The big picture

Almost all new businesses will start out as loss-making enterprises. This is because they need to spend money on resources – physical and human – in order to develop and launch their products. New businesses can usually sustain losses for a while, particularly if they have secured large amounts of equity finance from venture capital companies or business angels, or through debt finance from banks or other sources.

At some point, however, businesses must reach the break-even point. Break-even refers to a situation where the total revenue equals the total costs of production. A business is earning zero profit at the break-even point. But the assumption is that if it continues to increase the quantity of the product produced, it will start to earn profits. Total revenues will exceed total costs.

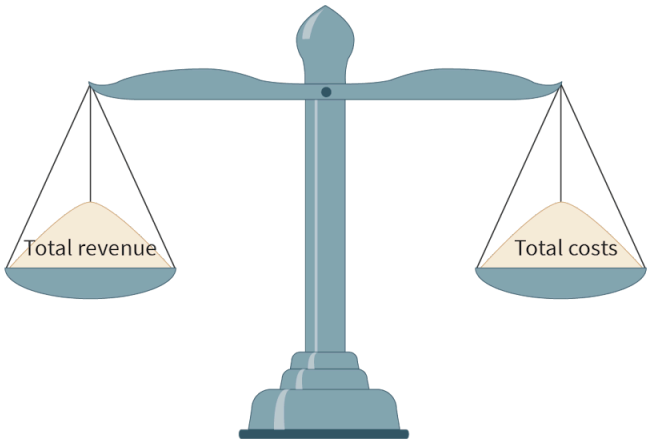

Figure 1. The break-even point is where total revenues equal total costs.

Overview (/study/app/hl/sid-351-cid-762729/o

Break-even analysis is one of the most important financial calculations that a business can make. By carrying out a break-even analysis, a business can anticipate the best price to charge for its product and consider how to change fixed and variable costs so that the business earns a profit earlier. Generally, the sooner the business can move into profit, the more likely it is to be economically sustainable. However, moving to the break-even point too quickly, by considering only short-term objectives, can also cause long-term problems for the business. Poor strategy can also mean a business never achieves profitability and therefore fails. A break-even analysis is often part of a business plan (Section 1.1.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-business-plan-id-36505/)).

An interesting example of this is Paytm, an Indian digital payments company that competes with Google Pay, Apple Pay, and PayPal, among other online payment companies. Paytm secured hundreds of millions of US dollars of financing from large equity investors, such as Berkshire Hathaway and other institutions. Paytm went public, through its parent company One97 Communications Ltd, on the Indian stock market in November 2021, when it was still a loss-making business. It was the largest IPO ever in India. Over the next few months, Paytm's stock price declined as some investors sold stock to realise investment profits, and other investors began to question its long-term growth prospects.

Figure 2. Digital payments company Paytm started out making losses but expects to reach break-even.

Credit: boonchai wedmakawand, Getty Images

In early 2022, Paytm announced that it expected to reach break-even within two years, which was sooner than some analyses expected, but perhaps not soon enough for some investors. It is not uncommon for businesses to take years to reach break-even. This is especially true of businesses, like Paytm, which need to grow very large to reach the economies of scale needed to reduce costs of production. According to Paytm, the company had to deal with some unexpected regulatory and

Student view

Overview (/study/app/business-hl/sid-351-cid-762729/o

privacy issues, which would raise costs. And increases in costs would make the break-even point harder to reach. By the time you read this, the financial situation and ability of Paytm to reach break-even will be clearer.

In this subtopic, you will learn how businesses calculate their break-even point, to draw a break-even chart and how cost and revenue changes alter the break-even analysis. Break-even analysis will also be evaluated as a tool for business decision-making.

Concept

Sustainability (economic)

Businesses/entrepreneurs are risk-takers and strive to make a profit that sustains the business activity. Sustaining business activity is important when businesses are providing for human needs, supporting the wellbeing of diverse stakeholders in the community and providing tax revenue to support public services and infrastructure.

Calculating the break-even point is essential for businesses to understand the role of the price of their produce, total revenues and total costs. Loss-making businesses use break-even analysis to determine when they can expect to achieve profits. This is vital information to determine whether the business has the financial resources to continue running during the initial period of losses that most businesses experience.

Learning objectives from the IBDP Business Management guide with assessment objective level:

- **Distinguish** between total contribution and contribution per unit (AO2)
- **Calculate** the break-even point and **construct** a break-even chart (AO4)
- **Analyse** the effects of changes in price or cost on the break-even quantity, profit and margin of safety using graphical and quantitative methods (AO2, AO4)
- **Discuss** the uses and limitations of break-even as a decision-making tool (AO3)
- **Apply** the contribution tool in a given context (AO2) (HL)

5. Operations management / 5.5 Break-even analysis

Calculating break-even

Student view

Total contribution versus contribution per unit Total contribution versus contribution per unit

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In this section, you will use the same cost and revenue figures for the coffee used in Subtopic 3.3 (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39300/) to explain the break-even point. Recording costs and revenues in a table (as shown in **Table 1**) is one way to find the break-even point.

Making connections

The concepts of fixed costs, variable costs, total costs and total revenues will be used in this section. You learned about costs and revenues in Subtopic 3.3 (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39300/).

Figure 1. Like all businesses, a coffee shop needs to find the break-even point to determine whether the business is viable.

Credit: Yagi-Studio, Getty Images

Table 1. Cost and revenue estimates for the coffee shop.

Quantity of cups of coffee	Variable costs ($)	Fixed costs ($)	Total costs ($)	Sales revenue per month ($) (Price per cup = $4)
0	0	7000	7000	(0 × 4) = 0
500	500	7000	7500	(500 × 4) = 2000

Student view

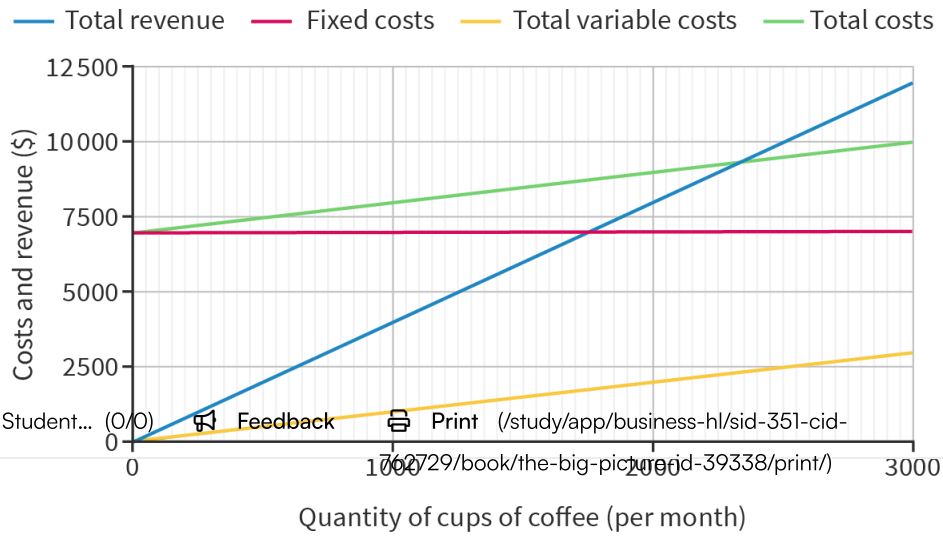
Overview (/study/app/hl/sid-351-cid-762729/o

Quantity of cups of coffee	Variable costs ($)	Fixed costs ($)	Total costs ($)	Sales revenue per month ($) (Price per cup = $4)
1000	1000	7000	8000	(1000 × 4) = 4000
1500	1500	7000	8500	(1500 × 4) = 6000
2000	2000	7000	9000	(2000 × 4) = 8000
2500	2500	7000	9500	(2500 × 4) = 10 000
3000	3000	7000	10 000	(3000 × 4) = 12 000

In **Table 1**, you can see various output levels for the coffee shop for one month, ranging from 0 to 3000. The variable cost of one cup of coffee is $1. Variable costs include the ingredients for the coffee, such as coffee beans, water and milk. So if the coffee shop produces 500 cups of coffee in the month, then the variable costs will be $500.

The fixed costs do not change depending on output. Fixed costs include the rent for the coffee shop, salaries for the workers, and some utilities (amongst other overheads). In the case of this coffee shop, fixed costs are $7000 per month. Adding together the variable costs and fixed costs gives the total costs at each level of output. So if the coffee shop produces 500 cups of coffee, the total costs are $7500.

Total revenue is the price of the cup of coffee multiplied by the number of cups sold. In this case, each cup sells for $4. So if the coffee shop sells 500 cups of coffee, then it would earn $2000 in sales revenue. The sales revenue increases as the number of sales increases, as you can see in **Table 1**. **Figure 2** shows the same data in a chart, which you also saw in Section 3.3.2 (/study/app/business-hl/sid-351-cid-762729/book/revenues-and-revenue-streams-id-39302/).



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Student view

Overview (/study/ap hl/sid-351-cid-762729/o

Figure 2. Total revenue, fixed costs, variable costs and total costs for a coffee shop with one coffee product.

More information for figure 2

The image is a line graph illustrating the financial aspects of a coffee shop with one coffee product. The X-axis represents the quantity of cups of coffee sold per month, ranging from 0 to 3000, while the Y-axis represents costs and revenue in dollars, ranging from $0 to $12,500.

There are four lines plotted on the graph: 1. Total Revenue (blue line): Starts at the origin and rises steeply, indicating a direct proportion between the number of cups sold and revenue. 2. Fixed Costs (red line): Remains constant at around $7,500, regardless of the number of cups sold, showing the costs that do not vary with production levels. 3. Total Variable Costs (yellow line): Starts at the origin and rises gradually, indicating an increase in costs as more cups are sold. 4. Total Costs (green line): Starts at the fixed costs level ($7,500) and rises progressively, reflecting the addition of variable costs to the fixed costs as production increases.

Overall, the graph shows that while total revenue increases sharply with the number of cups sold, total costs also rise but at a slower rate, influenced by fixed and variable costs.

[Generated by AI]

With this information you can also calculate the profits or losses for the coffee shop at various levels of output. The final column of **Table 2** shows the profit or loss information. Remember that figures in brackets indicate a negative value; in this case, losses.

Table 2. Profits for the coffee shop, depending on the level of output or sales.

Quantity of cups of coffee	Total costs ($)	Sales revenue per month ($) (Price per cup = $4)	Profit ($)
0	7000	(0 × 4) = 0	(7000)
500	7500	(500 × 4) = 2000	(5500)
1000	8000	(1000 × 4) = 4000	(4000)
1500	8500	(1500 × 4) = 6000	(2500)
2000	9000	(2000 × 4) = 8000	(1000)

Student view

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Quantity of cups of coffee	Total costs ($)	Sales revenue per month ($) (Price per cup = $4)	Profit ($)
2500	9500	(2500 × 4) = 10 000	500
3000	10 000	(3000 × 4) = 12 000	2000

Table 2 shows that at lower levels of output or sales, the coffee shop is making losses. Only when the shop sells somewhere between 2000 and 2500 cups of coffee per month do the total revenues exceed the total costs. At somewhere between 2000 and 2500 cups of coffee, the shop reaches the break-even point.

