

# HL IB Business Management



Your notes

## 5.5 Break-even Analysis

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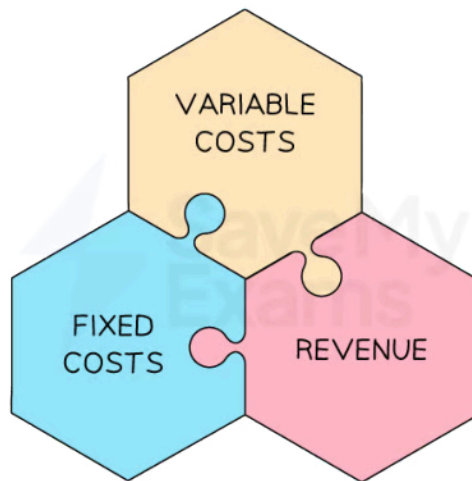
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## Break-even Analysis

### An Introduction to Break-even Analysis

- **Break-even analysis** is a financial tool used to determine **the number of units a business must sell to reach a point where the business revenue equals its expenses (no profit nor loss)**
  - It helps businesses understand the **minimum level of sales or output they need to achieve in order to cover all costs**
  - This helps business managers to make **informed decisions about pricing and production volumes**

### Diagram with the Three main Components of a Break-even Analysis



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*Variable costs, fixed costs and sales revenue are all used in calculating the break-even point*

- **Fixed costs** are costs that do not change regardless of the level of production or sales
  - E.g. rent, salaries and insurance
- **Variable costs** are costs that vary with the level of production or sales
  - E.g. raw materials, direct labour costs, packaging and shipping costs
- **Sales revenue** is the money gained from selling products/service and is calculated as follows
  - **Sales revenue = number of items sold x selling price**



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## Total Contribution Versus Contribution per unit

- Contribution refers to the amount of money that the sale of a particular product **contributes towards paying off the fixed costs** of a business
- Once the fixed costs are paid, the **contribution becomes profit**
- Contribution can be calculated on a per unit basis or as an aggregate

### Contribution per unit

- **Contribution per unit** is a measure by which selling price of a unit exceeds the cost of making the unit
- It is calculated using the formula:
  - $\text{Contribution per unit} = \text{Selling price per unit} - \text{Variable cost per unit}$
  - E.g. If a product sells for \$50 per unit and the variable cost of production is \$30 per unit, the contribution per unit would be \$20 (\$50 - \$30)

### Total contribution

- **Total contribution** is a measure of the combined profit per unit generated from the sale of each goods/services
- It can be calculated in one of two ways
  - $\text{Total contribution} = \text{Contribution per unit} \times \text{total units sold}$   
or
  - $\text{Total contribution} = \text{Total revenue} - \text{total variable costs}$
  - E.g if 1,000 units of a product are sold, and the contribution per unit is \$20, the total contribution would be \$20,000 (\$20 × 1,000)
- **Total contribution is not the total profit** made by the business because it does not take into account the fixed costs of the business

