3.4.6: Evaluating Capacity Alternatives

Evaluating Capacity Alternatives

Basically, since there is usually a fixed cost (FC) associated with the usage of a capacity, we look for the right quantity of output that gives us enough total revenue (TR) to cover for the total cost (TC) that we have to incur. This quantity is called Break-Even Point (BEP), Break-Even Quantity (Q_{BEP}).

Total cost is the summation of the fixed cost and the total variable cost (VC, which depends on the quantity of output). In other words, at Q_{BEP}, we have: TC = FC + VC

A list of relevant notation can be found below:

TC = total cost
FC = total fixed cost
VC = total variable cost
TR = total revenue
v = variable cost per unit
R = revenue per unit
Q = volume of output
Q_{BEP}= break even volume
P = profit

Fixed cost is regardless of the quantity of output. Some examples of fixed costs are rental costs, property taxes, equipment costs, heating and cooling expenses, and certain administrative costs

With the above notation and some simplification in the calculation, we have:

$$\begin{aligned} &TC = FC + VC \\ &VC = Q \times v \\ &TR = Q \times r \\ &P = TR - TC = Q \times r - (FC + Q \times v) \\ &Q_{BEP} = FC/(r - v) \end{aligned} \tag{3.4.6.1}$$

Example 3.4.6.1

The management of a pizza place would like to add a new line of small pizza, which will require leasing a new equipment for a monthly payment of $4,000. Variable costs would be $4 per pizza, and pizzas would retail for $9 each.

1. How many pizzas must be sold per month in order to break even?
2. What would the profit (loss) be if 1200 pizzas are made and sold in a month?
3. How many pizzas must be sold to realize a profit of $10,000 per month?
4. If demand is expected to be 700 pizzas per month, will this be a profitable investment?

Solution

1. Q_{BEP} = FC / (r – v) = 4000 / (9 – 4) = 800 pizzas per month
2. total revenue – total cost = 1200 x 9 – 1200 x 4 = $6000 (i.e. a profit)
3. P = $10000 = Q(r – v) – FC;
   Solving for Q will give us: Q = (10000 + 4000) / (9 – 4) = 2800
4. Producing less than 800 (i.e. Q_{BEP}) pizzas will bring in a loss. Since 700 < 800 (Q_{BEP}), it is not a profitable investment.

Finding a break-even point between "make" or "buy" decisions:

Question: For what quantities would buying the product be preferred to making it in-house? For quantities larger than the break-even quantity or for smaller ones?

v_m = per unit variable cost of "make"
v_b = per unit variable cost of "buy"

total cost of “make” = total cost of “buy”
= Q x v_m + FC = Q x v_b
= FC = Q x v_b – Q x v_m
= Q = FC / (v_b – v_m)

Example 3.4.6.2

The ABX Company has developed a new product and is wondering if they should make this product in-house or have a capable supplier make the product for them. The costs associated with each option are provided in the following table:

	Fixed Cost (annual)	Variable Cost
Make in-house	$160,000	$100
Buy		$150

1. What is the break-even quantity at which the company will be indifferent between the two options?
2. If the annual demand for the new product is estimated at 1000 units, should the company make or buy the product?
3. For what range of demand volume it will be better to make the product in-house?

Solution

Solution

1. Q_{BEP} = FC / (v_b – v_m) = 160,000 / (150 – 100) = 3200
2. Total cost of “make” = 1000 x 100 + 160,000 = $260,000; Total cost of “buy” = 1000 x 150 = $150,000
   Thus, it will be better to buy since it will be less costly in total.
3. It will always be better to use the option with the lower variable cost for quantities greater than the break-even quantity.
   This can also be proven as follows:

We want “make” to be better than “buy” in this part of the question. Thus, for any quantity Q, we need to have:

Total cost of “make” < Total cost of “buy”
= 160,000 + 100Q < 150Q
= 160,000 < 50Q
= 3200 < Q

Finding a break-even point between two make decisions

Question: For what quantities would machine A be preferred to machine B? For quantities larger that the break-even quantity or for smaller ones?

If we assume the two options for making a product are machine A, with a fixed cost of $FC_A$and a variable cost of v_A, and machine B, with a fixed cost of FC_B and a variable cost of v_B, we have:

total cost of A = total cost of B
= Q x v_A + FC_A= Q x V_B + FC_B
= FC_A– FC_B = Q x V_B – Q x V_A
= Q = (FC_A – FC_B) / (V_B – V_A)

In any problem, it is suggested that you write down the total cost of each option and simplify from there to make sure that you do not miss any possible additional cost factors (if any).

Example 3.4.6.3

The ABX Company has developed a new product and is going to make this product in-house. To be able to do this, they need to get a new equipment to be able to do the special type of processing required by the new product design. They have found two suppliers that sell such equipment. They are wondering which supplier they go ahead with. The costs associated with each option are provide in the following table:

	Fixed Cost (annual)	**Variable Cost**
Supplier A	$160,000	$150
Supplier B	$200,000	$100

1. What is the break-even quantity at which the company will be indifferent between the two options?
2. If the annual demand for the new product is estimated at 1000 units, which supplier should the company use?
3. For what range of demand volume each supplier will be better?

Solution

1. $Q_{BEP} = (FC_B - FC_A) / (v_A - v_B)$ = (200,000 – 160,000) / (150 – 100) = 40,000/50 = 800
2. Total cost of Supplier A = 1000 x 150 + 160,000 = $310,000; Total cost of Supplier B = 1000 x 100 + 200,000 = $300,000 Thus, it will be better to go with Supplier B, since it will be less costly in total.
3. It will always be better to use the option with the lower variable cost for quantities greater than the break-even quantity. This can also be proven as follows:

Let's see for what quantities Supplier B will be better than Supplier A. In that case, for the quantity Q, we need to have:

Total cost of Supplier B < Total cost of Supplier A
= 200,000 + 100Q < 160,000 + 150Q
= 40,000 < 50Q
= 800 < Q

This means that for quantities above 800 units, Supplier B will be cheaper in total. Thus, for quantities less than 800, Supplier A will be cheaper in total.