4	4	2

Cycle 3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2
B	4	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2
C	4	4	4	-	-	-	-	4	5	5	1	1	3	3	4	4	2
D	3	3	3	-	-	-	-	3	5	5	1	1	3	3	4	4	2

Resource	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sum	13	10	3	3	3	3	3	12	8	5	1	1	3	3	4	4	2

Resource Sum

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
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$$= R \cdot (R_v - R - R \cdot V)$$

$$= R \cdot (R_v - R - R \cdot V)$$

$$= R \cdot (R_v - R - R \cdot V)$$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
cycle 4																	
	A	B	B	E	E	E	E	G	G	G	I	I	J	J	K	K	L
	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2

Resource Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
cycle 5																	
	A	B	B	E	E	E	E	G	G	G	I	I	J	J	K	K	L
	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2

Resource Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
cycle 6																	
	A	B	B	E	E	E	E	G	G	G	I	I	J	J	K	K	L
	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2

Resource Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	1	6	6	3	3	3	3	5	5	5	1	1	3	3	4	4	2

IF(Activity, # of FF days consumed)

$$= R * (R_v - R_o - R * N_r)$$

R : Resource Per day
 R_v : اليوم الأول Resource
 R_o : اليوم الثاني Resource
 N_r : # of FF days consumed
 Dur of act

* Example: الوقت

Cycle 1

$$IF(H, 1) = 3 * (12 - 5 - 3 * 1) = 12.$$

2 = Dur of days (H)

