

## Using Break-even Analysis in Decision-making



### Introduction

Of all the sections in your BUSS1 course, this is definitely **one of the most important**. The concept of **contribution** is a crucial one in business. It focuses on how much profit a business makes from each unit of product sold and whether that profit is enough to allow the business to make money overall after taking account of its fixed costs.

In the previous section we looked at the important topics of sales, variable costs and fixed costs. These essential concepts come into play in break-even analysis, so we would recommend you look back at those ideas if you are still unsure what they mean.

Break-even analysis is a mathematical as well as business concept. You need to be able to perform the calculations on this area. If you are unsure of the calculations or a bit uneasy when it comes to anything to do with numbers, you should focus your revision on this topic.

However, break-even isn't just about numbers. You need to be able to understand the analysis and be able to **interpret** the results. You should also be able to describe the **limitations** of break-even analysis.

So what is "break-even"?

A business is said to "break-even" when it is earning **enough sales to cover all its costs**. The break-even point happens when **sales = total costs**. In other words, at the break-even point, the business isn't making a profit, but it isn't making a loss either!

It might help to use a football analogy to help explain break-even. If the business is making a profit, it is winning. If it is making a loss, then it is losing. If the business is breaking-even, then the score is a draw.

When we look at break-even, we are concerned with the following key issues:

- At what level of production (output) does break-even take place?
- What is the effect on break-even of changes in the business?
- What business decisions can be taken which affect break-even and which will help improve profits?

### Contribution

Contribution looks at the profit made on individual products. It is used in calculating how many items need to be sold to cover all the business' costs (variable and fixed).

Let's start with a really important definition & formula (you really do need to know these!)

**Definition:**

**Contribution is the difference between sales and variable costs of production**

**Formulae:**

**Contribution = total sales less total variable costs**

**Contribution per unit = selling price per unit less variable costs per unit**

Total contribution can also be calculated as:

**Contribution per unit x number of units sold**

Let's look at a simple worked example of contribution. Here is some information about a business that just sells one product:

- Selling price per unit £30
- Variable cost per unit £18
- Contribution per unit £12 (i.e. £30 less £18)
- Units sold 15,000

Using the formulae, we can perform the following calculation:

Contribution = £180,000 (i.e. £12 x 15,000 units)

Looking at the contribution per unit above (£12), you should be able to see that it can be increased by:

- Increasing the selling price per unit - i.e. more than £30
- Lowering the variable cost per unit - i.e. less than £18

Note that the total contribution of £180,000 is **not the total profit** made by the business. Why? This is because we have not yet taken account of the **fixed costs** of the business. Let's do that now...

Imagine that, in the example above, the business has the following fixed costs:

Admin: £18,000

Marketing: £25,000

Payroll: £50,000

Other overheads: £23,000

Total: £116,000

The total fixed costs of the business are £116,000. If we take these away from the contribution (£180,000), then we can calculate the overall profit or loss of the business:

Total profit = contribution less fixed costs

Total profit = £180,000 - £116,000  
= a profit of £64,000 (i.e. £180,000 less £116,000)

In the above example we calculated contribution per unit by subtracting variable cost per unit from selling price per unit.

Contribution per unit is a really useful number to have, and you find it used again and again in BUSS1 questions on break-even. Make sure you know the formula and are confident in calculating it!

## Break-even level of output

In this section, we'll take you through the different methods of calculating the production output (volume, or number of units produced) at which the business achieves break-even.

We'll look at three approaches:

- A table (or spreadsheet) showing sales and costs over different levels of output
- A formula which you can use to calculate break-even output
- A graph which charts sales and costs

Each of these approaches basically does the same thing, but you need to be happy with them all – you never know which one the examiner might include in the exam!

For each approach, we have to make some important assumptions:

- Selling price per unit stays the same, regardless of the amount produced
- Variable costs vary in direct proportion to output – i.e. variable cost per unit is the same
- All output is sold
- Fixed costs do not vary with output – they stay the same

I know what you are thinking – those assumptions don't sound very realistic! Correct. However, you have to make these assumptions for the three approaches listed above to work! So bear with us. The unrealistic nature of the assumptions can be used when it comes to discussing the **limitations of break-even analysis** (which is also in the BUSS1 specification).

