ME4001 2012

Q1

a) Depn charge = $\frac{10^6}{10}$ = 100 K per year

Book value at end of year 5 = 500 K

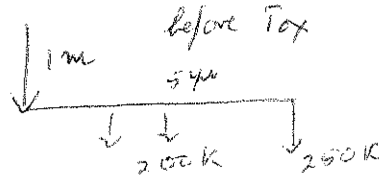
sale = 250 K

loss on sale = 250 K

∴ Tax = − 250 × 25% (Tax rebate)

∴ ~~Total~~ Net cash flow after Tax on the sale = 250 + 250 × 25%

= € 312.5 K



yearly cash flow after Tax = P(1 − T) + AT

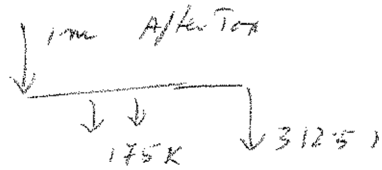
= 200(.75) + 100 × .25

= 150 + 25 = 175 K

PV of all cash flow = −1000 K

+ 175 [PWf − 15% − 5]

+ 312.5 [PWf' − 15% − 5]



= −1000 + 175 × 3.352

+ 312.5 × .4872

= −1000 + 586.6 + 152.25 = −261.15 K

DOES NOT MEET THE CRITERION.

b)

AC = 10 K + [1000 − 250 [PWf − 15% − 5]] × [CRF − 15% − 5]

= 10 K + [1000 − 250 × .4872] × .29832 K

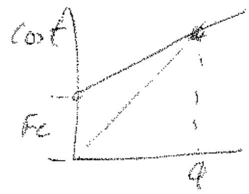
= 10 K + [1000 − 121.8] × .29832 K = 272 K per yr.

BE = $F_c + \varphi . V_c = \varphi . P$

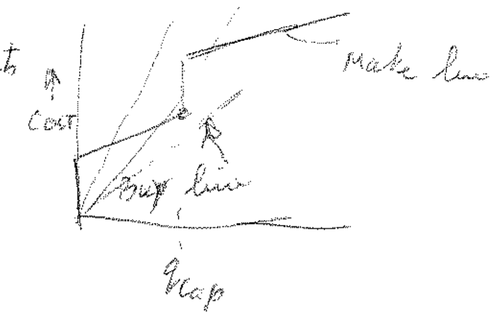
272 K + φ . 25 = φ 40

15 φ = 272 K

φ = 18.13 K items = 18.13 × 10³ items



capacity constraints



ME4001 — 2012

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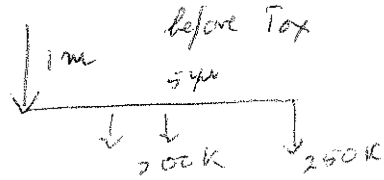
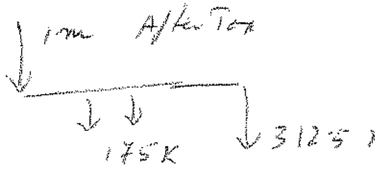


yearly cash flow after Tax = $P(1-T) + AT$
$= 200(.75) + 100 \times .25$
$= 150 + 25 = 175K$

PV of all cash flow $= -1000K$
$+ 175[PWf - 15\% - 5]$
$+ 312.5[PWf^{1} - 15\% - 5]$



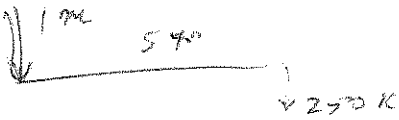
$= -1000 + 175 \times 3.352$
$+ 312.5 \times .4872$

$= -1000 + 586.6 + 152.25 = \underline{-261.15K}$

DOES NOT MEET THE CRITERION.

(b)

$AC = 10K + \left[1000 - 250[PWf^{1} - 15\% - 5]\right] \times [CRF - 15\% - 5]$



$= 10K + [1000 - 250 \times .4872] \times .29832 K$

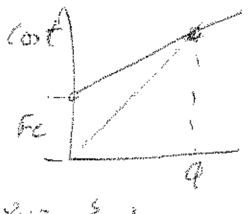
$= 10K + [1000 - 121.8] \times .29832 K = 272 K$ per yr.