$$IF(H, 2) = 3 * (20 - 6 - 3 * 2) = 24.$$

$$IF(H, 3) = 3 * (20 - 2 - 3 * 2) = 36$$

$$IF(H, 4) = 3 * (20 - 4 - 3 * 2) = 30$$

$$IF(H, 5) = 3 * (20 - 6 - 3 * 2) = 24$$

$$IF(H, 6) = 3 * (20 - 7 - 3 * 2) = 21$$

$$IF(H, 7) = 3 * (20 - 8 - 3 * 2) = 18$$

* Therefore, move H 3 days

Cycle 2 cal

$$IS(F,1) = 4 \times (9 - 5 - 4 \times 1) = 0$$

$$IF(F,2) = 4 \times (9 - 5 - 4 \times 1) = 0$$

$$IF(F,3) = 4 \times (9 - 4 - 4 \times 1) = 4$$

$$IF(F,4) = 4 \times (9 - 4 - 4 \times 1) = 4$$

$$IF(F,5) = 4 \times (9 - 3 - 4 \times 1) = 8$$

Therefore, move F
6 days

$$IF(F,6) = 4 \times (9 - 3 - 4 \times 1) = 8$$

2 Cycle 3 cal

$$IF(C,1) = 4 \times (13 - 3 - 4 \times 1) = 24$$

$$IF(C,2) = 4 \times (23 - 6 - 4 \times 2) = 36$$

$$IF(C,3) = 4 \times (23 - 6 - 4 \times 2) = 36$$

Therefore, move
C 4 days

$$IF(C,4) = 4 \times (23 - 6 - 4 \times 2) = 36$$

$$IF(D,1) = 3 \times (13 - 10 - 3 \times 1) = 0$$

$$IF(D,2) = 3 \times (13 - 3 - 3 \times 1) = 21$$

$$IF(D,3) = 3 \times (13 - 3 - 3 \times 1) = 21$$

$$IF(D,4) = 3 \times (13 - 3 - 3 \times 1) = 21$$

$$IF(D,5) = 3 \times (13 - 3 - 3 \times 1) = 21$$

[4] Cycle 4 cul

Re - consider Act D

$$IF(D, 1) = 3 * (9 - 6 - 3 * 1) = 0$$

$$IF(D, 2) = 3 * (9 - 3 - 3 * 1) = 9$$

$$IF(D, 3) = 3 * (9 - 3 - 3 * 1) = 9$$

$$IF(D, 4) = 3 * (9 - 7 - 3 * 1) = -3$$

$$IF(D, 5) = 3 * (9 - 7 - 3 * 1) = -3$$

Therefore, move D 3 days

* Back float calculations

cycle [5] cul

$$IF(D, 1) = 3 * (6 - 3 - 3 * 1) = 0$$

$$IF(D, 2) = 3 * (6 - 6 - 3 * 1) = -9$$

$$IF(D, 3) = 3 * (6 - 6 - 3 * 1) = -9$$

$$IF(C,1) = 4 * (7 + 6 - 1) = -12$$

$$IF(C,2) = 4 * (4 - 9 - 4 * 2) = -12$$

$$IF(C,3) = 4 * (14 - 9 - 4 * 2) = -12$$

$$IF(C,4) = 4 * (14 - 12 - 4 * 2) = -24$$

~~IF~~

Therefore, move D back 1 day

Cycle ☒ calc

$$IF(F,1) = 4 * (7 - 3 - 4 * 1) = 0$$

$$IF(F,2) = 4 * (7 - 4 - 4 * 1) = -4$$

$$IF(F,3) = 4 * (7 - 9 - 4 * 1) = -4$$

$$IF(F,4) = 4 * (7 - 5 - 4 * 1) = -8$$

$$IF(F,5) = 4 * (7 - 5 - 4 * 1) = -8$$

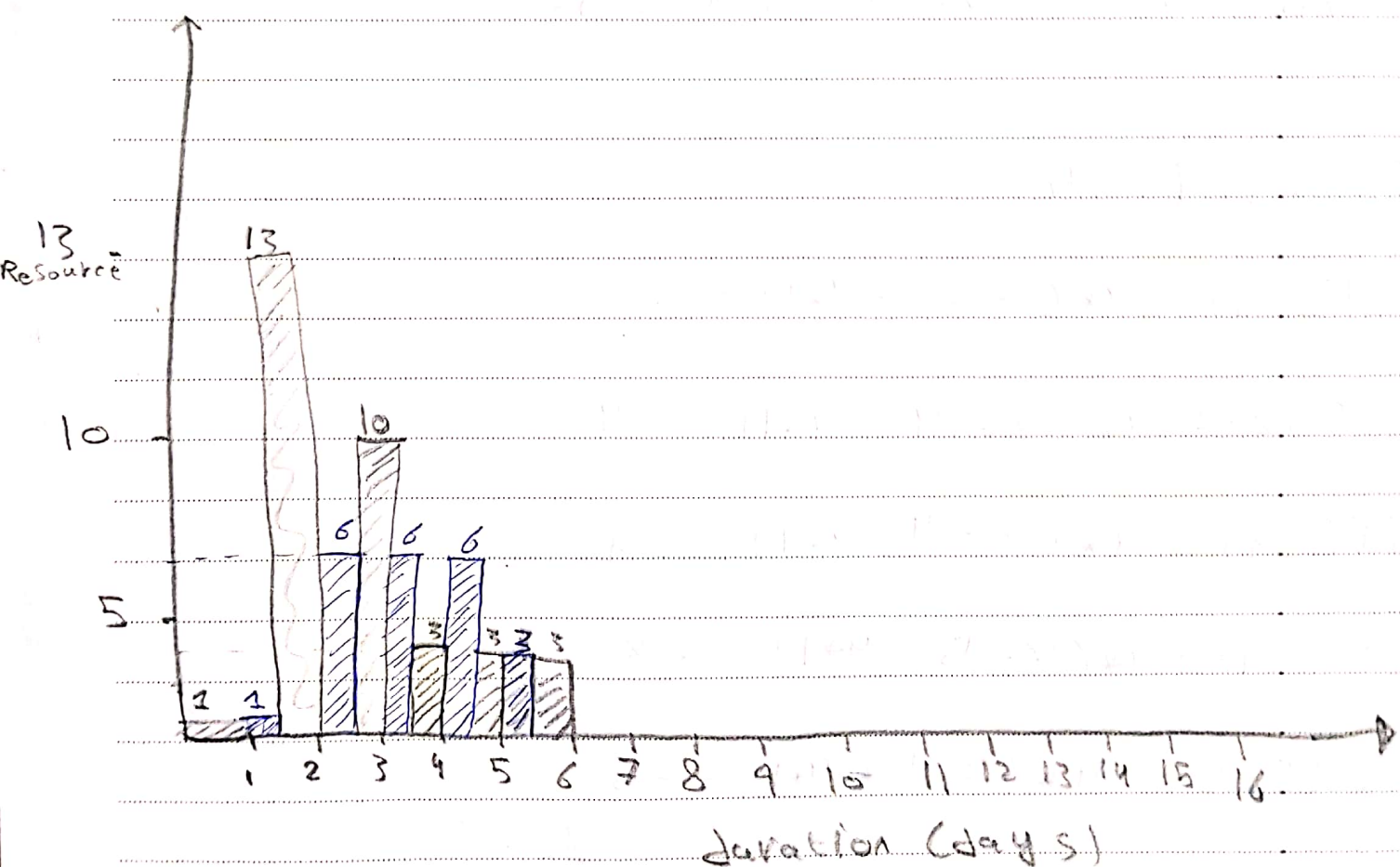
$$IF(F,6) = 4 * (7 - 5 - 4 * 1) = -8$$

$$IF(H, 1) = 3 \times (4 - 5 - 3 \times 1) = -12$$

$$IF(H, 2) = 3 \times (8 - 10 - 3 \times 2) = -24$$

$$IF(H, 3) = 3 \times (8 - 10 - 3 \times 2) = -24$$

There for more ~~activ~~ F back 1 day



 cycle 6
 cycle 0

Example 2 - Resource leveling based on Minimum Moment Algorithm approach
Activities are arranged according to their early start

Free float is indicated by -

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cycle 1			C	C	C	-	-	P	-	-	-	-		
	A	A	B	B	B	B	B	E	E	E	E	E	H	H
	5	5	9	9	9	9	9	10	10	10	10	10	8	8
			D	D	-	-	-	M	M	-	-	-		
			5	5				4	4					
Σ Res.	5	5	20	20	15	9	9	26	14	10	10	10	8	8

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cycle 1			C	C	C	-	-	---	---	---	---	P ₁₂		
	A	A	B	B	B	B	B	E	E	E	E	E	H	H
	5	5	9	9	9	9	9	10	10	10	10	10	8	8
			D	D	-	-	-	M	M	-	-	-		
			5	5				4	4					
Σ Res.	5	5	20	20	15	9	9	14	14	10	10	22	8	8

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cycle 2			C	C	C	-	-	---	---	---	---	P ₁₂		
	A	A	B	B	B	B	B	E	E	E	E	E	H	H
	5	5	9	9	9	9	9	10	10	10	10	10	8	8
			D	D	-	-	-	---	---	M ₄	M ₄	-		
			5	5						4	4			
Σ Res.	5	5	20	20	15	9	9	10	10	14	14	22	8	8

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cycle 3			---	---	C	C	C	---	---	---	---	P ₁₂		
	A	A	B	B	B	B	B	E	E	E	E	E	H	H
	5	5	9	9	9	9	9	10	10	10	10	10	8	8
			D	D	-	-	-	---	---	M ₄	M ₄	-		
			5	5						4	4			
Σ Res.	5	5	14	14	15	15	15	10	10	14	14	22	8	8

[illegible][illegible]

Example 2: ...

