COST-VOLUME-PROFIT ANALYSIS

TC = F + VX
π = PX - TC
π = PX - F - VX **(1)**

TC-TOTAL COST;
F-TOTAL FIXED COST;
V-VARIABLE COST/UNIT PRODUCED;
X-NUMBER OF UNITS PRODUCED AND SOLD;
P-UNIT SELLING PRICE;
π-TOTAL OPERATING PROFIT

 # OF UNITS TO BE SOLD FOR TARGET PROFIT π: = X = (π + F)/(P - V)
or **X = (π + F)/(CONTRIBUTION MARGIN)** **(2)**

FOR BREAK-EVEN, π = 0:

0 = PX - F - VX
X = F/(P - V) = F/(CONTRIBUTION MARGIN) **(3A)**
SALES DOLLARS = PX = PF/(CONTRIBUTION MARGIN) **(3B)**

PROFIT-VOLUME EQUATION:

π = - F + (P - V)X **(4)**

REQUIRED SELLING PRICE (for a target profit of π):

P = V + (π + F)/X **(5)**

REQUIRED FIXED COSTS (for a target profit of π):

F = (P - V)X - π **(6)**

REQUIRED VARIABLE COSTS (for a target profit of π):

V = P - (π + F)/X **(7)**

MARGIN OF SAFETY = SALES UNITS - BREAKEVEN UNITS

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WITH INCOME TAXES:

AFTER-TAX PROFIT (π_{at}) =
BEFORE-TAX PROFIT (π) * [1 - TAX RATE (τ)] **(8)**

NEW EQUATIONS

$\pi_{at} = (PX - F - VX)(1 - \tau)$ **(9)**

$X = \{\pi_{at} + F(1 - \tau)\} / (P - V)(1 - \tau)$ **(10)**

X = F/(P - V) = F/(CONTRIBUTION MARGIN) (11A)

SALES DOLLARS = PX = PF/(CONTRIBUTION MARGIN) (11B)

COST –VOLUME– PROFIT

COST ~ F = TOTAL FIXED COST

V =UNIT VARIABLE COSTS

VOLUME=X➔ UNITS

PRICE PER UNIT = P

PROFIT = $

$ = TOTAL SALES – TOTAL COSTS

$ = PX – (F + VX)

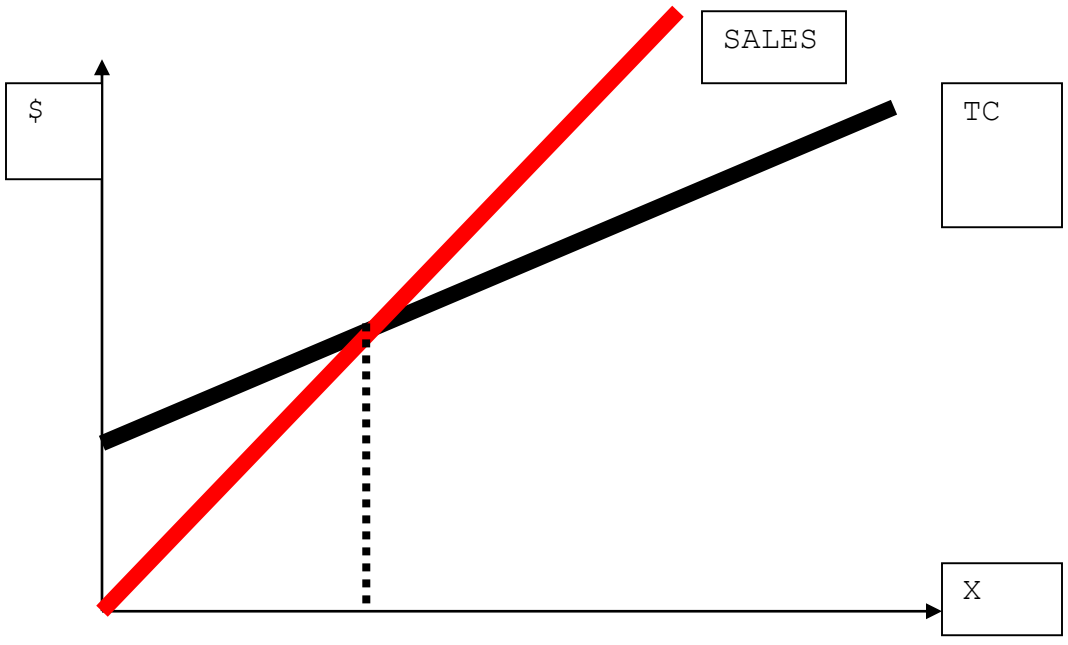
$ = (P – V) X – F --(1)

