

Part 2

Decision making

Managers need relevant information to help them make decisions and manage the decision-making process. For any particular decision there will be some costs that are relevant and others that are not relevant. The management accountant separates the relevant from the non-relevant and presents the information in a way that helps the manager see the expected consequences of a decision. Part 2 explains how management accounting helps answer questions of the following type:

- Can we make a profit from this new business proposal?
- What is the lowest price that we should charge for the service provided by our business?
- Should we close down an activity that appears to be making losses?
- What are the costs and benefits of investing in a new production process?
- Will the proposed investment in fixed assets earn a return that is higher than the cost of capital?
- If finance is scarce, which investment proposal will be our first choice?

Chapter 9 introduces the basic methods of break-even analysis for short-term decision making. This allows you to calculate the contribution to fixed cost and profit, find the break-even point and apply these techniques to examples of short-term decisions. Chapter 10 explains relevant costs in more detail, describes how pricing decisions are related to costs and explains how uncertainty is introduced into calculations for decision making. Chapter 11 moves into long-term decisions by explaining the basic methods of investment appraisal for capital budgeting. Chapter 12 applies these methods in illustrating applications of capital budgeting.

Part 2 DECISION MAKING		
LEVEL 1	Chapter 9 Short-term decision making	Chapter 11 Capital investment appraisal
LEVEL 2	Chapter 10 Relevant costs, pricing and decisions under uncertainty	Chapter 12 Capital budgeting applications

Chapter 9

Short-term decision making

Real world case 9.1

This case study shows a typical situation in which management accounting can be helpful. Read the case study now but only attempt the discussion points after you have finished studying the chapter.

Flying Brands is a company which delivers goods to customers. The business began some years ago by flying flowers from the Channel Islands to the UK mainland.

The Group has continued to drive profits forward with profit before tax up by 24 per cent, and profit before tax and before all exceptional items up by 10 per cent. The business is focused on profitable growth, and although sales in 2003 showed a fall on 2002 of 3 per cent, the temptation to chase marginal customers was resisted, and a greater emphasis was placed on increasing customer spend and improving operational efficiency. This is reflected in the contribution margin for the two main brands improving to 35 per cent compared to 32 per cent in 2002 . . .

Overheads increased during the year by 5 per cent, slightly above inflation, as the marketing team was considerably strengthened. Corporate overheads comprise the costs of the chief executive, the finance director, the non-executive directors and the legal, professional and other fees connected with the running of a public company . . . By driving increasing volumes of orders through our existing operations, we will see economies of scale and substantially improved recovery of fixed overheads.

Source: Flying Brands Limited, Annual Report 2004, pp. 10 and 11. www.fagl.co.uk, www.flyingflowers.com/.



Discussion points

- 1 How did the company improve its contribution to fixed overheads and profit?
- 2 What was the alternative strategy for improving contribution which the company rejected?

Contents

9.1	Introduction	208
9.2	Cost behaviour: fixed and variable costs	208
9.2.1	The economist's view	209
9.2.2	The accountant's view	210
9.2.3	Contribution analysis	213
9.3	Break-even analysis	213
9.3.1	Calculating the break-even point	213
9.3.2	Break-even chart	214
9.3.3	Profit–volume chart	215
9.4	Using break-even analysis	216
9.4.1	Covering fixed costs and making a profit	217
9.4.2	Beyond the break-even point	217
9.4.3	Margin of safety	218
9.4.4	Change in selling price	218
9.4.5	Change in variable cost	218
9.4.6	Change in fixed costs	219
9.4.7	More than one product	219
9.5	Limitations of break-even analysis	219
9.6	Applications of cost–volume–profit analysis	220
9.6.1	Special order to use up spare capacity	220
9.6.2	Abandonment of a line of business	220
9.6.3	Existence of a limiting factor	221
9.6.4	In-house activity versus bought-in contract	221
9.7	Cases in short-term decision making	222
9.7.1	Decisions on special orders	222
9.7.2	Abandonment decisions	223
9.7.3	Existence of limiting factors	224
9.7.4	Make or buy	225
9.7.5	In-house activity compared to bought-in services	226
9.8	Estimating fixed and variable costs	227
9.8.1	High-low method	227
9.8.2	Line of best fit	228
9.9	What the researchers have found	228
9.9.1	Contribution in practice	228
9.9.2	Economics and accounting: views of contribution analysis	229
9.10	Summary	229

Learning outcomes

After reading this chapter you should be able to:

- Explain how the accountant's view of cost behaviour differs from that of the economist.
- Define and calculate contribution and breakeven point, and prepare a breakeven chart and a profit–volume chart.
- Use breakeven analysis to explore the effect of changing unit selling price, unit variable cost or fixed cost.
- Explain the limitations of breakeven analysis.
- Explain applications of cost–volume–profit analysis.
- Show how calculation of contribution can be applied in short-term decision making.
- Describe and discuss examples of research into the use of information about contribution.

9.1 Introduction

In Chapter 1 the role of management accounting was explained in terms of directing attention, keeping the score and solving problems. This chapter turns to the problem-solving aspect of the management accountant's work and in particular to the use of management accounting information to help with decisions in the short term (where the short term is typically a period of weeks or months, extending to 12 months at the most, in which some costs are fixed and others are variable, depending on the level of activity). Chapters 11 and 12 explain the use of management accounting in making decisions about the longer term.

Activity 9.1

The classification of costs was explained at length in Chapter 2. If you have any doubts about that chapter, go back and work through it again. It is essential that you understand Chapter 2 before you attempt this chapter.

This chapter will first explain how costs and revenues behave in the short term as the volume of activity changes. This is called cost–volume–profit analysis. It makes use of graphs which will help you understand and present to others the analysis of costs, revenues and profits. The chapter explains the calculation of contribution and shows how it is used to identify the break-even point of neither profit nor loss.

The chapter will then show how the distinction between variable cost and fixed cost may be used in short-term decision making in situations of special orders, abandonment of a product line, and the existence of limiting factors. Finally, in a set of short case studies, you will see that each problem, while using the same principles of cost–volume–profit analysis, requires some adaptability in using the analysis in the specific circumstances.

9.2 Cost behaviour: fixed and variable costs

Chapter 2 explained that cost classification systems are as varied as the businesses they serve. Types of cost classification system were identified in that chapter by reference to questions which needed answers. Chapter 2 also provided definitions of variable cost and fixed cost, while Figures 2.1, 2.2 and 2.3 showed different types of cost behaviour as activity increased.

Definitions

A **variable cost** is one which varies directly with changes in the level of activity, over a defined period of time.

A **fixed cost** is one which is not affected by changes in the level of activity, over a defined period of time.

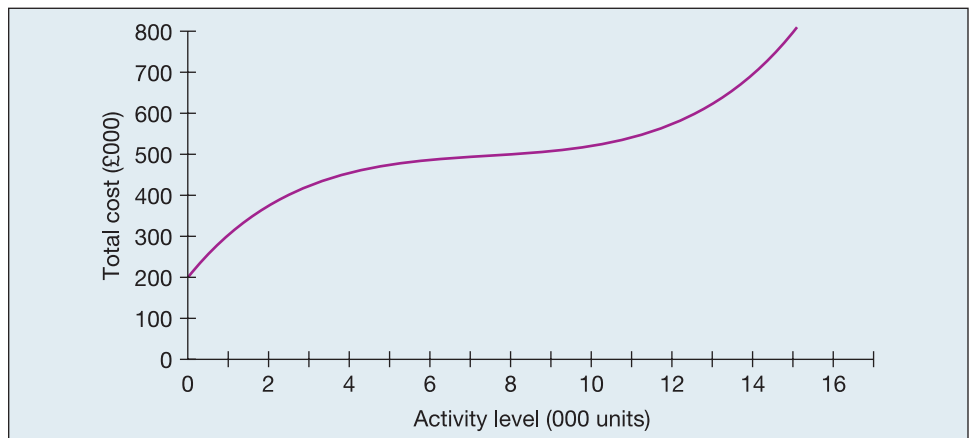
This chapter now moves on from that starting point outlined in Chapter 2 to ask more questions about the relationships between cost, volume of output and profit.

There are two ways of viewing the behaviour of cost in relation to activity level. One is referred to as *the economist's view* and the other is referred to as *the accountant's view*. Each is discussed here, and the use of the accountant's view is then justified as a reasonable short-term approximation.

9.2.1 The economist's view

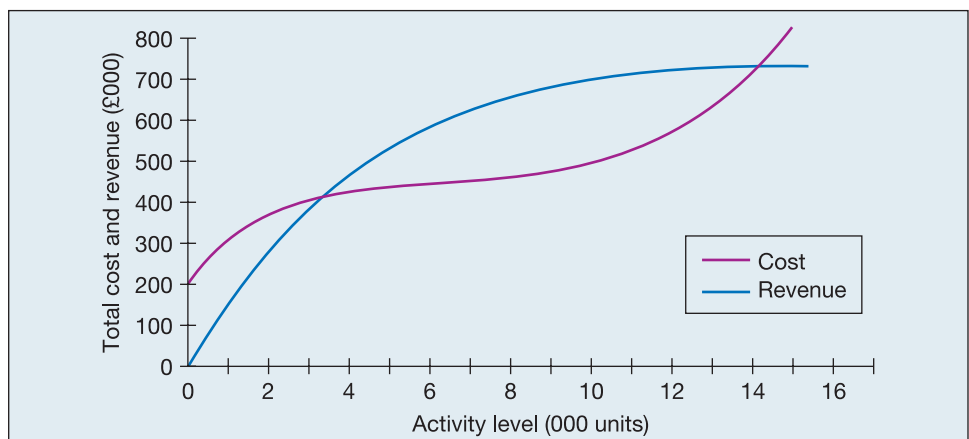
Figure 9.1 shows total cost related to activity level over a wide range of activity within a business. Starting at zero activity, there is a total cost of £200,000 shown representing the fixed cost of the operations, including items such as rent of premises, business rates, administration salaries and any similar costs incurred to allow operations to commence. Initially, the slope of the graph rises relatively steeply because high levels of costs are incurred as activity begins. Then the slope becomes less steep as the business begins to enjoy the economies of scale, sharing fixed costs over a wider range of activity so that the marginal cost of producing an extra item becomes progressively less. At the extreme right-hand side of the graph the slope begins to rise more steeply again as further fixed costs are incurred. Perhaps high rental has to be paid for new premises at this point to allow expansion, or labour resources become more scarce and higher labour rates have to be paid to employ staff.

