Alternative	Favorable Market	un-Favorable market
construct large Plant	200 000	-180 000
Construct small Plant	100 000	-20 000
Do nothing	0	0
	0,4	0,6

أحكم قيمة

max	min	Avg	
200 000	-180000	10 000	→ (200 000 + -180000) / 2
100 000	-20000	40 000	→ (100 000 + -20000) / 2

$$\Sigma\left[\frac{(|Et|)}{At}\,100\right] = 81.3\%$$

-ولكن

① $CFE = \Sigma Et = -15$

② $MSE = \frac{\Sigma E^2}{n} = \frac{5275}{8} = 659.4$

③ $MAP = \frac{\Sigma |Et|}{n} = \frac{195}{8} = 24.4$

④ $MAPE = \frac{\left[\frac{\Sigma |Et|\,100\%}{At}\right]}{n} = \frac{81.3\%}{8} = 10,2\%$

$* \frac{|E_t|}{A_t} \times 100\%$

EX :- calculate : CFc, MSE, MAD, MAPE.

(بس بربع الـ E_t → E_t^2)

(باخذ القيمة المطلقة → $|E_t|$)

Month	A_t demand	Forecast F_t	E_t error	E_t^2 error squared	$\lvert E_t \rvert$	* absolute error
1	200	225	-25	625	25	12.5%
2	240	220	+20	400	20	8.3%
3	300	285	+15	225	15	5%
4	270	290	-20	400	20	7,4%
5	230	250	-20	400	20	8.7%
6	260	240	20	4000	20	7,7%
7	210	250	-40	1660	40	19%
8	275	240	35	1225	35	12,7%

$\sum E_t = -15$

$\sum E_t^2 = 5,275$

$\sum |E_t| = 195$

عصام

① $MSE = \frac{\Sigma Et^2}{n}$

② $\sigma = \sqrt{\frac{\Sigma(Et - \bar{E})^2}{n-1}}$

③ $MAD = \frac{\Sigma |Et|}{n}$

④ MAPE :- a measurment that relates the forcast error to the level of demand and is useful for Putting forcast Performance in the error Perspective.

$$MAPE = \frac{\left[\frac{\Sigma |Et|}{At}\right] \times 100}{n}$$

Taking signd = $\frac{CFE}{MAD}$

↳ a measure that indicate wheather a method of forecasting is accurately Predicting actual changes in demand

Forecast Error

① cumulative sum of forcast error

$(cFc) = \Sigma E_t$

↳ a measurment of total forcast error that assesses the bais in a forcast.

$\bar{E}$ = mean bais $\frac{cFc}{n} = \frac{\Sigma E_t}{n}$

② MSE :- the mean squared error =

σ : Standerd deviation, and

MAD (mean absolute deviation) measure the dispersion of forcast error.

⑤ Regression (Time serries)

