GRAHAME STEVEN

Management Accounting – Decision Management

You don't have to use algebra or calculus to apply profit maximisation in paper P2, but a grasp of algebra will enhance your understanding of this technique.

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It's essential to appreciate that a business can use the profit maximising technique only when it's operating in an imperfect market – ie, one in which it can set the prices for its products. Even then, the method can be readily applied only in situations where the business has a stable cost structure with clearly defined fixed and variable costs.

Let's use a fictional firm called Cutting Edge (CE) to see how profit maximisation can be used. CE develops innovative high-tech products, brings them to market and then sells the rights of successful products to other companies. Although CE owns some production facilities, it uses other manufacturers if it doesn't have the in-house capability for a particular product. It tends to operate in imperfect markets, since most of its products have little or no competition in their initial stages and it sells any successful products on before a perfect market is created. Consequently, CE is in a position to use profit maximisation.

It is preparing to launch Digimension, a handheld device that measures the dimensions of objects using laser technology. Another company will manufacture this product.

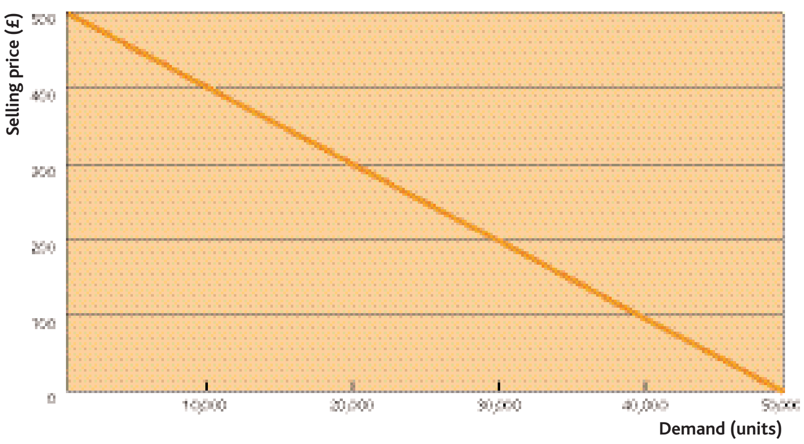
The following information was obtained for Digimension:

- Variable cost: £200 per unit.
- Fixed cost: £800,000 a year.
- Maximum demand: 50,000 units a year.
- Market data: each £1 movement in the selling price will increase or decrease demand by 100 units.

The first step is to determine the relationship between price and demand for Digimension from the market data. The key figures are maximum price and maximum demand, since a linear relationship is assumed to exist between price and demand.

The maximum demand will occur when the selling price is zero. The maximum price will produce a demand of zero units. The maximum price is simple to calculate from the information obtained, since it is the maximum demand (50,000 units) divided by the change in demand (100 units) for each £1 movement in the selling price – ie, £500. The graph in panel 1 illustrates the downward-sloping relationship between price and demand.

PANEL 1 DEMAND CURVE FOR DIGIMENSION



The next step is to determine the price and demand functions. The price function indicates the price that will be generated by particular levels of demand. While the maximum price (£500) has been determined, it's necessary to calculate the price movement that will change the demand by one unit. Since a £1 movement will change the demand by 100 units, a £0.01 movement will change demand by one unit. The price function for Digimension is, therefore, $p = 500 - 0.01d$ where p represents the price and d represents the demand. Any figure for demand will produce a point on the curve in panel 1

P2 Recommended reading

C Wilks, *Management Accounting – Decision Management Study System*, 2005 edition, CIMA Publishing, 2004.
C Drury, *Management and Cost Accounting*, International Thomson Business Press, 2000.
C Horngren, A Bhimani, G Foster and S Datar, *Management and Cost Accounting*, Financial Times/Prentice Hall, 2002.

using this equation. For example, a price of £250 will produce demand of 25,000 units.

The demand function indicates the demand that will be generated by a particular price. It can be readily determined from the price function, since it's expressed in terms of d instead of p:
p = 500 – 0.01d
Add 0.01d and – p to both sides of the equation and you get:
0.01d = 500 – p
Multiply both sides of the equation by 100 and you get:
d = 50,000 – 100p

Profits are maximised, in economic theory, when the marginal cost equals the marginal revenue. Although the variable cost (£200 per device) represents the marginal cost for Digimension, there is no figure available for marginal revenue, since this sum doesn't remain constant. As a result, it's necessary to derive an equation for marginal revenue. The first step for obtaining this equation is to determine the total revenue function – ie, the price multiplied by quantity. Since price is represented by the price function (500 – 0.01d) and quantity by d, this function is calculated as follows:
Total revenue = (500 – 0.01d)d = 500d – $0.01d^2$

Panel 2 portrays the total revenue that will be earned across Digimension's downward-sloping demand curve. The total sales revenue is zero at two points, since maximum demand (50,000 units) occurs when the price is zero, and zero demand occurs when the price is at the maximum (£500). Total revenue is maximised halfway along the demand curve – ie, at a price of £250. But profit will not normally be maximised at this point.