➔ (CM) X –F

0 = (P–V)X – F

$$X_{BE} = \frac{F}{(P - V)}$$

$$SALES_{BE} = PX_{BE} = \frac{PF}{(P - V)}$$



$$\$_T = (P - V)\ X - F$$

$$X_T = \frac{(\$_T + F)}{(P - V)}$$

$$SALES_T = PX_T = \frac{P(\$_T + F)}{(P - V)}$$

$$TAX\ RATE = T$$

$$\$_{AT} = (1 - T)\ \$_{BT}$$

$$\$_{BT} = \frac{\$_{AT}}{(1 - T)}$$

CASE STUDY
MICROHARD CORPORATION

You have just graduated from UTSA but your reputation has already reached the business community. You are considered a genius in cost management having earned an "A" in the course taught by Dr. A. Gill Bates owner of *Microhard Corporation* and king of the software world hears about you and immediately hires you to head the new Philly unit with a monthly production capacity of 4 million units. This unit produces and markets screen-savers. Gill wants you to produce at break-even in the first month and thereafter double your production and increase the net profits (after-tax) by $ one million in each subsequent month. Failure to meet either of the targets results in your termination. Life would have been easier for you but for a tough competitor *Pain-In-The-Byte Corporation (PITB)* which is a subsidiary of *Netscope*. *PITB* manufactures and markets the same software as you and sells it for $10 per unit. The IRS gives a special tax break to new units. As a result, you do not pay any taxes for the first six months of operation. Thereafter the tax rate is 40%.

- *January* You find out that your variable costs are $5 per unit and fixed costs are $1 million. If you price your product more than *PITB* you have no buyers. How many units should you produce?

- *February* Given this scenario will you be able to meet your targets?

- *March* You realize that to meet your targets for this month you have to lower your prices in order to grab *PITB*'s market share. How much should you sell your product for?

- *April* You pricing policy in March hurt *PITB*. As a result their profits went downhill and the local chief got fired. The newly hired executive vows to avenge the defeat and lowers the price of his product by 25%. You are forced to price your product accordingly. To achieve this you may have to cut down your fixed costs. The only way to reduce fixed costs is to fire yourself. Does the new pricing policy of *PITB* cost you your job?

- *May* Not content with its continuing pressure on you, *PITB* cuts

its price another one-thirds from April. Based on the analysis in April you realize that it is not possible to lower your fixed costs. You renegotiate with your suppliers and introduce innovative cost minimizing technology thereby reducing your variable costs to $_?_ per unit in order to attain the target set by Gill for this month.

- *June* Unexpected inflation forces your variable costs to $3.5 per unit. Will you be able to meet Gill's expectations or do you get fired?

- *July* The turn of events in July shocks Philly. A mysterious fire devastates *PITB*. The fire chief suspects foul play. An article in the *Philadelphia Inquirer* "Cut-Throat Competition In The Software Industry Responsible for The Crime" by crime investigator F. B. Inquisitive (known as *F.B.I.* to the underworld) suggests that you are responsible for the incident. Investigations by the local police reveal that unprecedented inflation had driven your variable costs to $5 per unit in July. Did you have a motive for the alleged crime? If the variable costs had stayed at the June level would you still have a motive?[1]

If *PITB* had not met the unfortunate fate would you have succeeded? Were Gill's targets realistic? Assume the number of units sold are equal to the number of units manufactured.

[1] No evidence was ever found implicating you. Your brilliant performance as the head of Philly unit resulted in your promotion as the Financial Controller of *Microhard*.

MICROHARD CORPORATION

WORKSHEET

MONTH	PRICE / UNIT	FIXED COSTS	VARIABLE COSTS / UNIT	NUMBER OF UNITS SOLD	PROFIT	TAX RATE
JAN.						
FEB.						
MAR.						
APL.						
MAY.						
JUN.						
JUL.						

JANUARY

FEBRUARY

MARCH

APRIL

MAY

JUNE

JULY

SOLUTION

MONTH	P	F	V	X	∏	TAX
JAN	10	1,000,000	5	?	0	0%
FEB	10	1,000,000	5	400,000	1,000,000	0%
MAR	?	1,000,000	5	800,000	2,000,000	0%
APL	7.50	?	5	1,600,000	3,000,000	0%
MAY	5.00	1,000,000	?	3,200,000	4,000,000	0%
JUN	5.00	1,000,000	3.5	4,000,000	5,000,000	0%
JULY	?	1,000,000	5	4,000,000	6,000,000 (after-tax)	40%

JANUARY

$$X = \frac{F}{P - V} = \frac{1{,}000{,}000}{(10 - 5)} = 200{,}000$$

FEBRUARY

$$X = \frac{\prod + F}{P - V} = \frac{1{,}000{,}000 + 1{,}000{,}000}{(10 - 5)}$$

$$= 400{,}000$$

MARCH

$$P = V + \frac{(\prod + F)}{X} = 5 + \frac{(2{,}000{,}000 + 1{,}000{,}000)}{800{,}000}$$

$$= 8.75$$

APRIL

$$F = (P - V)\,X - \prod = (7.5 - 5)\,1{,}600{,}000 - 3{,}000{,}000$$

$$= 1{,}000{,}000$$

MAY

$$V = P - (\prod + F)/X$$

$$= 5.00 - (4{,}000{,}000 + 1{,}000{,}000)/3{,}200{,}000$$

$$= \$3.44$$

JUNE

$\prod$ = (P – V) X – F
= (5 – 3.5) x 4,000,000 – 1,000,000
=5,000,000

JULY

$6 MILLION AFTER-TAX PROFIT
= $6 M / (1 - 0.4)
= $10 MILLION BEFORE-TAX PROFIT

P = V + ($\prod$ + F)/X
= 5.00 + (10,000,000 + 1,000,000)/4,000,000
=$7.75

WITH V = $3.5
P = V + ($\prod$ + F)/X
= 3.50 + (10,000,000 + 1,000,000)/4,000,000
=$6.25