Eng.Hussam Alghamdi

**Question ≠ 1:**

**A company has estimated the annual total production cost (TC) and selling price (SP) functions, with respect to the annual production volume (t) as follows:**

$TC(t) = 1000 + 2t$ **SR**

$TR(t) = 6t - 0.001t^2$ **SR/unit**

a) **Over what range of production is profit possible?**
b) **Determine the level of production for maximum profit?**
c) **Determine the level of production for maximum average profit per unit?**

**Solution:**

**a) Break – Even point**

**TR – TC =0**

$6t - 0.001t^2 - 1000 - 2t = 0$

$4t - 0.001t^2 - 1000 = 0$

$t_1 = 267.949 Unit / year$

$t_2 = 3732.05 Unit / year$

$\therefore 268 \le t \le 3732$

**b)** $\frac{\delta TP(t)}{\delta t} = 0$

$TP(t) = 4t - 0.001t^2 - 1000$

$\frac{\delta TP(t)}{\delta t} = 4 - 0.002t$

$\frac{\delta TP(t)}{\delta (t)} = 0$

$4 - 0.002t = 0$

$4 = 0.002t \Rightarrow t = \frac{4}{0.002} = 2000$

$\therefore t = 2000 Unit / year$

**c)** $\frac{\delta ATP(t)}{\delta t} = 0$

$$ATP(t) = \frac{4t - 0.001t^2 - 1000}{t}$$

$$ATP(t) = 4 - 0.001t - \frac{1000}{t}$$

$$\frac{\delta ATP(t)}{\delta t} = -0.001 + \frac{1000}{t^2}$$

$$-0.001 + \frac{1000}{t^2} = 0$$

$$t = \sqrt{\frac{1000}{0.001}} = 1000 Unit / year$$

$$\therefore t = 1000 Unit / year$$

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**Question ≠ 2**

**a) A company has tow processes that can be used to produce a given product with the following data:**

| *Process* | *Fixed Cost ( SR )* | *Variable Cost ( SR/unit )* |
|---|---|---|
| A | 3,000,000 | 200 |
| B | 1,800,000 | 210 |

**If the product is produced using Process A, the selling price per unit will be SR 250. what should be the selling price for process B, if the company will be use the same brek-even quantity of Process A?**

**Solution (a) :**

$\Pr ocess(A) \Rightarrow TC(x)_A = 3{,}000{,}000 + 200x$

$\Pr ocess(B) \Rightarrow TC(x)_B = 1{,}800{,}000 + 210x$

$TR(x)_A = 250x$

$TR(x)_B = Rx$

$TR(x)_A = TC(x)_A \Rightarrow TR(x)_A - TC(x)_A = 0$

$250x - 3{,}000{,}000 - 200x = 0$

$50x - 3{,}000{,}000 = 0 \Rightarrow x = \dfrac{3{,}000{,}000}{50}$

$\therefore x_o = 60{,}000 Unit$

$TR(x)_B = TC(x)_B \Rightarrow TR(x)_B - TC(x)_B = 0$

$Rx - 1{,}800{,}000 - 210x = 0$

$Same.Break - Even = 60{,}000 Unit$

$\therefore R(60{,}000) - 1{,}800{,}000 - 210(60{,}000) = 0$

$R = \dfrac{144{,}00{,}000}{60{,}000} = 240 SR/Unit$

$\therefore R = 240 SR/Unit$

**b) An analysis of the current operations of a firm results in the conclusion that the total cost (TC) is:**

$TC(x) = SR500{,}000 - 50x + 0.002x^2$ **where x is the number of units produced.**
**The selling price is SR 150 per unit.**

1) **Find marginal profit when x = 100,000 units.**
2) **Find the level of production for maximum profit.**
3) **What is the maximum profit.**

**Solution**

**(1) :**

$$TC(x) = 500{,}000 - 50x + 0.002x^2$$
$$TR(x) = 150x$$
$$TP(x) = TR(x) - TC(x)$$
$$TP(x) = 150x - 500{,}000 + 50x - 0.002x^2$$
$$\therefore TP(x) = 200x - 500{,}000 - 0.002x^2$$
$$MTP(x) = \frac{\delta TP(x)}{\delta x} \Rightarrow 200 - 0.004x$$
$$MTP(100{,}000) = 200 - 0.004(100{,}000)$$
$$MTP(100{,}000) = -200SR$$

