CHAPTER 5

DETERMINING OPTIMAL OUTPUT

Optimal output levels can be measured by two different methods. These are looking at total revenue and cost, and marginal revenue and cost. These analyze the optimal amount of output needed to reach maximum profits.

A. Analyzing Total Revenue and Total Cost

The following table illustrates the total fixed cost, total variable cost, and total revenue for each different level of production. This information represents the production cost per acre of producing soybeans, and assumes they sell for $5.00 per bushel. The information may come from research data and or personal data.

Quantity (Q) (Q/acre)	Total Fixed Cost (TFC) ($/acre)	Total Variable Cost (TVC) ($/acre)	Total Cost (TFC + TVC) ($/acre)	Total Revenue (TR) (Q*5.00/bu) ($/acre)
0	80	0	80	0
10	80	43	123	50
20	80	55	135	100
30	80	65	145	150
40	80	85	165	200
50	80	120	200	250
60	80	169	249	300
70	80	270	350	350

The ***Total Fixed Cost*** **(TFC)** column gives the fixed cost for each different level of soybean production. *Fixed cost*s include depreciation expense, long-term lease payments, taxes or other expenses that are fixed, no matter how the output level changes.

The ***Total Variable Cost*** **(TVC)** column gives the total cost per acre that do change as output is altered. *Variable cost*s include seed, feed, fertilizer, irrigation, labor, and other expenses that vary with different production levels.

The ***Total Cost*** **(TC)** column represents the total per acre cost associated with producing at each different level. These costs are found by adding the TVC to the TFC.

The ***Total Revenue*** **(TR)** column represents the per acre revenue produced from the different levels of output. It is developed from the assumed $5.00 dollar per bushel price for soybeans times each output level.

The maximum profit level can be analyzed by subtracting total cost from total revenue.

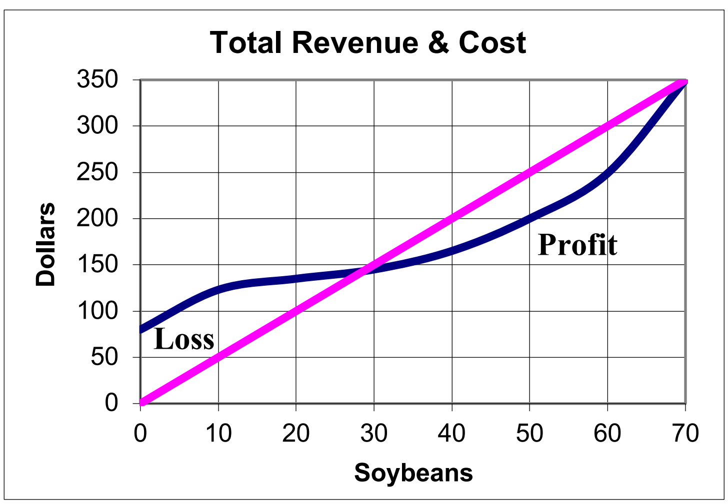
Profit = TR - TC

The example for the profit at 0 level of production is: 0 – 80 = -80

This $-80 per acre is a loss for not producing. The soybean farm has no revenue, but still has fixed expenses. The following table represents profit for each level of output.

Quantity (Q)	Total Cost (TC) $	Total Revenue (TR) $	Profit $
0	80	0	-80
10	123	50	-73
20	135	100	-35
30	145	150	-5
40	165	200	35
50	200	250	50
60	249	300	51
70	350	350	0

So maximum profit is achieved at sixty bushels of production, which yields $51 dollars per acre in profits. This may not make sense, because it may seem the more you produce, the more you make. However, there comes a point where the additional cost becomes greater than the added revenue. This relationship, along with a breakeven is easier to see by graphing the total revenue and cost relationships.