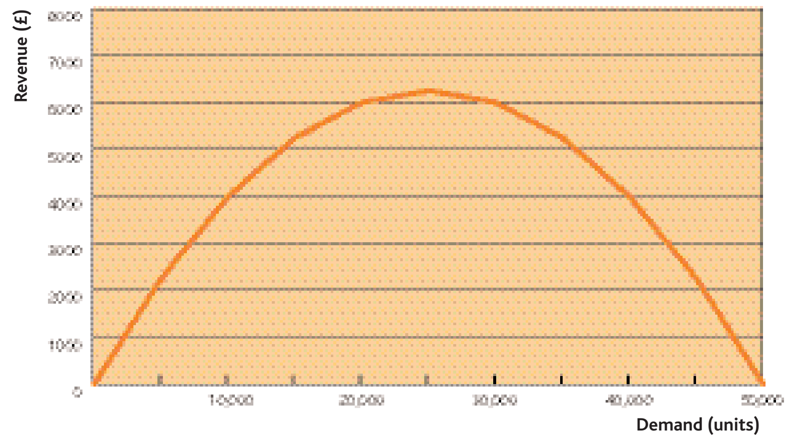
It is now possible to calculate the marginal revenue function by differentiating the total revenue function. Don't panic – the rules are simple. You don't need to prove them; you only have to know how to do it. How is it done? Multiply the coefficient (the number in front of d) by the power, then reduce the power by 1. To differentiate the total revenue function, multiply 500 by 1 and reduce the power of d by 1 to d^0, and then multiply 0.01 by 2 and reduce the power of d by 1 to d^1. This will produce the following equation:
Marginal revenue = 500 – 0.02d

Don't forget that any number expressed to the power of 0 is always 1, while d^1 is, by convention, expressed as d.

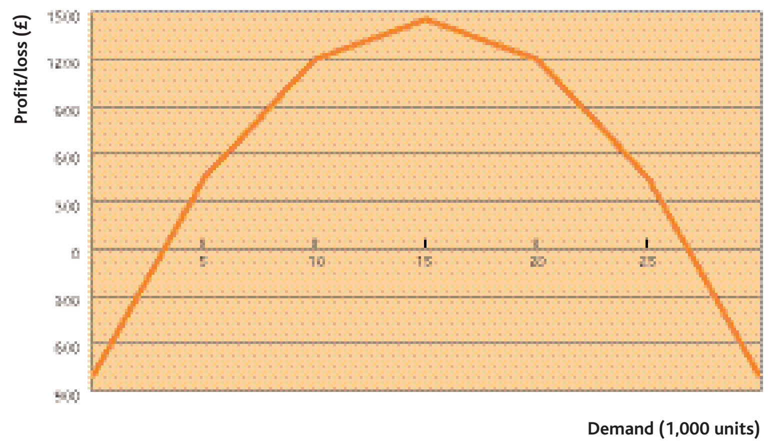
It is now possible to calculate the profit-maximising price, since profits are maximised when the marginal cost (£200) equals the marginal revenue (500 – 0.02d). The first step is to calculate the profit-maximising demand:
200 = 500 – 0.02d
300 = 0.02d
d = 15,000

The next step is to calculate the profit-maximising price. This is achieved by inserting the profit-maximising demand into the price function:
p = £500 – 0.01d
p = £500 – (0.01 x 15,000)
p = £350

PANEL 2 TOTAL SALES REVENUE FOR DIGIMENSION



PANEL 3 TOTAL PROFIT/LOSS FOR DIGIMENSION



This selling price will produce a profit of £1,450,000 – that is, [15,000 x (£350 – £200)] – £800,000. Any other price, as demonstrated in panel 3, will produce a lower profit.

Profit maximisation enables the setting of prices that will maximise profits in an imperfect market. It is dependent on good market data to establish the relationship between price and demand. It also assumes that this relationship is linear, which may not always be the case. It's also likely that the price-demand relationship will change constantly, since it's based on people's views. Profit maximisation also requires stable cost structures across a wide range of activity. It must, therefore, be used with care. Understanding, as always, is the key. FM

Note from the examiner: as stated at the start of this article, calculus does not appear in the P2 syllabus. When required in exam questions, an explanatory note will be included – eg, "NB: If selling price (p) = a – bx, then marginal revenue = a – 2bx."

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