Figure 3 shows this data drawn in a graph. You can see the break-even point (BEP), where the total cost and total revenue lines intersect, at the break-even quantity, labeled as Q_{BEP}. In fact, this is another way to find the break-even point, when total revenues are equal to total costs.

$$\text{Break-even point} \rightarrow \text{total revenue} = \text{total costs}$$

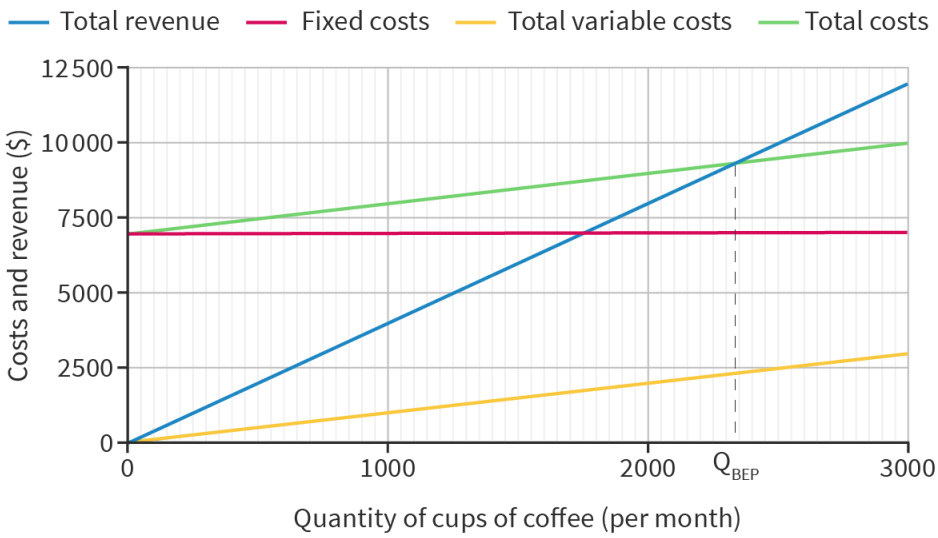

Figure 3. Total revenue, fixed costs, variable costs and total costs for a coffee shop with one coffee product.

More information for figure 3

The graph displays the relationship between the quantity of coffee sold per month and the associated costs and revenue in dollars for a coffee shop. The x-axis represents the quantity of cups of coffee sold per month, ranging from 0 to 3000. The y-axis represents costs and revenue in dollars, ranging from 0 to 12500. There are four lines plotted:

1. **Total Revenue** (Blue line): Starts at 0 and increases linearly, reaching $12500 at 3000 cups.
2. **Fixed Costs** (Red line): Starts at a constant value of approximately $4470 and remains constant across all quantities.
3. **Total Variable Costs** (Yellow line): Begins at 0, increasing linearly to around $7450 at 3000 cups.

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

4. **Total Costs** (Green line): Starts at the fixed cost level and increases linearly, reaching about $11920.

The graph also marks the Break-even Point (Q_BEP), where total costs intersect with total revenue, close to 2000 cups, indicating the point at which the business starts to make a profit.

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Contribution per unit and total contribution

You should be aware that even at low levels of output, the assumption is that the coffee shop can cover the variable costs of the coffee with its revenues. Each cup of coffee has a variable cost of only $1, but the shop charges customers $4. This means that for each cup of coffee sold, the shop has $3 that it can use to pay some of the $7000 fixed costs. The $3 'contributes' to paying the fixed costs; it is called the contribution per unit. The total contribution refers to all the contributions summed at a certain level of output.

Contribution per unit and total contribution are calculated using the following formula:

$$\text{Contribution per unit} = \text{price per unit} - \text{variable cost per unit}$$

$$\text{Total contribution (at a certain quantity)} = \text{contribution per unit} \times \text{quantity (output)}$$

Reaching the break-even point requires the coffee shop to cover the fixed costs with its contributions from each cup of coffee. Once the shop has sold enough cups of coffee so that all the fixed costs have been covered by these contributions (total contribution), the business will break even. In this case, it means that the shop needs to sell cups of coffee until the accumulated $3 contributions are equal to the $7000 fixed costs. Thus, the formula for break-even quantity is:

Break-even quantity = fixed costs ÷ contribution per unit

= $7000 ÷ $3

= 2334 cups

(This is 2333.33 rounded up to the next whole number.)

Student view

Overview (/study/app/hl/sid-351-cid-762729/o

Because it is not possible to produce a partial cup of coffee, the number is rounded up to the next cup. So the break-even quantity for the coffee shop is 2334 cups of coffee per month.

Once the total contribution is greater than the fixed costs, then the business has earned a profit of that amount. This will become important later when you learn about target profit calculations.

Exam tip

When you calculate the break-even quantity, you may find that you get a fraction of a product, as in the example above. In this case, always round up to the next whole number.

Of course, a business will not want to limit its output to the break-even quantity. This would be too risky, because even a small reduction in output, increases in costs of production, or lower revenues would immediately lead to losses. So businesses aim to produce far above the break-even quantity. This will increase their profits and also provide a buffer against changes that might increase costs, such as inflation, or changes that might reduce revenues, such as increased competition.

The margin of safety is the difference between the break-even quantity and the current level of output. It shows how far output can fall before the business would start to experience losses.

Imagine that the coffee shop is actually selling 3200 cups of coffee per month. The margin of safety is calculated as follows:

Margin of safety = actual output – break-even quantity

= 3200 – 2334

= 866 cups

Target profit, target output and target price

Businesses will often have profit, output or price objectives and break-even analysis can help understand the implications of those objectives.

Target profit

Some businesses may have a specific profit objective (Subtopic 1.3 (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-36515/)) in mind and can use break-even analysis to determine the quantity or output necessary to reach their profit goals. These profit goals are known as the target profit.

Student view

Overview (/study/app/hl/sid-351-cid-762729/o

Again, using the example of the coffee shop, imagine that you wanted to earn $4000 in profits per month. You know from the previous work that when the total contribution is greater than the fixed costs, the business is earning a profit. Thus, one way of calculating profit is:

$$\text{Profit} = (\text{output} \times \text{contribution per unit}) - \text{fixed costs}$$

You already know the profit you want to achieve, however. So you can input the information you have and solve for the variable you do not have; the target output that would give you your desired profits.

$4000 = (output × $3) – $7000

$11 000 = output × $3

$11 000 ÷ 3 = output

Target output = 3667 cups

(This is 3666.67 rounded up to the next whole number.)

Target output

A business may set a target output (or planned output). These plans could be related to the capacity of the business, such as seats in a restaurant, bicycles in a commercial bike park, or places in a school. A business might also set planned output in order to carry out sales forecasting or for another reason.

Break-even analysis will allow the business to determine what the profits or losses will be under different output scenarios. Using the data from **Table 1**, you can see that if the coffee shop plans to sell 3000 cups of coffee, it can anticipate $2000 in profits at the current price of $4 per cup. As was already discussed, when the planned output is above the break-even quantity, this provides the business a margin of safety.

You can also use the profit formula to determine the profits at the planned level of output:

Profit = (output x contribution per unit) – fixed costs

= (3000 × $3) – $7000

Student view

Overview (/study/app/hl/sid-351-cid-762729/o

= $2000

Target price

Sometimes a business needs to set a target price. For example, the coffee shop could face new competition that only charges $3.50 for a cup of coffee. To be more competitive, the coffee shop may want to consider lowering the price of its own coffee. This would reduce the contribution per unit to $2.50 and the break-even quantity would increase. Knowing that, the coffee shop may need to change its product, promotion or other elements of the marketing mix in order to achieve break-even. You will explore more implications of changes to costs and revenues in Section 5.5.3 (/study/app/business-hl/sid-351-cid-762729/book/impact-of-changes-in-price-or-costs-on-breakeven-id-39498/).

Table 3. Summary of equations related to break-even analysis.

Equation	Formula	Units	Comment
Contribution per unit	Selling price — variable cost per unit	Currency (for example € or $)	
Total contribution	Contribution per unit × output	Currency (for example € or $)	
Break-even quantity (BEQ)	Fixed cost ÷ contribution per unit	Units of output	Always round decimals up. A low figure is desirable.
Margin of safety	Current level of output — break-even point	Units of output	A high figure is desirable.
Profit (at a certain level of output)	(Output × contribution per unit) — fixed costs	Currency (for example € or $)	

Activity

Learner profile: Thinkers
Approaches to learning: Thinking skills (transfer)

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

Figure 4. Break-even at a pizza restaurant.
Credit: milanfoto, Getty Images

Imagine that you are thinking about opening a simple, takeaway pizza restaurant in a space that has recently become available to rent in your town. As a part of your business plan, you decide to carry out a break-even analysis in order to determine whether setting up the pizza restaurant is a good idea.

According to your research, the average variable costs of making one pizza are $1.50. This would include flour, yeast, tomatoes, cheese and the pizza toppings. Fixed costs are much higher, at $13 000 per month. This would include salaries for multiple employees, rent, electricity and other utilities as well as other overheads. You are thinking about charging an average price of $12.50 per pizza.

You would like to earn $5000 in profit each month.

Questions

1. Calculation the contribution per unit.
2. Calculate the break-even quantity.
3. Calculate the target output for the desired level of profit.
4. Calculate the margin of safety at the target output.

Question 1

Contribution per unit = (price per unit — variable cost per unit)

= $12.50 — $1.50

= $11

This is the amount of money from selling each pizza that can ‘contribute’ to paying the fixed costs.

Student view

Question 2

Overview (/study/ap hl/sid-351-cid-762729/o

Break-even quantity = (fixed cost ÷ contribution per unit)

= $13 000 ÷ $11

= 1182 pizzas per month

(This is 1181.82 rounded up to the next whole number.)

The break-even quantity is the minimum number of pizzas that you must sell in a month in order to cover your total costs.

Question 3

Profit = (output × contribution per unit) — fixed costs

$5000 = (output × $11) — $13 000

$18 000 = output × $11

$18 000 ÷ $11 = output

= 1636 pizzas per month

The pizza restaurant will have to produce 1636 pizzas every month to reach a profit of $5000. If the restaurant is open seven days per week, that is equivalent to about 54 to 55 pizzas per day.

Question 4

Margin of safety = (target output — break-even quantity)

= 1636 — 1182

= 454 pizzas per month

A margin of safety of 454 pizzas tells you that you can afford to sell 454 fewer pizzas next month and you will still be able to pay your total costs. At that level, however, you will not have any profits for yourself. A business will normally strive for a margin of safety that is as large as possible in order to earn more profits and also to act as a buffer if costs of production rise or revenues decline.

Activity

Learner profile: Thinkers
Approaches to learning: Thinking skills (transfer)

Divia's Driving School

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

Last year, Divia took out a $22 000 loan to buy a car. Since then, she has decided to change careers and has set up her own business as a driving instructor.

Figure 5. Divia's Driving School.
Credit: Deepak Sethi, Getty Images

In addition to the monthly loan repayments, Divia has to pay insurance, tax and advertising costs. These are her fixed costs. Divia's fixed costs are $800 per month.

Divia charges $15 for each one-hour driving lesson. She estimates that each lesson costs her about $3 in petrol.

In an average month, Divia will give around 80 driving lessons. This is her output.

Questions

1. Calculate the contribution per unit for Divia's driving lessons.
2. Calculate the break-even quantity for Divia's Driving School.
3. Calculate the total contribution for the actual monthly output.
4. Calculate the margin of safety.

Question 1

Contribution per unit = (price per unit — variable cost per unit)

= $15 — $3

= $12

This is the amount of money for each driving lesson that can 'contribute' to paying the fixed costs.

Student view

Question 2

Overview (/study/ap hl/sid-351-cid-762729/o

Break-even quantity = (fixed cost ÷ contribution per unit)

= $800 ÷ $12

= 67 lessons

(This is 66.7 rounded up to the next whole number.)

The break-even quantity is the minimum number of driving lessons that Divia must sell per month in order to cover her total costs. As a reminder, the break-even quantity is always expressed as a whole number, so you would always round a fraction of a unit to the next higher unit.