Figure 9.1
Total cost varying with activity



To calculate profit, a business must compare its cost with its revenue. The economist's portrayal of revenue is superimposed on the cost line in Figure 9.2. The total revenue starts at zero when there is zero activity. It rises rapidly when supply begins and customers are willing to pay relatively high prices for the goods. Then, as

Figure 9.2
Revenue and costs: the economist's view



supply increases, the marginal selling price of each item decreases progressively as it becomes more difficult to sell larger volumes of output. Where the total revenue line is below the total cost line the business is making a loss, and where the total revenue line is above the total cost line the business is making a profit. The business represented by the graph in Figure 9.2 shows losses at the left-hand and right-hand sides of the diagram and a profit in the centre. Successful businesses aim to stay in the profit-making region.

9.2.2 The accountant's view

The economist's view of costs covers a very wide range of output. In any particular period, especially in the short term, the actual range of output will be relatively narrow. Looking at Figure 9.2, the lines close to the break-even point are close to being straight lines over a narrow range either side. Accounting assumes that at any point in time this relatively narrow range is available in practice and so the cost and revenue curves are approximately straight lines.

The data in Table 9.1 is used in this section to illustrate the accountant's view of how costs change with levels of activity.

Table 9.1
Table of data showing variable and fixed costs

Activity level	0 units	100 units	200 units	300 units
	£	£	£	£
Variable cost	0	10	20	30
Fixed cost	20	20	20	20
Total cost	20	30	40	50

The graph in Figure 9.2 represents activity level changes which could take some time to achieve as the business grows. The accountant takes a much shorter time perspective and looks at a relatively limited range of activity that might be achieved within that time period. In those circumstances, it may be reasonable to use straight-line graphs rather than curves, although great care is needed before assuming it is safe to use straight lines.

Using the data of Table 9.1, a graph of variable cost is shown in Figure 9.3 and a graph of fixed cost is shown in Figure 9.4.

Figure 9.3
Variable cost

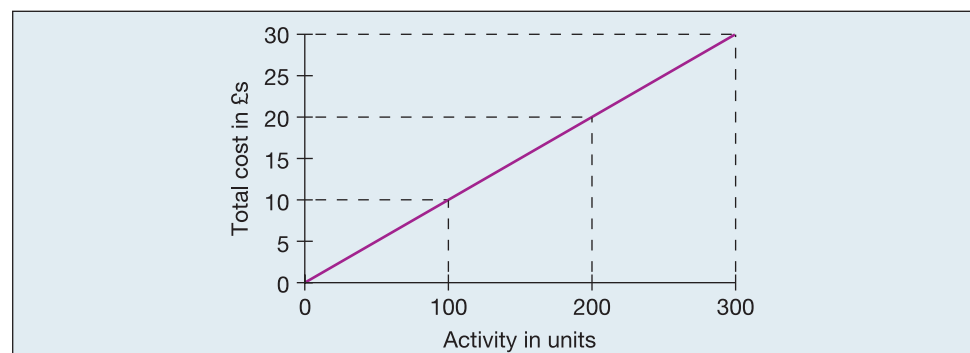
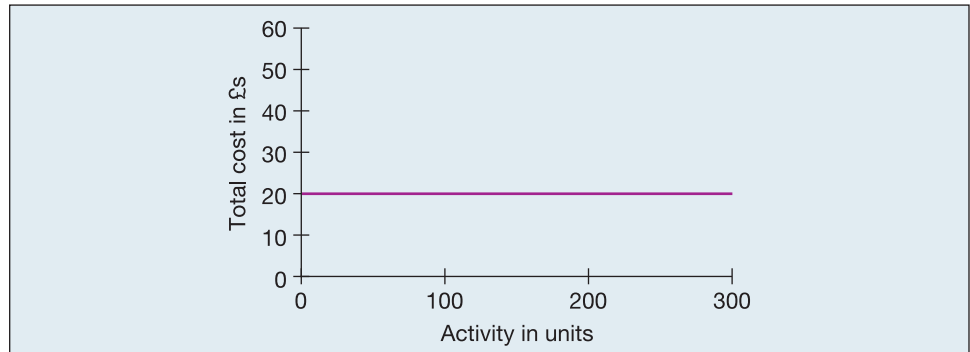
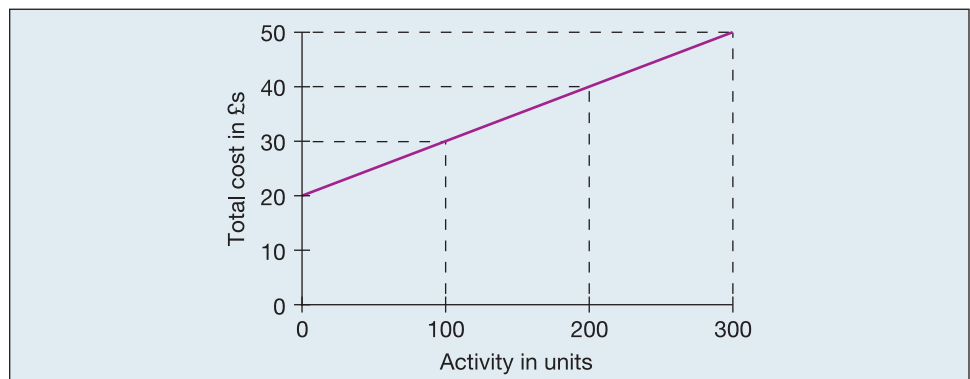


Figure 9.4
Fixed cost



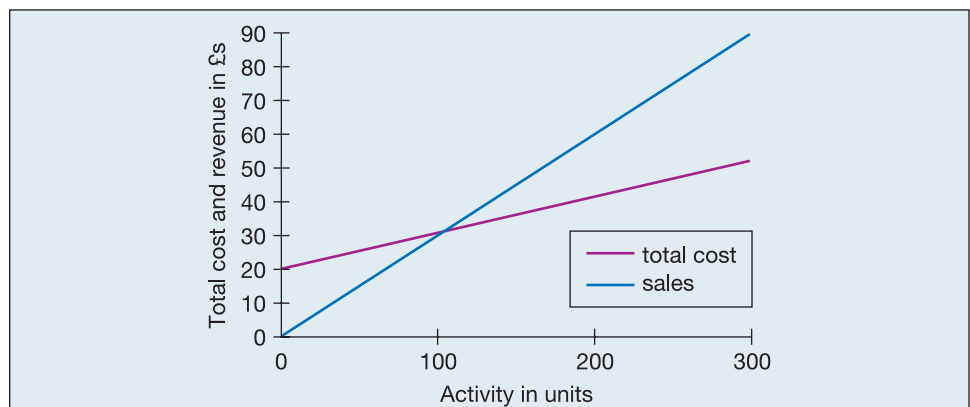
In Figure 9.5, these two graphs are added together to give a graph of total cost. The total cost starts at £20 and increases by £10 for every 100 units of activity. The total cost line meets the vertical axis at the fixed cost amount of £20. The slope of the total cost line gives a picture of how fast the variable costs are rising as activity level increases.

Figure 9.5
Total cost



The profit of the business is measured by comparing costs with revenues. Here again, the accountant takes the view that it may be reasonable, over a short time-scale and relatively limited range of activity, to use a straight line. In Figure 9.6, a sales line

Figure 9.6
Total cost and total sales



is added based on a selling price of 30 pence per unit, so that total sales are £30 for 100 units, £60 for 200 units and £90 for 300 units.

The sales line is below the cost line at the left-hand side of the graph, crossing the cost line when the activity is 100 units. This shows that for activity levels below 100 units the business will make a loss. At 100 units of activity the business makes neither profit nor loss. This is called the **break-even point**. Beyond 100 units of activity the business makes a profit and the amount of profit is measured by the vertical difference between the sales and cost lines.

Definition

The **break-even point** is that point of activity (measured as sales volume) where total sales and total cost are equal, so that there is neither profit nor loss.

The graph shown in Figure 9.6 is more commonly called a **break-even chart**. It shows the activity level at which total costs equal total sales and at which the business makes neither a profit nor a loss. It also shows what happens to costs and revenues on either side of this breakeven point. If activity falls below the break-even level, then the amount of loss will be measured by the vertical distance between the cost and sales line.