$BE = F_c + Q.V_c = Q.P$

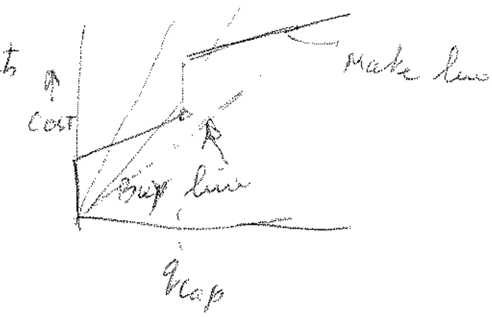
$272K + Q.25 = Q\,40$

$15Q = 272 K$

$Q = \underline{18.13 K}$ items $= 18.13 \times 10^3$ items

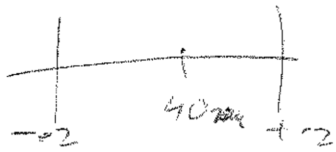


Capacity constraints



2. a) Taguchi → loss to society if not manufactured at the optimum.
- Cost functions for "Nominal is better", "lower is better" & "higher is better"

$$Loss = k(x-m)^2$$
$$15 = k(.2)^2$$
$$k = 375 \text{ €}/mm^2$$



Dimension	loss/Part	loss for the group loss/Part × n
39.85	$375\times(.15)^2 = 8.437$	$15\times 8.437 = 126.56$
39.95	$375\times(.05)^2 = 0.9375$	$25\times .9375 = 23.44$
40.05	$375\times(.05)^2 = .9375$	$= 28.13$
40.10	$375\times(.1)^2 = 3.75$	$= 67.5$
40.15	$375\times(.15)^2 = 8.437$	$= 101.25$

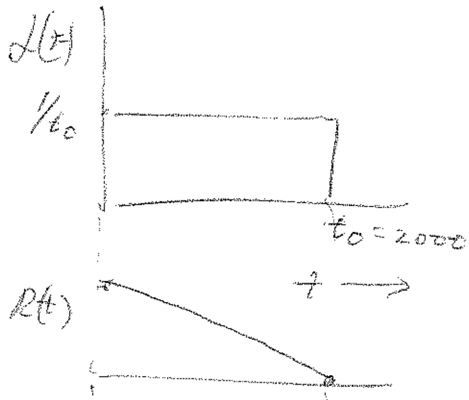
Σ 346.88

∴ Ave loss/Part $= € \frac{346.88}{100} = €\ 3.47$

b) Bath-tub curve — $\lambda(t)$ vs time — explain the shape & the 3 sections
Reliability — $R(t)$ — Define

for $t \leq 2000$

$f(t) = \frac{1}{t_0}$ (as Area under the curve = 1)



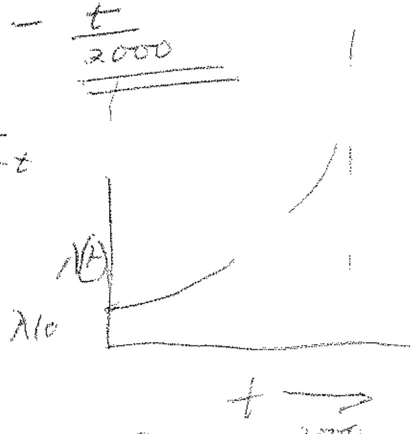
$$f(t) = -\frac{d\,R(t)}{dt}$$
$$\therefore \int d\,R(t) = \int f(t)\,dt$$
$$R(t) = -\frac{1}{t_0}\cdot t + c$$

at $t=0$, $R(t)=1$, ∴ $c=1$ $\Rightarrow$ $R(t) = \frac{-t}{t_0} + 1$

$$R(t) = 1 - \frac{t}{2000}$$

$$\lambda(t) = \frac{f(t)}{R(t)} = \frac{1/t_0}{1 - t/t_0} = \frac{1}{t_0 - t}$$

$$\therefore \lambda(t) = \frac{1}{2000 - t}$$



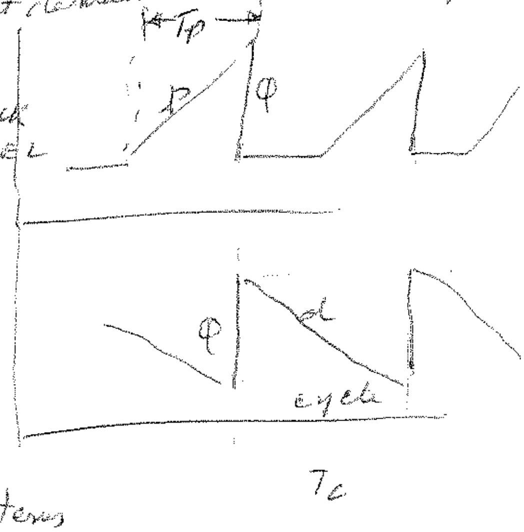
$$\lambda(0) = \frac{1}{2000}$$

$$MTBF = \int_0^{\infty} R(t)\,dt = \int_0^{t_0} R(t)\,dt = \int_0^{2000}\left(1 - \frac{t}{2000}\right)dt = \left[t - \frac{t^2}{2\times 2000}\right]_0^{2000} = 1000 \text{ hr}$$