## Using a table to calculate break-even output

Here is a table showing the sales, variable costs, fixed costs and profits from various levels of output for a one-product business:

The product is sold for £10 per unit. The variable cost per unit is £4. Fixed costs are £40,000 (the same at each level of output).

Output	Sales	Variable Costs	Fixed Costs	Total Costs	Profit
'000	£'000	£'000	£'000	£'000	£'000
0	0	0	40	40	-40
1	10	4	40	44	-34
2	20	8	40	48	-28
3	30	12	40	52	-22
4	40	16	40	56	-16
5	50	20	40	60	-10
6	60	24	40	64	-4
7	70	28	40	68	2
8	80	32	40	72	8
9	90	36	40	76	14
10	100	40	40	80	20

Using the table, you can see that the break-even output is somewhere between 6,000 and 7,000 units. At 6,000 units, the business makes a loss of £4,000. At 7,000 units, the business makes a profit of £2,000.

### Using a formula to calculate break-even output

Let's use the same information as above to show how a formula can be used to quickly calculate the break-even output.

Remember contribution per unit? (Of course you do!)

Contribution per unit = selling price per unit less variable cost per unit

In this example, contribution per unit = £10 less £4 = £6 per unit

Here comes the clever bit – the formula

$$\text{Break-even output (units)} = \text{Fixed costs (£)} / \text{Contribution per unit (£)}$$

So, break-even output = £40,000 divided by £6 = 6,666

Note: break-even output is always expressed in terms of units

**So break-even output = 6,666 units**

If the information is available, it is always quicker and easier to use this formula rather than use a table or draw a chart.

### Using a chart to calculate break-even output

Using graph paper, it is possible to chart the financial data that allows the break-even output to be measured. We'll use the same example data one last time!

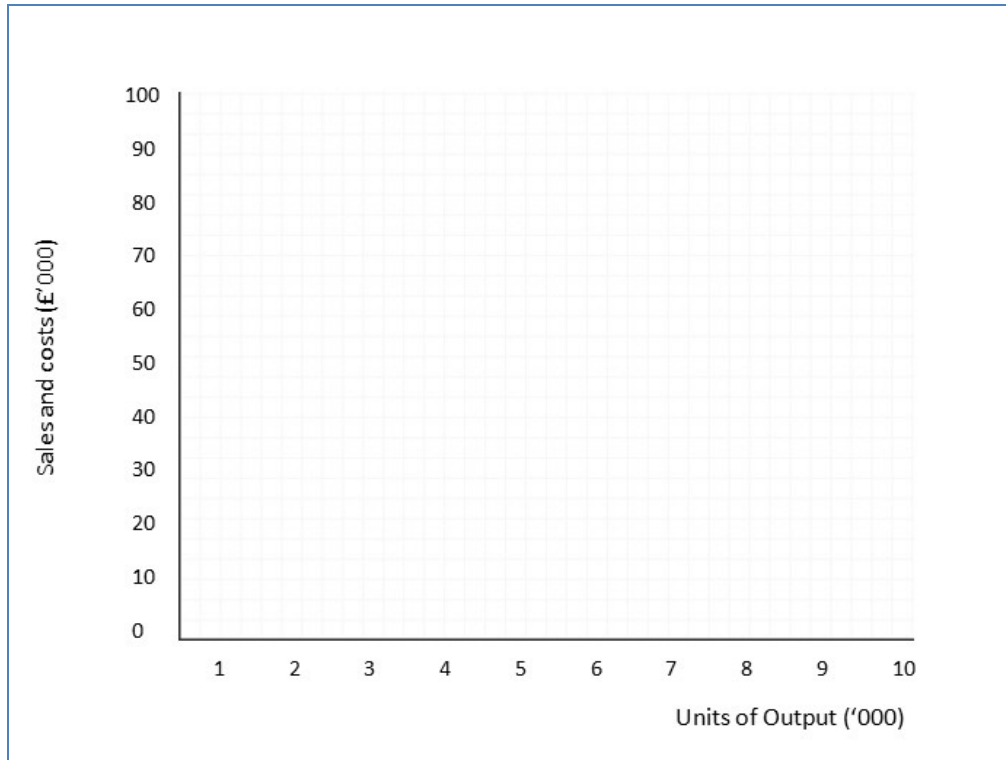
#### Step 1

The first step is to produce two axes:

The vertical axis shows the value of sales & costs

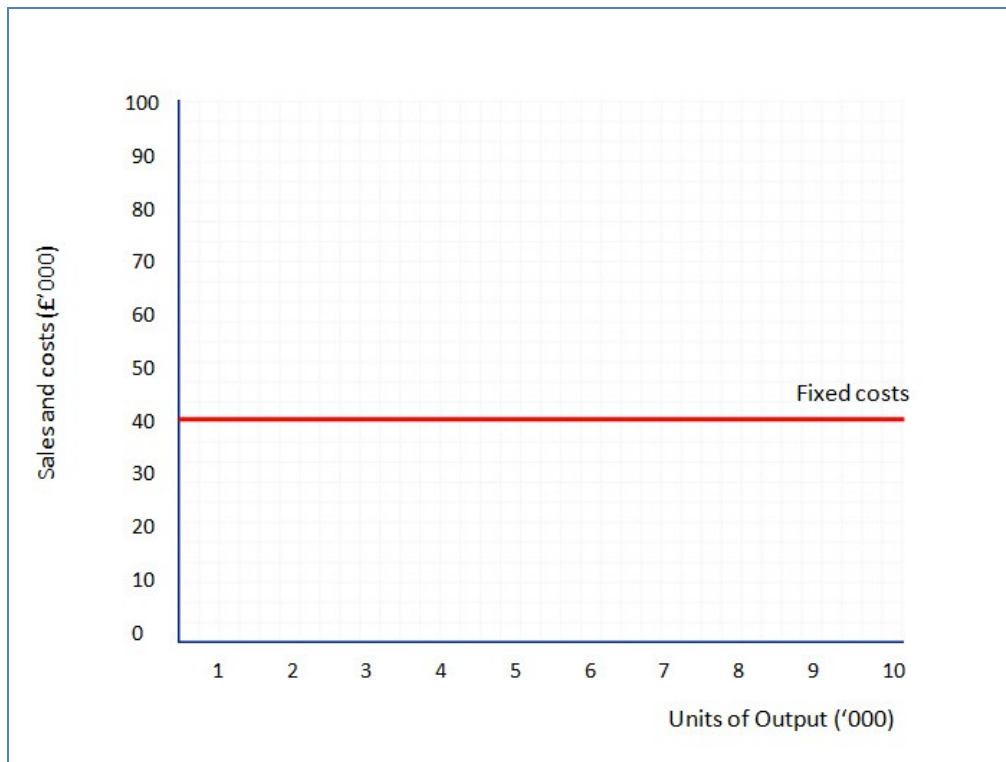
The horizontal axis shows the output

So here is what the blank chart would look like:



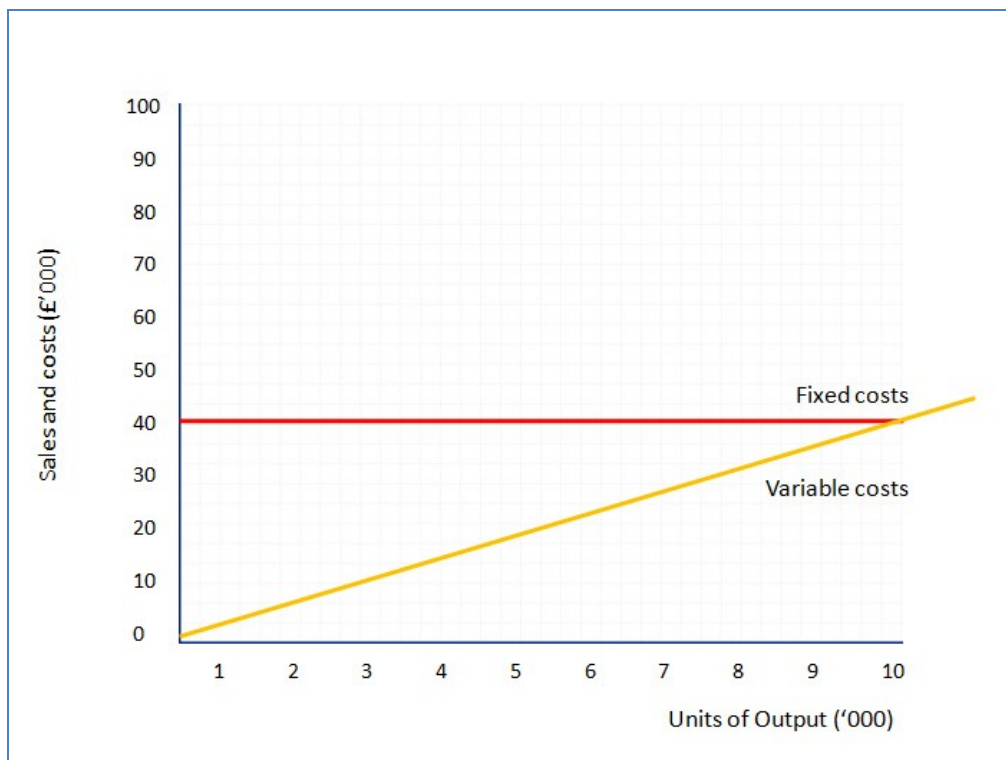
## Step 2

The next step is to add the fixed cost line. Remember that we assume fixed costs don't change with the level of output. So the fixed cost line (in red below) is a horizontal line, showing £40,000.



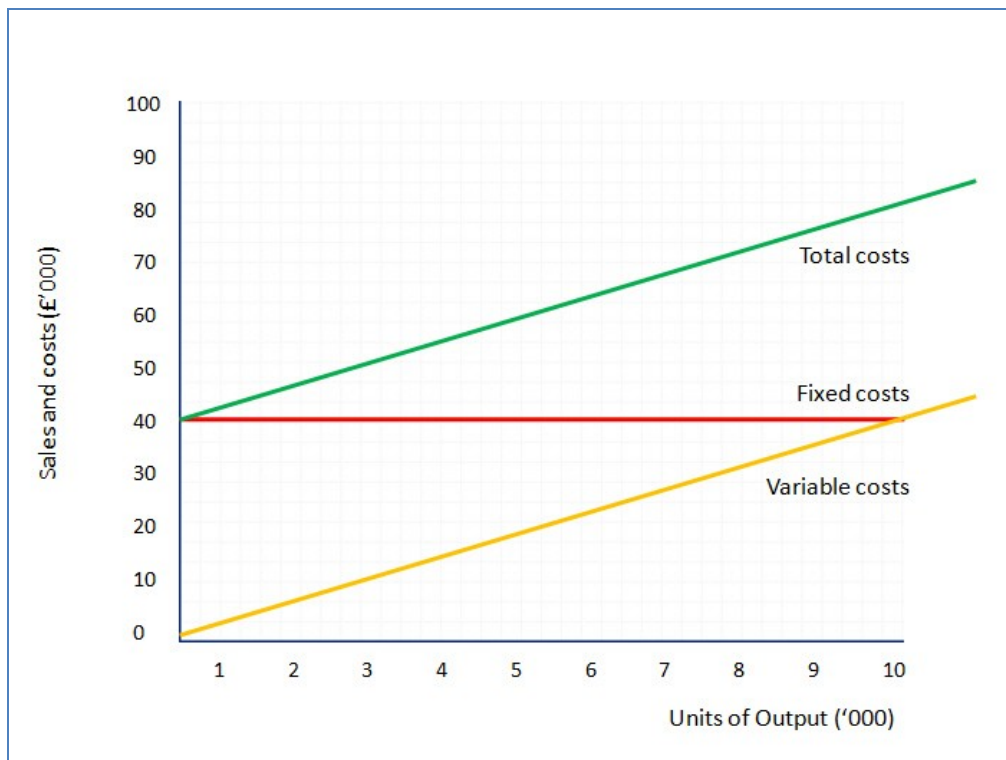
### Step 3

Next we add the variable costs. We assume that variable costs vary directly with output. In our example, the variable cost per unit is £4. So variable costs for 1,000 units will be £4,000, and at 5,000 units they will be £20,000. Remember that you only need to plot a couple of points to be able to draw the straight line (in yellow below).