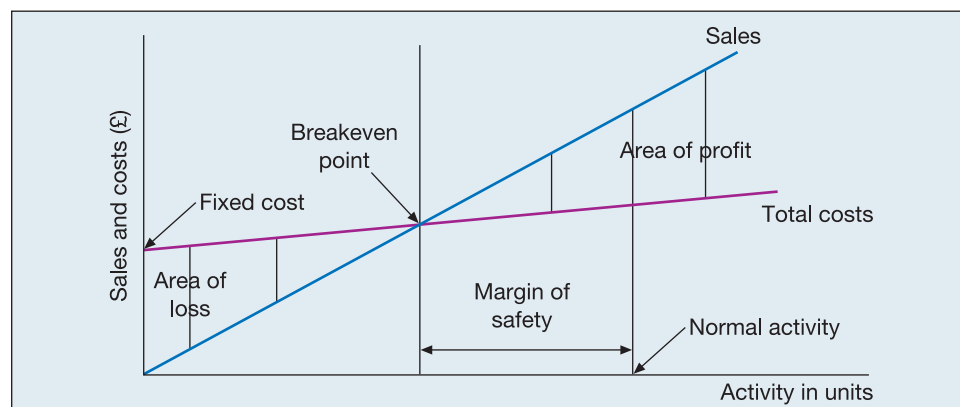
If activity rises above the break-even level, then the amount of profit will be measured by the vertical distance between the sales and cost line. If the business is operating at an activity level higher than the break-even point, the distance between these two points is called the **margin of safety**. This indicates how much activity has to fall from its present level before profit becomes zero.

Definition

The **margin of safety** is the difference between the break-even sales and the normal level of sales (measured in units or in £s of sales).

Figure 9.7 summarises the various features of a break-even chart. The use of a chart of this type to depict the behaviour of costs and sales over a range of activity in the short term has been found extremely helpful in presenting management accounting information to non-financial managers who are involved in making decisions which have financial consequences.

Figure 9.7
The features of a break-even chart



9.2.3 Contribution analysis

Contribution analysis is based on the idea that in the short term it is possible to survive in business providing sales revenue covers variable cost. The **contribution per unit** from a product is the amount by which its selling price exceeds its variable cost. The excess of selling price over variable cost makes a contribution to covering fixed costs and then making a profit. In the short term it may be worth continuing in business if the selling price is greater than variable cost, so that there is a contribution to fixed costs, even where some part of the fixed costs is not covered. In the long term, it is essential to earn sufficient sales revenue to cover *all* costs.

Definition

Contribution per unit is the selling price per unit minus the variable cost per unit. It measures the contribution made by each item of output to the fixed costs and profit of the organisation.

9.3 Break-even analysis

Break-even analysis is a technique of management accounting which is based on calculating the break-even point and analysing the consequences of changes in various factors calculating the break-even point. The idea of contribution is central to break-even analysis in evaluating the effects of various short-term decisions.

This section explains ways of finding the break-even point. It uses the information in Exhibit 9.1 to compare different approaches.

Exhibit 9.1

Illustration: market trader

A market trader rents a stall at a fixed price of £200 for a day and sells souvenirs. These cost the trader 50 pence each to buy and have a selling price of 90 pence each. How many souvenirs must be sold to break even?

Activity 9.2

Hopefully, you will find the case study so easy to solve that you will already have computed the answer. If so, then analyse how you arrived at the answer before you read the next paragraphs and compare your method with the descriptions given there. It is always better to work out a method for yourself, if it is a good one, than to try remembering something from a book.

9.3.1 Calculating the break-even point

Calculating contribution

The contribution from a product is the amount by which its selling price exceeds its variable cost. The idea of contribution is central to break-even analysis in evaluating the effects of various decisions.

Once the contribution per unit is known it can be compared with the fixed costs. The business does not begin to make a profit until the fixed costs are covered, so the formula is applied as:

Break-even point	equals	$\frac{\text{Fixed costs}}{\text{Contribution per unit}}$
------------------	--------	---

Taking the data from the illustration in Exhibit 9.1, the contribution is 40 pence per souvenir (selling price 90 pence minus variable cost 50 pence) and the fixed costs are £200:

$$\text{Break-even point} = \frac{200}{0.40} = 500 \text{ units}$$

Algebraic method

It is possible to use simple algebra to calculate the break-even point, but only if you prefer mathematical methods of solving a problem.

The equation for the break-even point is:

Sales	equals	Fixed costs + Variable costs
-------	--------	------------------------------

If the number of souvenirs sold at the break-even point is n , then the total sales revenue is $0.9n$ and the total variable cost is $0.5n$:

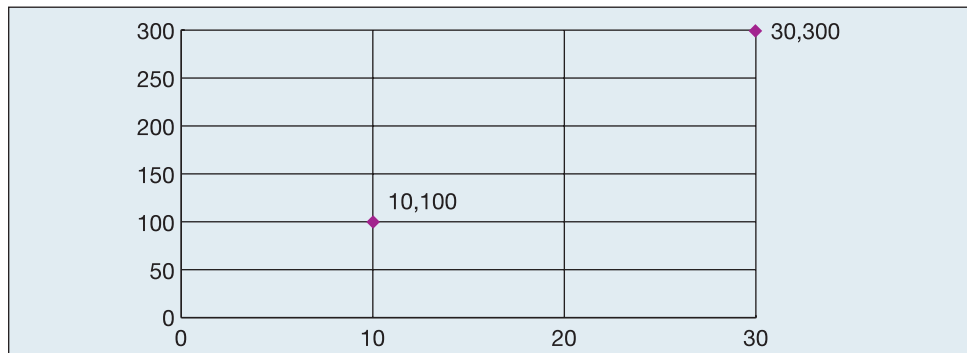
$$\begin{aligned} 0.9n &= 200 + 0.5n \\ 0.4n &= 200 \end{aligned}$$

Solving the equation, $n = 500$ souvenirs to be sold to break even.

9.3.2 Break-even chart

The general appearance of a break-even chart has already been shown in Figure 9.7. To plot the graph some points on each line are necessary. Because they are all straight lines only two points are needed, together with a ruler and pencil to join them. Points on a graph may be defined by specifying two co-ordinates in the form (x, y) . A point defined as $(10, 100)$ means that it lies at the intersection of a line up from 10 on the horizontal (x) axis and a line across from 100 on the vertical (y) axis. In Figure 9.8, two points are plotted, namely, $(10, 100)$ and $(30, 300)$. These may then be joined by a straight line.

Figure 9.8
Plotting points for a graph



The graph needs to cover an activity scale wide enough to show both sides of the break-even point, so it is a useful idea to work round the break-even point by choosing one point which is loss making and one point which is profit making. The point of zero activity will usually be loss making because there is nil revenue but there are fixed costs. So the start of the sales line can be plotted at $(0, 0)$ and the start of the cost line

at (0, £200). For a position of profit, the sales and total cost must be calculated for a higher activity level, which in this case might be 900 souvenirs:

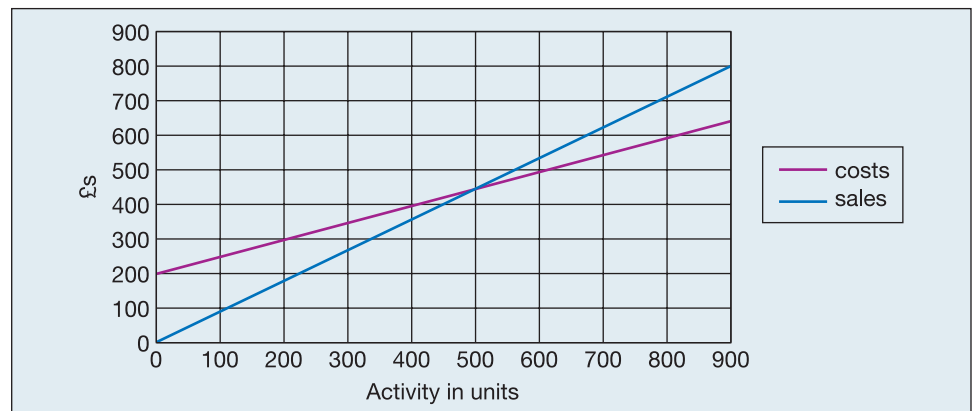
Sales of 900 souvenirs at 90 pence each = £810

The sales line will therefore join the points (0, £0) and (900, £810):

	£
Variable cost of 900 souvenirs at 50 pence each	= 450
Fixed cost	= <u>200</u>
Total cost	<u>650</u>

The total cost line joins (0, £200) and (900, £650). Figure 9.9 shows the break-even chart with a breakeven point at 500 units sold. Gridlines are added to show the points plotted.

Figure 9.9
Break-even chart



9.3.3 Profit-volume chart

Defining the profit-volume ratio

Profit is an important aspect of most management accounting reports. However, the break-even chart does not show directly the amount of profit. It has to be estimated by measuring the vertical distance between the sales and total cost lines. There is another form of graph used in management accounting called a **profit-volume chart**. The horizontal axis plots the volume, measured by activity level in £s of sales, and the vertical axis plots the profit at that activity level.

The activity level is measured in £s of sales in order that the slope of the graph matches the profit/volume ratio, a slightly confusing name for the ratio which calculates contribution as a percentage of sales value:

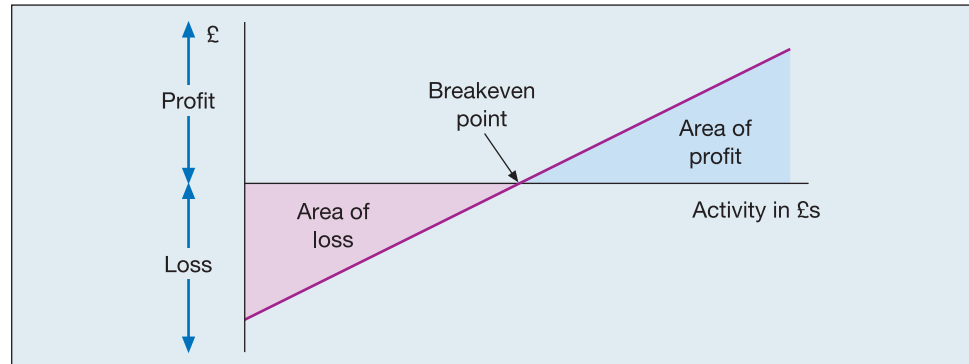
Profit/volume ratio	equals	$\frac{\text{Contribution per unit}}{\text{Selling price per unit}} \times 100$
---------------------	--------	---

Figure 9.10 sets out a diagram showing the main features of a profit-volume chart.