Question 3

Total contribution = (contribution per unit × actual quantity or output)

= $12 × 80 lessons

= $960

The total contribution is found by adding all the individual contributions per unit that Divia makes from each lesson given. If this number is greater than the total costs, then Divia will make a profit. If not, Divia will make a loss.

Question 4

Margin of safety = (actual output — break-even quantity)

= 80 lessons — 67 lessons

= 13 lessons

A margin of safety of 13 lessons tells you that Divia can afford to sell 13 fewer lessons next month and she will still be able to pay her total costs. A business will normally strive for a margin of safety that is as large as possible in order to earn more profits and also to act as a buffer if costs of production rise or revenues decline.

3 section questions

Question 1

Use the following information to calculate the break-even quantity. Express the result as a number of units, with the number only.

Student view

Fixed costs = $200

Selling price = $10

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Variable costs = $8

Output = 150 units

100 ✓

Accepted answers
100

Explanation
Break-even quantity = fixed costs ÷ contribution per unit

= $200 ÷ ($10 — $8)

= $200 ÷ $2

= 100 units

Note: Break-even quantity is always expressed in units of output (quantity), not currency.

Question 2

Use the following information to calculate the margin of safety.

Fixed costs = $10

Selling price = $4

Variable costs = $2

Actual output = 15 units

1 10 units ✓

2 5 units

3 $7.50

4 $25.00

Explanation
The margin of safety is calculated by subtracting the break-even point from the current output.

Student view

Break-even point = fixed costs ÷ contribution per unit

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The break-even point is $10 ÷ ($4-$2), which is 5 units of output.

Current output — break-even point = margin of safety

Therefore, as the output is 15 units, the margin of safety must be 10 units.

Question 3

If the break-even quantity is 50 units, the selling price is $20 and variable costs per unit are $15, what are the fixed costs?

1 $250 ✓

2 $10

3 $50

4 $85

Explanation

Break-even quantity = fixed costs ÷ contribution per unit

Rearranging this formula gives:

Fixed costs = break-even quantity x contribution per unit

In this case, the contribution per unit is $5 ($20 — $15)

Therefore, fixed costs are equal to 50 x $5, which is $250.

5. Operations management / 5.5 Break-even analysis

Break-even charts

Aspects of break-even analysis Aspects of break-even analysis

Student view

Break-even charts are a graphical representation of a company's costs and revenues. It is very helpful to see costs and revenue figures in graphic form because it makes visually spotting the break-even point easy. Seeing the impact of changing costs and revenues is also helpful.

Overview (/study/ap hl/sid-351-cid-762729/o

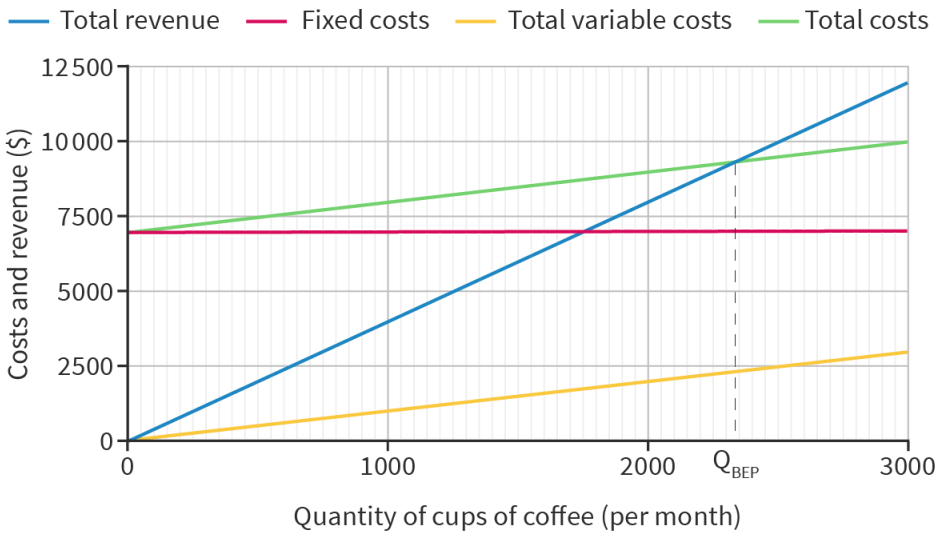

Figure 1. Total revenue, fixed costs, variable costs and total costs for a coffee shop with one coffee product.

More information for figure 1

The graph illustrates a break-even chart for a coffee shop that sells a single coffee product. The X-axis represents the quantity of coffee cups sold per month, ranging from 0 to 3000. The Y-axis represents costs and revenue in dollars, ranging from 0 to 12500. There are four lines on the graph:

1. Total Revenue (blue line) starts at the origin and increases linearly, showing a positive slope that continues rising across the entire quantity range.
2. Fixed Costs (red line) remains constant throughout, drawn horizontally around $7500, indicating consistent expenditures regardless of sales volume.
3. Total Variable Costs (yellow line) starts at $0 and rises gradually, indicating a linear increase as more coffee is sold.
4. Total Costs (green line) begins at the fixed cost level and increases at a rate parallel and inclusive of total variable costs, intersecting the total revenue line.

The intersection point of the Total Revenue and Total Costs lines is marked "Q_BEP", indicating the break-even point where revenue exceeds total costs, signifying a no-profit, no-loss situation.

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In IB examinations, it is extremely common to be asked to construct a break-even chart. Although this is a relatively simple task, many students lose marks as they rush their work and make simple mistakes. So it is good to learn how to do it right!

Student view

Overview (/study/app/business-hl/sid-351-cid-762729/o

Constructing a break-even chart

Exam tip

Students often make mistakes when drawing charts for the exam. You may wish to draw your charts in pencil so you can easily correct mistakes. When you are finished, you can quickly go over it in pen to darken the lines on the IB graph paper so it will scan better and be easier for the examiner to read.

Using the information from Divia's Driving School in the previous section, you can explore how to construct a break-even chart. Again, the key figures to remember are:

- Selling price = $15
- Variable costs per unit = $3
- Fixed costs = $800
- Actual output = 80 lessons
- Break-even quantity = 67 lessons

Figure 2. Divia needs to sell 67 driving lessons per month for her driving school business to break-even.

Credit: Deepak Sethi, Getty Images

Step 1: Calculate the break-even quantity

You already completed this in the previous section activity, finding that the break-even quantity for Divia's Driving School is 67 lessons.

Student view

Overview (/study/app/business-hl/sid-351-cid-762729/o

Step 2: Construct a quick table to record information for the cost and revenue lines

Because you only need two points to draw each line, it is helpful to choose two quantity values from the *x*-axis and complete the cost and revenue information with those values, as in **Table 1** below.

Table 1. A quick table to record two values for each variable.

Quantity of lessons	Variable costs ($)	Fixed costs ($)	Total costs ($)	Total revenue ($)
0	0	800	800	0
140	420	800	1220	2100

Zero is a logical starting point and easy to calculate cost and revenue values, as you can see in the first row of **Table 1**. The second quantity should be at least double the break-even quantity. Choosing a quantity that is double the break-even gives your graph symmetry and ensures that you can clearly see a range of values for profit as well as losses.

Step 3: Draw the two axes

The *x*-axis shows different quantities of production, so is labelled 'Output' or ‘Quantity’.

The maximum quantity on the *x*-axis should be at least double the BEQ. This way, the BEP/BEQ can be in the middle of the graph, and it becomes easier to draw and to analyse. Consider a logical way to space out the scale. In this case, it makes sense to label up to 150 and use each grid line to represent 5 units.

The y-axis is labelled 'Revenue and costs', both of which are measured in $, or whichever currency is used in the case study.

The maximum value on the *y*-axis will be the total revenue at the highest quantity registered on the *x*-axis, in this case $2100. Consider a logical way to space out the scale. In this example, it makes sense to label up to $2500 and use each grid line to represent $100.

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

Figure 2. Draw the two axes of the break-even chart.

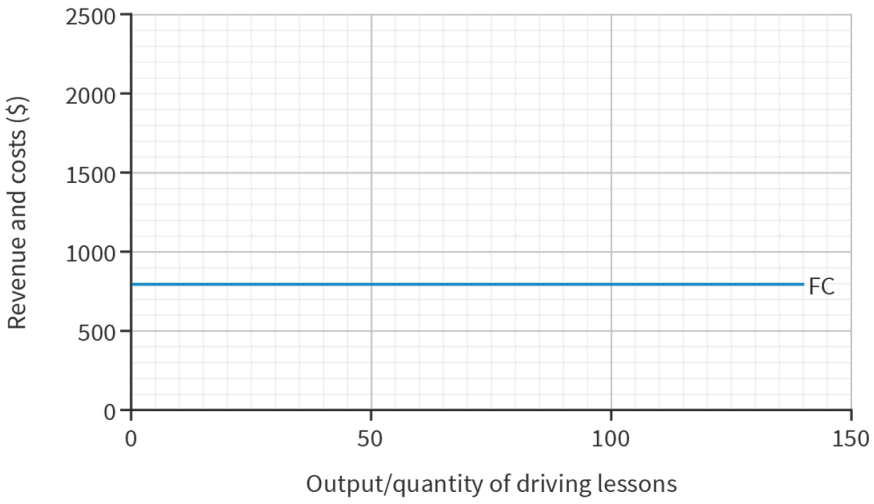
More information for figure 2

This graph depicts a break-even chart for driving lessons. The X-axis is labeled as 'Output/quantity of driving lessons' and represents the number of driving lessons provided. The Y-axis is labeled as 'Revenue and costs ($)' and represents the financial aspect, using a scale up to $2500, with each grid line representing $100 increments. The grid serves as a backdrop for plotting potential revenue lines against the quantity of lessons provided, though the actual data points or curves are not depicted yet in this graph.

[Generated by AI]

Step 4: Draw the fixed costs line

Fixed costs can be defined as those costs that do not vary directly with output. So, no matter what the level of output, they remain the same. This makes drawing the fixed costs line easy. It is always a straight horizontal line cutting the *y*-axis at the level of fixed cost. For Divia's Driving school, the fixed costs are $800.



Student view

Overview (/study/ap hl/sid-351-cid-762729/o

Figure 3. Add the fixed costs (FC) line to the break-even chart.

More information for figure 3

The image is a graph showing the relationship between the revenue and costs (in dollars) on the Y-axis and the output/quantity of driving lessons on the X-axis. Both axes are labeled, with the Y-axis ranging from 0 to 2500 and the X-axis ranging from 0 to 150. The graph contains a horizontal line labeled "FC" at the $800 mark on the Y-axis, indicating fixed costs. This line extends across the graph horizontally, reflecting that fixed costs remain constant regardless of the number of lessons provided. Fixed costs are visually represented as a straight blue line across the grid at the $800 level.

[Generated by AI]

Step 5: Draw the total costs line

As you can see from the table, total costs can be calculated by simply adding together fixed costs and total variable costs. Since total variable costs are always zero when output is zero, this means that the total costs line will always start on the *y*-axis, at the same point as the fixed cost line.