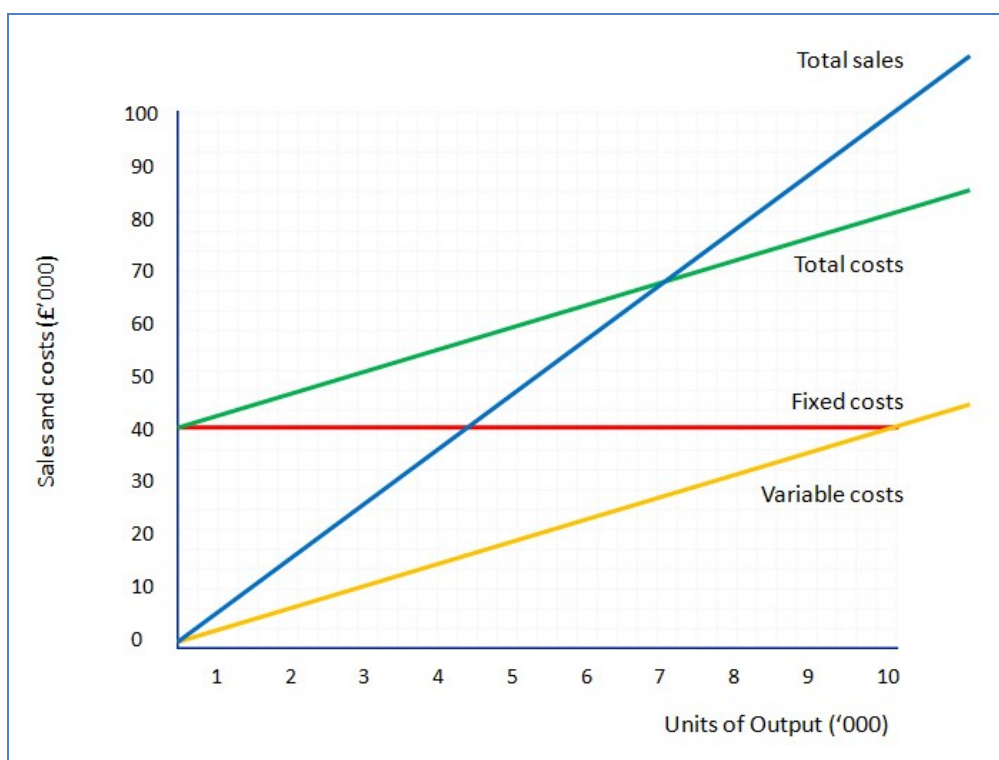
### Step 4

Next step is to add the variable costs to the fixed costs for each level of output. This is important. Remember that to calculate break-even we need to know total costs. The total cost line is shown in green on the chart.



### Step 5

Having dealt with costs, we can now draw the line for total sales. Remember that we assume that all output is sold for the same selling price (in this case - £10 per unit). So total sales for 2,000 units will be £20,000; 10,000 units will make £100,000 of sales. The total sales line is drawn in blue below.