Illustration of a profit-volume chart

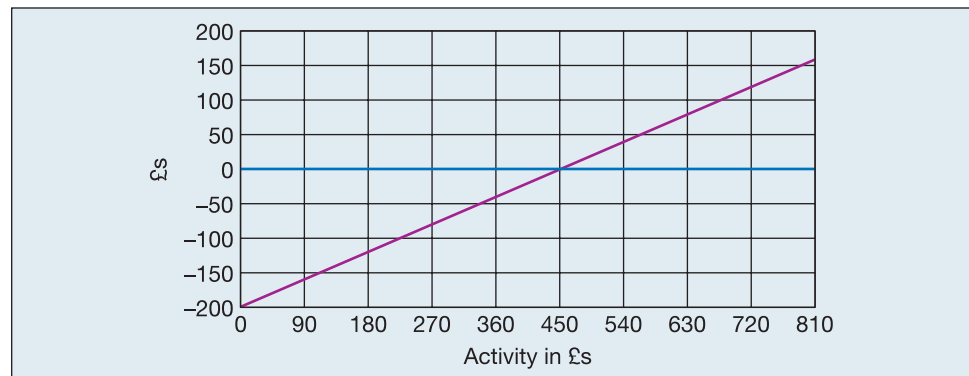
Taking the data used in preparing Figure 9.9, the preparation of a profit-volume chart requires only the profit line to be drawn. When sales are zero, there will be a loss equal to the fixed cost, which gives the first point to plot at (£0, £-200). When 900 units are

Figure 9.10
Profit-volume chart



sold the sales are £810 and the profit is £160, giving the second point to plot at (£810, £160). The result is shown in Figure 9.11.

Figure 9.11
Profit-volume chart using data from the 'market trader' case study



The gridlines are included to show where the profit line has been plotted. The break-even point of zero profit or loss is at a sales level of £450. The graph rises by £40 of profit for every £90 increase in sales activity, giving a slope of 44.4 per cent.

The profit-volume ratio is calculated by formula as:

$$\frac{\text{Contribution per unit}}{\text{Sales price per unit}} = \frac{40 \text{ pence}}{90 \text{ pence}} = 44.4\%$$

9.4 Using break-even analysis

Break-even analysis is a very useful tool. It may be used to answer questions of the following type:

- What level of sales is necessary to cover fixed costs and make a specified profit?
- What is the effect of contribution per unit beyond the break-even point?
- What happens to the break-even point when the selling price of one unit changes?
- What happens to the break-even point when the variable cost per unit changes?
- What happens to the break-even point when the fixed costs change?

Each of these questions is now dealt with in this section by an illustration and an explanation following the illustration.

9.4.1 Covering fixed costs and making a profit

To find the level of sales necessary to cover fixed costs and make a specified profit requires a knowledge of selling price per unit, variable cost per unit, and the fixed costs together with the desired profit. These are set out in the data table.

<i>Data</i>	
Selling price per unit	80 pence
Variable cost per unit	30 pence
Fixed cost	£300
Desired level of profit	£400

The contribution per unit is 50 pence (80 pence – 30 pence). To find the break-even point, the fixed costs of £300 are divided by the contribution per unit to obtain a break-even point of 600 units.

To meet fixed costs of £300 and desired profit of £400 requires the contribution to cover £700 in all. This is achieved by selling 1,400 units.

$$\text{Volume of sales required} = \frac{700}{0.5} = 1,400 \text{ units}$$

Activity 9.3

Check that 1,400 units at a contribution of 50 pence each gives a total contribution of £700. It is always a useful precaution to check the arithmetic of a calculation as a safeguard against carelessness.

9.4.2 Beyond the break-even point

Beyond the break-even point the fixed costs are covered and the sales of further units are making a contribution to profit. The higher the contribution per unit, the greater the profit from any particular level of activity. The data table sets out some information on selling prices, variable costs and fixed costs of two products.

Data

A dry-cleaning shop takes two types of clothing. Jackets cost £6 to clean and the customer is charged £9 per garment. Coats cost £10 to clean and the customer is charged £12 per garment. The monthly fixed costs are £600 for each type of garment (representing the rental costs of two different types of machine). The shop expects to clean 500 jackets and 500 coats each month.

Activity 9.4

Before reading the analysis of Table 9.2, calculate the contribution made by each product, work out the break-even point of each, and then explore the effect on the break-even point of:

- changes in the price charged to customers;*
- changes in the variable costs; and*
- changes in the fixed costs.*

If you have access to a spreadsheet package, this is the kind of problem for which spreadsheets are highly suitable.

The calculations set out in Table 9.2 show that, although both products have the same fixed costs, the jackets have a lower break-even point because they make a higher

Table 9.2
Calculation of break-even point and of sales beyond the break-even point

	<i>Jackets</i> £	<i>Coats</i> £
Selling price	9	12
Variable cost	<u>6</u>	<u>10</u>
Contribution per item	<u>3</u>	<u>2</u>
Fixed costs	£600	£600
Break-even point	200 units	300 units
Profit for sales of 500 units	900	400

contribution per unit. Beyond the break-even point they continue to contribute more per unit. The profits at any given level of activity are therefore higher for jackets.

9.4.3 Margin of safety

The **margin of safety** has been defined as the difference between the sales level at the break-even point and the normal level of sales (actual or forecast), measured in units or in dollars of sales. In the case of the dry-cleaning shop, the margin of safety for jackets is 300 jackets (500 – 200) when 500 jackets are cleaned each month. The margin of safety for coats is 200 coats (500 – 300) when 500 coats are cleaned each month. The margin of safety is interpreted by saying that cleaning of jackets may fall by 300 per month before the break-even point is reached but cleaning of coats will reach the break-even point after a reduction of only 200 in coats cleaned. Cleaning coats is therefore riskier than cleaning jackets, if expected output is compared to break-even volume.

The margin of safety can also be expressed as a percentage using the formula:

$$\frac{\text{Normal output} - \text{break-even volume}}{\text{Normal output}} \times 100\%$$

The *margin of safety percentage* is $300 \times 100/500 = 60\%$ for jackets and $200 \times 100/500 = 40\%$ for coats. The interpretation is that output has to fall by 60% from present levels for jackets before the break-even point is reached, but only by 40% for coats.

9.4.4 Change in selling price

If the selling price per unit increases and costs remain constant, then the contribution per unit will increase and the break-even volume will be lower. Take as an example the dry-cleaning business of the previous illustration. If the selling price of cleaning a coat rises to £15, then the contribution per unit will rise to £5. That will require cleaning only 120 coats to break even. The risk of raising the price is that customers may move elsewhere, so that while it may not be difficult to exceed the break-even point at a selling price of £12, it may be extremely difficult at a selling price of £15.

9.4.5 Change in variable cost

The effect of a change in variable cost is very similar to the effect of a change in selling price. If the variable cost per unit increases, then the contribution per unit will decrease, with the result that more items will have to be sold in order to reach the break-even point. If it is possible to reduce variable costs, then the contribution per unit will increase. The enterprise will reach the break-even point at a lower level of activity and will then be earning profits at a faster rate.

9.4.6 Change in fixed costs

If fixed costs increase, then more units have to be sold in order to reach the break-even point. Where the fixed costs of an operation are relatively high, there is a perception of greater risk because a cutback in activity for any reason is more likely to lead to a loss. Where an organisation has relatively low fixed costs, there may be less concern about margins of safety because the break-even point is correspondingly lower.

9.4.7 More than one product

Break-even analysis and break-even charts can only represent one type of product. If a business is producing and selling more than one item, then separate charts and analyses will be needed. However, if there is a fixed proportion of sales of different items, break-even analysis may be applied to a batch of goods in the specific proportion. A combined contribution is calculated for the batch of goods and then a combined break-even point is calculated.

Suppose a sweet manufacturer produces chocolate bars, boiled sweets and walnut whirls. Experience shows that orders from retailers are always in the proportions: 5 chocolate bars, 1 bag of boiled sweets and 2 walnut whirls. The contribution from a chocolate bar is 3 pence, the contribution from a bag of boiled sweets is 2 pence and the contribution from a walnut whirl is 4 pence. Fixed costs for one month are £1,000. What is the break-even point?

Calculation

Take a batch of goods in the fixed proportions 5:1:2.

The contribution of one batch is $(5 \times 3 \text{ pence}) + (1 \times 2 \text{ pence}) + (2 \times 4 \text{ pence}) = 25 \text{ pence}$.

The break-even point is calculated as fixed overhead/contribution per unit. This equals $\text{£}1,000/25 \text{ pence} = 4,000 \text{ batches}$.

To find the actual volume of production multiply the number of batches by the contents of each. So 4,000 batches contain 20,000 chocolate bars, 4,000 bags of boiled sweets and 8,000 walnut whips. These are the activity levels required in combination for break even.

9.5 Limitations of break-even analysis

Break-even analysis is a useful tool for problem solving and decision making, but some of the limitations should be noted:

- 1 The break-even analysis assumes that cost and revenue behaviour patterns are known and that the change in activity levels can be represented by a straight line.
- 2 It may not always be feasible to split costs neatly into variable and fixed categories. Some costs show mixed behaviour.
- 3 The break-even analysis assumes that fixed costs remain constant over the volume range under consideration. If that is not the case, then the graph of total costs will have a step in it where the fixed costs are expected to increase.
- 4 Break-even analysis, as described so far in this book, assumes input and output volumes are the same, so that there is no build-up of stocks and work-in-progress.
- 5 Break-even charts and simple analyses can only deal with one product at a time.
- 6 It is assumed that cost behaviour depends entirely on volume.