3 STAT. INV. Mgt — used in Distribution Type inventory (Finished goods) with each item having independent demand — EOQ All parameters have to be calculated for all items —

MRP — used in Manufacturing Inventory with Parent items & dependent items, used also as a scheduling tool — only the parent item demand has to be known, the dependent demand is worked out using BOM

Prove $\varphi = \sqrt{\dfrac{2d(C_{SM}+C_{SA})}{C_H\,(d/p+1)}}$



$p = 10{,}000$ $\quad C_{SM} = 1500$ set up

$d = 1{,}000$ $\quad C_{SA} = 2000$ (Transport)

$C_H = 25 \times \frac{26}{52} \times \frac{1}{100} = £0.125/\text{unit}$

$$\varphi = \sqrt{\frac{2 \cdot 1000\,(1500+2000)}{.125\left(\frac{1000}{10{,}000}+1\right)}} = 7135 \text{ items}$$

$$C_{MIN} = \frac{\varphi}{2}\,C_H\left(\frac{d}{p}+1\right) + \frac{d}{\varphi}\left(C_{SM}+C_{SA}\right)$$

$$= \frac{7135}{2} \times .125\,(1.1) + \frac{1000}{7135}(1500+2000) = 490.53 + 490.53$$
$$= \underline{981.06}$$

Total cost $= Md + C_{MIN} = 25000 + 981.06 = 25981.06$

Allowable variation $= 981.06 \times 1.1$

$$981.06 \times 1.1 = \frac{\varphi}{2}(.125 \times 1.1) + \frac{1000}{\varphi}(3500)$$

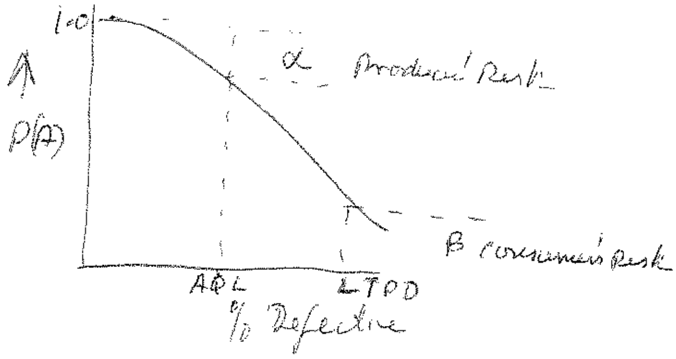
$$\varphi^2 - 15696\,\varphi + 50.9 \times 10^6 = 0$$

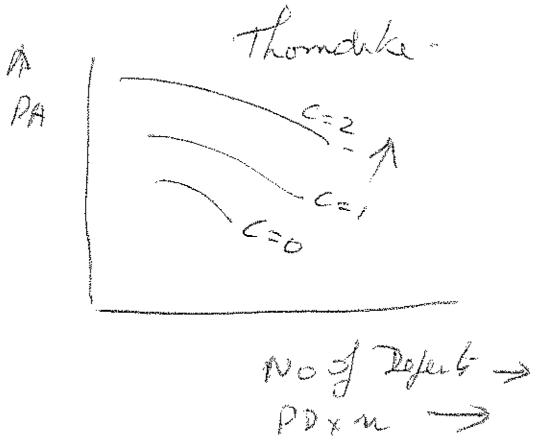
$$\varphi = \frac{15696 \pm \sqrt{15969^2 - 4 \times 50.9 \times 10^6}}{2}$$

$$= \frac{15696 \pm 6539}{2}$$

$$= \underbrace{4578 \text{ or } 11117}_{\text{Prod. Range}}$$

4/ a)