1) cycle 1 calculations:

$$\begin{aligned} IF(P, 1) &= 12 \times (26 - 14 - 12 \times 1) = 0 \\ IF(P, 2) &= 12 \times (26 - 10 - 12 \times 1) = 48 \\ IF(P, 3) &= 12 \times (26 - 10 - 12 \times 1) = 48 \\ IF(P, 4) &= 12 \times (26 - 10 - 12 \times 1) = 48 \end{aligned}$$

$$\begin{aligned} IF(M, 1) &= 4 \times (26 - 10 - 4 \times 1) = 48 \\ IF(M, 2) &= 4 \times (40 - 20 - 4 \times 2) = 48 \\ IF(M, 3) &= 4 \times (40 - 20 - 4 \times 2) = 48 \end{aligned}$$

2) Resource (P) is ...

Therefore, move P 4 days

2) cycle 2 calculations: (reconsider M):

$$\begin{aligned} IF(M, 1) &= 4 \times (14 - 10 - 4 \times 1) = 0 \\ IF(M, 2) &= 4 \times (28 - 20 - 4 \times 2) = 0 \\ IF(M, 3) &= 4 \times (28 - 32 - 4 \times 2) = -48 \end{aligned}$$

Therefore, move M 2 days.

3) cycle 3 calculations:

$$\begin{aligned} IF(C, 1) &= 6 \times (20 - 9 - 6 \times 1) = 30 \\ IF(C, 2) &= 6 \times (40 - 18 - 6 \times 2) = 60 \\ IF(D, 1) &= 5 \times (20 - 15 - 5 \times 1) = 0 \\ IF(D, 2) &= 5 \times (40 - 24 - 5 \times 2) = 30 \\ IF(D, 3) &= 5 \times (40 - 18 - 5 \times 2) = 60 \end{aligned}$$

C has more resource per day.

Therefore, move C 2 days.

4) cycle 4 calculations:

Re-consider D

$$\begin{aligned} IF(D, 1) &= 5 \times (14 - 15 - 5 \times 1) = -20 \\ IF(D, 2) &= 5 \times (28 - 30 - 5 \times 2) = -60 \\ IF(D, 3) &= 5 \times (28 - 30 - 5 \times 2) = -60 \end{aligned}$$

Therefore, don't move D

* Backlook consideration:

$$\begin{aligned} IF(C, 1) &= 6 \times (15 - 14 - 6 \times 1) = -30 \\ IF(C, 2) &= 6 \times (30 - 28 - 6 \times 2) = -60 \end{aligned}$$

Therefore, Don't Move C
(Still calculating for cycle 4...)

