GE401
ENGINEERING
ECONOMY
HW of chapter no.8

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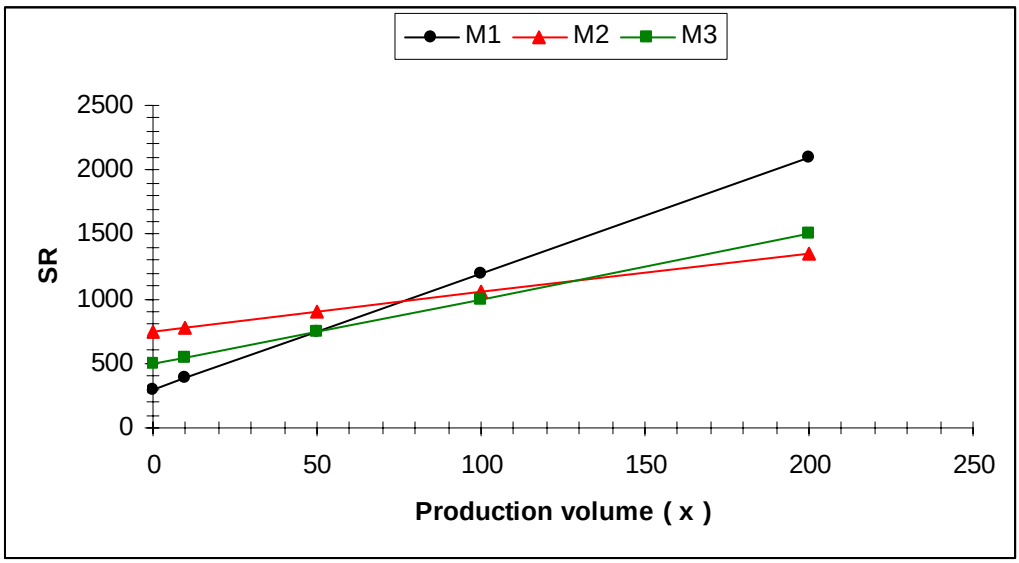
Problem ≠ 2
Page (401)

Solution :

a) The most economical machine tool to use for all order sizes between 1 and 200 units

Machine Tool	Total cost (SR/Order)
M1	300 + 9 x
M2	750 + 3 x
M3	500 + 5 x

Machine Tool	TC (x)	X1	X2	X3	X4	X5
		0	10	50	100	200
M1	300 + 9 x	300	390	750	1200	2100
M2	750 + 3 x	750	780	900	1050	1350
M3	500 + 5 x	500	550	750	1000	1500



- M1 = M2

  $300 + 9x = 750 + 3x$
  $9x - 3x = 750 - 300$
  $x = 450/6 = 75$ unit

- M1 = M3

  $300 + 9x = 500 + 5x$
  $9x - 5x = 500 - 300$
  $x = 200/4 = 50$ unit

- M2 = M3

  $750 + 3x = 500 + 5x$
  $5x - 3x = 750 - 500$
  $x = 250/2 = 125$ unit

From graphics or analysis:

$1 \le x \le 50 \rightarrow$ Use M1

$5 \le x \le 125 \rightarrow$ Use M3

$125 \le x \le 200 \rightarrow$ Use M2

b) If order size 75 units we will use M3

The total production cost for M3 :

TC (75) = 500 + 5 (75) = SR 875

c) If order size 160 unit , most economical machine is M2 but assume the most economical machine is unavailable .

If M2 unavailable, use available machine (M1 , M3)

TC (160) for M2 = 750 + 3 (160) = SR 1230
TC (160) for M3 = 500 + 5 (160) = SR 1300
TC (160) for M1 = 300 + 9 (160) = SR 1740

- ✓ From analysis or graphics the most economical machine is M3 if M2 is unavailable.

Penalty = M3 – M2
Penalty = 1300 – 1230 = SR 70

Problem ≠ 6
Page (402)

Solution :

- Capacity of plant = 300,000 pallet/year .
- Now the plant is operating at 70% of capacity , now capacity = 0.7 * 300,000 = 210,000 pallet/year .
- Selling price (SP) = 18.25 SR/pallet .
- Variable cost (VC) = 15.75 SR/pallet .
- Fixed cost (FC) = 550,000 SR/year .

a)

✓ TC (x) = FC + VC (x)

$$TC(x) = 550{,}000 + 15.75\,x$$

✓ TR (x) = SP * x

$$TR(x) = 18.25\,x$$

✓ TP (x) = TR (x) – TC (x)

$$TP(x) = 18.25\,x - 550{,}000 - 15{,}75\,x$$

$$TP(x) = 2.5\,x - 550{,}000$$

TP (210,000) = 2.5 (210,000) – 550,000
TP (210,000) = -25,000 SR → Loss

b) Break-Even point:

$x_o \rightarrow$ TR = TC → TP = 0
TP (x) = 0 → 2.5 x – 550,000 = 0

$$x_o = \frac{550{,}000}{2.5} = 220{,}000\,pallet/year$$

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c) 90% of capacity = 0.9 * 300,000 = 270,000 pallet/year

TP (270,000) = 2.5 (270,000) – 550,000
TP (270,000) = + 125,000 SR → Profit

d) If fixed cost could be reduced by 40%, what would be the effect on the break–even sales volume?