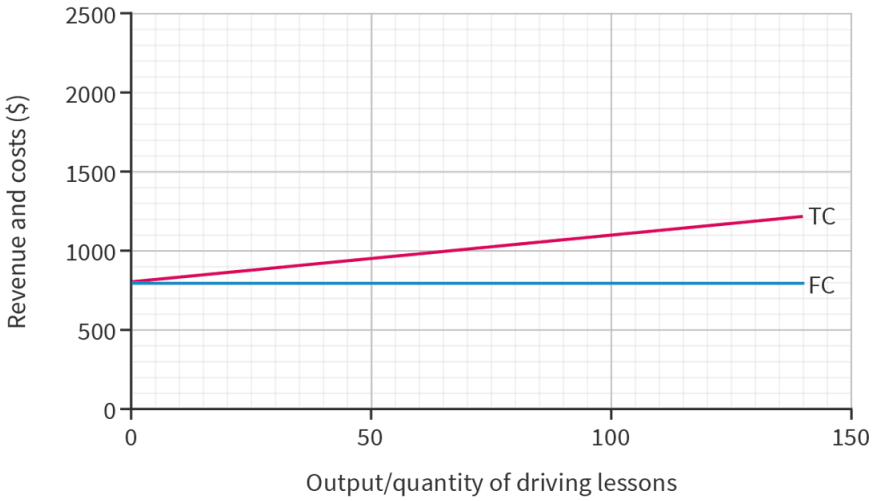


Figure 4. Draw the total costs (TC) line.

More information for figure 4

The graph displays two lines representing costs against the output or quantity of driving lessons. The X-axis is labeled 'Output/quantity of driving lessons' and ranges from 0 to 150. The Y-axis is labeled 'Revenue and costs ($)' and ranges from $0 to $2500.

There are two lines on the graph: 1. The fixed costs (FC) line is a horizontal line at $1000, indicating that the fixed costs remain constant regardless of the number of driving lessons. 2. The total costs (TC) line starts at the same point as the FC line on the Y-axis (at $1000) and slopes upwards, showing an increase in total costs as the number of driving lessons increases.

Student view

Overview (/study/app/hl/sid-351-cid-762729/o

The graph illustrates how total costs encompass both fixed and variable costs, with the variable costs increasing with the quantity of lessons, leading to the upward sloping TC line.

[Generated by AI]

Step 6: Draw the total revenue line

Total revenue is all the money a business receives from selling goods and services. If a business sells zero quantity, then its total revenue will be zero. Therefore, the total revenue line always begins at the origin.

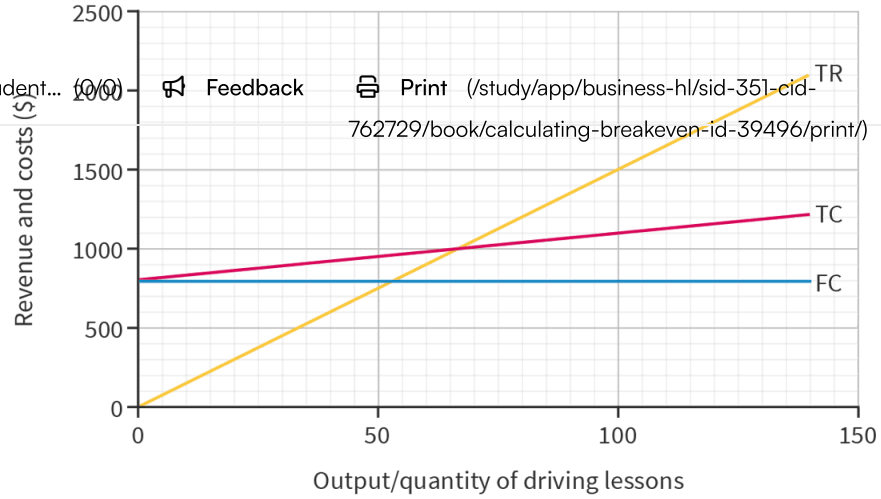


Figure 5. Draw the total revenue (TR) line.

More information for figure 5

The image is a graph displaying a comparison between revenue and costs in relation to the output or quantity of driving lessons. The X-axis represents the output/quantity of driving lessons, ranging from 0 to 150. The Y-axis represents revenue and costs in dollars, with increments showing $500, $1000, $1500, $2000, and $2500.

There are three distinct lines on the graph: 1. **TR (Total Revenue)**: This line starts from the origin point (0,0) and rises steadily across the graph, indicating that as the number of driving lessons increases, the total revenue correspondingly increases. 2. **TC (Total Cost)**: This line is positioned above the FC line and starts at approximately $1000 on the Y-axis, rising slowly. It shows the incremental increase in costs with additional driving lessons. 3. **FC (Fixed Cost)**: This line remains constant across the graph at approximately $1000, illustrating fixed costs that do not change with the number of lessons.

The graph highlights the relationships between fixed costs, total costs, and total revenue, demonstrating how these factors scale with increased quantities.

Student view

[Generated by AI]

Overview (/study/ap hl/sid-351-cid-762729/o

Step 7: Mark the break-even point and break-even quantity

Break-even quantity is the output where total revenue and total costs are the same. No profit or loss is made. On a break-even chart, it can be found at the break-even point, where the total cost and total revenue lines cross. You can indicate the break-even quantity with a dotted line.

At this point, you need to check that your total revenue line intersects with the total cost line at the break-even point (BEP), and label the break-even quantity (BEQ) that you calculated in Step 1.

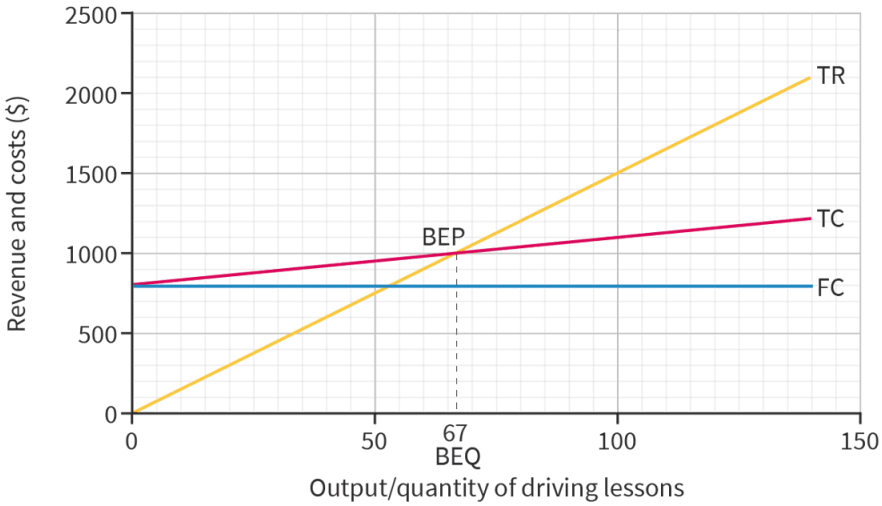


Figure 6. Mark the break-even point (BEP) where the TR and TC lines cross, and the break-even quantity (BEQ).

More information for figure 6

The graph illustrates the break-even analysis for driving lessons. The X-axis represents the output or quantity of driving lessons with a range from 0 to 150. The Y-axis shows revenue and costs in dollars, ranging from 0 to 2500. Three lines are visible: the Total Revenue (TR) line, which is upward sloping; the Total Cost (TC) line, which slopes gently upwards; and the Fixed Cost (FC) line, which is horizontal. The break-even point (BEP) is marked where the TR and TC lines intersect at 67 lessons, where the break-even quantity (BEQ) is labeled. This point indicates where total revenue equals total costs, delineating profit and loss regions on the graph.

[Generated by AI]

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

Step 8: Mark the current (or planned) output and indicate the margin of safety (if the question requires)

The margin of safety is the difference between the actual, current (or planned) level of output and the break-even quantity. This can easily be added to a break-even chart by finding the output figure on the *x*-axis and then marking the difference between that and the break-even quantity.

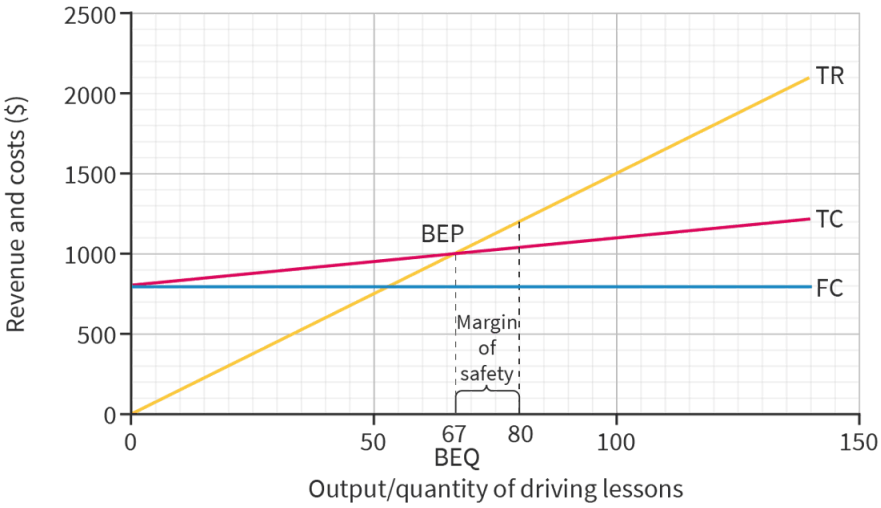


Figure 7. Mark the current (or planned) output and indicate the margin of safety.

More information for figure 7

The image is a break-even graph showing the relationship between revenue and costs against the output or quantity of driving lessons. The x-axis represents the BEQ (Break-Even Quantity), ranging from 0 to 150. The y-axis represents revenue and costs in dollars, ranging from 0 to 2500.

Several lines are plotted: - The Total Revenue (TR) line starts at the origin (0,0) and increases linearly upward, indicating increasing revenue with more driving lessons. - The Fixed Cost (FC) line is a horizontal line starting around the $1000 level, indicating fixed costs that do not change with more driving lessons. - The Total Cost (TC) line starts at the fixed cost level ($1000) and inclines gradually, representing total cost which includes both variable and fixed costs.

The Break-Even Point (BEP) is marked where the TC line intersects with the TR line, indicating the output level where costs equal revenue. The Margin of Safety is labeled between the BEP and the 80 driving lessons mark, illustrating the difference between planned output and the break-even point.

[Generated by AI]

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

Step 9: Shade in the profit and loss

A company will only make a profit if its output is greater than its break-even quantity. If it fails to achieve these sales levels, it will make a loss. Any output to the right of the break-even quatity will lead to profit, while any output to the left of the break-even quantity represents a loss.

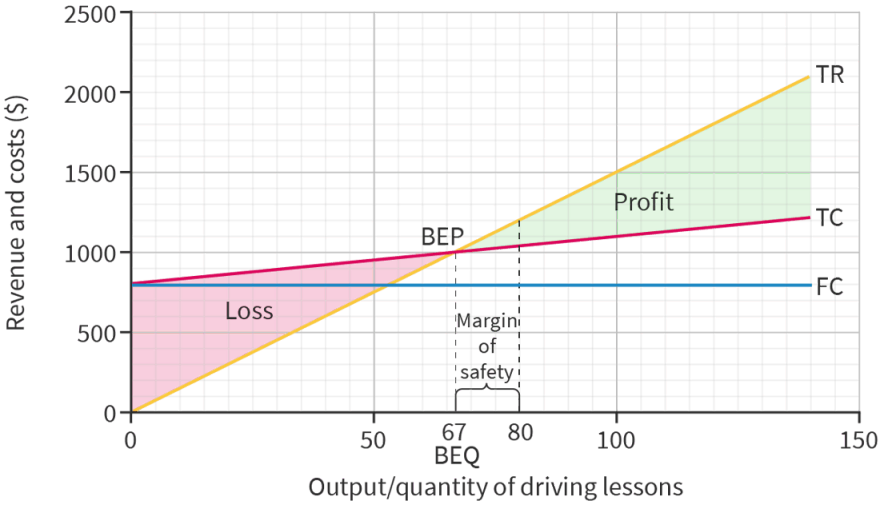


Figure 8. Shade in the profit and loss.