$$y = B_0 + B_1 X$$

$$y = 5 + 2x$$

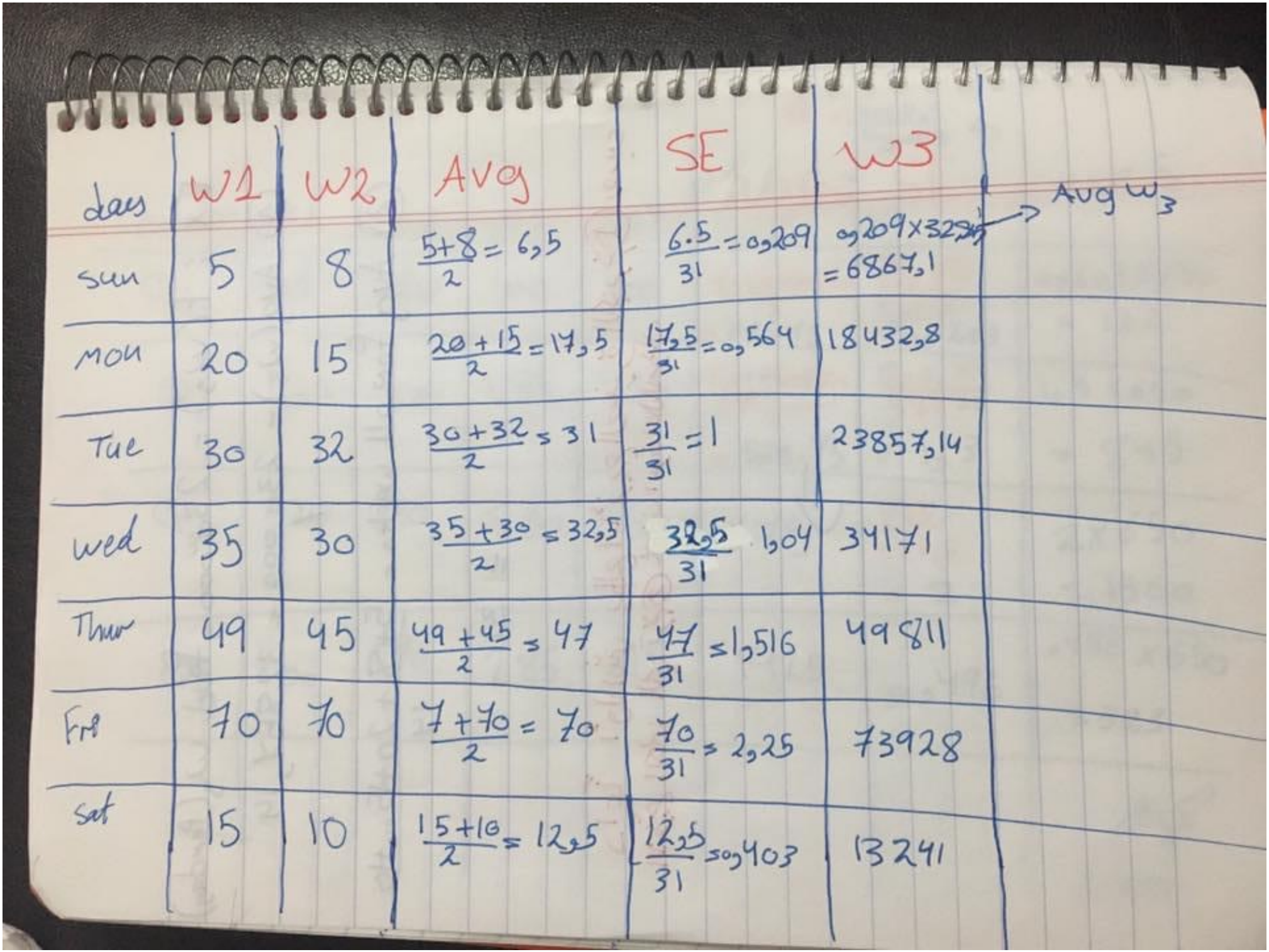
$$y(5) = 5 + 2(5) = 15$$

$$SSX = \Sigma x^2 - \left[\frac{(\Sigma X)^2}{n}\right]$$

$$SSXY = \Sigma xy - \left[\frac{(\Sigma x)(\Sigma y)}{n}\right]$$

$$\bar{X} = \frac{\Sigma X}{n} \quad , \quad \bar{y} = \frac{\Sigma y}{n}$$

$$B_1 = \frac{SSXY}{SSX} \quad , \quad B_0 = \bar{y} - B_1(\bar{X})$$



days	W1	W2	Avg	SE	W3
sun	5	8	$\frac{5+8}{2} = 6,5$	$\frac{6.5}{31} = 0,209$	$0,209 \times 32,5$ → Avg w_3 $= 6867,1$
mon	20	15	$\frac{20+15}{2} = 17,5$	$\frac{17,5}{31} = 0,564$	18432,8
Tue	30	32	$\frac{30+32}{2} = 31$	$\frac{31}{31} = 1$	23857,14
wed	35	30	$\frac{35+30}{2} = 32,5$	$\frac{32,5}{31}$ 1,04	34171
Thur	49	45	$\frac{49+45}{2} = 47$	$\frac{47}{31} = 1,516$	49811
Fri	70	70	$\frac{7+70}{2} = 70$	$\frac{70}{31} = 2,25$	73928
sat	15	10	$\frac{15+10}{2} = 12,5$	$\frac{12,5}{31} = 0,403$	13241

Ex : $F(w_3) = 230\,000$, Find w_3 (Per day)

(1) $Avg(w_3) = \frac{230\,000}{7} = 32857,14$

(2) Avg for all weeks $= \frac{5+8+20+15 \ldots +10}{14}$

$= 31$

داعاً أولا نشتغل بالأفرع الصغيرة اللي برقم (1) بعدين الأفرع الكلية اللي ترقم (2) عشان اعرف اصل السؤال.

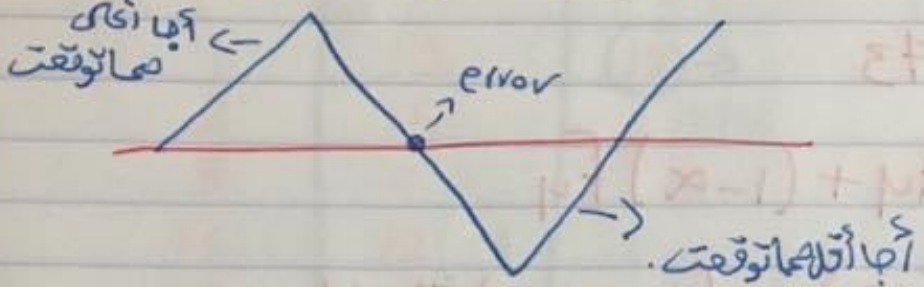
$\Rightarrow$

SE = Avg Q.5 / Avg. All Q

Quarter	yr. 1	yr. 2	yr. 3	yr. 4	Avg(Q5)	SE	yr. 5
Q_1	45	70	100	100	$\frac{45+70+100+100}{4}$ = 78.75	$\frac{78.75}{387.5}$ = 0,203	0,203 X 650 = 132
Q_2	335	370	585	725	$\frac{335+370+585+725}{4}$ = 503.75	$\frac{503.75}{387.75}$ = 1,3	1,3 X 650 = 845
Q_3	520	590	830	1160	775	$\frac{775}{387,5}$ = 2	2 X 650 = 1300
Q_4	100	170	285	215	1925	0,496	,496 X 650 = 323
							2600