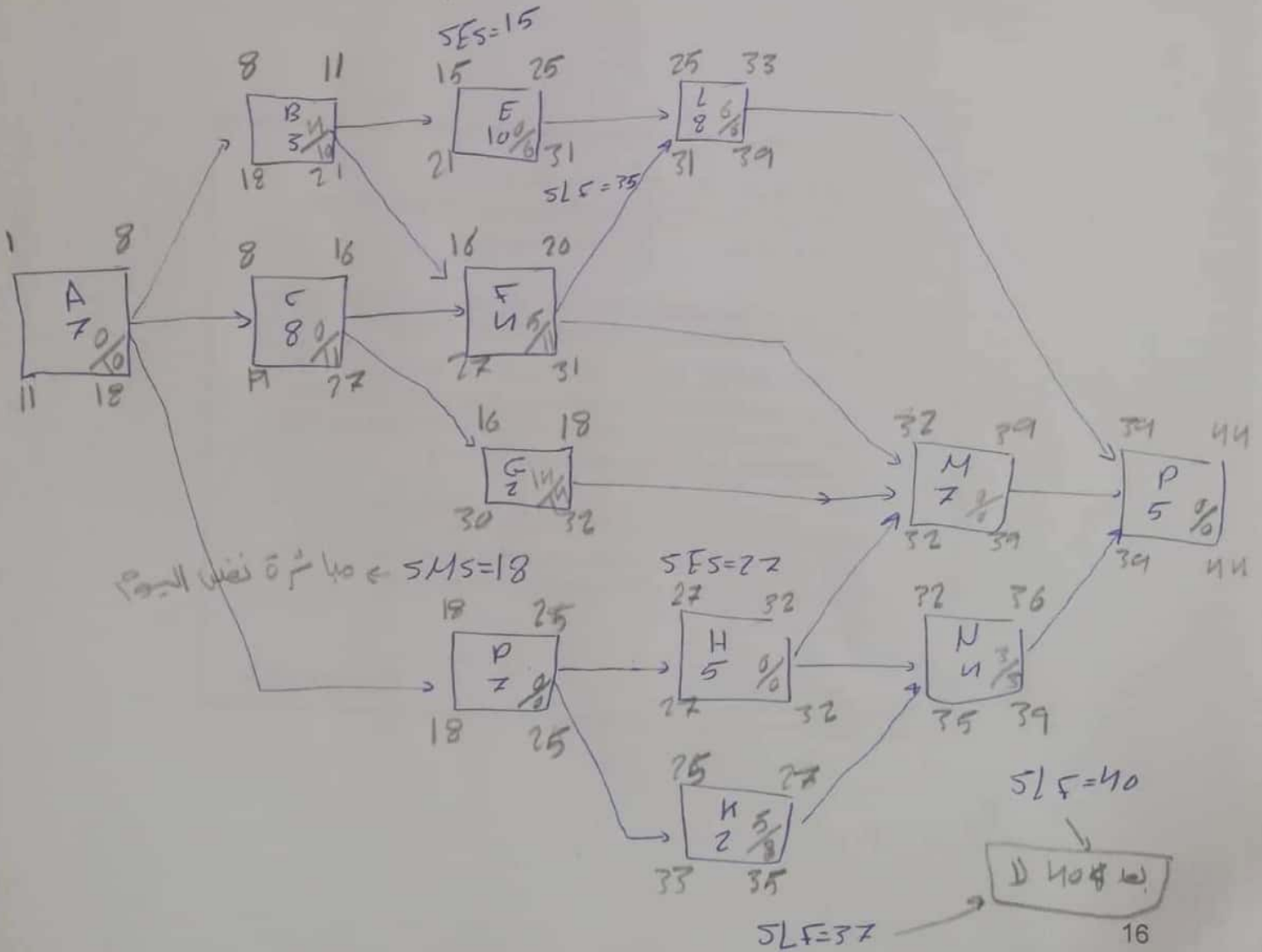
• Locate the critical paths

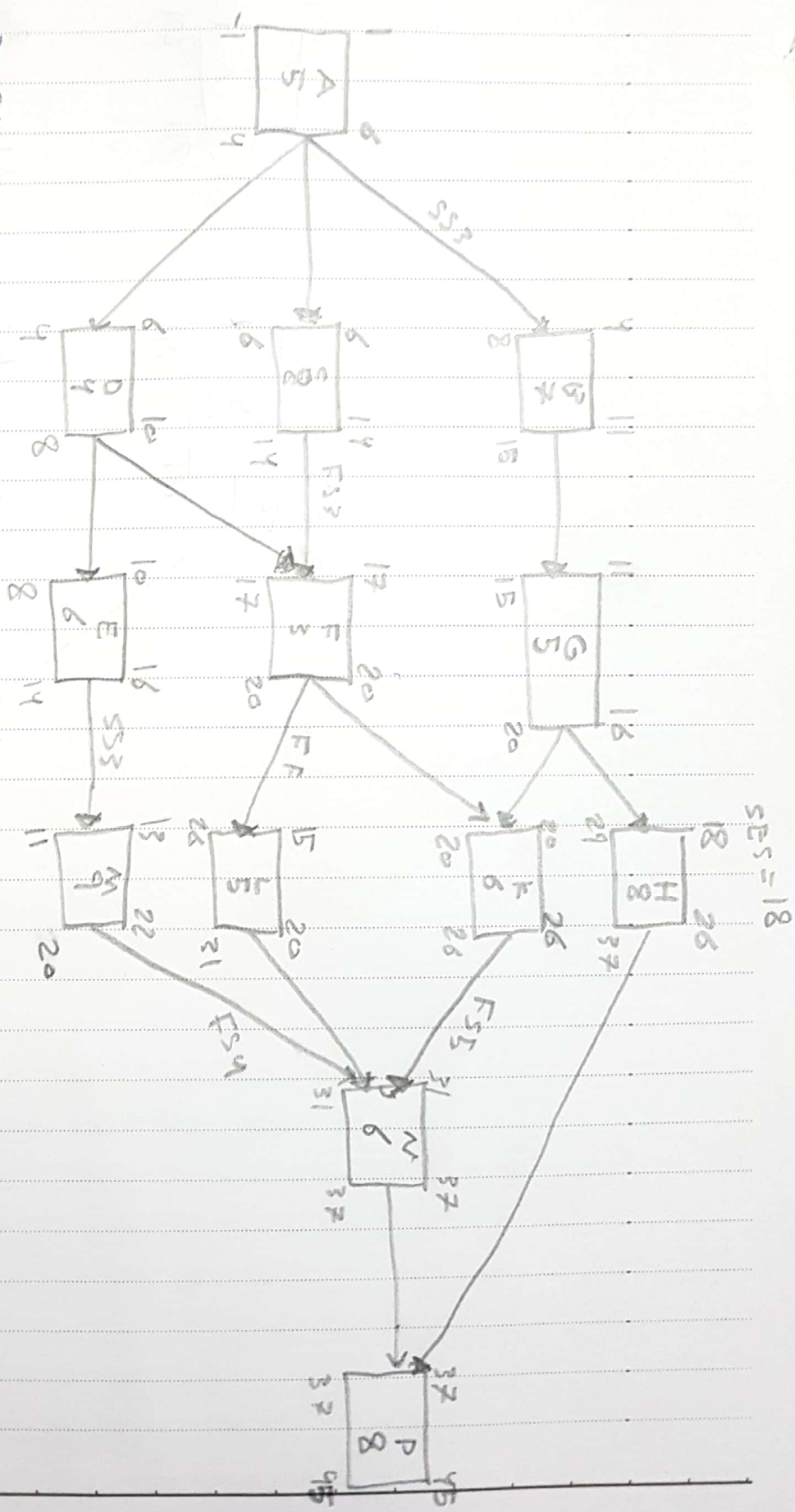
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31