More information for figure 8

The graph represents revenue and costs against output/quantity of driving lessons. The x-axis is labeled "Output/quantity of driving lessons" ranging from 0 to 150. The y-axis represents "Revenue and costs ($)" ranging from 0 to 2500.

A point labeled "BEP" (Break-Even Point) occurs at approximately 67 lessons on the x-axis and $1500 on the y-axis. To the left of BEP is a shaded red region labeled "Loss," indicating a loss in revenue and costs below the break-even output. To the right is a green shaded area labeled "Profit," indicating profits above this point.

There are lines labeled "TR" (Total Revenue), "TC" (Total Costs), and "FC" (Fixed Costs). There is also a vertical dashed line indicating the "Margin of Safety," located between the BEP at 67 lessons and a slightly higher quantity around 80 lessons.

[Generated by AI]

Exam tip

When you construct a break-even chart, you are expected to draw it to scale. This means that you need to be very careful how to number the quantities on the x-axis and the costs/revenues on the y-axis. This is a simple step that many students are not able to execute properly, especially under time constraints.

Student view

Overview (/study/app/hl/sid-351-cid-762729/o

Make use of the grid lines on graph paper to help you scale your axes properly. Once you have the maximum values for each axis, you must break down that number into uniform distances using the grid lines. So if the maximum quantity you have on your graph is 1000, you might consider making each grid line worth 50 (which would make use of 20 grid lines on your graph paper). If the maximum quantity is 200, then each grid line might be worth 10.

It is useful just to practise identifying an appropriate scale and labelling numbers on an axis as a separate skill. You could ask your teacher to set out some exercises just for this.

Activity

Learner profile: Thinkers
Approaches to learning: Thinking skills (transfer)

In Section 5.5.1 (/study/app/business-hl/sid-351-cid-762729/book/calculating-breakeven-id-39496/), you carried out an activity to calculate the following information for a pizza restaurant:

- the break-even quantity
- the target output for the desired level of profit
- the margin of safety at the target output

Now use the cost and revenue information to create a break-even chart for the same pizza restaurant, making sure you:

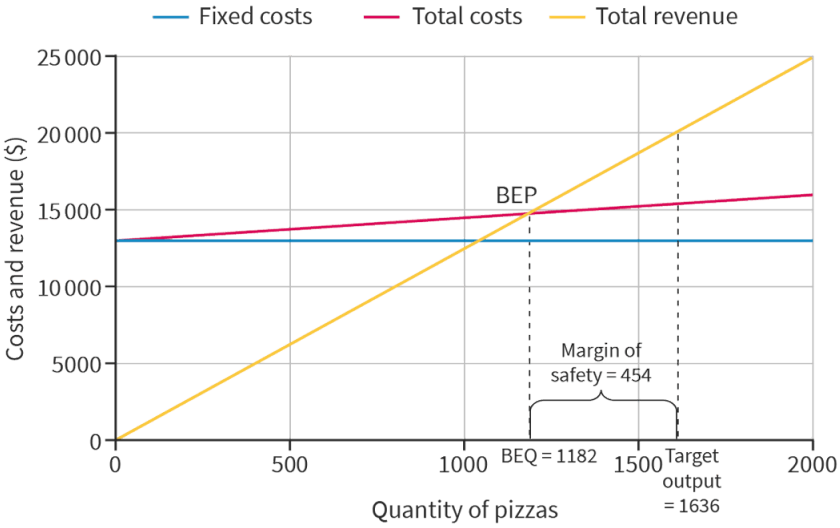
- include a title
- label both axes
- draw lines for fixed costs, total costs, and total revenue
- identify the break-even point (BEQ) and the break-even quantity (BEQ)
- identify the margin of safety at the target output

The data for creating the break-even chart for the pizza restaurant.

Quantity	Variable costs ($)	Fixed costs ($)	Total costs ($)	Total revenue ($)	
0	0	13 000	13 000	0	
500	750	13 000	13 750	6250	
1000	1500	13 000	14 500	12500	
1500	2250	13 000	15 250	18750	

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

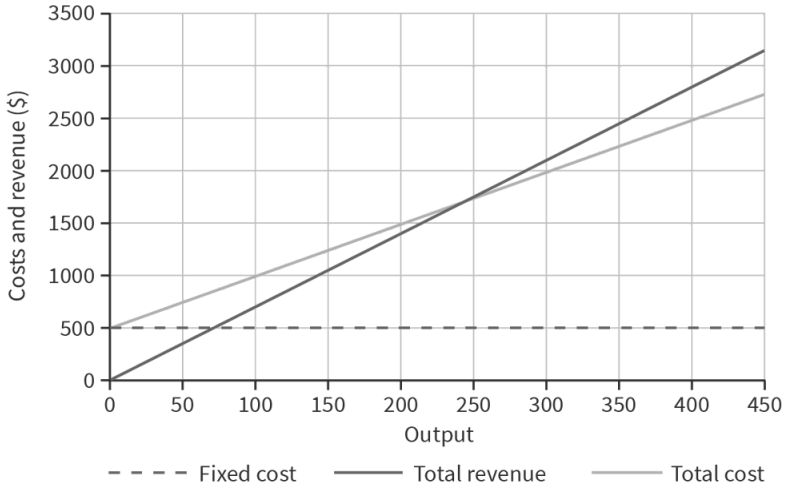


The break-even chart for the pizza restaurant.

4 section questions

Question 1

In the diagram below, what is the break-even level of output? (Hint: the answer is a number explicitly listed on the horizontal axis - express your answer as a number of units, giving the number only.)



More information

250

Accepted answers

250

Explanation

Overview (/study/ap hl/sid-351-cid-762729/o

The break-even point (or break-even level of output) can be found where total revenue is equal to total costs. In this case, it is at an output of 250.

Question 2

In a break-even chart, the 1 Fixed cost ✓ line is always drawn horizontally, parallel to the *x*-axis.

Accepted answers and explanation

#1 Fixed cost

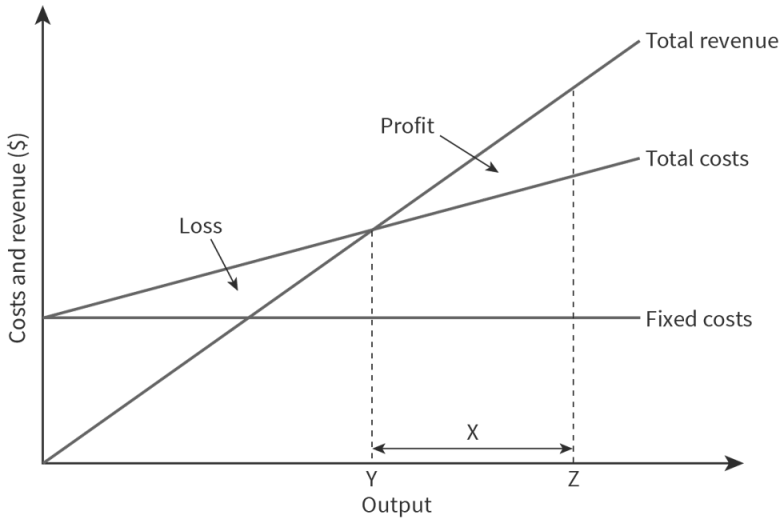
fixed costs

General explanation

Fixed costs are those that do not vary directly with output. The x-axis on a break-even chart displays the output. A horizontal line shows that fixed costs are constant at every level of output.

Question 3

In the diagram below, what does X represent?



More information

1 Margin of safety ✓

2 Loss

3 Total variable costs

4 Profit

Student view

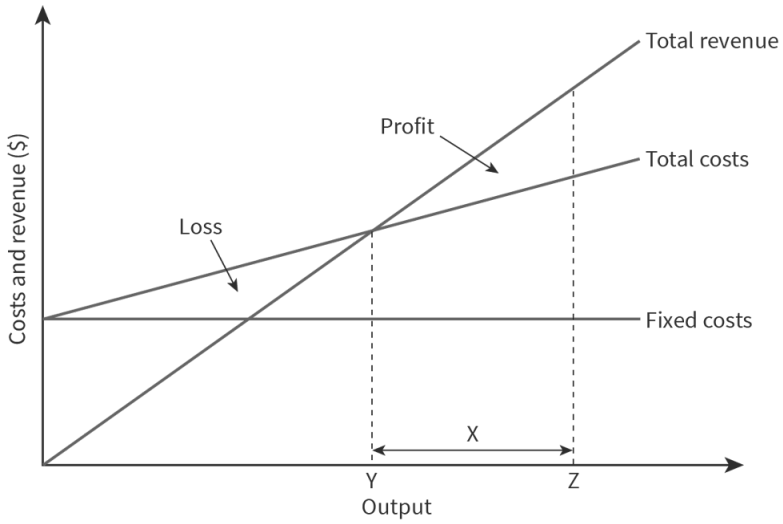
Overview (/study/ap hl/sid-351-cid-762729/o

Explanation

The margin of safety is the difference between a company's break-even point and its current or planned level of output.

Question 4

In a break-even chart, where does the total cost line begin?



More information

1 Where the fixed costs line intersects the *y*-axis ✓

2 After the margin of safety

3 At the break-even point

4 On the *x*-axis

Explanation

Total costs are the fixed costs plus total variable costs. At zero output, variable costs are zero, therefore total cost and fixed cost must start at the same point.

5. Operations management / 5.5 Break-even analysis

Impact of changes in price or costs on break-even

Student view

Analysing changes in price or cost Analysing changes in price or cost

A break-even chart can help a business determine the output needed to earn a profit. It is a useful tool for business planning. However, the environment in which businesses operate is dynamic. Changes in internal and external factors can affect total revenues and total costs, even on an hourly or daily basis. Thus, businesses must constantly adjust their break-even analyses to reflect the changes they experience.

International Mindedness

Many businesses operate in multiple countries. Changes to the external environment in those countries, including changes to international supply chains, can have a positive or negative impact on costs of production and change the break-even quantity.

The interactive charts below can help you understand how the break-even quantity can change with changes to total revenue and fixed, variable and total costs.

Changes in total revenue

Figure 1 shows the break-even chart for Divia's Driving School with the detailed figures removed for simplicity. Use the slider to change the position of the total revenue line according to the two situations below, and answer the questions.

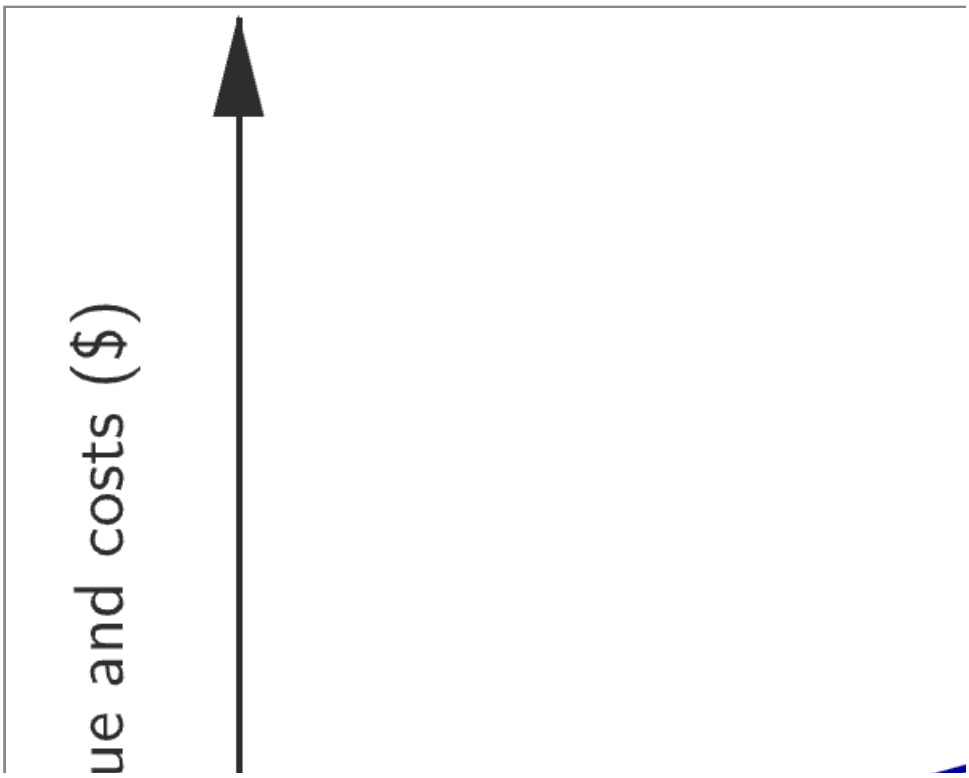


Figure 1. Impact of changes in total revenue on the break-even quantity.