### Step 6

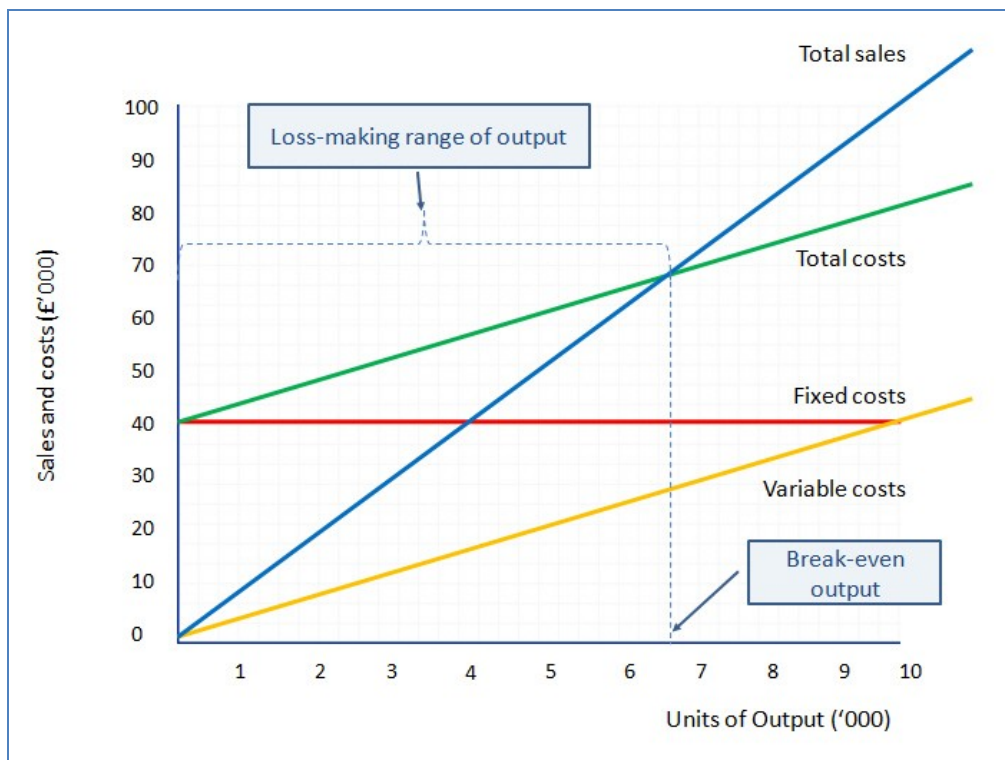
Almost there! The last step is to use these lines to identify certain information from the chart.

First, the break-even output. Remember this is the point where total sales = total costs. So the output is the point where the total sales line crosses the total costs line (e.g. where the blue line crosses the green line). Find this point on the chart and then follow a vertical line down to the output (horizontal) axis. You can see this brings us to 6,666 (approximately, since our chart isn't drawn perfectly to scale!).

Another thing you can notice from the chart is the over a range of output, total costs are higher than total sales (green line higher than the blue line). That means that in this range, the business is making losses. This is the **loss-making range of output**.

If the actual output is more than the break-even output, the business will be making a profit. In our example, any output more than 6,666 units will mean profits are earned.

The difference between the actual output and the break-even output is known as the "margin of safety". For example, if actual output were 8,000 units, then the margin of safety = 8,000 units less 6,666 units = 1,334 units.



### Changes to break-even

We have looked at three approaches to calculating break-even output using the same information.

The next stage is to consider what happens to break-even if the data changes. The best way to see the effect of these changes is to work through some calculations, which you can do in our exercises. However, here is a simple summary which you might find helpful:



Change	Effect on Contribution per Unit	Effect on Break-even Output
Higher selling price	Higher	Lower
Lower selling price	Lower	Higher
Higher variable cost per unit	Lower	Higher
Lower variable cost per unit	Higher	Lower
Increase in fixed costs	No change	Higher
Decrease in fixed costs	No change	Lower

The purpose of looking at the effect of changes in assumptions is to understand what happens to profit as key data in the business changes. This is usually referred to as “**what-if analysis**”.

What-if analysis can be done using any of the three methods. However, it is much easier and quicker to use the break-even formulae rather than drawing charts of new tables. We'll use the formulae for our worked example below.

Here is the starting data for our example:

### ***Gordon's Seafood Restaurant***

Gordon Romsey is planning to open a new seafood restaurant in the popular Cornish village of Padstow to compete with his good friend Rick Strain. His business plan makes the following assumptions:

Average selling price per meal	£40
Average variable cost per meal	£10
Monthly fixed costs	£9,300

Your task: calculate:

- (1) The contribution per unit & current break-even output
- (2) The current margin of safety assuming that Gordon sells 1,200 meals per month
- (3) What would happen to break-even output if the average selling price per meal increased to £50
- (4) What the margin of safety would be if monthly fixed costs were 20% higher but there was no change in the number of meals served per month and the average selling price stays at £40 per meal

So, using our break-even formulae, we can quickly get to the answers. Here's how:

**Question (1)**

Contribution per unit = £40 - £10 = £30

Break-even output = fixed costs / contribution per unit = £9,300 / £30 = 930 meals per month

**Question (2)**

Margin of safety = current output less break-even output = 1,200 meals – 930 meals = 270 meals

**Question (3)**

An increase of £10 in the average selling price per meal would increase the contribution per unit to £40 (i.e. £50 - £10).