3) $E_3 = 9 - 12,9 = \boxed{-3,9}$

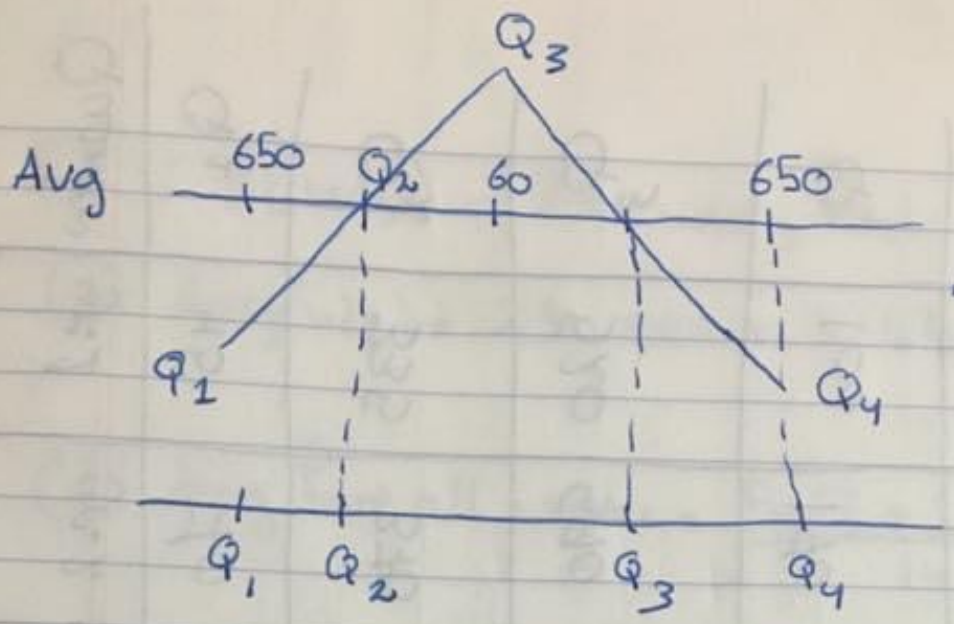
← التوقع أكبر من اللي أنا جبته



(4) Seasonal Patterns :- [Multiplicative seasonal method]

are regularly repeating upward or downward measurment in demand measerd in Periods of less than one year (hrs, day, weeks, months or quartly.

* In the next, the time, Periods are called seasons.



Ex:- A amanager wants to forcast customer demand for each next Quarter of yr.5 .Based on the estimated of total yr.5 demand of 2600 customer.

*داعاً أول الشي بعسس

1) Avg. Q yrs $= \frac{2600}{4} = 650$ → number of quarters.

2) Avg. for all Q $= \frac{45 + 70 + 100 + 100 + 335 + 370 + \dots + \dots + 215}{16}$

$= 387.5$

$$F_4 = \alpha A_3 + (1-\alpha) F_3$$
$$= (0,3)(0,9) + (1-0,3)\,12,9$$
$$= 11,73$$

$$F_5 = \alpha A_4 + (1-\alpha) F_4$$
$$= 0,3\,(12) + [1-0,3)\,11,7$$
$$= 11,8$$

$$F_6 = \alpha A_5 + (1-\alpha) F_5$$
$$= (0,3)(13) + (0,7)\,11,8$$
$$= 12,16$$

$$Et = At - Ft$$

1) $E_1 = 12 - 12 = 0 \Rightarrow A_1 - F_1$

2) $E_2 = 15 - 12 = 3 \Rightarrow A_2 - F_2$

Ex :~ using Exponential Smoothing.

Period	Actual	Ft (Forast)
1	12	(12) →
2	15	
3	9	
4	12	
5	13	

$F_1 = A_1$

$\alpha = 0,3$

Find :~ F_2, F_3, F_4, F_5, F_6 => exponential Smoothing.

$$F_{t+1} = \alpha A_t + (1-\alpha) F_t$$

$$F_2 = \alpha A_1 + (1-\alpha) F_1$$

$$= (0,3)12 + (1-0,3)12 = 12$$

$$F_3 = \alpha (A_2) + (1-\alpha) F_2$$

$$= (0,3)(15) + (1-0,3)(12)$$

① $F_4 = \alpha(A_3) + (1-\alpha)F_3$ ← أوجدنا الـ MoA لأنو عندي أكثر من فترة لو فترة وحدة بستخدم Naïve

$$F_3 = \frac{A_2 + A_1}{2} = \frac{480 + 380}{2}$$

$$= 390,1$$

$$F_4 = 0,1(411) + 0,9(390) = 392,1$$

② $E_4 = A_4 - F_4 = 415 - 392,1$

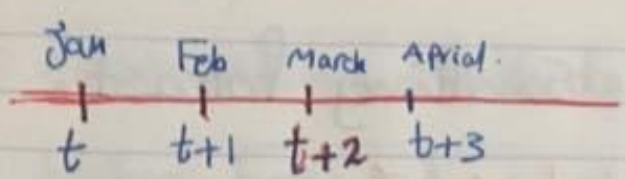
given ↩

$$22.1 \approx 23$$

③ $F_5 = \alpha(A_4) + (1-\alpha)F_4$

$$= (415)0,1 + (1-0,1)392,1$$

$$= 394,4$$



Ex:-

week	At	Ft
1	400	
2	380	
3	411	

Ex:- using exponential smothing if $\alpha = 0.1$

1) calculate F_4

2) what is E_4 if $A_4 = 415$

3) what is F_5 ??

(3) Exponential Smoothing forcast.