#### Examiner Tip

You may be provided with the total contribution figure

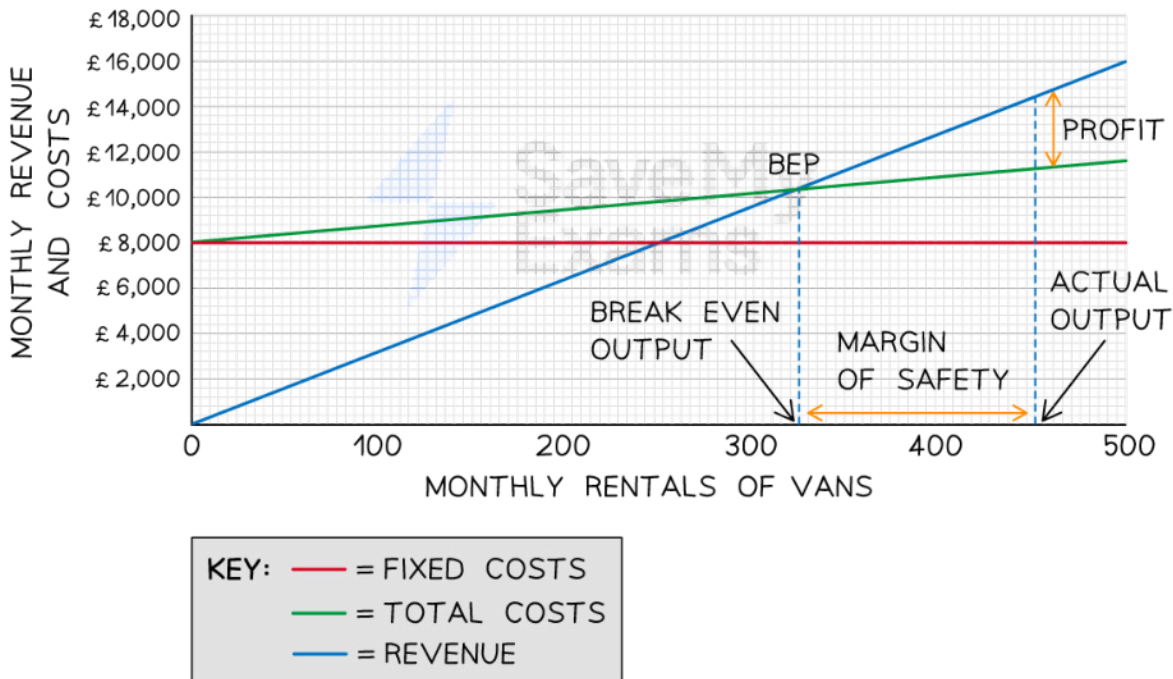
To calculate contribution per unit - and, therefore, be able to calculate the break even point - you need to divide the total contribution by the number of units produced



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## Interpreting Break-even Charts

- A break even chart is a **visual representation** of the break even point and is used to identify the following
  - **Fixed costs, total costs and revenue** over a range of output
  - The **break even point** - where total costs are equal to revenue
  - **Profit or loss** made at each level of output
  - The **margin of safety**



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*The break even chart for A2B Limited shows that at 324 units the total revenue = the total costs*

### Diagram analysis

- Fixed costs do not change as output increases
  - A2B's fixed costs are £8,000 and these do not change whether the business produces 0 units or 500 units
- Total costs are made up of fixed and variable costs
  - At 0 units of output, they are made up exclusively of fixed costs
  - At 500 units the total variable costs equate to £11,800
  - This line **slopes upwards** because total variable costs increase as output increases
- The revenue line also slopes upwards
  - At 0 units of output, the revenue is £0

- At 500 units the total revenue equates to £11,800
- Revenue will increase with the output
- The line will **slope more steeply than the total costs** and will **cross the total costs line** at some point
  
- The point at which the total costs and the revenue lines cross is the **break even point**
  - The break even level of output for A2B is 324 units
  
- The margin of safety can be identified as the **difference on the x-axis between the actual level of output** (in this case 450 units) **and the break even point**
  
- The profit made at a specific level of output can be identified as the **space between the revenue and total costs lines**
  - In this instance the profit made at 450 units of output is  $£14,400 - £11,250 = £3,150$



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## Calculating the Break Even Point

- The Break Even Point occurs where the **total revenue earned for a product is exactly equal to its total costs** and where the business is making **neither a profit nor a loss**

$$\text{Break Even Point} = \frac{\text{Fixed costs}}{\text{Contribution per unit}}$$

- The **contribution per unit** value is used to calculate the Break Even Point
- The break even point is expressed as **units** (e.g. the number of scented candles)
- Identifying the break even point allows a business to understand **how many items it needs to produce and sell** to cover all costs before it starts to make a profit
  - Each subsequent unit sold past this point will generate **profit** for the business



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 **Worked example**

**Selected Cost and Revenue data for Montrose Glamping**

	AUS\$
Revenue per pod per night	95
Variable costs per pod per night	19
Annual fixed costs	55,000

Using the information in the table, calculate how many pods need to be occupied each month for Montrose Glamping to break even.