So the break-even output will now be £9,300 / £40 = 744 meals per month

That means that the break-even output has fallen from 930 to 744 meals. Gordon's restaurant has to sell fewer meals before it breaks even. That's good news!

**Question (4)**

Fixed costs will be 20% higher: that means fixed costs will be £9,300 x 1.2 = £11,160

Break-even output will now be £11,160 / £30 = 1,116 meals per month

[note: the break-even output has risen (bad news) because fixed costs have gone up]

Margin of safety now = 1,200 meals – 1,116 meals = 84 meals per month

The margin of safety has fallen (bad news)

## Strengths and limitations of break-even analysis

Break-even analysis is a practical and popular tool for many businesses, particularly start-ups. However, you also need to know about the limitations of the method. Here is a summary:

Strengths	Limitations
Focuses entrepreneur on how long it will take before a start-up reaches profitability – i.e. what output or total sales is required	Unrealistic assumptions – products are not sold at the same price at different levels of output; fixed costs <b>do</b> vary when output changes
Helps entrepreneur understand the viability of a business proposition, and also those who will lend money to, or invest in the business	Sales are unlikely to be the same as output – there may be some build up of stocks or wasted output too
Margin of safety calculation shows how much a sales forecast can prove over-optimistic before losses are incurred	Variable costs do not always stay the same. For example, as output rises, the business may benefit from being able to buy inputs at lower prices (buying power), which would

	reduce variable cost per unit.
Helps entrepreneur understand the level of risk involved in a start-up	Most businesses sell more than one product, so break-even for the business becomes harder to calculate
Illustrates the importance of a start-up keeping fixed costs down to a minimum (higher fixed costs = higher break-even output)	Break-even analysis should be seen as a planning aid rather than a decision-making tool
Calculations are quick and easy – great for giving quick estimates	

### Exam tips

Focus your BUSS1 studies on understanding how various changes in the business can affect the break-even level of output. A break-even chart can help you illustrate this, but it is more important to understand why the changes affect break-even output, and what a business can do in response.

Don't assume that break-even analysis is a proven, scientific method. It makes lots of assumptions about the ability of the business to identify which costs are variable and which are fixed - in reality this can be quite tough.

Break-even analysis is particularly useful for a new business or for any business which is loss-making or barely making profits.

In the exam, you are unlikely to be asked to draw a break-even chart from scratch. But you might have to complete the missing bits of a part-complete chart and/or identify the results of the chart.

## Guided revision questions

### Revision questions for Using Break-even in Decision-making

- (1) What is meant by the term “break-even” (2 marks)
- (2) Why is it important for a start-up to understand the break-even point? (4 marks)
- (3) Define the formula for calculating “contribution” (2 marks)
- (4) A computer games retailer buys 450 boxed games for £12 which will be sold for £40 each. What is the total contribution from these games? (3 marks)
- (5) If the total contribution is £260,000 and fixed costs are £190,000, what is the profit? (2 marks)
- (6) If the total contribution is £75,000 and variable costs are £360,000, what is the total revenue? (2 marks)
- (7) State two ways in which contribution can be used by a business to help make decisions (3 marks)
- (8) What happens to the break-even output if there is an increase in the rent paid on a business’ factory? (2 marks)
- (9) What is the effect on break-even output of a reduction in the contribution per unit? (2 marks)
- (10) A hairdresser is concerned that she has to work 30 hours per week just to break-even. State three things she could do to reduce the break-even level of output (3 marks)
- (11) An entrepreneur discovers that the actual break-even level of output for his start-up is much higher than he had assumed in his business plan. Analyse three possible reasons why this might be so (4 marks)
- (12) Explain what is meant by the term “margin of safety” (3 marks)
- (13) State three weaknesses or limitations in break-even analysis (3 marks)