↳ A weighted moving average methods that calculate the average of a time servies by giving recent demands more weighted than earlier.

$$\text{New forecast} = \alpha\left(\text{last Period Acutal demand}\right) + (1-\alpha)\times$$

[last Period forcast]

$$F_{t+1} = \alpha A_t + (1-\alpha) F_t$$. where :-

F_{t+1} = New forecast

F_t = Previous Period forcast

A_t = Previous Period Actual demand

α = Smoothing (or weighed) Content. ثابت

مراجعة قبل ما نكمل

* Forecasting Methods :-

① Naive Forcast اذا كان عندي نقطة وحدة معنى موجودة

$F_{t+1} = A_t$, $E = A_i - F_i$

② Moving Average (M.A)

a) Simple Moving Average

$$F_{t+1} = \sum_{i=1}^{n} \frac{A_i}{n}$$

b) weighted moving Average

$$WMA_{t+1} = \sum_{i=1}^{n} w_i * A_i$$

③ ⟹

Periods	At	weight
1	12	
2	15	0,1
3	9	0,5
4	12	0
5	13	0,4

Ex: use (0,4 , 0 , 0,5 , 0,1) as wieghts for most recent data. Find F_6

$$F_6 = A_5(\ _5) + A_4(w_4) + A_3(w_3) + A_2(w_2)$$

$$= 13(0,4) + 12(0) + 9(0,5) + 15(0,1)$$

$$F_6 = 11,2$$

(B) weighted Moving Avreage

→ used when some trend might be Ptesent.

→ weights based on experinced intuition.

$$WMA_{t+1} = \sum_{i=1}^{n} wi * Ai$$

wi :- the weight for Period i ,

$$\sum_{i=1}^{n} wi = 1$$

eg : $WMA_{t+1} = w1(A_1) + w_2(A_2) + w_3(A_3)$ ---

$w1 + w_2 + w_3 = 1$

$$F_4 = \frac{\sum_{i=1}^{3} At}{n}$$

$$= \frac{A_1 + A_2 + A_3}{3} = \frac{400 + 380 + 411}{3}$$

$$F_4 = 397$$

② $A_4 = 415$, $F_4 = 397$

$$Et = At - Ft = 415 - 397 = 18$$

③ $$F_5 = \frac{A_4 + A_3 + A_2}{3} = \frac{415 + 411 + 380}{3}$$

$$F_5 = 402$$

Ex 8.

① compute a 3-week moving Average forcast in week 4.

② if the actual number of Patient arrivals in week 4 is 415, what is the forcast error for week 4??

③ what is the forcast for week 5?

Week	Patient Arrivals
1	400
2	380
3	411
4	415

Present	At	Ft
1	10	33
2	20	10
3	34	20
4	50	34

(2) Moving Average (MA)

A) simple moving Avrege forcast. (No trend)

$$F_{t+1} = \sum_{i=1}^{n} \frac{A_i}{n}, \quad E_t = A_t - F_t$$

A_t = demand in Period t.

E_t = Forcast error for Period t.

Example :-

⟹

$$E = \frac{a + 4M + b}{6}$$ ⇒ حساب توقع الوقت Duration.

* Time series Techniques

① Naive forcast: Assume demand in next Period is the same as demand in most recent Period.

$F_{t+1} = At$

F_{t+1} = the forcast for the next Period.

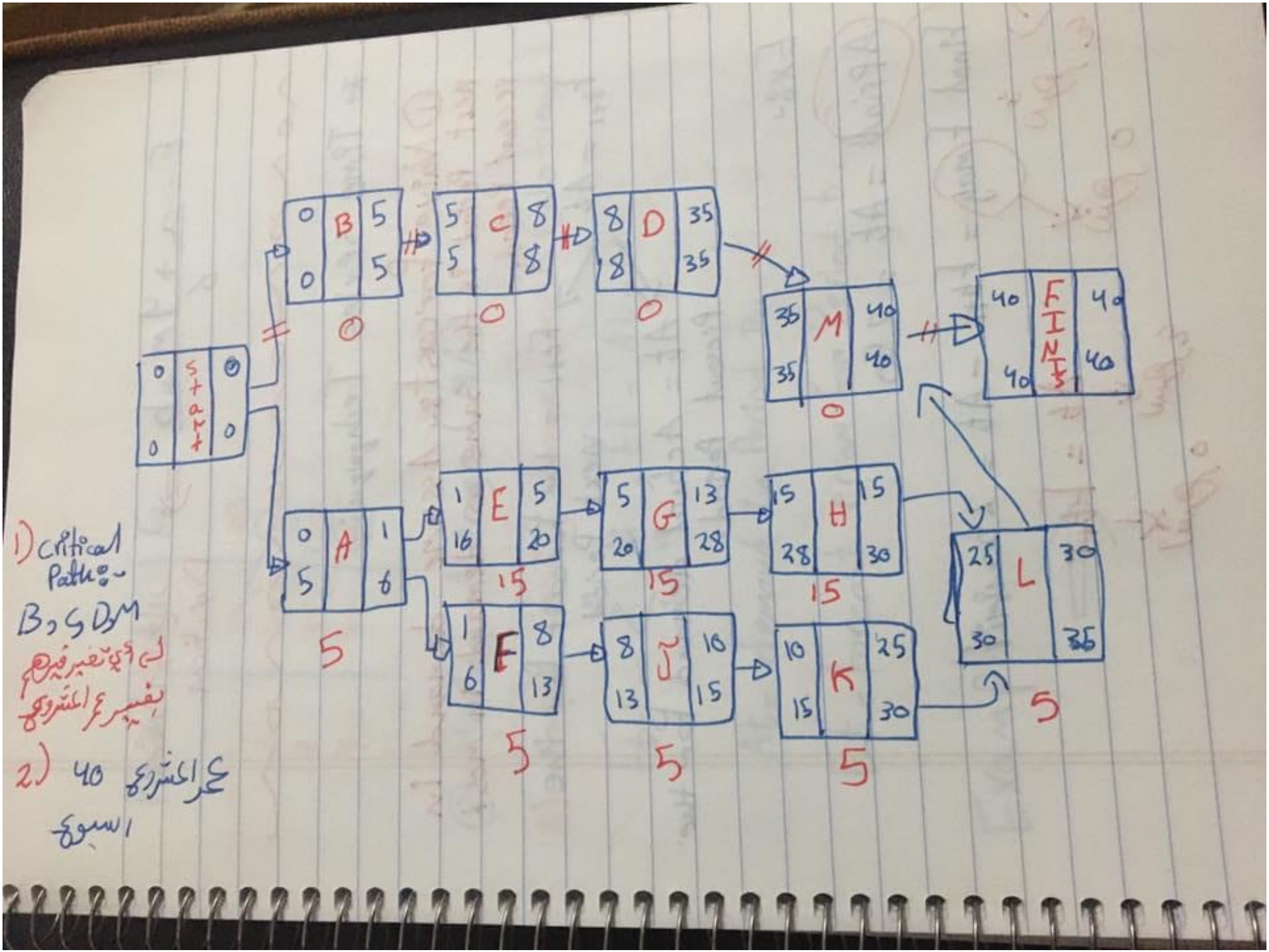
At = Actual demand for the Present Period.