More information for figure 1

An interactive break-even chart represents the financial situation showing the relationship between total revenue (TR), total costs (TC), and the break-even point (BEQ). It helps users understand how changes in pricing and demand affect a business's profitability.

The output level where TR equals TC, meaning no profit or loss. The x-axis represents the quantity of driving lessons provided, while the y-axis represents revenue and costs in dollars. The BEQ is where the TR line intersects the TC line. By moving the slider, users can explore different scenarios.

When total revenue increases, the TR line shifts upwards and becomes steeper, meaning revenue per unit is higher. The BEQ moves left, meaning fewer sales are needed to cover costs and start making a profit. The TC and FC lines remain unchanged because costs do not directly change with revenue.

When the total revenue decreases the TR line shifts downwards and becomes less steep, indicating lower revenue per unit. The BEQ moves right, meaning more sales are needed before covering costs. The TC and fixed cost (FC) lines remain unchanged, as they depend on production and operational expenses, not revenue.

Through this interactivity, users will gain insights into the principles of break-even analysis, understanding how pricing strategies, market competition, and demand influence a business's financial health.

Situation 1

Divia has started to use social media to improve promotion. Demand increases and Divia raises her prices, but she keeps the same number of customers. As a result, the total revenue of the business increases. Use the slider in **Figure 1** to increase the total revenue and see what happens to the break-even quantity. Notice that the point of origin does not change, because at zero quantity, total revenue remains zero. However, all the other points for total revenue shift upwards, and the total revenue line becomes steeper.

- What happens to the break-even quantity?

> The break-even quantity decreases. This means that Divia has to sell fewer driving lessons to reach break-even. Profits will rise and there will be a larger margin of safety.

Situation 2

A new driving school opens in the area and Divia lowers her prices in order to keep her customers. Her revenues fall. Use the slider in **Figure 1** to decrease the total revenue and see what happens to the break-even quantity. Notice that the point of origin does not change, because at zero quantity,

Overview (/study/ap hl/sid-351-cid-762729/o

total revenue remains zero. However, all the other points for total revenue shift downwards, and the total revenue line becomes less steep.

- What happens to the break-even quantity?

The break-even quantity increases. This means that Divia needs to sell more driving lessons to reach break-even. Profits will decrease and there will be a smaller margin of safety.

Changes in fixed costs

Changes in fixed costs will also change the break-even quantity. Use the slider in **Figure 2** to change the position of the fixed costs line according to the two situations below, and answer the questions.

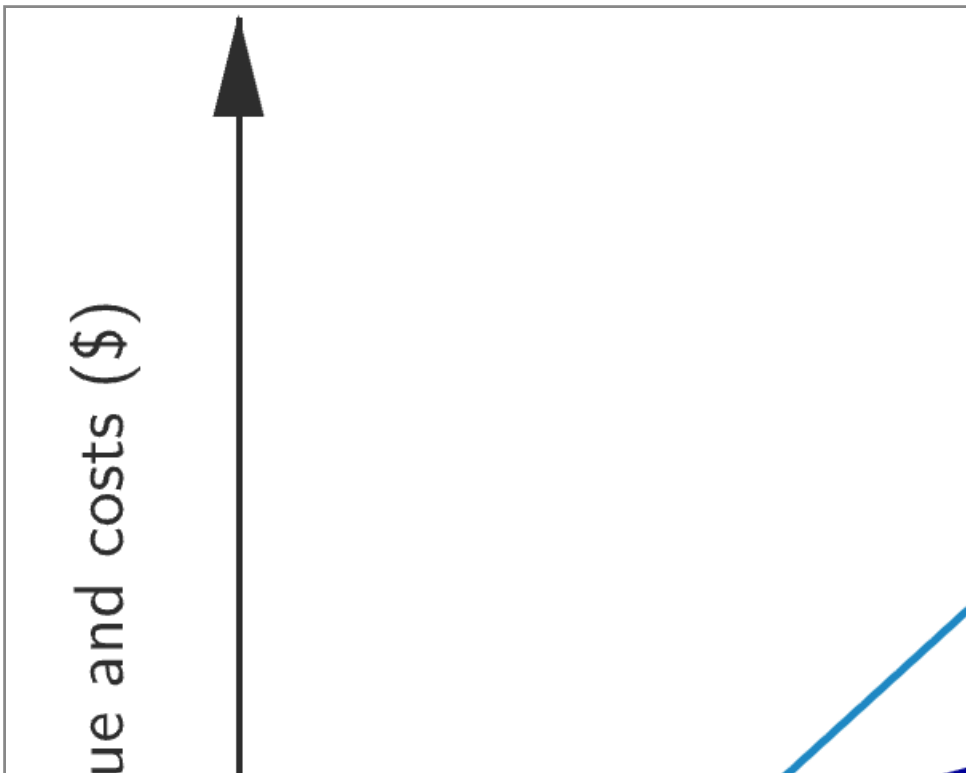


Figure 2. Impact of Changes in Fixed Costs on the Break-even Quantity.

More information for figure 2

An interactive break-even graph represents the financial situation showing the relationship between total revenue (TR), total costs (TC), and the break-even point (BEQ). It helps users understand how changes in pricing and demand affect a business's profitability.

The x-axis represents the quantity of driving lessons provided, while the y-axis represents revenue and costs in dollars. The BEQ is where the fixed cost (FC) line intersects the TR line. By moving the slider, users can explore different scenarios.

When the FC increases, the TC line shifts upward, increasing the BEQ. FC line moves up if FC increases, meaning higher revenue is needed to break even. The TR line remains unchanged, as revenue does not depend on cost changes.

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

When the fixed cost decreases, the TC line shifts downward, lowering the break-even point. The FC line moves down if fixed costs decrease, making it easier to achieve profitability. The TR line remains unchanged since revenue calculations are unaffected by cost reductions.

Through this interactivity, users will gain insights into the principles of break-even analysis, understanding how pricing strategies, market competition, and demand influence a business's financial health.

Situation 1

Divia's car insurance fees, which are paid yearly and are not dependent on the amount of driving Divia does, have increased. Use the slider in **Figure 2** to increase the fixed costs and see what happens to the break-even point. Notice that the fixed cost line remains horizontal, because the fixed costs do not change depending on output.

- What happens to the break-even quantity?

The break-even quantity increases. This means that Divia needs to sell more driving lessons to reach break-even. Profits will decrease and there will be a smaller margin of safety.

Situation 2

Due to increased competition among website providers, the fees that Divia pays each year for her website have decreased. Use the slider in **Figure 2** to decrease the fixed costs again and see what happens to the break-even point. Notice that the fixed cost line remains horizontal because the fixed costs do not change depending on output.

- What happens to the break-even quantity?

The break-even quantity decreases. This means that Divia needs to sell fewer driving lessons to reach break-even. Profits will increase and there will be a larger margin of safety.

Changes in variable costs

Changes in variable costs will also change the break-even point. Use the slider in **Figure 3** to change the position of the fixed cost line according to the two situations below, and answer the questions.

Student view

Overview (/study/ap hl/sid-351-cid-762729/o

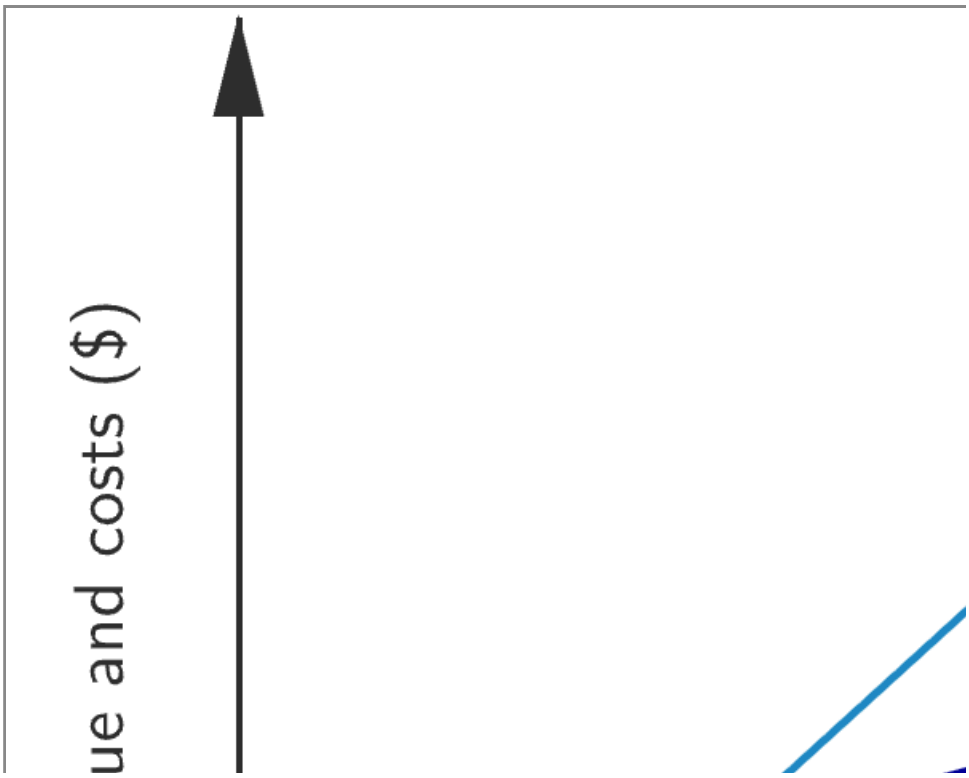


Figure 3. Impact of Changes in Total Costs on the Break-even Quantity.

More information for figure 3

An interactive break-even graph represents the financial situation showing the relationship between total revenue (TR), total costs (TC), and the break-even point (BEQ). It helps users understand how changes in pricing and demand affect a business's profitability.

The x-axis represents the quantity of driving lessons provided, while the y-axis represents revenue and costs in dollars. The BEQ is where the TC line intersects the TR line. By moving the slider, users can explore different scenarios.

When variable costs increase, the TC line shifts upward and becomes steeper, reflecting higher costs per unit. The BEQ moves right, meaning more sales are required to cover the increased costs. FC line remains unchanged, as fixed costs (FC) are not affected.

When the variable costs decrease, the TC line shifts downward and becomes less steep, indicating lower costs per unit. The BEQ moves left, meaning fewer sales are needed to reach profitability. The FC line remains unchanged, as FC do not vary with production.

Through this interactivity, users will gain insights into the principles of break-even analysis, understanding how pricing strategies, market competition, and demand influence a business's financial health.