ex1





$P = 0/0$
 $N = 0/0$
 $H = 1/1$
 $F = 5/0$
 $L = 1/1$
 $M = 1/2$

$F = 0/0$
 $G = 4/4$
 $F = 4/0$
 $E = 3/2$
 $B = 0/4$
 $C = 3/0$

$P = 0/0$
 $N = 0/0$
 $H = 11/11$

$K = 0/0$
 $L = 11/11$
 $M = 5/-2$

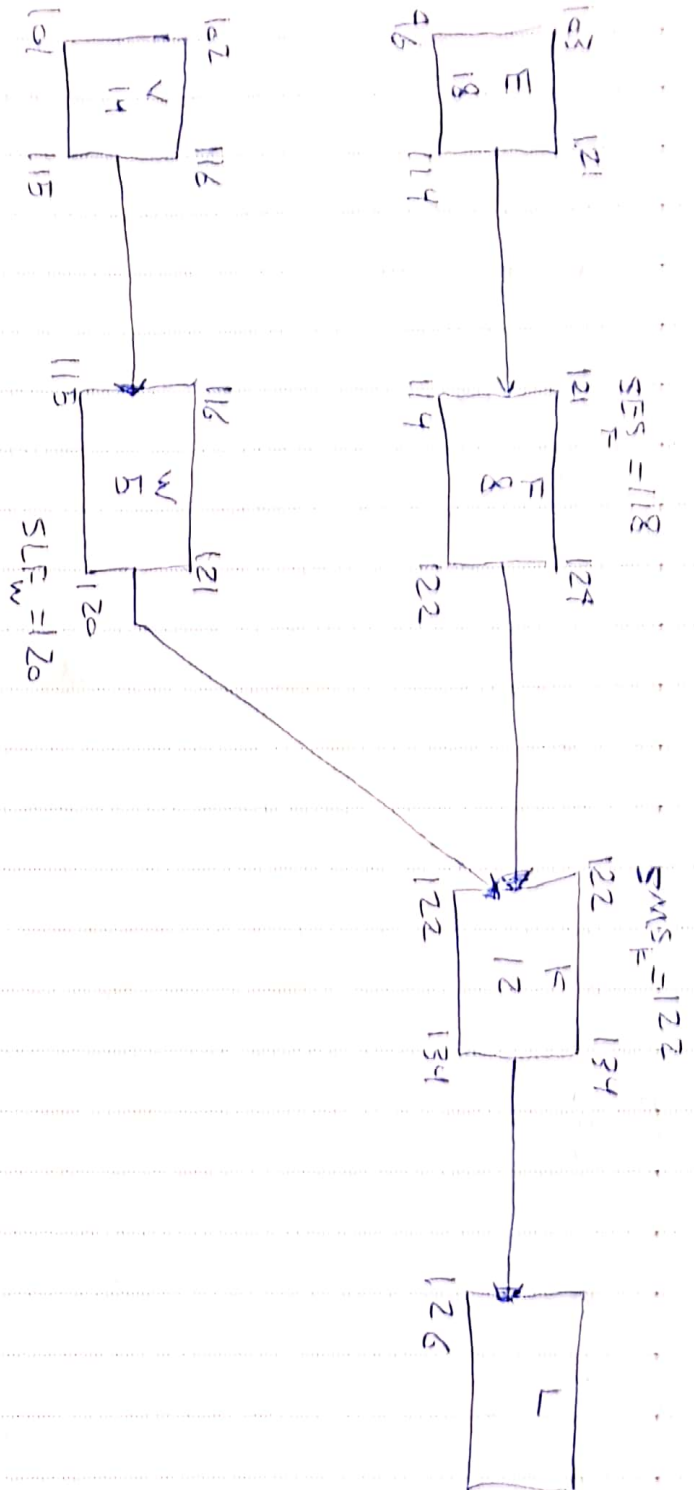
$G = 2/4$
 $F = 0/0$
 $E = 0/-2$

$B = 0/4$
 $C = 0/0$
 $D = 0/-2$

$A = 0/-2$

SLF_M = 20

Ex 2:



جدولة earned Value (EV)

①

* Earned Value : هي القيمة المكتسبة

* اوله من تعامل بال (EV) هي وزارة الدفاع الامريكية بشأن تكمن من مشاريعها

* Department of Defense (DoD):

* يستخدم (EV) بشأن اهل (مرد ~~المشروع~~ ^{التوقع} المنجز في العمل ومقارنة العمل المنجز له مع العمل المتبقي

* تستخدم الـ EV لحساب

- ١- حساب النسبة المئوية الكاملة للمشروع
- ٢- أداء الكلفة
- ٣- اداء الجدول

* بال EV يستخدم عدة أمور للحصول على الصورة العامة للمشروع :

1- BCWS : Budgeted cost of work scheduled
(Planned) * يعني حسب شو كنت متخطط

2- BCWP : Budgeted cost of work performed ^{تنفيذ}
(Earned) _{عمل}

3- ACWP : Actual cost of work performed (Actual)

4- BAC : Budgeted cost At completion . ^{والانتهاء من المشروع} _{قد يتغير كذا متوقع} _{يكتلفني}

5- EAC : Estimated cost At completion . ^{من بداية المشروع} _{يكون ضروري انشور بحسب} _{قد يتغير دفعت}

* اي انني ^{حسب} _{planned} يعني

في زمنية
المشروع كذا

هو كل الجسوع عند اليوم او 6 مثلا

Planned

2

* BCWS = Budgeted cost of work scheduled
تكلفة العمل المخطط في الميزانية

* هذا يكون على اساس التخطيط الى صدار للمشروع

* BCWS : هو مقدار المال أو ساعات العمل التي تم التخطيط لها

Actual

* ACWP = Actual cost of work performed

* هو المبلغ الفعلي للأموال (أو ساعات العمل) التي تم إنفاقها في أي وقت خلال المشروع