These limitations may be overcome by modifying the break-even analysis. However, that would involve considerably more computation work and is beyond the scope of this textbook.

9.6 Applications of cost-volume-profit analysis

Break-even analysis is a particular example of the more general technique of **cost-volume-profit analysis**. This analysis emphasises the relationship between sales revenue, costs and profit in the short term. In this context the short term is a period of time over which some costs are fixed, whatever the level of output, within a range limited by the existing capacity of the business. In the longer term, all costs become variable because the capacity of a business can be altered by acquiring new premises, hiring more employees or investing in more equipment.

Definition

Cost-volume-profit analysis evaluates the effects of forecast changes in sales, variable costs and fixed costs, to assist in decision making.

In using cost-volume-profit analysis, management accounting is meeting the needs of directing attention and solving problems. In the short term, decisions have to be made within the existing constraints of the capacity of the business and the aim of that decision making will be to maximise short-term profit. Typical decision-making situations requiring cost-volume-profit analysis would be:

- accepting a special order to use up spare capacity;
- abandoning a line of business;
- the existence of a limiting factor;
- carrying out an activity in-house rather than buying in a service under contract.

Each of these situations is now considered in turn.

Activity 9.5

Those who comment on the applications of cost-volume-profit analysis always emphasise that it is a short-run decision-making tool. Write a 200-word note explaining this view.

9.6.1 Special order to use up spare capacity

In the short term, a business must ensure that the revenue from each item of activity at least covers variable costs and makes a contribution to fixed costs. Once the fixed costs are covered by contribution, the greater the level of activity, the higher the profit. When the business reaches full capacity there will be a new element of fixed cost to consider should the business decide to increase its capacity. If there is no increase in capacity, then the business should concentrate on those activities producing the highest contribution per unit or per item.

But supposing the business is *not* operating at full capacity. Should it lower its sales price in an attempt to increase the volume of activity? The question may arise in the form of a request from a customer for a special price for a particular order. (Customers may well know that the business is not operating at full capacity and may therefore try to use their bargaining power to force a lower sales price.) Should the business accept the special order? Cost-volume-profit analysis gives the answer that the special order is acceptable provided the sales price per item covers the variable costs per item and provided there is no alternative use for the spare capacity which could result in a higher contribution per item.

9.6.2 Abandonment of a line of business

The management of a business may be concerned because one line of business appears not to be covering all its costs. This situation may arise particularly where costs are

being used for score-keeping purposes and all fixed costs have been allocated to products. As was shown in Chapter 4, the allocation of fixed costs to products is a process which allows a range of choices, which may lead to confusion. However, the allocation of fixed costs is not relevant to decision making because the fixed costs are incurred irrespective of whether any business activity takes place.

When a line of business comes under scrutiny for its profitability, cost–volume–profit analysis shows that in the short term it is worth continuing with the line if it makes a contribution to fixed costs. If the line of business is abandoned and nothing better takes its place, then a worse situation results because that contribution is lost but the fixed costs run on regardless.

9.6.3 Existence of a limiting factor

In the short term, it may be that one of the inputs to a business activity is restricted in its availability. There may be a shortage of raw materials or a limited supply of skilled labour. There may be a delivery delay on machinery or a planning restriction which prevents the extension of a building on the business premises. There may then be a need to choose from a range of possible activities so as to maximise short-term profit. The item which is restricted in availability is called the **limiting factor**. In order to apply cost–volume–profit analysis the shortage must be short-term, with the expectation of a return to unrestricted activity.

Cost–volume–profit analysis shows that maximisation of profit will occur if the activity is chosen which gives the highest **contribution per unit of limiting factor**.

9.6.4 In-house activity versus bought-in contract

For a manufacturing business, there may be a decision between making a component in-house as compared with buying the item ready-made. For a service business there

Real world case 9.2

Royal Dutch/Shell Group discusses here its profit margins in the Chemical unit.

... earnings in 2003 were \$185 million lower. Sales volumes, including traded products, increased by 19 per cent from a year ago benefiting from capacity additions and volumes from new units. However, there was a decline in overall Chemicals unit margins (defined as proceeds less cost of feedstock energy and distribution per tonne of product sold). This was due to high and volatile feedstock and energy costs and surplus capacity, particularly in the USA. Fixed costs were higher, reflecting planned increases in capacity and higher than normal asset maintenance activity, project expenses, increased costs for benefits including pensions, as well as the adverse impact of the weaker US dollar.



Source: Royal Dutch Shell, Annual Report 2003, p. 31, www.shell.com.

Discussion points

- 1 What was the main cause of the fall in contribution margin?
- 2 What are the variable costs and the fixed costs described in the extract?

may be a decision between employing staff in-house and using the services of an agency which supplies staff as and when required. Cost–volume–profit analysis shows that the decision should be based on comparison of variable costs per unit, relating this to the difference in fixed costs between the options.

9.7 Cases in short-term decision making

Cost–volume–profit analysis is particularly well suited to management needs in short-term decision making. Fiona McTaggart now discusses four cases she has come across where cost–volume–profit analysis has been relevant. The first relates to a decision about taking on a special order to fill a gap where the business was not running at full capacity. The second relates to a potential abandonment of a line of business, the third deals with a limiting factor causing scarcity of an input to the production process, and the fourth relates to buying in services.

9.7.1 Decisions on special orders



FIONA: My first story is about a car hire business in a holiday resort which was experiencing a temporary fall in activity in the run-up to the start of the tourist season. Their normal charge was £3.00 per mile, to cover all costs including the driver's wages. A telephone installation company offered a three-month contract to run engineers between two towns on a return journey of 100 miles, at a fixed price of £180 per journey. The car hire company asked my advice about accepting this offer of £1.80 per mile.

I asked the company what the drivers and cars would be doing each day if the contract was not taken up and the answer was that they would not be doing anything other than waiting at the depot and cleaning their cars. My advice was that, on that basis, the contract would be worth undertaking if it covered the variable costs of each journey and made a contribution to fixed costs and profit.

We sat down to look at the fixed costs and produced the statement shown in Table 9.3. Quite deliberately I did not write any amounts against the separate items of fixed costs because I wanted to emphasise that these are the unavoidable elements that will arise whether or not the contract is taken up.

From the data provided, I calculated the variable cost per mile as 20 pence for petrol and 8 pence for tyres, giving 28 pence in all. The normal charge of £3.00 per mile is intended to cover this 28 pence per mile plus the fixed cost per mile, amounting to £2.10 per mile using the average annual mileage per car. That total cost of £2.38 per mile leaves a profit of 62 pence per mile or £24,800 per annum if the average mileage is achieved.

It is clear that to cover all costs the charge of £3.00 is probably about right, but if the drivers and cars are otherwise unoccupied, extra journeys on the special contract contribute £1.52 per mile (£1.80 – £0.28) to fixed costs and profit. I advised them to take up the contract on two conditions:

- (a) they must be as sure as they could be that there will not be an upturn in business during the hire period which would mean they were turning down the possibility of carrying passengers who would pay £3.00 per mile; and*
- (b) if the journeys involve extra payments to drivers for overtime or late-night work, those extra payments should be regarded as part of the variable cost of the contract and the costings recalculated on that basis.*

They took my advice and carried out the contract. It fitted perfectly into the quiet period of business and the company realised later that the contract had made a useful contribution to profit at a time when drivers and cars would otherwise have been inactive.

Table 9.3
Analysis of variable and fixed costs of car hire firm

<i>Variable costs:</i>	
Petrol	£1.20 per litre
Fuel consumption	6 miles per litre
Tyre costs	£1,600 per set of 4 tyres
Tyre replacement	every 20,000 miles
<i>Fixed costs:</i>	£84,000
<i>These covered:</i>	
Driver's wages	
Insurance	
Licence fee for airport waiting	
Licence fee to town council	
Depreciation of vehicle	
Annual testing	
Radio control membership	
<i>Average annual mileage per car:</i>	40,000 miles

In Fiona's example, the company made use of the idea that, in the short term, any contract is worth taking on if it covers variable costs and makes some contribution to fixed costs and profit. Care needs to be taken that the special order does not create a precedent for future work, particularly if existing customers find that special treatment is being given which appears to undercut the price they are paying. The company may find it difficult in future to return to the price which covers all costs. In the long term, the company must charge a price which covers fixed costs as well as variable costs if it is to survive.

Fiona's second illustration relates to a decision on abandoning a line of activity.

9.7.2

Abandonment decisions



FIONA: A private tuition college was providing two types of secretarial training course. The first was teaching wordprocessing and the second was teaching office skills. The college had produced the profit and loss statement shown in Table 9.4.

Table 9.4
Information for abandonment decision

	<i>Wordprocessing</i> £000s	<i>Office skills</i> £000s	<i>Total</i> £000s
Tuition fee income	<u>485</u>	<u>500</u>	<u>985</u>
Variable costs	200	330	530
Fixed overhead	<u>120</u>	<u>220</u>	<u>340</u>
Total costs	<u>320</u>	<u>550</u>	<u>870</u>
Profit/(loss)	<u><u>165</u></u>	<u><u>(50)</u></u>	<u><u>115</u></u>

On the basis of this profit and loss statement the owners of the business were on the point of cancelling all further courses in office skills. I asked them how they had decided on the allocation of fixed overheads and they explained that these comprised primarily administrative staff costs and permanent teaching staff, plus items such as rent and business rates as well as depreciation of wordprocessors and of the equipment used in the cabin which had been set up to simulate the most up-to-date office conditions. The cabin itself was depreciated over twenty years. Fixed overhead which could be allocated directly

to the relevant courses, such as depreciation of equipment, was allocated in its entirety to the relevant course type. This approach was also used for teaching costs where these were specific to one course type. Fixed overhead which could apply to each type of course, such as administrative staff salaries, was spread in proportion to the number of courses given.