[4 marks]

**Step 1 - State the formula to calculate the break-even point**

$$\text{Break Even Point} = \frac{\text{Fixed costs}}{\text{Contribution per unit}}$$

[1 mark]

**Step 2 - Calculate the contribution**

$$\begin{aligned} &\text{Selling price} - \text{variable cost per unit} \\ &= \$95 - \$19 \\ &= \$76 \end{aligned}$$

[1 mark]

**Step 3 - Apply the formula to calculate the break-even point**

$$\begin{aligned} &\frac{\$55,000}{\$76} \\ &= 723.68 \end{aligned}$$

[1 mark]

**Step 4 - Always round UP to the nearest whole number because only whole products can be sold**

$$723.68$$

= 724 camping pods

[1 mark]



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## The margin of safety

- The margin of safety is the **difference** between the actual level of output of a business and its **break even level of output**
- The margin of safety can be calculated using the following formula

$$\text{Margin of Safety} = \text{Actual output} - \text{Break even output}$$



### Worked example

The cost, sales and revenue for an electric bicycle manufacturer are presented in the table below

Annual fixed costs	£42,000
Selling price per unit	£750
Variable cost per unit	£350
Number of units sold	240

Using the data, calculate the margin of safety. You are advised to show your workings.

[4 marks]

#### Step 1 - Calculate the contribution

$$£750 - £350$$

$$= £400$$

[1 mark]

#### Step 2 - Calculate the break even point

$$\frac{£ 42,000}{£ 400}$$

$$= 105 \text{ units}$$

$$= 105 \text{ units}$$

[2 marks]

#### Step 3 - Calculate the margin of safety

$$240 \text{ units} - 105 \text{ units}$$

$$= 135 \text{ units}$$

[1 mark]

### Calculating profit or loss

- Profit or loss can be calculated in two ways

$$\text{Profit (Loss)} = \text{Total contribution} - \text{Total fixed costs}$$

or

$$\text{Profit (Loss)} = \text{Total revenue} - \text{Total costs}$$



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### Worked example

ForêtSaut is an outdoor treetop activity centre. In 2022 it earned revenue of €462,540 with fixed costs of €281,720 and total variable costs of €131,280.

Calculate the total profit made by ForêtSaut in 2022.

[2 marks]

#### Step 1: Calculate the total contribution

$$\begin{aligned}\text{Total contribution} &= \text{Total revenue} - \text{Total variable costs} \\ &= €462,540 - €131,280 \\ &= €331,260\end{aligned}$$

[1 mark]

#### Step 2: Use the contribution figure to calculate profit

$$\begin{aligned}\text{Profit (Loss)} &= \text{Total contribution} - \text{Total fixed costs} \\ &= €331,260 - €281,720 \\ &= €49,540\end{aligned}$$

[1 mark]

### Examiner Tip

You may be asked to use principles of break even to calculate

- Target profit output
- Target profit
- Target price

Practice rearranging the formula for target profit output to find the other variables so that you don't have to remember all three formulas.

## Calculating the target profit output

- Break even analysis can also be used to calculate the **level of output needed to earn a target level of profit**
- The target profit output can be calculated using the formula



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$$\text{Target profit output} = \frac{\text{Fixed costs} + \text{Target profit}}{\text{Contribution per unit}}$$

- This calculation helps a business **plan the resources** such as stock, machinery and workers required

### Worked example

ForêtSaut is an outdoor treetop activity centre. In 2022 it attracted 38,545 customers and earned revenue of €462,540 with fixed costs of €281,720 and total variable costs of €131,280. In 2023 it has set a profit target of €84,000.

Calculate the target profit output if ForêtSaut is to achieve its target profit in 2023.