Student view

Overview (/study/app/hl/sid-351-cid-762729/o

Situation 1

Petrol prices have increased. This means that Divia is paying more for each kilometre she drives with her students. Petrol is a variable cost because it changes with the quantity of driving lessons. So variable costs increase. This means that total costs will increase. (Assume fixed costs remain the same.) Use the slider in **Figure 3** to increase the total costs and see what happens to the break-even quantity. Notice that the point where the total costs intersect the *y*-axis does not change because fixed costs are the same. However, all the other points for total costs shift upwards, and the total cost line becomes steeper.

- What happens to the break-even quantity?

The break-even quantity increases. This means that Divia needs to sell more driving lessons to reach break-even. Profits will decrease and there will be a smaller margin of safety.

Situation 2

Petrol prices decrease again. This means that Divia needs to pay less for the petrol she uses. Variable costs and therefore total costs decrease (assuming fixed costs remain the same). Use the slider in **Figure 3** to decrease the total costs and see what happens to the break-even quantity. Notice that the point where total costs intersect the *y*-axis does not change because fixed costs are the same. However, all the other points for total costs shift downwards, and the total cost line becomes less steep.

- What happens to the break-even quantity?

The break-even quantity decreases. This means that Divia needs to sell fewer driving lessons to reach break-even. Profits will increase and there will be a larger margin of safety.

Activity

Learner profile: Thinkers
Approaches to learning: Thinking skills (critical thinking)

Download and complete the table below to summarise the impacts of changes in total revenue (TR), fixed costs (FC) and variable costs.

Now check the Solution table on the second page of the Download.

Student view

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/breakeven-charts-id-39497/print/) Assign

Overview (/study/app/hl/sid-351-cid-762729/o

Download file (https://d3vrb2m3yrmyfi.cloudfront.net/media/edusys_2/content_uploads/5.5.3 tables for download (1).4a69d235be1bf72d8ce9.pdf)

Case study

The impact of supply chain disruptions on bakeries

Bakeries around the world, including in many countries like Egypt — where bread is a particularly important staple product for the population — experienced supply chain disruptions from the conflict in Ukraine. Egypt imports more than half the wheat that it needs to produce bread and other products. In some years, Egypt imports more than 80% of its wheat. Restrictions on transport in the Azov Sea and port closures disrupted wheat shipments from Russia, which is the largest exporter of wheat. Economic sanctions against Russia also made it more difficult to secure wheat imports for Egypt.

Figure 4. Supply chain disruptions have increased the cost of production for bread.
Credit: Michael Zwahlen / EyeEm, Getty Images

Ukraine and Russia together supply about one-third of the global wheat supply. Ukraine banned the export of wheat during the conflict. These disruptions mean the global price of wheat increased by more than 50%. As a result, bakeries have had to increase prices to avoid operating at a loss. The increased variable costs have resulted in higher break-even quantities for bakeries all over the world.

Questions

1. Define break-even quantity. [2 marks]
2. Explain why increased variable costs of production would increase the break-even quantity for bakeries. [4 marks]

Student view

Overview (/study/app/hl/sid-351-cid-762729/o

Question 1

The break-even quantity is the quantity or output where total revenue equals total costs. Below this quantity, the business experiences losses. Above this quantity, the business experiences profits.

Define is an AO1 level command term, requiring the precise meaning of a term.

- One mark is given for a vague definition.
- Two marks are given for a complete definition.
- Definitions do not require application to the stimulus material.

Question 2

Variable costs of production refer to the costs of the resources used to make a product. When variable costs increase, the contribution per unit will decrease, because contribution per unit is calculated as price minus variable cost per unit. The break-even quantity is calculated by dividing fixed costs by contribution per unit. When contribution per unit is smaller, this increases the value for the break-even point, because it takes a larger quantity of output to cover fixed costs.

In this case, the rising variable costs of wheat, and lower contribution per unit, mean that bakeries will have to sell more units of bread to reach the break-even point. Some bakeries have been increasing their prices to regain a higher contribution per unit and lower the break-even again.

Explain is an AO2 level command term, requiring a detailed account including reasons or causes. Explain *why*, explain *how*.

- Other responses may be possible and, if appropriately explained and applied in context, may receive full marks.
- To achieve full marks, you must always include theory and application to the case study in your responses to the **explain** command term.

Exam tip

There are occasions when a product may fail to break even, yet a company keeps on producing it.

This might happen, for example, if the product is new and the business hopes that it will make a profit in the future. This relates to the Boston Consulting Group matrix, which you studied in Subtopic 4.1 (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-37435/), and which states that money from profitable products may be used to subsidise those attempting to gain increased market share.

Student view

Overview (/study/app/business-hl/sid-351-cid-762729/o

Another situation where this might happen would be for non-profit social enterprises that earn revenues. It could be that the losses are covered by other sources of finance, such as donations. In cases where the product or service being provided is especially important for people or the planet, it may be possible to find a way to continue producing the product.

It is also worth noting that social enterprises are likely to have higher break-even quantities because they may be charging lower prices to maximise the impact of their product. Or they may be distributing more value to stakeholders, such as paying employees living/higher wages or paying suppliers fairly. As a result, their costs are higher.

3 section questions

Question 1

If variable costs per unit increase and all other factors stay the same, what will happen to the break-even quantity and contribution per unit?

1 Break-even quantity will increase; contribution per unit will decrease. ✓

2 Break-even quantity will decrease; contribution per unit will increase.

3 Break-even quantity will increase; contribution per unit will increase.

4 Break-even quantity will decrease, contribution per unit will decrease.

Explanation

Contribution per unit = selling price — variable costs per unit

Therefore, if variable costs per unit increase, the contribution will decrease.

The break-even quantity can be found by dividing the fixed costs by the contribution. Therefore, if contribution is lower, the break-even quantity will increase.

Question 2

In the diagram below, which costs have increased?

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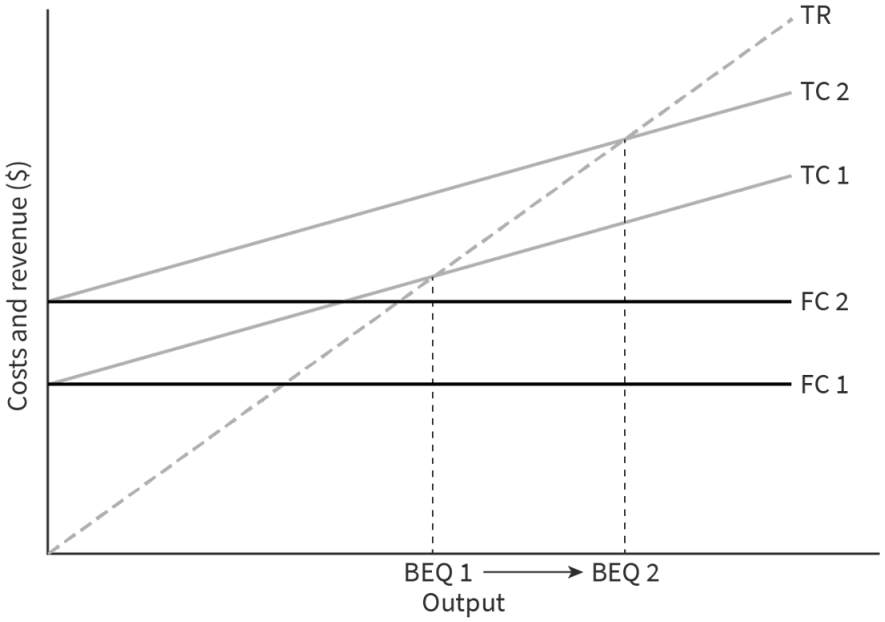

More information

1 Fixed costs and total costs ✓

2 Fixed costs, total variable costs and total costs

3 Fixed costs and total variable costs

4 Total variable costs and total costs

Explanation

Total costs are total variable costs plus fixed costs. In the diagram, fixed costs have increased. This has caused both the fixed costs and total costs to increase.

Question 3

Which pair of factors will cause the break-even quantity to increase?

1 Increased fixed costs and increased variable costs per unit ✓

2 Reduced fixed costs and increased selling price

3 Increased variable costs and increased selling price

4 Increased fixed costs and increased selling price

Explanation

Break-even quantity is calculated by dividing fixed costs by contribution. If fixed costs increase, then so will the break-even quantity.

Student view

Contribution is calculated by subtracting variable costs per unit from the selling price. Therefore, increasing variable costs will reduce contribution and increase the break-even quantity.

Evaluation of break-even analysis

As with all quantitative and qualitative business management tools, break-even analysis has a variety of uses, but also limitations.

Uses of break-even analysis

There are many uses for a break-even analysis. First and foremost, break-even analysis is a part of any good business plan as it enables a new business to understand what output it needs to achieve in order to earn profit. Not all businesses can earn a profit, and it is better to analyse whether this is the case for your business sooner rather than later.

When seeking funding, whether it is debt financing with a bank or equity financing with an investor, external stakeholders will want to see a break-even analysis so they can determine the level of risk involved. Businesses will be able to get financing from external stakeholders if there is a reasonable chance to earn profit.

Figure 1. A bank will want to see a break-even analysis before providing a business loan.

Credit: SDI Productions, Getty Images

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Finally, a break-even analysis enables a business to change the cost and price/revenue assumptions of a business, as you did in Section 5.5.3 (/study/app/business-hl/sid-351-cid-762729/book/impact-of-changes-in-price-or-costs-on-breakeven-id-39498/). Examining a number of scenarios can help a business to judge risk and also to make changes to the business to increase the chances of reaching break-even at a lower level of output. For example, if a business is not satisfied with the projected break-even quantity, then it could raise or lower prices to increase revenues or lower costs of production, in order to lower the break-even quantity. It could also change the incentives for sales teams to earn higher revenues. Or it could change the capacity of the business to support increased sales. At this point in the course, you have learned many strategies that a business could take to increase revenues or decrease costs.

Limitations of break-even analysis

As with all quantitative tools, however, break-even analysis has limitations. The figures used for fixed costs, variable costs and revenues are estimates. It is very likely that costs will be different than anticipated, and revenues cannot be predicted with complete accuracy. Business activity is dynamic and any change to internal or external factors will impact costs and revenues. So, businesses need to pay attention to these changes and revise their break-even analyses with changing conditions.

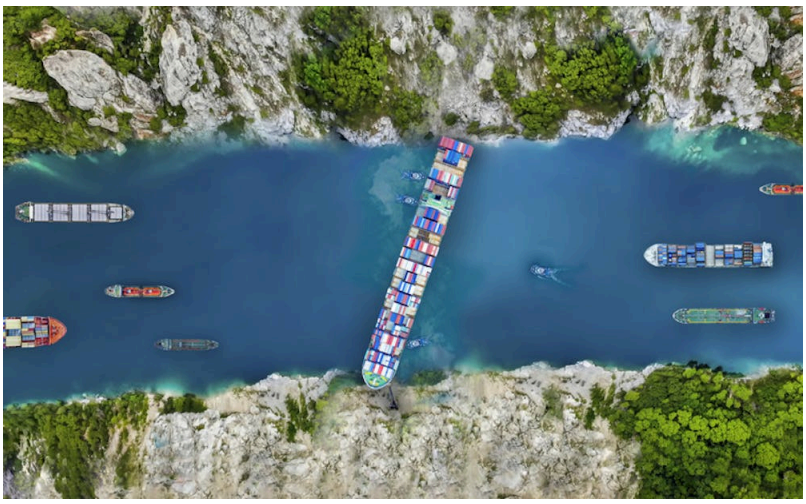

Figure 2. Supply chain problems, like this accident in a shipping canal, could increase costs of production and raise the break-even quantity.