Ex:

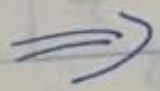
April = At = 250

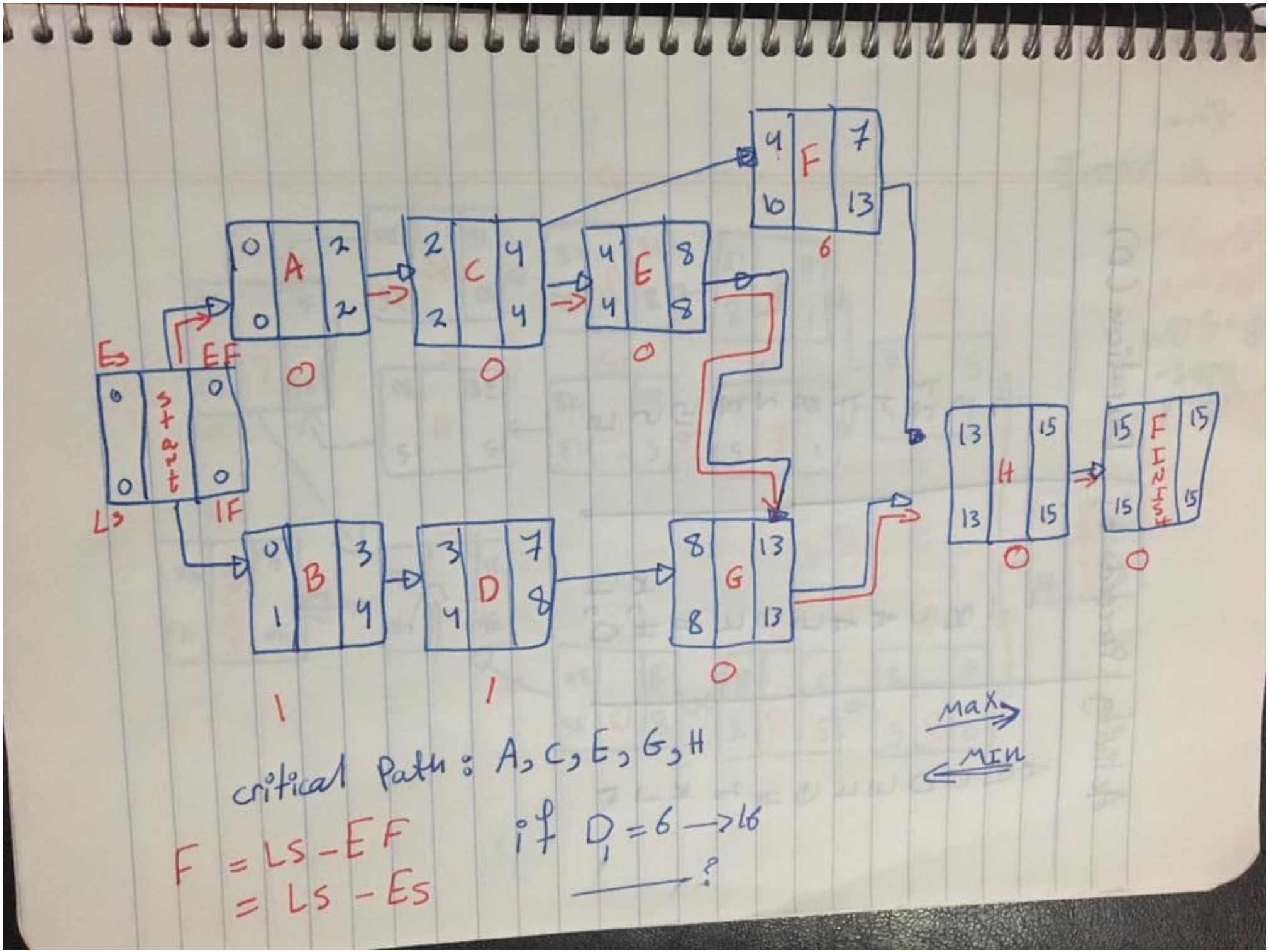
Final F May = F_{t+1} = At = 250 unit

$At = F_{t+1}$



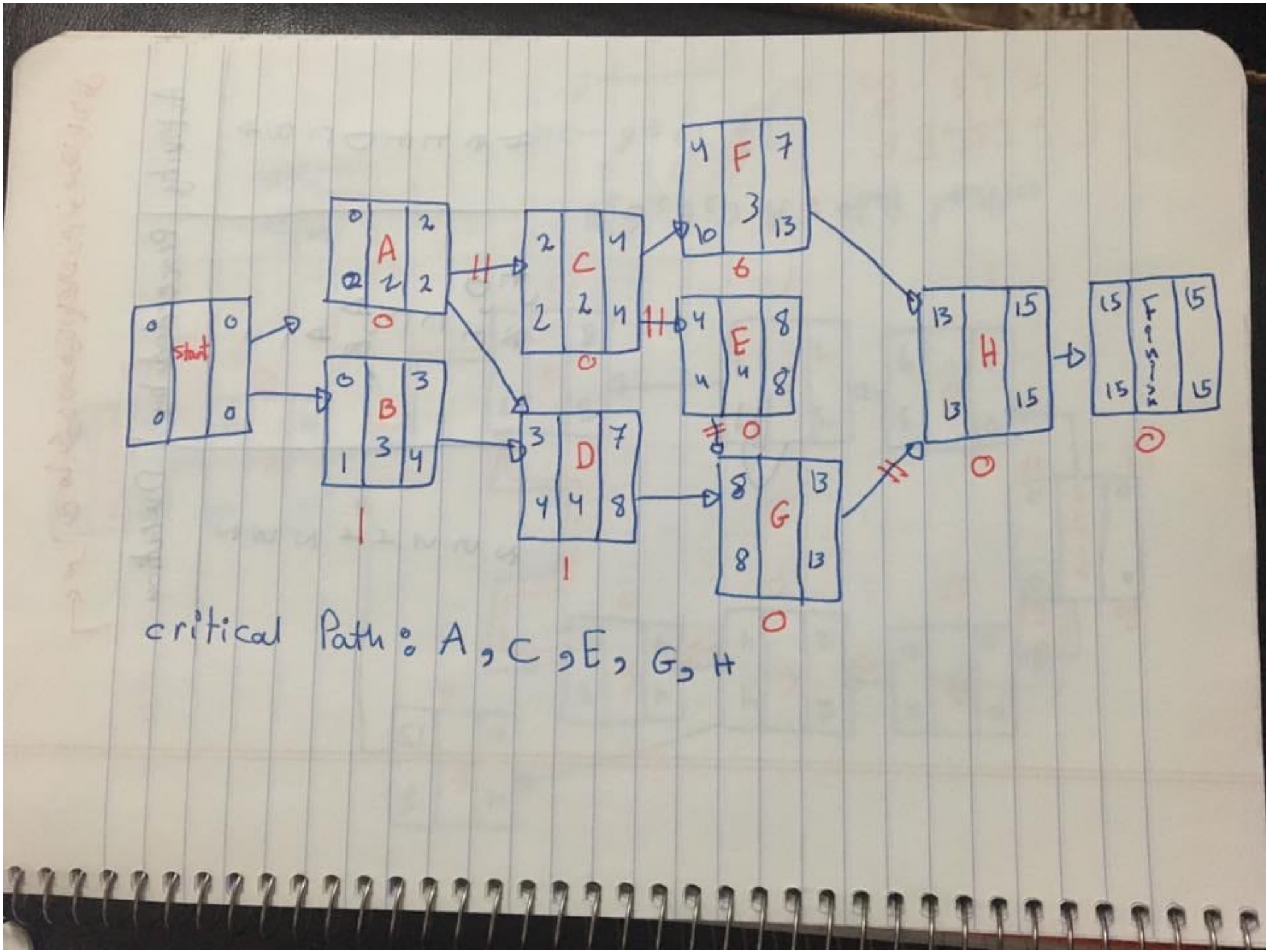
Activity	Proceeds by	Duration (D)
A	–	1
B	–	5
C	B	3
D	C	27
E	A	4
F	A	7
G	E	8
H	G	2
J	F	2
K	J	15
L	H, K	5
M	D, L	5





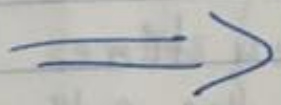
← مراح ما يكون معطينا ياها لازم نوجدها بالأول

Activity	Proceeded by	Duration
A	–	2
B	–	3
C	A	2
D	A, B	4
E	C	4
F	C	3
G	D, E	5
H	F, G	2



کی صین تعقد ۷

Activity	Predecessors	Time
A	- مابتقدم کل اشیا	2
B	-	3
C	A	2
D	A, B	4
E	C	4
F	C	3
G	D, E	5
H	F, G	2



- Earliest start (ES) :~ the earlied Possible beginning time for the activity.
لي أول فترة يقدر البلش فيها.
- latest start (LS) :~ the lasstest Possible beginning time from activites that will allow the project to be finished on schedule.

