ENGINEERING ECONOMICS

(CSE-305)

LECTURE: 02
(Solutions)

COSTS CONCEPTS
AND
THE ECONOMIC ENVIRONMENT

Example: Fixed Vs Variable Cost

- In connection with surfacing a new highway the contractor has a choice of two sites on which to set up the asphalt mixing plant equipment. The contractor estimates that it will cost $1.15 per cubic yard per mile to haul the asphalt paving material from the mixing plant to the job site. Factors relating to the two site alternative s are as follows

Cost Factor	Site A	Site B
Average hauling distance	6 Miles	4.3 Miles
Monthly Rental of Site	$1000	$5000
Cost to set up and remove equipment	$15000	$25000
Hauling cost	$1.15	$1.15

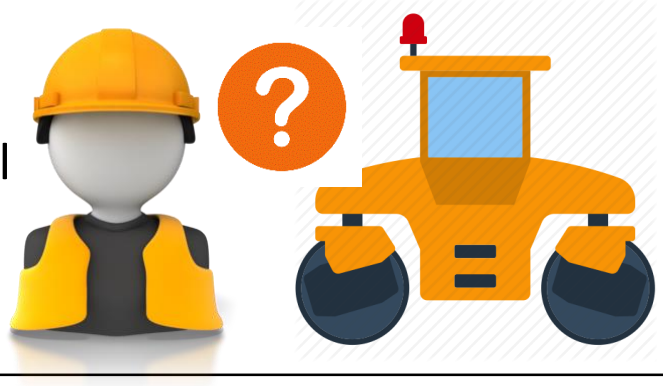
If site B is to be selected there will be an added charge of $96 per day for a flagman.

The job involves 50000 cubic yards of maixed asphalt paving material. It is estimated that 4 months i.e. 17 weeks of 5 working days per week will be required for the job. Compare the two sites in terms of their fixed , variable and total costs. Which one is better site.

For the selected site how many cubic yards of paving material does the contractor have to deliver before starting to make a profit if paid $8.05 per cubic yard delivered to the job site.???????

Example: Fixed Vs Variable Cost

- Rent , Setup Removal and Flagman are all Fixed costs
- Calculate them for each site.
- Hauling is a Variable cost find out for both site A and Site B
- Add them you will find the solution to the best Site
- In order to calculate profit
- First calculate all of the fixed costs.
- Then find the variable cost per yard delivered.
- Total cost= total revenue
- $53,160+ $4.95x=$8.05x
- Find x and that is your profit on the job
- after delivering... cubic yards of material



Quiz: Fixed Vs Variable Cost

Four college students who live in the same geographical area intend to go for Christmas vacation a distance of 400 miles each way. One of the student has an automobile and agrees to take the other three if they will pay the cost of operating the automobile for the trip. When they return from the trip the owner presents each of them with a bill for $102.40, stating that she has kept a careful records of the cost of operating the car and that based on an annual average of 15000 miles the cost per mile is $0.0384. The three others feel the charge is too high and ask to see the cost figures on which it is based . The owner shows them the following list.

Cost element	Cost per mile.
Gasoline	$0.120
Oil and lubrication	$0.021
Tires	$0.027
Depreciation	$0.150
Insurance and taxes	$0.024
Repairs	$0.030
Garage	$0.012
Total	$0.384

Quiz: Fixed Vs Variable Cost

- The three riders after reflecting on the situation form the opinion that only the costs for gasoline, oil and lubrication , tires and repairs are a function of mileage driven (variable costs) and thus could be caused by the trip. Since these four costs total only $0.198 per mile and thus $158.40 for the 800 mile trip the share for the each student would be $158.40/3= $52.80
- Obviously the opposing views are substantially different. Which if either is correct? What are the consequences of the two different view points in this matter and what should be the decision making criterion?

Solution

In this instance assume that the owner of the automobile agreed to accept $52.80 per person from the three riders, based on the variable costs that were purely incremental for the Christmas trip verses the owners average annual mileage. That is the s $52.80 per person is the with a trip cost relative to the without alternative.

Now what would be the situation be if the three students because of the low cost returned and proposed another 800mile trip the following weekend and what if there were several more trips planned like this. This would result in more advanced operating changes. From 15000 miles per year to 15800 and would soon be equaling 20000 miles per year.

On the basis it would be valid to compute the extra cost per mile as $0.198.

Since the normal operating range would be changed,

the fixed costs would have to be considered. A more

valid incremental cost would be obtained by computing

the total annual cost

Sunk Cost Confusion

- **Which one is sunk cost?**

Suppose your firm is considering the replacement of a piece of equipment. It originally cost $50000, is presently shown on the company records with a value of $20000, and can be sold for an estimated $5000.

Solution

For purposes of replacement 50000 is the sunk.

Another view sunk cost is difference between company record and current realizable selling cost.

Bicycle example 2.3 (book). Bicycle costs $1350, down payment 400

Bicycle b 1200

Sunk cost = 400

Example

Student go to school misses 20k and spend 5k

Total opportunity cost =25k

Example 2.4 (book)

Example

If the equation for price is given by

50,000 – 200D,

the demand D that maximizes the total revenue is equal to

50000/400= 125 units.

This is also called incremental or marginal revenue.

Example 2.6

A company produces an electric timing switch that is used in consumer and commercial products made by several other manufacturing firms. The fixed cost (C_F) is $73000 per month, and the variable cost (c_v) is $ 83 per unit. The selling price per unit is p=180-0.02D based on previous equations. For this situation find the following:

a. Determine the optimal volume for this product and confirm that a profit occurs at this demand

b. Determine the volumes at which breakeven occurs that is what is the range of profitable demand?