Soybean Q	TC	TR	Profit
0	80	0	-80
10	123	50	-73
20	135	100	-35
30	145	150	-5
40	165	200	-35
50	200	250	50
60	249	300	51
70	350	350	0

The quantity is represented on the horizontal axis, while dollars are on the vertical axis. A sixty-bushel yield represents the highest profit. On the graph, this area is the point where the TR is the greatest distance and above the total cost. The graph also shows a break even, where TR equals TC. This occurs just after 30 bushels of production. To analyze the optimal output even further, we can apply marginal analysis.

B. Analyzing Marginal Revenue and Cost

Again, marginal refers to the "change in." This type of analysis measures the value for every decision level of output. We are now looking at dollars, so the marginal analysis will look into the change in total revenue and total cost from changing production levels. We will consider marginal cost and marginal revenue using the original information for quantity, total revenue, and total cost.

Quantity (Q)	Total Cost (TC) $	Total Revenue (TR) $
0	80	0
10	123	50
20	135	100
30	145	150
40	165	200
50	200	250
60	249	300
70	350	350

Marginal Cost is the cost associated with producing an additional output level. This looks at the change in total cost resulting from a change in production.

Marginal Cost = <u>New TC – Previous TC</u>
Change in Level of Output

The change in cost from increasing the production from 0 to 10 bushels is $80 to $123. Applying these to the formula gives a marginal cost of:

MC = (123 – 80) / (10 – 0)
= 4.3

MC = 4.3 means that there is a $4.30 increase <u>per bushel</u> in cost from increasing production from the 0 level (no production) to the 10 bushels per acre level.

Another example of MC is moving from 50 to 60 bushels of yield. This increase in production has a marginal cost of:

MC = (249 – 200) / 60 – 50)
= 4.9

MC = 4.9 means that there is a $4.90 increase per bushel in cost moving from 50 to 60 bushels of soybeans.

The following chart shows the remaining MC values:

Quantity	Total Cost	Marginal Cost

(Q)	(TC) $	(MC) $
0	80	-
10	123	4.30
20	135	1.20
30	145	1.00
40	165	2.00
50	200	3.50
60	249	4.90
70	350	10.10

These costs are on a per bushel basis. So each marginal cost is the per bushel change in cost from increasing soybean production. However, to analyze the optimal output we must look into the revenue created from a change in outputs.

Marginal Revenue (MR) looks at the value of production for additional units produced. However, for the example this is the value per bushel of the output. So assuming the price of soybeans is $5.00 per bushel, the MR will be a constant at $5.

To find the optimal input level using marginal analysis we wish to equate the MC = MR. This gives us the most production, while maintaining a greater benefit (MR) than cost (MC).

Quantity (Q)	Total Cost (TC) $	Marginal Cost (MC) $	Marginal Revenue (MR) $
0	80	XIX	5.00
10	123	4.30	5.00
20	135	1.20	5.00
30	145	1.00	5.00
40	165	2.00	5.00
50	200	3.50	5.00
60	249	4.90	5.00
70	350	10.10	5.00

Where marginal revenue equals marginal cost (MR = MC), the producer has reached the highest level of production possible to achieve the highest profit. This is similar to a producer deciding what level of inputs maximizes profits. However, now we are looking into how much production will maximize profits.

The table illustrates maximum profit occurs at 60 bushels production (MC = 4.9, MR = 5.0). The previous section of determining profits using total revenue and cost also targeted 60 bushels as the optimal level of production.

However, MR and MC analysis also show the changes in values from changing production. What would be the consequence from changing 60 to 70 bushels of production? Marginal analysis shows that the MC highly exceeds the MR, so it is not a good decision. Therefore, both methods result in the same decision, but illustrate it in a different manner. The marginal analysis also exhibits that MR slightly exceeds MC (4.9 – 5.0), so actually there is still a slight amount of additional profit after 60 bushels, but it is before 70 bushels.

Production is not always at a profitable level. Many producers in agriculture face highs and lows for efficiency, and therefore have years that result in losses. In years of a loss, understanding the cost of producing is important to make the best decision possible