**2)**

$$\frac{\delta TP(x)}{\delta x} = 0 \Rightarrow 200 - 0.004x = 0$$
$$x = \frac{200}{0.004} = 50{,}000Unit$$

**3)**

$$Max.TP(x) at.x = 50{,}000Unit$$
$$TP(50{,}000) = 200(50{,}000) - 0.002(50{,}000)^2 - 500{,}000$$
$$\max TP(50{,}000) = 4{,}500{,}000SR$$

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**Question ≠ 3**

**Two machine ( A & B ) are being considered for a project investment. The variable cost and annual fixed cost are shown in the following table:**

| Machine | Fixed Cost (SR) | Variable Cost (SR/Unit) |
|---|---|---|
| **A** | **3600** | **10.5** |
| **B** | **4275** | **8.25** |

a) **What is the number of units/year for break even between the two machines?**
b) **If the estimated number of units/year is 1000, what the annual saving are estimated if machine (B) is purchased instead of machine (A)?**
c) **If machine (B) is producing 1000 units/year, what revenue/unit must be generated in order to break – even?**

**Solution:**

$TC(x)_A = 3600 + 10.5x$
$TC(x)_B = 4275 + 8.25x$

**a)**

$TC(x)_A = TC(x)_B$
$3600 + 10.5x = 4275 + 8.25x$
$2.25x = 675$
$x = \frac{675}{2.25} = 300 Units$

**b)**

$TC(1000)_A = 3600 + 10.5(1000) = 14{,}100 SR/Year$
$TC(1000)_B = 4275 + 8.25(1000) = 12{,}525 SR/Year$

**Annual saving are estimated if machine (B) is purchased instead of machine (A)**

**14,100 – 12,525 = 1575 SR/Year .**

**c)**

$$TC(x)_B = 4275 + 8.25x$$
$$TR(x)_B = Rx$$
$$TR(x)_B - TC(x)_B = 0$$
$$Rx - 4275 - 8.25x = 0$$
$$Where..x = 1000..Unit/Year$$
$$R(1000) - 4275 - 8.25(1000) = 0$$
$$\therefore R = \frac{12525}{1000} = 12.525$$
$$R = 12.525 SR/Unit$$

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**Question ≠ 4**

**A company has estimated that the total production cost (TC) and selling price (SP) for a given product are as follows:**

$TC(t) = 35{,}000 + 50t$ **SR**

$SP(t) = 150 - 0.02t$ **SR/Unit**

**Where t is number of units produced annually. It is required to:**

a) **Calculate the total revenue and total profit when revenue is maximum.**
b) **Calculate the average and total profit when profit is maximum.**

**Solution :**

$$TC(t) = 35{,}000 + 50t$$

$$TR(t) = (150 - 0.02t)t \Rightarrow 150t - 0.02t^2$$

$$TP(t) = TR(t) - TC(t)$$

$$TP(t) = 150t - 0.02t^2 - 35{,}000 - 50t \Rightarrow 100t - 0.02t^2 - 35{,}000$$

$$ATP(t) = \frac{100t - 0.02t^2 - 35{,}000}{t} \Rightarrow 100 - 0.02t - \frac{35{,}000}{t}$$

**a)**

$$\frac{\delta TR(t)}{\delta t} = 0 \Rightarrow 150 - 0.04t = 0$$

$$t = 3750 Units$$

$$TR(3750) = 150(3750) - 0.02(3750)^2 = 281{,}250 SR$$

$$TP(3750) = 100(3750) - 0.02(3750)^2 - 35{,}000 = 58{,}750 SR$$

**b)**

$$\frac{\delta TP(t)}{\delta t} = 0 \Rightarrow 100 - 0.04t = 0$$

$$\therefore t = 2500 Unit$$

$$ATP(2500) = 100 - 0.02(2500) - \frac{35{,}000}{2500} = 36 SR$$

$$TP(2500) = 100(2500) - 0.02(2500)^2 - 35{,}000 = 90{,}000 SR$$