Solution

A) $D^* = (a-c_v)/2b$ =2425 units per month

Is $(a-c_v) > 0$ == 180-83 =97

Total revenue – Total cost >0 $(aD-bD^2)-(c_F+c_vD)$

B) total revenue =total cost

$-bD^2 +(a-c_v)D – C_F$

Apply quadratic equation rule

Thus the range of profitable demand is 932 to 3918 units per month.

Example 2.7

An engineering consulting firm measures its output in a standard service hour unit, which is a function of the personnel grade levels in the professional staff. The *variable cost (c_v)* is $62 per standard service hour. The charge out rate i.e. selling price (p) is 1.38Cv=$85.56 per hour. The maximum output of the firm is 160,000 hours per year, and its fixed cost (C_F) is $2024000 per year, for this firm.

a. What is the breakeven point in standard service hours and in percentage of total capacity

b. What is the percentage reduction in the breakeven point if fixed costs are reduced by 10%; if variable cost per hour is reduced 10%; if both costs are reduced by 10%; and if the selling price per unit is increased by 10%.

Solution

A) Total revenue = Total cost (Breakeven point)

$pD' = C_F + c_v D'$

$D' = C_F/(p - c_v)$

D'=$2024,000/($85.56-$62)= 85908 hours per year

D'=$85908/160,000= 0.537 or 53.7% of capacity.

B)

10% reduction in Cf:

D'=(0.9)*$2024,000/($85.56-$62)=77318 hours per year

And (85908-77318)/85908 = 0.10 or a 10% reduction in D'

Solution

10% reduction in Cv

D'= $2024,000/($85.56-0.9($62))= 68011 hours per year

$85908-68011/$85908 = 0.208 or a 20.8% reduction in D'

10% reduction in Cv and Cf

D'=0.9($2024,000)/($85.56- $0.9($62))= 61210 hours per year

85908-61120/85908=0.287, or a 28.7 % reduction in D'

10% increase in p;

D'=$2024,000/(1.1($85.56- $62))= 63,021 hours per year.

85908-63021/85908=0.266 or a 26.6% reduction in D'

Solution

- **The breakeven point for an operating situation can be determined in units of output , percentage utilization of capacity or sales volume. In this example the breakeven point D' was calculated in units of output 85908 standard service hours and then using the total capacity figure 160,000 hours per year..**
- **It was expressed as percentage utilization of capacity 53.7%.**
- **In terms of sales volume the breakeven point in this example is**
- **85908* (85.56)= $ 7,350,288**

Problem 2.8

A plant has a capacity of 4100 hydraulic pumps per month. The fixed cost (C_F) is $504000 per month. The variable cost (c_v) is $166 per pump, and sales price (p) is $328 per pump (assume that sales equal output volume).

a. What is the breakeven point in number of pumps per month?

b. What percentage reduction will occur in the breakeven point if fixed costs were reduced by 18% and unit variable costs by 6%?

Solution

Revenues = R(x) = 328 D
Costs = C(x) = 166D + 504000
Breakeven occurs when revenues equal costs (i.e., no profit, no loss):

328D = 166D + 504000
162D = 504000
D ≈ 3111 pumps (which is within the plant's capacity, so all is good).

With an 18% reduction, fixed costs will be $504000*(82%) = $413280
With a 6% reduction, unit variable costs will be $166*(94%) = $156.04
The new cost function after those reductions is C(x) = 156.04D + 413280
New breakeven is 328D = 156.04D + 413280 → x ≈ 2403

From 3111 pumps to 2403 pumps represents a reduction of (3111-2403)/3111 = 22.76%

Problem # 03

The annual fixed costs (C_F) for a plant are $100,000, and the variable costs (C_v) are $140,000 at 70% utilization of available capacity, with net sales of $280,000.

What is the breakeven point in units of production if the selling price per unit is $40?

$TR=pD$

$280000/40=D=7000$

$C_v=c_vD$

$140000/D=c_v=20$

$pD=C_F+c_vD \ldots D=C_F/(p-c_v)$

$D=(100000)/(40-20)$

Solution

CF= $100,000

CV= $140,000

p = 40

TR= $280,000

TR = price × demand = p • D

D=TR/p = 280000/40= 7000 units

Breakeven point= TR= TC = $C_F + C_V$

$c_v = C_V/D$= 140000/7000=20

$pD' = C_F + cvD'$….. $D' = C_F/(p-c_v)$

D'=100000/((40-20)) = 5000 units

Problem# 04

A company produces circuit boards used to update outdated computer equipment. The fixed cost (C_F) is \$42,000 per month, and the variable cost (c_v) is \$53 per circuit board. The selling price per unit is p = \$150 −0.02D. Maximum output of the plant is 4,000 units per month.

a. Determine optimum demand for this product. $D=a-c_v/2b$

b. What is the maximum profit per month? *P=TR-CT*

c. At what volumes do breakeven occur? *Quadratic Equation*

d. What is the company's range of profitable demand? *Quadratic Equation*

Solution

a. **Determine optimum demand for this product.**

CF= $42,000 per month

cv= $53 per circuit board

p = 150 – 0.02D

Max Output = 4000 units per month

D= a-cv/2b

(150-53)/(2(0.02)) = 2,425 units per month.

b. **What is the maximum profit per month?**

Profit = Total Revenue – Total Costs =

(150*2425 – 0.02*24252) – (42,000 + 53*2425) = $75,612.50

Solution

c. At what volumes do breakeven occur?

Break Even occurs when:

Total Revenue = Total Cost

-0.02D2 + (150-53)D – 42,000 = 0

D=(-97±√(〖97〗^2-4(-0.02)(-42,000)))/(2(-0.02))

D1’ = 481 and D2’=4369, these are the volumes at which break even occurs.

481 and 4369

d. What is the company’s range of profitable demand?

The domain or range of profitable demand is between 480 – 4369.