* تكبر عندما تم دفعة

Earned (بحر)

* BCWP = Budgeted cost of work performed

* This is the Earned Value

* BCWP : هو مقدار المال أو ساعات العمل المكتسبة بناءً على العمل الذي تم إنجازه

1 * Cost Performance : (إدارة التكلفة) → هذا تعيين الميزانية أو المصروفات

- cost variance (CV) (مؤشر التكلفة)

- cost performance index (CPI) (مؤشر أداء التكلفة)

2 * Schedule Performance → تحت النظم ولا تعيينها بالوقت

// Variance (SV)

// performance index (SPI)

$$* CV = BCWP - ACWP \text{ (Earned - Actual)}$$

$$* CPI = \frac{BCWP}{ACWP} \quad \frac{\text{Earned}}{\text{Actual}}$$

+ $ACWP > BCWP \rightarrow$ over budget

$CPI > 1 \rightarrow$ under Budget , $CV + \rightarrow$ under Budget

SV & SPI } * Calc % complete

$$\% \text{ complete} = \left[\frac{BCWP}{BAC} \right] * 100\%$$

$$* SV = BCWP - BCWS$$

$$* SPI = \frac{BCWP}{BCWS} \quad \frac{\text{Earned}}{\text{Planned}}$$

+ $SV, SPI > 1 \rightarrow$ ahead of schedule

Forecasting
(التوقع)

$$EAC = ACWP + (BAC - BCWP)$$

* BAC = Budgeted cost At completion
التقدير الكلفة الاكبر للكلفة الاجمالي للبناء

* EAC = Estimated cost At completion

ملاحظات:
الكلية حسب اداء
المشروع الى الان

ex:

Activity	Cost \$	Month 1	M 2	M 3	M 4	M 5	M 6
site work	22,000	#					
Fencing	10,000		#				
paving	18,000			#			
Excavation	30,000		#				
Foundation	50,000			#			
Framing	40,000				#		
Rough Elec.	6,000				#		
Rough Plump	16,000				#		
Drywall	13,000					#	
suspend ceiling	4,000					#	
Interior Finish	34,000						#
Carpentry	14,000						#
Σ	257,000						

- After $3\frac{1}{2}$ Months
 - The site work, excavation, Foundation Fencing and rough electrical are completed
 - The Framing is one half - complete
 - The rough plumbing is three - $\left(\frac{3}{4}\right)^2$ fourths complete
 - The paving is half complete.
- The incurred cost to date are \$152,000

- Determine % complete, CPI & SPI?
- is the project under/over budget?
- is the project ahead/behind schedule?
- Estimate the cost at comp

بقيمة من الميزانية

$$ACWP = \$152,000$$

من جودة العمل

$$\begin{aligned}
 BCWP &= \text{Site Work} + \text{excavation} + \text{Foundation} + \text{Fencing} \\
 &\quad + \text{Rough Electrical} + \frac{1}{2} \text{Framing} + \frac{3}{4} \text{Rough plumbing} \\
 &\quad + \frac{1}{2} \text{paving} \\
 &= 22,000 + 30,000 + 50,000 + 10,000 + 6,000 \\
 &\quad + \frac{1}{2} \times 40,000 + \frac{3}{4} \times 16,000 + \frac{1}{2} \times 18,000 \\
 &= \$159,000
 \end{aligned}$$

$$\begin{aligned}
 BCWS &= \text{Site Work} + \text{Fencing} + \text{paving} + \text{Excavation} + \text{Foundation} \\
 &\quad + \frac{1}{2} (\text{Framing} + \text{Rough Elec} + \text{Rough plumb}) \\
 &= 22,000 + 10,000 + 18,000 + 30,000 + 50,000 \\
 &\quad + \frac{1}{2} (40,000 + 6,000 + 16,000) \\
 &= \$161,000
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{1} \% \text{ COMP.} &= \frac{BCWP}{BAC} \times 100\% \\
 &= \frac{159,000}{257,000} \times 100\% = 61.9\%
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{2} CPI &= \frac{BCWP}{ACWP} = \frac{159,000}{152,000} \approx \\
 &\approx 1.05 > 1 \\
 &\quad (\text{under budget})
 \end{aligned}$$

$$\textcircled{3} SPI = \frac{BCWP}{BCWS} = \frac{159,000}{161,000}$$

$$\approx 0.99 < 1$$

behind schedule

$$BAC = \$257,000$$

$$\begin{aligned}
 EAC &= ACWP + (BAC - BCWP) \\
 &= 152,000 + (257,000 - 159,000) \\
 &= \$250,000
 \end{aligned}$$

8. The following eight activities constitute an overall bar chart portrayal of a four-month project.

Activity	Cost	Month 1	Month 2	Month 3	Month 4
A	\$ 2,000				
B	\$ 1,000				
C	\$ 6,000				
D	\$ 2,000				
E	\$ 7,000				
F	\$ 9,000				
G	\$ 3,000				
H	\$10,000				

After one and one-half months, Activities A, B, D, and half of E were completed, for a cost of \$8,000. For this project, using earned value concepts, determine the schedule variance and the cost variance. State if the project is over or under budget and if it is ahead or behind schedule.