[3 marks]

#### Step 1: Calculate the contribution per unit

$$\begin{aligned} \text{Contribution per unit} &= \frac{\text{Total contribution}}{\text{Units of output}} \\ &= \frac{€ 331,260}{38,545 \text{ customers}} \\ &= €8.60 \end{aligned}$$

[1 mark]

#### Step 2: Apply the formula to calculate target profit output

$$\begin{aligned} \text{Target profit output} &= \frac{\text{Fixed costs} + \text{Target profit}}{\text{Contribution per unit}} \\ &= \frac{€ 281,720 + € 84,000}{€ 8.60} \end{aligned}$$

[1 mark]

$$\begin{aligned} &= \frac{€ 365,720}{€ 8.60} \\ &= 42,526 \text{ customers (rounded up to next whole unit)} \end{aligned}$$

[1 mark]

## Calculating the target profit

- The **target profit output formula** can be rearranged to calculate the **target profit** and the **target price**
- The **target profit** is the profit a business should expect to achieve **at the target profit output level**
- It is calculated using the formula

$$\text{Target profit} = (\text{Target profit output} \times \text{Contribution}) - \text{Fixed costs}$$

- This calculation can help a business with **financial planning** including forecasting cash flow



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### Worked example

ForêtSaut is an outdoor treetop activity centre. In 2022 it attracted 38,545 customers and earned revenue of €462,540 with fixed costs of €281,720 and total variable costs of €131,280. In 2023 it has set a target profit output of 42,526 customers.

Using 2022's costs and revenues data, calculate ForêtSaut's target profit if it is to achieve its total profit output of 42,526 customers in 2023.

[3 marks]

#### Step 1: Calculate the contribution per unit

$$\text{Contribution per unit} = \frac{\text{Total contribution}}{\text{Units of output}}$$

$$= \frac{€ 331,260}{38,545 \text{ customers}}$$

$$= € 8.60$$

[1 mark]

#### Step 2: Apply the formula to calculate target profit

$$\text{Target profit} = (\text{Target profit output} \times \text{Contribution}) - \text{Fixed costs}$$

$$= (42,526 \times € 8.60) - € 281,720$$

$$= € 84,003$$

[2 marks]

## Calculating the target price

- The **target price** is the price at which a product should be sold **in order to achieve the target profit**

- It is calculated using the formula

$$\text{Target price} = \frac{(\text{Target profit output} \times \text{Variable costs per unit}) + (\text{Fixed costs} + \text{Target profit})}{\text{Target profit output}}$$

- This calculation can help a business with its **marketing planning**, in particular its pricing strategy and sales promotions



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### Worked example

ForêtSaut is an outdoor treetop activity centre. In 2022 it attracted 38,545 customers and earned revenue of €462,540 with fixed costs of €281,720 and total variable costs of €131,280. In 2023 it has set a target profit of €84,000 from 42,526 customers.

Using 2022's costs and revenues data, calculate ForêtSaut's target price if it is to achieve its target profit €84,000 in 2023.

[4 marks]

#### Step 1: Calculate variable costs per unit

$$\begin{aligned}\text{Variable costs per unit} &= \text{€ } 131,280 \div 38,545 \text{ customers} \\ &= \text{€ } 3.41\end{aligned}$$

[1 mark]

#### Step 2: Multiply target profit output by variable costs per unit

$$\begin{aligned}&= 42,526 \times \text{€ } 3.41 \\ &= \text{€ } 145,014\end{aligned}$$

[1 mark]

#### Step 3 – Add fixed costs to target profit

$$\begin{aligned}&= \text{€ } 281,720 + \text{€ } 84,000 \\ &= \text{€ } 365,720\end{aligned}$$

[1 mark]

#### Step 4: Apply the formula to calculate the target price and round to two decimal places

$$\begin{aligned}&= \frac{\text{€ } 145,014 + \text{€ } 365,720}{42,526} \\ &= \text{€ } 12.00\end{aligned}$$

[2 marks]