I pointed out to the owners that their profit and loss statement would be more informative if it were set out in the format shown in Table 9.5.

Table 9.5
Revised data for abandonment decision

	Wordprocessing £000s	Office skills £000s	Total £000s
Tuition fee income	485	500	985
Variable costs	<u>200</u>	<u>330</u>	<u>530</u>
Contribution	285	170	455
Fixed overhead			<u>340</u>
Profit			<u>115</u>

From Table 9.5 it is relatively straightforward to see that the office skills programme is making a contribution of £170,000 to fixed costs and profit, after covering its own variable costs. If the programme were not offered, then the business would have only the contribution of £285,000 from wordprocessing which would not cover the fixed overhead of £340,000. Far from abandoning the office skills programme, it was essential to retain it. The allocation of fixed overheads was, for short-term analysis purposes, irrelevant. The cabin and office equipment had already been purchased and would continue to depreciate whether used or not. If put up for sale, these assets would have a negligible value. Administrative and permanent staff were also in place and could not instantly be disengaged.

I advised them that while it was preferable in the short term to keep both programmes running, there were some questions they should ask themselves for longer-term planning:

- 1 To what extent do clients take up the wordprocessing courses because the office skills course may be studied at the same time and in the same place?
- 2 How much fixed cost could be avoided in the longer term if either course ceased to exist?
- 3 Would it be a more effective use of resources to concentrate only on one type of course so that the fixed costs are restricted to one type of equipment and perhaps relatively fewer administrative staff?

The answers might lead to reorganisation towards one type of course only. On the other hand, it might be found that the two programmes are so interrelated that each needs the other and the fixed costs are effectively essential to both, whatever the accounting allocation process.

Fiona's third story concerns a business where there was a restriction in the amount of a factor of input to the production process.

9.7.3 Existence of limiting factors



FIONA: A kitchen equipment service company had come across a problem of a shortage of trained engineers in a district because new oil exploration activity had attracted the best staff by making offers of high salaries.

On a short-term basis the company felt it could not continue to service washing machines, dishwashers and built-in ovens in that area and would prefer to concentrate on the most profitable use of its labour resource. Table 9.6 shows the most recent annual data available, based on the situation before the employee shortage crisis arose. However, the total labour force now available was estimated in cost terms at £40,000.

Table 9.6
Data for limiting factor problem

	Washing machines £000s	Dishwashers £000s	Built-in ovens £000s
Sales	80	120	180
Direct materials	10	20	18
Direct labour	30	30	60
Variable overhead	<u>10</u>	<u>30</u>	<u>30</u>
Total variable cost	<u>50</u>	<u>80</u>	<u>108</u>
Contribution	<u>30</u>	<u>40</u>	<u>72</u>

I advised them that, in these circumstances, the limiting factor of labour should be used so as to maximise the contribution from every £ of labour used. First, I calculated the contribution per £ of scarce resource for each of the three types of service contract (see Table 9.7).

Table 9.7
Calculation of contribution per £ of limiting factor

	Washing machines £000s	Dishwashers £000s	Built-in ovens £000s
Contribution	30	40	72
Direct labour	30	30	60
Contribution per £ of labour	£1.00	£1.33	£1.20

The highest contribution per £ of labour is therefore provided by dishwashers, followed by built-in ovens. So I explained that it would be best to use the scarce labour resource first of all to service dishwashers. At the existing level of sales that would take up £30,000 worth of labour, leaving the balance of £10,000 worth of labour to service built-in ovens on a restricted basis. If more dishwasher work became available, that would be the preferred choice for profit generation.

This would be a short-term solution, but in the longer term it would be essential to consider whether the market could stand higher charges for servicing equipment, which would allow higher wage rates to be paid and thus permit all three types of work to continue.

Fiona has used in this example a particular case of a general principle that where limiting factors apply, profit is made as high as possible where the greatest contribution is obtained each time the scarce resource is used.

9.7.4 Make or buy

The management of a manufacturing business may have to decide whether to make a component in-house or buy the item ready-made.

Fiona McTaggart explains the problem:



FIONA: *A car manufacturer has a problem regarding one quite small component used on a production line. The component may be purchased from an external supplier at £100 per item. It is currently being manufactured in-house at a cost of £110 per item, comprising fixed cost £30 per item and variable cost £80 per item. Annual output is currently 50,000 components and the trend of output is expected to be rising.*

The external price looks attractive at first glance but, before I can advise the car manufacturer, I need to know more about the fixed cost. It is currently £1,500,000 per annum

(£30 times 50,000 components). If the company can avoid the fixed cost by purchasing from the outside supplier, then I will compare the additional variable cost of £20 (£100 – £80) with the saving of £1,500,000. The company breaks even at 75,000 components (calculated as fixed cost saving of £1,500,000 divided by additional variable cost of £20). If demand is less than 75,000, then it is more cost effective to buy from the external supplier. If demand is more than 75,000, then it is more cost effective to manufacture in-house (provided fixed costs do not change at a higher level of output).

If the fixed cost of £1,500,000 cannot be avoided (perhaps it represents rent and property costs which would be incurred even if there were no production), then there is no advantage in buying from the external supplier. The relevant comparison in such a situation is between the variable cost of £80 and the external price of £100.

I would also advise the company that non-financial matters such as quality control and reliability of supply should be taken into consideration when deciding on external purchase rather than internal production.

9.7.5 In-house activity compared with bought-in services

In her final example, Fiona describes a situation where a company was considering buying in services rather than employing its own staff. Cost–volume–profit analysis implies that the decision should be based on the costs saved by not undertaking the activity in-house (the variable costs and any fixed costs that are avoidable) together with the costs incurred in buying the product or service from an external supplier (price multiplied by quantity purchased).

Real world case 9.3

Delta Air Lines is an airline carrier based in Atlanta, USA.

Delta's hopes of survival rest on a series of initiatives: a new pilot contract; the simplification of its fares; and 'Operation Clockwork', an attempt to reduce the costs of running a 'hub and spoke' operation to get close to the economies of low-cost carriers. Hubs have been central to the business of traditional airlines, in collecting customers from small cities that are too uneconomic to serve with direct air services. Hub schedules used to be organised around maximising revenues from marginal passengers – those willing to pay high fares for efficient connections. The director of operations strategy and planning said: 'Historically we had to trade off the inefficiencies of the traditional hub for high fares from connecting passengers. Today, people pay low fares.' The overall aim of Operation Clockwork is to improve productivity: there will be a 22 per cent reduction in the time aircraft spend on the ground as a result of increasing the number of departures per day from nine to 10.5. Employees will handle six to seven flights per day, up from four to five, incentivised by performance bonuses of up to \$100 per month. Turnaround times will be reduced by asking passengers to board while the plane is being cleaned, closing the doors earlier and not waiting for late connecting flights, asking more staff to stay with the aircraft throughout the day, and reducing the number of gate changes, previously used to make customer connections more convenient.

Based on *Financial Times*, 2 February 2005, p. 12, 'Delta flies in the face of tradition'.
Source: company website: www.delta.com.

Discussion points

- 1 How will the company improve the contribution from selling flights to passengers?
- 2 What are the business risks the company faces in its plans to cut costs?



FIONA: A company had been employing its own legal department, comprising a qualified solicitor and two assistants. The solicitor was about to retire and the company had to decide whether to advertise for a replacement or to use a commercial law service as and when required. There would be no redundancy costs in respect of the two assistants because the younger one could be redeployed to a vacancy elsewhere in the organisation and the other would continue to be required as the internal contact with the commercial law service.

I showed the management that, because the commercial law service would charge on an hourly basis, the costs to be compared were the variable costs per hour charged by the commercial service and the fixed costs per annum of the in-house solicitor's salary. We compared the hourly charge rate of £400 with the solicitor's salary of £60,000 and the assistant's salary of £36,000 and worked out that the break-even point would be 240 hours of the commercial law service each year. If more than 240 hours are requested next year, it would be worth continuing the in-house service.

9.8 Estimating fixed and variable costs

It may be useful to have some methods for estimating the fixed and variable costs when we only know the total costs for an activity. These methods assume the same straight-line graph that is shown in section 9.2.2 as 'the accountant's view'. The equation for a straight line is:

$$Y = a + bx$$

In words, this says:

Total cost = fixed cost + (variable cost per unit) multiplied by (the volume in units)

9.8.1 High-low method

Look at the information provided in Table 9.8 showing total cost at three different levels of output.

Table 9.8
Output and total costs

Production (units)	Total cost
300	£5,000
400	£5,800
500	£6,600

The 'high-low' method asks:

- (1) What is the difference between the highest and lowest numbers of production units?

$$(500 - 300) = 200$$

- (2) What is the difference in costs for these two levels of production units?

$$£(6,600 - 5,000) = £1,600$$

- (3) How much does the cost increase per unit of production?

$$£1,600/200 = £80 \text{ per unit}$$

The variable cost is £80 per unit

- (4) Use the variable cost at any level of output to find the fixed cost.

For 300 patients the variable costs are $300 \times £80 = £2,400$

Total costs for 300 patients are £5,000

Fixed costs are therefore £2,600

- (5) The equation of the cost line is $y = a + bx$, where b represents total fixed cost and a represents variable cost per unit.