Q8

$$* ACWP = \$8,000$$

$$* BCWS = A + B + \frac{C}{2} + \frac{D}{2} + E$$

$$= 2,000 + 1,000 + \frac{1,600}{2} + \frac{1}{2} \cdot 2,000$$

$$+ \frac{1}{4} * 7,000 = \$8,750$$

$$BCWP = A + B + D + \frac{1}{2} E$$

$$= 2,000 + 1,000 + 2,000 + \frac{1}{2} * 2,000 = \$8$$

$$SV = BCWP - BCWS$$

$$= 8,500 - 8,750 = -250$$

(behind schedule)
سلبی

$$CV = BCWP - ACWP$$

$$= 8,500 - 8,000 = +500 \text{ (under budget)}$$

7. The following depicts a six-month schedule for a project.

Activity	Cost	Duration	Start	Finish	Duration	Start	Finish
A	\$ 50						
B	\$120						
C	\$ 80						
D	\$200						
E	\$120						
F	\$300						
G	\$ 60						
H	\$ 70						
J	\$ 50						
K	\$ 60						

After three months on the job (July 1), the contractor concluded that 20% of Activity F (Activities A, B, and D are completed) was completed, 80% of Activity C was completed, and 40% of Activity E was completed. The project has cost the contractor a total of \$535. For this project, using earned value concepts, determine the schedule variance and the cost variance. State if the project is over or under budget and if it is ahead or behind schedule.

$$ACWP = \$535$$

$$BCWS = A + B + C + D + \frac{1}{2} E + \frac{1}{2}$$

$$= 50 + 120 + 80 + 200 + \frac{1}{2} \times 120 + \frac{1}{2} = \boxed{510 \$}$$

$$BCWP = 0.2F + A + B + D + 0.8C + 0.4E$$

$$= \boxed{\$542}$$

$$SV = BCWP - BCWS$$

$$= 542 - 510 = +32 \text{ (ahead of schedule)}$$

$$CV = BCWP - ACWP$$

$$= 542 - 535 = +7 \text{ (under budget)}$$

$$\% \text{ complete} = \frac{BCWP}{BAC} \times 100\% = \frac{542}{1116} \times 100\%$$

$$= \boxed{48.82\%}$$

Example 1:

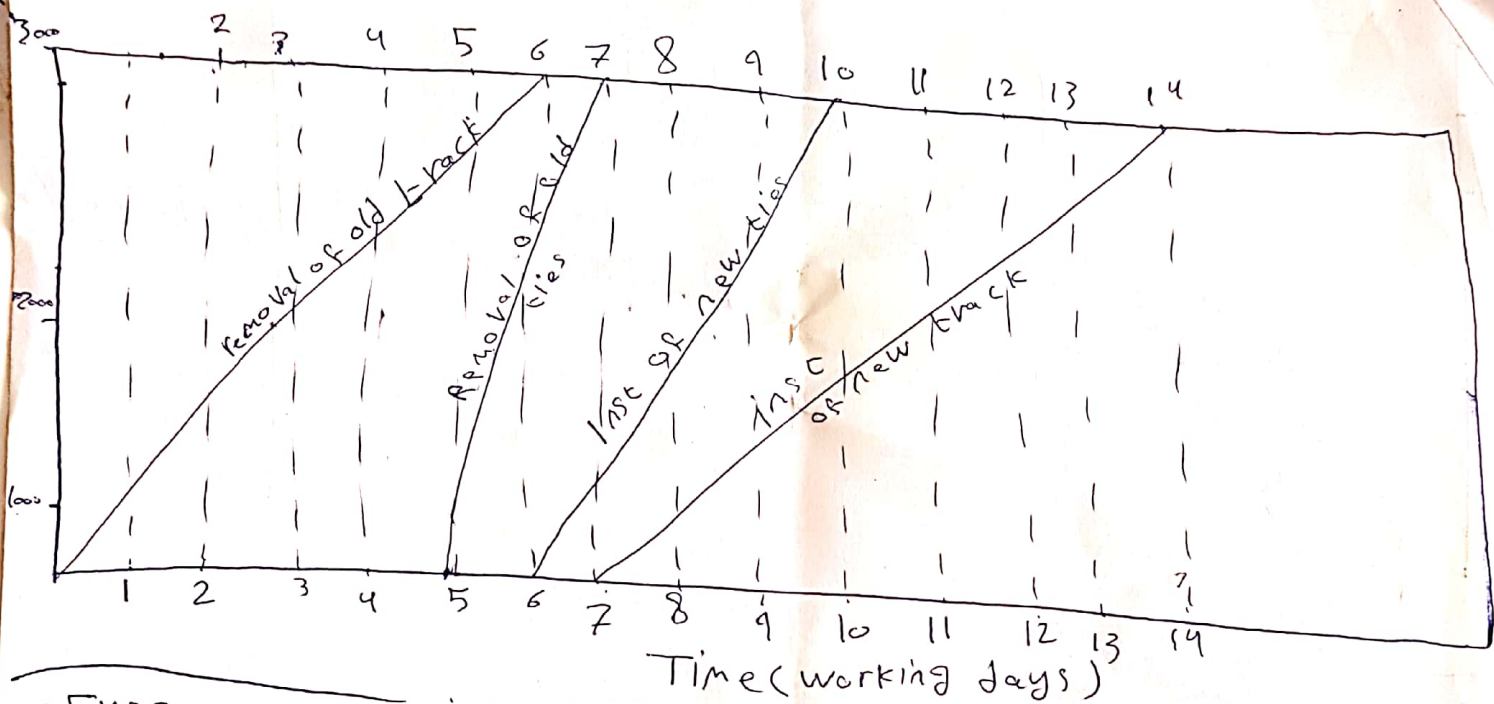
- * Develop a linear schedule for a project that consists of replacing the track on an existing railroad line, involving 3,000 ft of track.
- * Activities and production rates are shown in the next slide.
- * Assume a min of 1-day time buffer between activities