AQL = 2%   n = 100

∴ expected No of defects = 2

∴ Z = 2 in the Poisson series

ie $P(A) = e^{-Z}\left(\frac{1}{0!} + \frac{Z}{1!} + \frac{Z^2}{2!} + \frac{Z^3}{3!} \cdots\right)$

as $c \leq 2$ only the 1st 3 terms are taken

$\therefore P(A) = e^{-2}\left(1 + 2 + \frac{2^2}{2!}\right) = .6766$

$\therefore \alpha = 1 - P(A) = .32 = 32\%$

b) 15, 15.5, 16.5, 14, 14.5, 15, 14, 13.5, 14, 15

u u D u u D D u u

observed Runs = 5

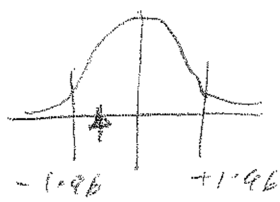
expected No of runs $= \frac{20-1}{3} = 6.333$

$\sigma_{u/D} = \sqrt{\frac{16 \times 10 - 29}{90}} = 1.206$

95% confidence ⇒ Z = ±1.96

$Z_1 = \frac{\text{Actual No} - \text{Expected No}}{\sigma_{u/D}} = \frac{5 - 6.333}{1.206} = -1.105$

As Z_1 is between ±1.96 — the variation is due to Random causes.



4) c/

Total No of defects = 1+1+2+1+2+2+2 = 11

" " of items = 347

$\therefore \bar{P} = \frac{11}{347} = .0317$ & $\sigma = \sqrt{\frac{.0317(1-.0317)}{347/7}}$