New fixed cost = (1- 0.4) * 550,000 = 330,000 SR

TC (x) = 330,000 + 15.75 x
TP (x) = 2.5 x – 330,000

Break – Even point

TP (x) = 0

2.5 x – 330,000 = 0

$x_o = 132{,}000\, pallet / year$ → Reduce break – even point

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Problem ≠ 7
Page (402)

Solution:

- Direct material cost = SR 5 / unit
- Direct labor cost = SR 2.9 / unit
- Overhead cost = SR 4.1 / unit
- Selling price = SR 20 / unit

What is the maximum scrap rate permissible in order to break even ?

FC = 0

VC = 5 + 2.9 + 4.1 = 12 SR/unit

TC (x) = 12 x

TR (x) = 20 x

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Input (y) = 100 % → Inspection → Output (x) = (1- ρ) y

x = (1 – ρ) y

y = x / (1 – ρ)

$$TC(y) = 12\,y$$

$$TC(x) = 12\,(x/1-\rho)$$

$$TR(x) = 20\,x$$

TR (x) = TC (x)

20 x = 12 x * 1/1-ρ

20 – 12 = 1/1-ρ

1-ρ = 1/8

ρ = 1 – 0.6

ρ = 0.4

Maximum scrap rate

$$\rho = 40\ \%$$

Problem ≠ 10
Page (403)

Solution:

$$TC(x) = 50{,}000 + 20.2x + 0.0001x^2$$

$$TR(x) = 35\,x$$

a) Level of production in AC (x) is minimum

$$AC(x) = \frac{TC(x)}{x} \Rightarrow \frac{50{,}000 + 20.2x + 0.0001x^2}{x} \Rightarrow 50{,}000x^{-1} + 20.2 + 0.0001x$$

$$\frac{\delta AC(x)}{\delta x} = \frac{-50{,}000}{x^2} + 0.0001 = 0$$

$$x = 22360.68 \approx 22360 barrel / weak$$

Minimum AC (x)

$$AC(22360) = \frac{50{,}000}{22360} + 20.2 + 0.0001(22360) = 24.67 SR / barrel$$

b) Maximum weakly profit

TP (x) = TR (x) – TC (x)

$$TP(x) = 14.8x - 50{,}000 - 0.0001x^2$$

$$\frac{\delta TP(x)}{\delta x} = 0 \Rightarrow 14.8 - 0.0002x = 0$$

x = 74,000 barrel/weak

maximum TP (74,000) =
$14.8(74{,}000) - 50{,}000 - 0.0001(74{,}000)^2 \Rightarrow TP(74{,}000) = 497{,}600 SR$

c) Break – Even point:

TP (x) = 0

$$14.8x - 50{,}000 - 0.0001x^2 = 0$$

$x_1 = 3459.23 barrel / weak$
$x_2 = 144541 barrel / weak$

$$3459.23 \le x \le 14{,}454$$

d) If limit capacity = 50,000 barrel/weak

$$3459.23 \le x \le 50{,}000$$

Problem ≠ 12
Page (404)

Solution:

a)

$$TC(Q) = 15(\frac{2000}{Q}) + (0.6Q + 150)$$

$$\frac{\delta TC(Q)}{\delta Q} = 0 \Rightarrow \frac{-30{,}000}{Q^2} + 0.6 = 0$$

$$Q^* = 223.61 Unit/order$$

b) TC (223.61) = 15 (2000/223.61) + 0.6 (223.61) + 150

TC (223.61) = 418.33 SR/order

c) Number of order = $\frac{A}{Q^*} = \frac{2000}{223.61} = 8.94 \approx 9 Order/year$

d) Purchase order is decreased by 50%

$$P_c = 0.5 * 15 = 7.5 SR/order$$

$$TC(Q) = 7.5(\frac{2000}{Q}) + (0.6Q + 150)$$

$$\frac{\delta TC(Q)}{\delta Q} = 0 \Rightarrow \frac{-15{,}000}{Q^2} + 0.6 = 0$$

$$Q = 158.1 Unit/Order$$