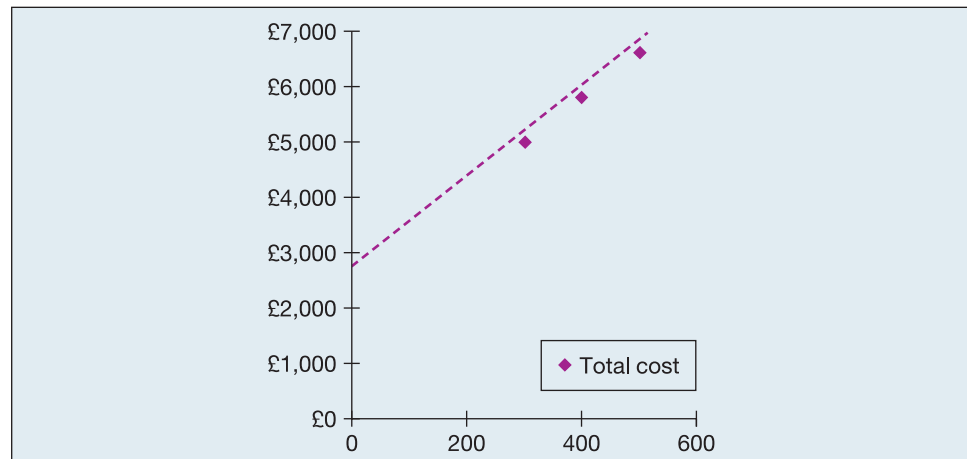
The equation for total costs is $2,600 + 80x$

[Check this at another level of output, e.g. 400 units. Calculate $2,600 + (400 \times £80) = £5,800$]

9.8.2 Line of best fit

Draw a graph with units of production on the horizontal (x) axis and total costs on the vertical (y) axis. Plot the points that are known and then draw the best straight line through them. The variable cost per unit is represented by the slope of the line. The fixed cost is represented by the point where the graph meets the y axis.

Figure 9.12
Scatter plot



9.9 What the researchers have found

9.9.1 Contribution in practice

Ring and Tigert (2001) used contribution analysis to explain why internet grocery retailing did not succeed in the United States. They compared the costs of store-based retailing and internet retailing. The variable costs of internet retailing are higher because there are the additional costs of selecting the goods in the warehouse to make up the order and delivering the order to the home. This additional variable cost reduces the contribution compared with that available with store-based retailing. Research showed that customers were expecting the same prices for the groceries purchased and were not prepared to pay a higher price for the convenience of home delivery. Traders were competing with each other by not charging for packing and delivery. The fixed costs of operating an internet-based system were not greatly different from the fixed costs of operating conventional stores. So the authors described the packing and delivery costs as 'killer costs' for the internet selling operation. The article described the different approaches taken in different countries, such as

delivering to central 'pickup points' rather than to the home, or requiring customers to come to the store to select and pack their own goods. The authors concluded that online grocery shopping had not achieved large-scale success, partly because customers still want to visit stores for perishable food and partly because the additional costs did not leave sufficient margin.

9.9.2 Economics and accounting: views of contribution analysis

Groth and Byers (1996) compare views of economics and accounting on a range of issues in management accounting. They focus on the crucial importance of economic contribution margin in decision making and management. They list a range of situations in which contribution margin is a crucial factor in economic analysis. The list includes: pricing and marketing strategy in markets having elasticity of price-demand, the evaluation of incremental sales, bidding for incremental business, and risk management with respect to the behaviour of competitors.

9.10 Summary

Key themes in this chapter are:

- The accountant's view of cost behaviour differs from that of the economist. The accountant assumes that total cost and total revenue vary on a straight-line basis as the volume of output and sales increases. The economist sees total cost varying in a non-linear manner due to economies of scale and sees total revenue gradually levelling off as customers reach the point where they do not wish to buy more of the item.
- **Contribution** is defined as sales minus variable cost. **Contribution per unit** is compared with fixed overhead cost to calculate break-even point. A break-even chart and a profit-volume chart are useful ways of showing how contribution and profit change as the volume of output and sales increases.
- **Break-even analysis** can be used to explore the effect of changing unit selling price, unit variable cost or fixed cost.
- **Break-even analysis** has limitations because it is only suitable for *short-term decision making* and can only focus on one product at a time.
- A **break-even chart** is a graph that shows sales and costs over a range of activity, including the activity level at which total costs equal total sales and at which the business makes neither a profit nor a loss.
- **Cost-volume-profit analysis** means comparing sales revenue with variable cost and fixed cost to calculate profit or loss over a range of activity, to help with short-term decision making.
- A **profit-volume chart** is a graph on which the horizontal axis shows the volume, measured by activity level in £s of sales, and the vertical axis shows the profit at that activity level.
- The **profit/volume ratio** is calculated as contribution as a percentage of sales value:
- The calculation of contribution can be applied in the short-term for decisions such as:
 - *Decisions on special orders* (Does a lower price leave a positive contribution?).
 - *Abandonment decisions* (Is the product or service making a positive contribution?).
 - *Limiting factors* (Which product or service gives the highest contribution per unit of limiting factor?).
 - *Make or buy* (How does the price of the external product or service compare with the internal variable cost and the fixed overheads that will be saved?).

References and further reading

- Groth, J.C. and Byers, S.S. (1996) 'Creating value: economics and accounting – perspectives for managers', *Management Decision*, 34(10): 56–64.
- Ring, L.J. and Tigert, D.J. (2001) 'Viewpoint: the decline and fall of Internet grocery retailers', *International Journal of Retail and Distribution Management*, 29(6): 264–71.

QUESTIONS

The Questions section of each chapter has three types of question. 'Test your understanding' questions which help you review your reading are in the 'A' series of questions. You will find the answer to these by reading and thinking about the material in the textbook. 'Application' questions to test your ability to apply technical skills are in the 'B' series of questions. Questions requiring you to show skills in 'Problem solving and evaluation' are in the 'C' series of questions. A letter [S] indicates that there is a solution at the end of the book.

A Test your understanding

- A9.1** Define *variable cost* and *fixed cost* (section 9.2).
- A9.2** Contrast the economist's view of costs and revenues with that taken in management accounting (sections 9.2.1 and 9.2.2).
- A9.3** Sketch, and explain the main features of, a break-even chart (section 9.3).
- A9.4** Explain the algebraic method for determining the break-even point (section 9.3.1).
- A9.5** Explain the formula method for determining the break-even point (section 9.3.1).
- A9.6** Sketch, and explain the main features of, a profit–volume chart (section 9.3.2).
- A9.7** What happens to the break-even point when the sales price per unit falls (section 9.4.4)?
- A9.8** What happens to the break-even point when the variable cost per unit falls (section 9.4.5)?
- A9.9** What happens to the break-even point when fixed overheads increase (section 9.4.6)?
- A9.10** State the limitations of break-even analysis (section 9.5).
- A9.11** Give three examples of applications of cost–volume–profit analysis (section 9.6).
- A9.12** Explain how cost–volume–profit analysis may help in:
- decisions on special orders (section 9.7.1);
 - abandonment decisions (section 9.7.2);
 - situations of limiting factors (section 9.7.3); and
 - a decision on buying in services (sections 9.7.4, 9.7.5).

B Application

B9.1 [S]

Fixed costs are £5,000. Variable cost per unit is £3 and the unit selling price is £5.50. What is the break-even volume of sales?

B9.2 [S]

Plot a break-even chart based on the following data and label the features of interest on the chart:

<i>Number of units</i>	<i>Fixed cost</i> £	<i>Variable cost</i> £	<i>Total cost</i> £	<i>Sales</i> £
10	200	100	300	150
20	200	200	400	300
30	200	300	500	450
40	200	400	600	600
50	200	500	700	750

B9.3 [S]

Montrose Glass Products Ltd manufactures three ranges of high-quality paper-weights – Basic, Standard and Deluxe. Its accountant has prepared a draft budget for Year 7:

	<i>Basic</i> £000s	<i>Standard</i> £000s	<i>Deluxe</i> £000s	<i>Total</i> £000s
Revenue	45	35	40	120
Material	<u>15</u>	<u>10</u>	<u>10</u>	<u>35</u>
Labour	20	15	5	40
Variable overhead	5	12	5	22
Fixed overhead	<u>9</u>	<u>5</u>	<u>6</u>	<u>20</u>
	<u>49</u>	<u>42</u>	<u>26</u>	<u>117</u>
Profit/(loss)	<u>(4)</u>	<u>(7)</u>	<u>14</u>	<u>3</u>

Fixed overheads are allocated to each product line on the basis of direct labour hours.

The directors are concerned about the viability of the company and are currently considering the cessation of both Basic and Standard ranges, since both are apparently making losses.

Required

- If the directors close down only the manufacture of Basic paperweights, what is the effect on total profit?
- If the directors close down only the manufacture of Standard paperweights, what is the effect on total profit?
- What is the best decision with regard to keeping profit as high as possible?

B9.4 [S]

Chris Gibson Kitchenware Limited sells kitchen appliances to department stores. Product costs are ascertained using an absorption costing system from which the following statement has been prepared in respect of the business's three product lines.

	<i>Dishwashers</i> £000s	<i>Fridges</i> £000s	<i>Ovens</i> £000s	<i>Total</i> £000s
Sales	180	330	270	780
Less total costs	<u>(200)</u>	<u>(250)</u>	<u>(220)</u>	<u>(670)</u>
Profit/(loss)	<u>(20)</u>	<u>8</u>	<u>50</u>	<u>110</u>

It has been estimated that costs are 60 per cent variable and 40 per cent fixed.

Required

- Restate the table distinguishing variable and fixed costs.
- Advise whether dishwashers should be dropped from the product range in order to improve profitability.

B9.5 [S]

Capital Tours Limited sells weekend tours of London for £200 per person. Last month 1,000 tours were sold and costs were £180,000 (representing a total cost per tour of £180). These costs included £60,000 which were fixed costs.

A local college wishing to send 200 students on an educational trip has offered Capital Tours £140 per tour.

Required

- Explain, with reasons, whether Capital Tours should accept the offer.
- Explain the danger, in the long term, of Capital Tours using prices based on variable (marginal) costing.