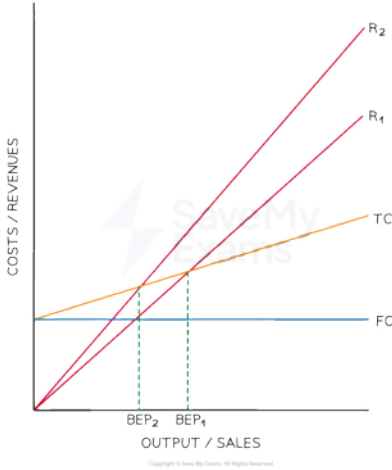
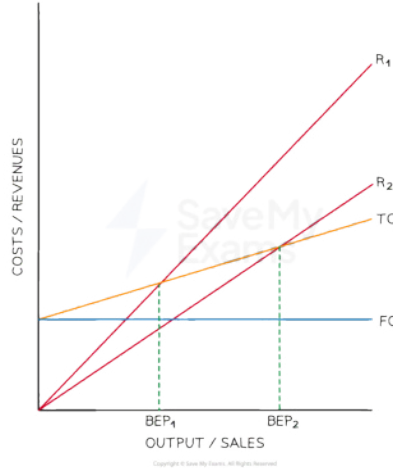
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## Changes to & Limitations of Break-even

### Changes to Break-even

- Changing any of the variables of break-even (selling price, variable cost per unit or total fixed costs) changes **the break-even point and level of profit** it can expect to achieve

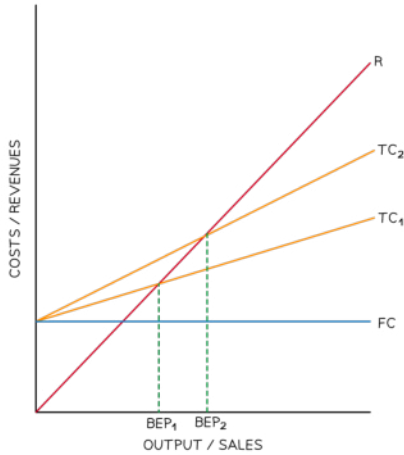
#### How the Break-even Point & Level of Profit is Affected by Changes in Variables

Increased Selling Price	Decreased Selling Price
<ul style="list-style-type: none"> <li>An increase in the selling price <b>reduces</b> the break-even point</li> </ul>  <ul style="list-style-type: none"> <li>An increase in the selling price increases revenue at each level of output from <math>R_1</math> to <math>R_2</math></li> <li>The Break-even Point falls from <math>BEP_1</math> to <math>BEP_2</math></li> <li>Profit on each unit of output greater than the break-even point is increased</li> </ul>	<ul style="list-style-type: none"> <li>A decrease in the selling price <b>increases</b> the break-even point</li> </ul>  <ul style="list-style-type: none"> <li>A decrease in the selling price reduces revenue at each level of output from <math>R_1</math> to <math>R_2</math></li> <li>The Break-even Point rises from <math>BEP_1</math> to <math>BEP_2</math></li> <li>Profit on each unit of output greater than the break-even point is decreased</li> </ul>
Increased Variable Costs	Decreased Variable Costs



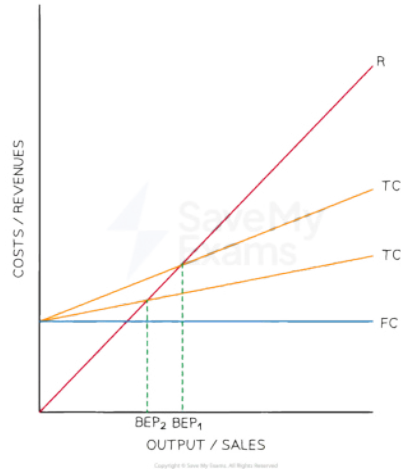
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- An increase in variable costs **increases** the break-even point



- An increase in variable costs increases total costs at each level of output from  $TC_1$  to  $TC_2$
- The Break-even Point increases from  $BEP_1$  to  $BEP_2$
- Profit on each unit of output greater than the break-even point is decreased