- Earliest Finish time : (EF) :~ the earliest stawt time plus the time needed for the activity.

- lastest Finish time :~ (LF) :~ the latest Possible comption time for an activity that will not dely the entire Project

current M.P $= \frac{O}{\Sigma I} = \frac{O}{\text{Labour} + \text{Material} + \text{Capital} + \text{energy}}$

$= \frac{240}{3000 + 1000 + 350 + 150}$

$= 0,0533$ crates / \$

New $= \frac{260}{3080 + 1000 + 350 + 150}$

$= 0,568$ crates / \$

the increase in P $= \Delta P = \frac{P_{new} - P_{current}}{P_{current}}$

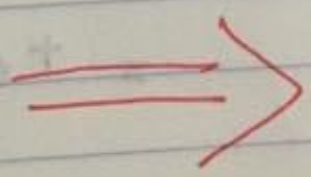
$= \frac{0,0568 - 0,0533}{0,0533}$

$= +6.6\%$

Problem 1.2

Avg cost Per labour is 10$

	Current	New
outPut	240 crates	260 crates
Labour hour	300	308 (300+8)
Material	1000/day	1000 (same)
capital	350/day	350 (same)
energy	150/day	150/day
Labour cost	10$ * 300 = 3000/day	10$ * 308 = 3080/day



① Current Labour Productivity = $\frac{\text{output}}{\text{Input}} = \frac{240}{3 \text{ Labour}} \times 100$

$= 0,8$ crates/L.h

② Suggest = $\frac{O}{I} = \frac{260}{3 \times 100} = \frac{260}{308} =$

48

$= 0,844$ crates/L.hr

$\Delta P \frac{0,844 - 0,8}{0,8} = 5,5\%$

Solved Problem 1.11 P. 57

* current situation

- output = 240 crates Paw 100 loges
- He currently Purshase 100 loges / day
- each bgs requires 3 Labour.hr to Produced

* Suggest situation

- output = 260 crates Per 100 bgs
- His Labour-hr will increase by 8 hrs per day.

* what will be the input on Productivity (crates / labour.hr) if buyer hired?

② الطريقة الثانية

Multi factor Productivity = output / Input

current	Suggest
8 / 640+400	14 / 640+800
= 0,007 b/$	= 0,0097 title/$

$$\Delta P_1 = \frac{0,437 - 0,25}{0,25}\% = +75\% \uparrow$$

الجديد — القديم — القديم — لأنها موجبة

$$\Delta P_2 = \frac{0,0097 - 0,0077}{0,0077} = +26 \uparrow$$

برضوه لأنها موجبة

③ $$\frac{P_{new} - P_{current}}{P.current}$$

* Both the labour (single factor) & multiple factor Productivity measure show an increase in Productivity

لازم نشرح الحل بالآخر

ex 2 & P 50

	Current system	Suggested
Staff	4 labour	same (4)
W.H → working hours	8 hrs / day	same (8)
Payroll cost	640 / day	same (640)
overhead cost	400 / day	800
out Put	8 titles/day	14 title / day

الطريقة الأولى

① Single factor Productivity = $\frac{\text{unit Produced}}{\text{Labour.hrs}}$ ↑ دايماً بضرب عدد الـ Labour في عدد الساعات

current

$$\frac{8 \text{ title/day}}{4 \text{ Labour} * 8 \text{ hrs/day}}$$

$= ,25$ title/Labour

Suggest

$$\frac{14 \text{ titles/day}}{4 * 8}$$

$= 0,4375$ title/$

① * Labor Productivity = $\frac{\text{units Produced}}{\text{Labor-hours used (Input used)}}$