B9.6 [S] [CIMA question]

A retail company has a number of individual retail outlets in different towns. Each outlet has its own manager who can make decisions about the individual retail outlet, provided these decisions are within the parameters of the overall company policy. The performance of each individual manager is measured based on the profits of the retail outlet that he or she manages.

Company policy

It is company policy that each of the retail outlets should stock the following categories of items for sale to customers:

- newspapers and magazines
- fresh fruit and vegetables
- tinned food items
- frozen food items

Company policy also requires that no single category occupy more than 40% or less than 15% of the total display space available. In addition, at their own discretion, managers are permitted to use up to 10% of the total display space available for other products that meet other localised needs.

The KL retail outlet

The following weekly sales and cost data relate to the KL retail outlet, one of the outlets owned by the company:

	<i>Sales</i> \$000	<i>Purchase costs</i> \$000	<i>Display space</i> %
Newspapers and magazines	150	105	25
Fresh fruit and vegetables	130	75	20
Tinned food items	400	240	30
Frozen food items	200	90	15
Other products	150	100	10

The total display space available is 800 square metres.

For each category of items for sale:

- sales revenue is directly proportional to the floor area occupied;
- purchase costs are directly proportional to sales revenue.

In addition to the purchase costs of the items sold, the retail outlet incurs other costs that total \$280,000 per week.

Required:

- Demonstrate, using the above information and appropriate calculations, how the manager of the KL retail outlet should allocate the space available between the different categories of items for sale to customers in order to maximise his weekly profit.

(7 marks)

- You have recently joined the retail company as its Assistant Management Accountant and, as your first project, you have been asked to compare the profitability of a number of the retail outlets. One of those within your comparison is the KL retail outlet.

You have visited the KL retail outlet and have investigated the costs that are being incurred in addition to the purchase costs of the items sold. You have confirmed that typically the retail outlet incurs other costs that total \$280,000 per week. Further analysis has shown that these include staff salary costs (excluding any profit-related bonus earned by the manager), staff training costs, rent, light and heat, power, equipment depreciation, point of sale software costs, stationery, telephone, inventory storage and handling costs, marketing costs and head-office charges.

You have discussed these other costs with the manager of the retail outlet. The manager of the retail outlet does not think that gross profit should be used as the basis for allocating space to items. He has suggested that some of the other costs be attributed to the product category to which they relate rather than ignored when making the space allocation decision.

Required:

Prepare a report, addressed to the manager of the KL retail outlet that explains

- (i) the principles of Direct Product Profitability (DPP);
- (ii) how these principles may be applied to his retail outlet; and
- (iii) how their application may improve the profits of his retail outlet.

(18 marks)

CIMA Paper P2 – Management Accounting – Decision Management November 2008, Question Five

Hint for answering the question

'Direct Product Profitability' is a method of using activity-based costing with particular focus on the overhead costs that relate to the products. Overhead costs that relate to the wider operation of the business are not direct product overheads and so do not affect Direct Product Profitability.

B9.7 [S] [CIMA question]

The following table shows the number of patients treated and the total costs for a hospital for each of the past four months:

Month	Patients	Total Cost \$
1	5,000	37,500
2	8,400	45,660
3	8,300	45,050
4	5,900	39,420

Applying the high-low method to the above information, an equation that could be used to forecast total cost (\$) from the number of patients to be treated (where x = number of patients to be treated) is:

- A** $22,900 + 2.40x$
- B** $24,300 + 2.50x$
- C** $25,000 + 2.50x$
- D** $25,500 + 2.40x$

CIMA Paper P1 – Management Accounting – Performance Evaluation November 2008, Question 1.4

C Problem solving and evaluation

C9.1 [S]

Dairyproducts Ltd has recently developed sales of cream in aerosol dispensers which are sold alongside the company's traditional products of cartons of cream and packets of cheese. The company is now considering the sale of cream cheese in aerosol dispensers.

It is company policy that any new product must be capable of generating sufficient profit to cover all costs, including estimated initial marketing and advertising expenditure of £1,000,000.

Current weekly production, with unit costs and selling prices, is as follows:

	<i>Units of output</i>	<i>Variable cost (£)</i>	<i>Fixed cost (£)</i>	<i>Selling price (£)</i>
Cartons of cream	400,000	0.45	0.15	0.75
Aerosol cans of cream	96,000	0.50	0.25	1.05
Packets of cheese	280,000	1.00	0.20	1.30

Sales volume is equal to production volume. A 50-week trading year is assumed. Rates of absorption of fixed costs are based on current levels of output.

In order to produce cream cheese in aerosol dispensers, the aerosol machine would require modification at a cost of £400,000 which is to be recovered through sales within one year. Additional annual fixed costs of £500,000 would be incurred in manufacturing the new product. Variable cost of production would be 50 pence per can. Initial research has estimated demand as follows:

<i>Price per can (£)</i>	<i>Maximum weekly demand (cans)</i>
1.50	60,000
1.40	80,000
1.15	100,000

There is adequate capacity on the aerosol machine, but the factory is operating near capacity in other areas. The new product would have to be produced by reducing production elsewhere and two alternatives have been identified:

- reduce production of cream cartons by 20 per cent per annum; or
- reduce production of packet cheese by 25 per cent per annum.

The directors consider that the new product must cover any loss of profit caused by this reduction in volume. They are also aware that market research has shown growing customer dissatisfaction because of wastage with cream sold in cartons.

Required

Prepare a memorandum to the board of directors of Dairyproducts Ltd showing the outcome of the alternative courses of action open to the company and make a recommendation on the most profitable.

C9.2

A company is able to sell four products and is planning its production mix for the next period. Estimated costs, sales and production data are:

<i>Product</i>	<i>L £</i>	<i>M £</i>	<i>N £</i>	<i>O £</i>
Selling price per unit	<u>60</u>	<u>90</u>	<u>120</u>	<u>108</u>
Less variable costs				
Labour (at £6 per hour)	18	12	42	30
Material (at £3 per kg)	<u>18</u>	<u>54</u>	<u>30</u>	<u>36</u>
= Contribution per unit	<u>24</u>	<u>24</u>	<u>48</u>	<u>42</u>
Resources per unit				
Labour (hours)	3	2	7	5
Material (kg)	6	18	10	12
Maximum demand (units)	5,000	5,000	5,000	5,000

Required:

- (a) Based on the foregoing information, show the most profitable production mix under each of the following mutually exclusive assumptions:
- if labour hours are limited to 50,000 in a period; or
 - if material is limited to 110,000 kg in a period.
- (b) Write a short explanation, suitable for sending to the production director, explaining your recommendation in each case.

C9.3

You are employed as the accountant for Cars Ltd, a local garage which has a bodyshop. The bodyshop manager, Mr George, has contacted you saying that one of the company's present customers has offered the company a one-year contract for additional work. The customer requires a discount of 10 per cent to be allowed on the total invoice value. Mr George provides you with the following information:

- 1 Additional capital expenditure will be:

	£
Video conferencing facility	10,000
Additional storage trolleys	5,000
Computerised estimating system	10,000

The customer insists on installation of the video conferencing facility which will not be usable for any other contract. The storage trolleys and estimating system may be used on other work after the end of this particular contract.

- 2 Additional staff will be required. Three full-time skilled technicians earning £8.00 per hour will each work 39 hours per week on the new contract. They are each allowed 6 weeks per year paid holidays and 2 weeks paid training. Labour efficiency is 95 per cent measured as the ratio of sold hours/hours attended. Training time and holiday time are charged to direct costs of the department. For each technician the new contract will leave some unsold hours available for any other jobs coming into the bodyshop. One full-time car cleaner will be required earning £10,500 per annum.
- 3 The customer has said that the potential increase in sales due to chargeable hours from this contract could be 4,500 hours at a rate of £20.00 per hour before discount. In addition the increase in sales of car parts is calculated on the basis of £40.00 per hour with an average gross profit of 15 per cent before discount. The increase in paint sales is calculated on the basis of £3.50 per hour with an average gross profit of 40 per cent before discount.
- 4 Additional annual overheads will be as follows:

	£
Variable costs	5,500
Fixed costs	6,500

- 5 Depreciation is calculated on a straight line basis as follows:

	%
Storage trolleys	20
Computers	25

Mr George has asked your opinion on the acceptability of the customer's proposal.

Required:

Write a memo to Mr George:

- assessing the financial aspects of the proposal; and
- commenting briefly on other considerations relevant to the decision-making process.

Case studies

Real life case studies

Prepare short answers to Case studies 9.1, 9.2 and 9.3.

Case study 9.4

Cans plc is developing a new form of 'crinkly can' for soft drinks. The crinkly can has grooves in the side which match the size of the fingers of a hand. The company's research and development department employs 50 people full-time and accounts for 2 per cent of the company's costs. The design manager thinks that it may be important in future to develop special designs for particular commercial customers, even if this involves relatively small production runs and a higher price to the customer for each can. He said 'Our profit margins are not yet satisfactory. I would like to maintain our existing level of sales of the standard can at the standard price, but also take advantage of our design skills and sell additional cans of the new style cans in smaller batches but at a higher price.'

Explain the further information you would need in order to report on the benefits and problems for creating higher contribution margins and higher profit margins on the basis of the design manager's proposals.

Case study 9.5

Greetings Ltd operates a chain of shops selling birthday cards and related products. Each shop has a contribution target and a profit target. The monthly contribution target is calculated by deducting total variable cost of cards and related products from the total sales of the month. The profit target is calculated by deducting the shop's fixed costs (staff salaries, rent, business rates, insurance, heat and light) from contribution. The managers of each shop will earn a bonus if they exceed the contribution target or the profit target of the month. What actions can a shop manager take to exceed the targets set?