- A decrease in variable costs **decreases** the break-even point



- A decrease in variable costs decreases total costs at each level of output from  $TC_1$  to  $TC_2$
- The Break-even Point falls from  $BEP_1$  to  $BEP_2$
- Profit on each unit of output greater than the break-even point is increased

**Increased Fixed Costs**

**Decreased Fixed Costs**

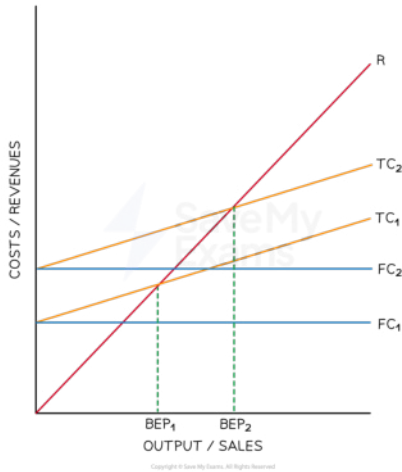
- An increase in fixed costs **increases** the break-even point

- A decrease in fixed costs **decreases** the break-even point

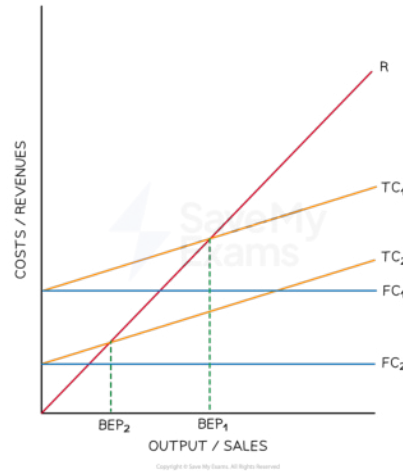




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- An increase in fixed costs increases total costs at each level of output from  $TC_1$  to  $TC_2$
- The Break-even Point increases from  $BEP_1$  to  $BEP_2$
- Profit on each unit of output greater than the break-even point is decreased



- A decrease in fixed costs reduces total costs at each level of output from  $TC_1$  to  $TC_2$
- The Break-even Point falls from  $BEP_1$  to  $BEP_2$
- Profit on each unit of output greater than the break-even point is increased



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## Benefits & Limitations of Break-even Analysis

- Break-even analysis provides valuable insights into the financial viability and performance of a business
- It is particularly useful for **communicating with stakeholders** including investors or lenders
  - It demonstrates the financial viability of the business and gives an insight into potential returns on investment

### The Benefits of Break-even Analysis

Use of Break-even	Explanation
Profitability assessment	<ul style="list-style-type: none"> <li>▪ It allows businesses to <b>assess their profitability</b> by determining the minimum level of sales needed to cover all costs</li> <li>▪ It helps identify the <b>level of sales required to avoid losses</b> and provides a <b>target for achieving profits</b></li> </ul>
Cost control	<ul style="list-style-type: none"> <li>▪ Break-even analysis helps in <b>identifying fixed and variable costs</b> and their impact on the business</li> <li>▪ By understanding the cost structure businesses can <b>evaluate their spending patterns</b> and <b>reduce unnecessary expenses</b></li> </ul>
Pricing decisions	<ul style="list-style-type: none"> <li>▪ Break-even analysis provides insights into pricing decisions by helping businesses <b>determine the minimum price required to cover costs</b> and achieve the desired level of profit</li> <li>▪ It ensures that prices are set at a level that generates <b>sufficient revenue to meet expenses and generate profits</b></li> </ul>
Financial planning	<ul style="list-style-type: none"> <li>▪ Break-even analysis assists in financial planning by providing a <b>reference point for target setting</b> such as realistic sales targets and plans for necessary expenses</li> </ul>
Sensitivity analysis	<ul style="list-style-type: none"> <li>▪ Break-even analysis allows businesses to conduct sensitivity analysis by <b>evaluating the impact of changes in variables such as costs, prices, and sales volumes</b> on the break-even point</li> <li>▪ This helps in <b>understanding the potential risks and uncertainties</b> such as a new competitor entering the market or suppliers increasing prices</li> </ul>