$= .02488$

$P_1 = \frac{1}{50} = .02$

$P_2 = \frac{1}{48} = .02083$

$P_3 = \frac{2}{52} = .03846$

$P_4 = \frac{1}{48} = .02083$

$P_5 = \frac{2}{51} = .03921$

$P_6 = \frac{2}{50} = .04$

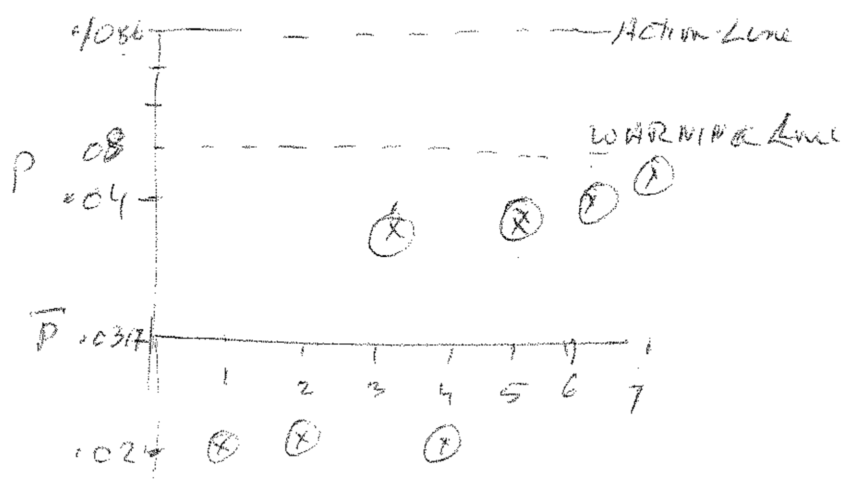
$P_7 = \frac{2}{48} = .04166$

control lines are at

warning $= \pm 1.96\sigma = 1.96 \times .02488 = .04876 \rightarrow .08046$

Action $= \pm 3.09\sigma = 3.09 \times .02488 = .0769 \rightarrow .1086$

within control but Trend upwards - lower lines Not Required



5/

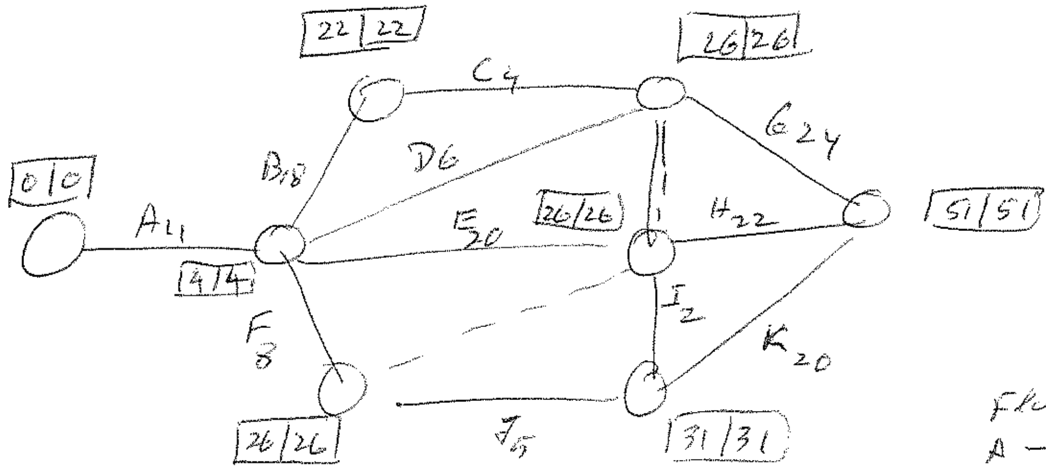
Fixed position

Line production / Line Layout / Product lay out
Batch Production / Process lay out
Cell Lay out / Group Tech lay out
FMC / FMS
Continuous production (Chemical plant)

Discussion on

Adv / Dis Adv & used when.
— WIP, Queue time, Prod Planning & Control
scheduling / Types of labour / supervision.
Types of Machinery used / cost of setting up
Capital cost / B/D & Maintenance -
Product variety / volume etc -
Health & Safety (in Fixed Posn)

6



CP ⇒ A-B-C - Dummy - Dummy - J - K

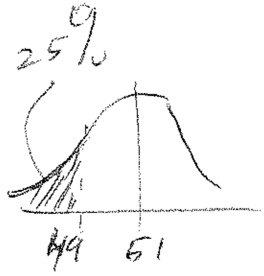
Scheduled finish date = 51

$\sigma^2_{CP} = 1^2 + 2^2 + .5^2 + 1^2 + 1.5^2 = 8.5$

$\sigma_{CP} = 2.915$

$z = \dfrac{49-51}{2.915} = -.686$

from Tables Δ = 25%



Float

A	0
B	0
C	0
D	16
E	2
F	14
G	1
H	3
I	3
J	0
K	0

Activities on CP have to be shortened - Lowest crash cost is on K (€80); reduce K by 1 day.

Now path A-B-C-G is also critical. Hence Activities A, B, C & J have to be considered. The lowest cost is on A (90) [then B (95)]. Crash Time for A is 3. Hence A reduced by 1 day only & B is reduced by 2 days (as the Float on E is 2 & Path A-E--- will also go critical).

Total cost = 80 + 90 + 2×95 = €360

7

Capacity > requirements ⇒ Dummy outlet
use "Least cost Allocation"

Cost Matrix

	A	B	C	D
M_1	8	11	10	6
M_2	5	10	5	6
M_3	6	7	4	6

Allocation

	A	B	C	D	Dummy	
M_1		150		150	100	~~400~~ ~~250~~ ~~100~~ 0
M_2	200				0	~~200~~ 0
M_3	50	100	350		0	~~500~~ ~~150~~ ~~100~~ 0
	~~250~~ ~~50~~ 0	~~250~~ 150 0	~~350~~ 0	150 0	~~100~~ 0	1600

evaluate $M1-A$ = ~~cost [8-6~~ cost of cells $[M_1A - M_3A + M_3B - M_1B]$

$= 8 - 6 + 7 - 11 = -2$

SHADOW COST Matrix $= C' =$

	A	B	C	D	Dummy	v
	10	11	8	6	0	10
	5	6	3	1	-5	5
	6	7	4	2	-4	6
u	0	1	-2	-4	-10	

No of occupied cells $= m+n-1$
$= 8-1 = 7$

$C - C' =$

A	B	C	D	
-2	0	2	0	0
0	4	2	11	
0	0	0	10	

-ve No. — optimum NOT Reached.
LOAD M_1-A

New Allocation

A	B	C	D	Dummy
50	100		150	100
200				
	150	350		

$m+n-1 = 7$

SHADOW cost Matrix C' =

	A	B	C	D	Dummy	v
	8	11	8	6	0	8
	5	8	5	3	-3	5
	4	7	4	2	-4	4
u	0	3	0	-2	-8	

Good

$C - C'$ =

A	B	C	D	Dummy
0	0	2	0	0
0	2	0	3	3
2	0	0	4	4

all +ve
optimum Reached

∴ The allocation of Manufacture & Transport plan

	A	B	C	D	
M1	50 (8)	100 (11)		150 (6)	100 (0)
M2	200 (5)				
M3		150 (7)	350 (4)		

$$\text{Cost} = 50\times 8 + 200\times 5 + 100\times 11 + 150\times 7 + 350\times 4 + 150\times 6$$

$$= 400 + 1000 + 1100 + 1050 + 1400 + 900$$

$$= £5850$$