↳ one resource input

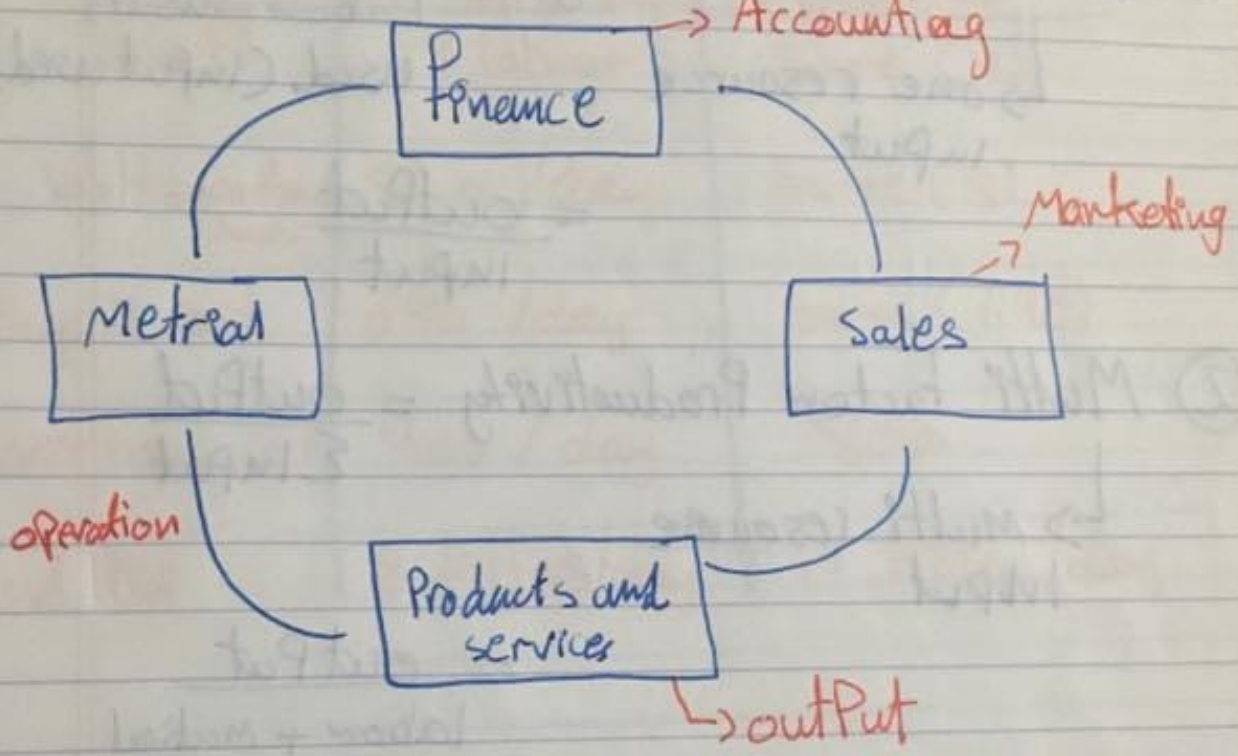
$= \frac{\text{output}}{\text{Input}}$

② Multi Factor Productivity = $\frac{\text{output}}{\Sigma \text{Input}}$

↳ Multi resource Input

$= \frac{\text{output}}{\text{labor + matiral + energy + etc...}}$

* Essentind functions :-



*quality assurnce → معايير الجودة

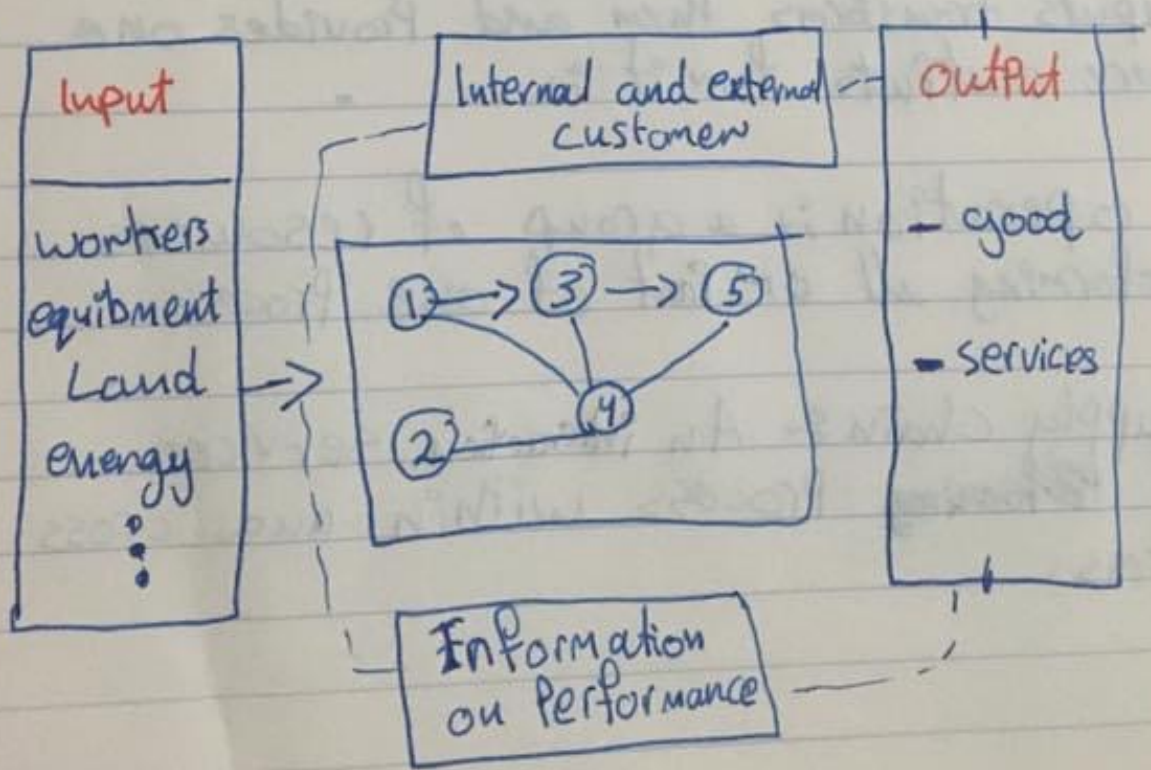
$$\text{Productivity} = \frac{\text{units Produced}}{\text{Inputs}}$$

* operation Managment → transforming input into output.

* that Produces services or Product of the satisfaction of outcome

* supply chain Manggment (SCM) :- the system of firms Process with those of it is suppliers and customers to the flow of metrial services and information with customer demand.

* How Process Work



Ch 1 :- Introduction to OM

* Production ⇒ the creation of goods and servicing.

* operation Managment ⇒ the systemic desgin, direction and control of Process that transform employee input into servies and Products for internal as well as external customen.

* Process ⇒ is an activity of group of activites that takes on or more input transform them and Provides one or more puputs transforms them and Provides one more outputs for it is .

* operation :- a group of resources Performing all or Part of one Process.

* supply chain :- An interaction services of ~~Performing~~ Process within and cross terms.