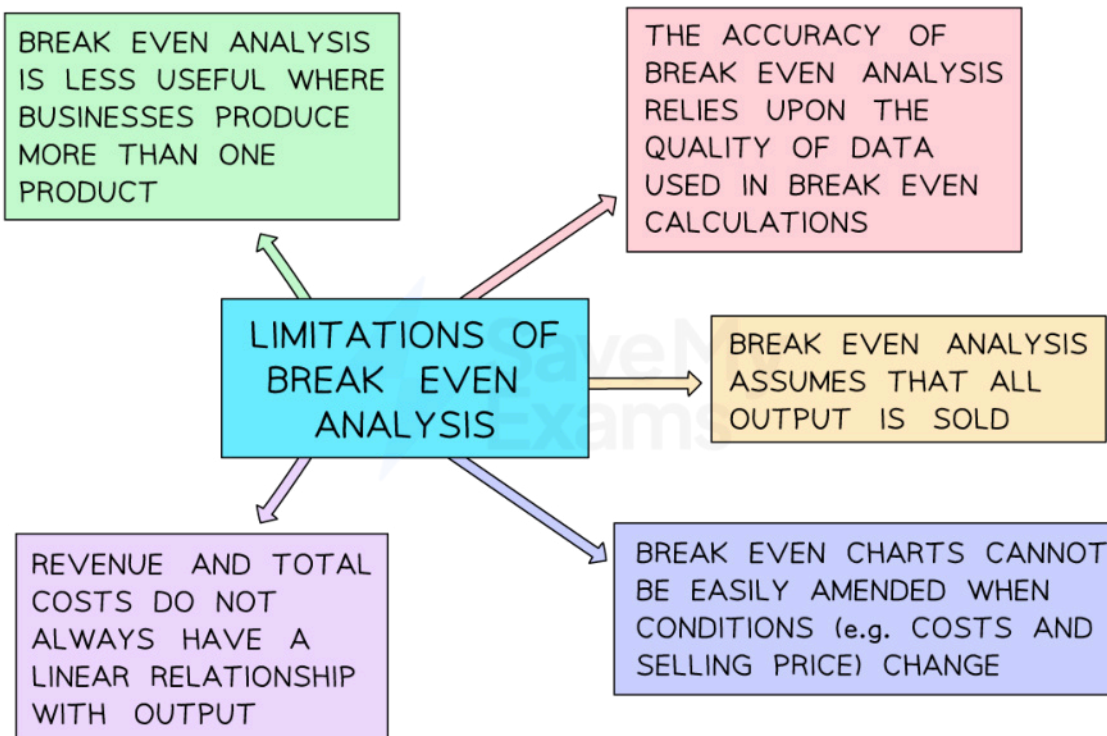


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Performance monitoring	<ul style="list-style-type: none"> <li>▪ Break-even analysis serves as a <b>benchmark for monitoring business performance</b> over time</li> <li>▪ By <b>comparing actual sales and costs against the break-even point</b> businesses can assess their financial health and track progress</li> </ul>
Decision making	<ul style="list-style-type: none"> <li>▪ Break-even analysis provides a <b>basis for informed decision making</b></li> <li>▪ It helps in evaluating the feasibility of new projects and expansion plans - by considering the break-even point, businesses can <b>assess the potential risks and rewards</b> associated with different decisions</li> </ul>

- In common with other **quantitative analysis tools** break-even analysis has some limitations

### Diagram Explaining the Limitations of Break-even Analysis



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### *The limitations of break-even analysis*

 **Examiner Tip**

Break-even analysis has both an important internal and external role too. Businesses looking to borrow money (or attract investors) should take care to model the break even point, margin of safety and level of profit (or loss) at different levels of output and be prepared to justify the figures.

**Your notes**