Activity	production rate (ft/hr)	production per day (ft)	Duration (days)
Removal of old track	62.5	500	6
Removal of old railroad ties	187.5	1500	2
installation of new ties	93.75	750	4
installation of new track	54	432	7

EX: 1

29.17

①



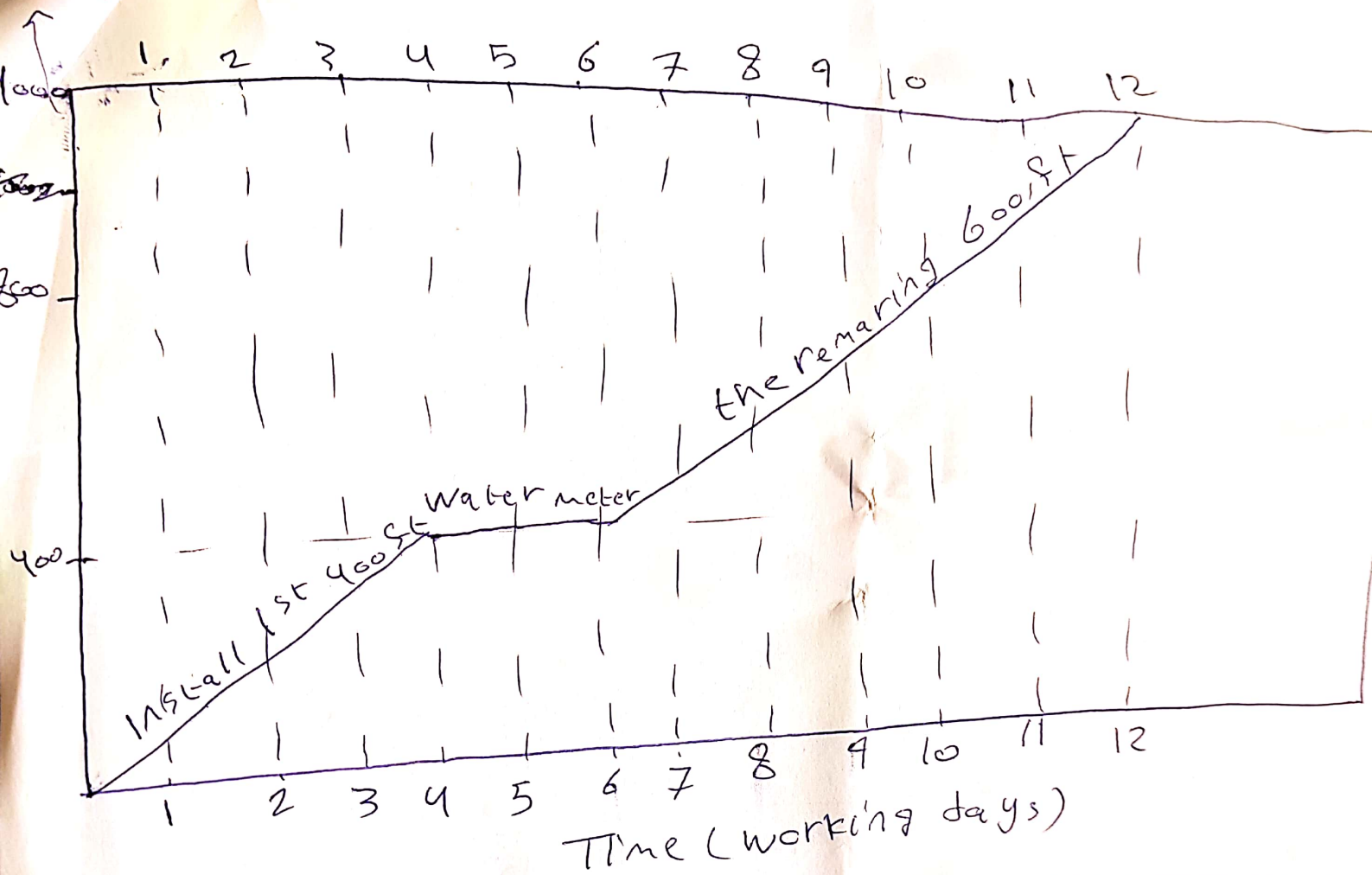
EX: 2

- * Develop a linear schedule for the project below
- * A shallow trench for, 1000-foot water line installation will take 10 days
- * It will take 4 days to install the first 400 ft of pipe
- * A water meter will then be installed during the following 2 days at the end of the pipe.
- * After the meter is installed, the remaining 600 ft of pipe will be installed in 6 days.

EX 2^o

②

PIPE



Ex 3:

- Develop a linear schedule for a project to replace an old existing walkway
- The walkway is 16,000 ft long and 4 ft wide
It consists of activities shown in the next slide
- Assume a minimum 1-week time buffer between activities

Ex 3

Activity	Description	Production rate (linear ft/wk)	Duration (wk)
A	Demolition and removal of old asphalt pavement	2000	8
B	Level and roll	1000	16
C	Place 3 inch aggregate base	1800	9
D	Pave with asphalt	1800	9
E	install new signs and markings	5400	3