Credit: SONGHPOL THESAKIT, Getty Images

Another limitation of break-even analysis is that it assumes that costs of production are constant (linear) across different levels of output. However, you learned in Subtopic 1.5 (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-36532/) that as output increases, businesses are likely to experience economies of scaleeconomies of scale (undefined), leading to lower average costs of production. The break-even method outlined here does not account for this. If costs of production decline as output increases, then the break-even quantity could be achieved at a lower output.

Student view

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Also, break-even analysis assumes that all customers pay the same price for the product, again producing a linear result. However, in reality this is unlikely to be the case. Many businesses can use dynamic pricingdynamic pricing (undefined) to charge different prices to different customers for the same product. For example, people who buy train tickets may pay different prices based on their age, or how close to the travel time they booked the ticket. When businesses use dynamic pricing, they are often able to raise their overall revenues, which would reduce the break-even quantity.

Finally, a company with many products would need to conduct a separate break-even analysis for each product, which can be difficult for large businesses with a diverse product portfolio.

Making connections

One assumption of break-even analysis is that customers all pay the same price for the product. However, it is often the case that businesses can charge different prices to different customers according to their willingness and ability to pay. In business management, this is called dynamic pricing. HL students learn more about dynamic pricing in Section 4.5.4 (/study/app/business-hl/sid-351-cid-762729/book/further-pricing-methods-id-39008/).

IBDP Economics students also learn about this pricing technique. In that course, dynamic pricing is called price discrimination.

Table 1. Summary of uses and limitations of break-even analysis.

Uses of break-even analysis	Limitations of break-even analysis
Business plan. For a business to assess whether its idea will earn a profit.	**Changing assumptions.** Costs and revenues will change, so businesses need to regularly update assumptions for break-even analysis.
Financing. Banks and investors will ask for a break-even analysis so they can judge the risk of a loan or investment.	**Costs and revenues are not linear.** Break-even analysis assumes costs and revenues are linear, but in reality they are not.
Strategy changes. A business can examine several different cost and revenue scenarios in order to consider strategy changes that might increase revenues or decrease costs.	**Time-consuming for large product portfolios.** Separate break-even analyses must be done for each product.

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Theory of Knowledge

Break-even analysis is deceptively simple. With just a few variables, a business can make predictions about profit levels at any given output. But there is a world of complexity behind each of the variables. Imagine how many factors there are, both internal and external, that affect business revenues and costs of production. And these factors can change at any time, even daily, hourly or by the minute.

When external stakeholders examine a break-even analysis, they should not be blinded by the maths and think that the analysis is scientific. A given break-even analysis is only one of an infinite set of possible outcomes for the business. Some of those possible outcomes are more informed than others, but none of them are certain.

- To what extent can the maths behind break-even analysis be considered reliable in a dynamic business environment?

Activity

Learner profile: Thinkers
Approaches to learning: Thinking skills (transfer)

Imagine that you are planning on starting a clothes laundry business in your neighbourhood. Using that context:

1. Imagine how break-even analysis would be useful to you as a business owner.
2. What other kinds of research would you need to carry out in order to determine whether this business is viable (in other words, whether it has the possibility of earning a reasonable profit?)

Discuss with a partner or as a class.

3 section questions

Question 1

Which of these is **not** a weakness of break-even analysis?

1 It can help determine whether a business is viable (can earn a reasonable profit). ✓

2 Economies of scale are ignored.

Student view

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3 Only one selling price can be used.

4 It assumes that all inventory is solid.

Explanation

Although it is far from perfect, break-even analysis is quick and easy to perform. Therefore it can allow small businesses, such as sole traders, to make simple decisions about price and output that can determine the viability of the business (its ability to earn a reasonable profit).

The other options are all weaknesses of using break-even analysis.

Question 2

In which situation is break-even analysis **least** useful?

1 A business that sells many different products ✓

2 When a quick decision is needed

3 In an IB Business Management examination

4 For a sole trader with little financial experience

Explanation

Break-even analysis is best viewed as a simplistic guide. In the real world, there are so many variables that a business's costs and revenue will be constantly changing.

The simplicity of break-even analysis makes it ideal for small business owners. It gives a quick impression of how many items need to be sold.

Of course, it is imperative that you learn break-even for your Business Management exam!

Question 3

A weakness of break-even analysis is that it does not take into account that fixed costs may change as output increases. What is the key term that describes falling average costs as output increases?

Economies of scale ✓

Accepted answers

Economies of scale

Also accepted

Economy of scale

Student view

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Explanation

Economies of scale are factors that cause the average cost of production to fall as output increases. Common internal economies of scale include financial, purchasing and marketing.

5. Operations management / 5.5 Break-even analysis

Terminology exercise

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/terminology-exercise-id-39500/print/) Assign

Check that you understand the terminology used in this subtopic by dragging the correct word into each space.

At some point, a business must reach the point, where the total revenue equals the total costs of production. At this point, the assumption is that if a business continues to increase the quantity of the product produced, it will start to earn , where total revenue will exceed total .

Break-even analysis assumes that even at low levels of output, a business can cover the of its product with its revenues. The difference between the selling and the variable costs is known as the per unit. When the business produces an output where total contribution covers the , the break-even point has been reached. Thus, the formula for the break-even point (quantity) is the fixed costs divided by the contribution per unit.

contribution costs price break-even profit variable costs fixed costs

Check

Question: 1 of 3 questions

Interactive 1. Mastering Break-Even Analysis.

5. Operations management / 5.5 Break-even analysis

Tool: Contribution (HL)

Tool: Contribution (HL) Tool: Contribution (HL)

Student view

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/tool-contribution-hl-id-39501/print/) Assign

Overview (/study/app/business-hl/sid-351-cid-762729/o

In Section 5.5.1 (/study/app/business-hl/sid-351-cid-762729/book/calculating-breakeven-id-39496/), you learned about the concept of contribution per unit (undefined)contribution per unit (undefined). The contribution per unit is the amount of money left after the variable costs per unit have been subtracted from the price per unit. Total contribution is the sum of these contributions at a certain quantity (output).

As a reminder, the formulas for contribution are:

$$\text{Contribution per unit} = \text{price per unit} - \text{variable cost per unit}$$

$$\text{Total contribution (at a certain quantity)} = \text{contribution per unit} \times \text{quantity (output)}$$

Exam tip

Remember that contribution is not the same as profit. Contribution is calculated as price minus variable costs. In order to calculate profit, fixed costs must also be taken from the sales revenue.

Uses of contribution calculations

There are several ways in which contribution calculations can be used in business:

Determining the break-event point

As you learned in Section 5.5.1 (/study/app/business-hl/sid-351-cid-762729/book/calculating-breakeven-id-39496/), contribution calculations enable a business to determine the break-even point. To reach the break-even point, a business must cover its fixed costs with the contributions. Thus, the formula for break-even is:

$$\text{Break-even quantity} = \frac{\text{fixed costs}}{\text{contribution per unit}}$$

Choosing work (orders)

Another use for contribution calculations is to help a business choose what work to take on, or which orders to accept. Generally, where a business has more work or orders than it can take on, the business should choose the work or orders that have the largest contribution value.

For example, Méndez Ltd manufactures chairs and tables and has received two orders. One order is for the production of 1000 chairs; the other order is for the production of 800 tables. However, Méndez Ltd only has the resources to accept one order so the company needs to decide which order to accept. **Table 1** shows the estimated revenue and cost details.

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Figure 1. Should Méndez Ltd accept an order for making chairs or tables?

Credit: Jordan Lye, Getty Images

Table 1. Revenue and cost comparison for an order for producing chairs or tables for Méndez Ltd.

	Chairs ($)	Tables ($)
Sales revenue	12 000	17 000
Variable costs	8900	15 400
Contribution	3100	1600

Following the calculation, and considering that only one order can be accepted, the business should accept the order of chairs, since the contribution of the chair ($3100) is larger than the contribution of the tables ($1600).

Make or buy analysis

Businesses often have a choice of whether to produce a product or component themselves, or to outsource the production to a third party. To make this decision, they need to consider both qualitative and quantitative factors. Keeping the work in-house allows for closer quality controls

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and overall management of the production process. On the other hand, using subcontractors helps companies deal with fluctuations in demand.

Contribution plays a role in the quantitative analysis of the make or buy decision. A business needs to be careful to consider the revenues and costs involved with the decision. When dealing with products that make a contribution to fixed costs, a business will need to consider contribution in the make or buy decision; if the business chooses to buy rather than make, then the contributions of the product will be 'lost' and will need to be made up by other product lines.

Allocating direct and indirect costs for contribution calculations

In Subtopic 3.3 (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39300/), you learned about costs and revenues and about the distinction between direct costs and indirect costs .

Direct costs are those that can only be attributed to a single part of the business – that is, directly linked to the sale of the goods or the provision of the service. Examples include the resource costs for a particular product, operations costs for a particular department, utility costs of a single branch of a chain store, and so on.

Direct costs are relatively easy to allocate for the purposes of calculating contribution. They are clearly associated with a particular product or department. However, indirect costs are not easy to allocate. Indirect costs involve a number of business activities that support the business as a whole, such as nationwide advertising campaigns, salaries of the board of directors, IT costs, and so on. It is difficult to determine how to allocate these indirect costs when calculating the contribution for a particular product.

A business has the following options when dealing with indirect costs for contribution calculations:

- contribution costing
- absorption costing

Contribution costing

Contribution costing involves using costs to support decision-making that only considers the direct costs of the product, department or region and their contribution to the indirect costs of the business as a whole. For example, if Méndez Ltd produced chairs, tables and bed frames, the

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business could calculate the contribution for each product line, as shown in **Table 2**. These contributions combined would cover the indirect costs for the entire business, in this case, $1 000 000.

Table 2. Contributions for various furniture products at Méndez Ltd.

	Chairs ($)	Tables ($)	Bed frames ($)
Total revenue	1 500 000	2 000 000	2 300 000
Total direct costs	750 000	1 200 000	1 500 000
Contribution	750 000	800 000	800 000

Total contribution for all products = $750 000 + $800 000 + $800 000 = $2 350 000

Indirect costs = $1 000 000

Profits = $1 350 000

Using contribution costing, it seems that tables and bed frames are contributing more to the overall profit than chairs for Méndez Ltd.

Absorption costing

Absorption costing (undefined)Absorption costing (undefined) involves dividing the indirect costs among the products, departments or regions based on predetermined criteria such as output, sales revenue, number of employees, or the value of the equipment. The indirect costs would be allocated proportionally based on the differences between the products, departments or regions. This provides a more accurate picture of the various contributions to a business's profits. However, it is more complex to calculate.

Again, using the example of Méndez Ltd, the indirect costs were $1 million. Examine the information in **Table 3** below to consider two ways that the business could use absorption costing to allocate these indirect costs.

Table 3. Data on sales revenue and employees at Méndez Ltd.

Product	Sales revenue ($ millions)	% of total sales revenue	Employees	% of total employees
Chairs	1500 000	26	3	30

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Product	Sales revenue ($ millions)	% of total sales revenue	Employees	% of total employees
Tables	2 000 000	34	4	40
Bed frames	2 300 000	40	3	30

If Méndez Ltd decided to allocate the $1 million indirect costs to the different products based on the relative sales revenues of each product in the third column, then the indirect costs would be allocated as follows:

Indirect costs for chairs = $1 000 000 × 0.26 = $260 000
Indirect costs for tables = $1 000 000 × 0.34 = $340 000
Indirect costs for bed frames = $1 000 000 × 0.40 = $400 000

With this information, it is now possible to determine the profits earned by each product rather than just the contribution as was done in **Table 2**. The new calculations that include indirect costs are in **Table 4** below.

Table 4. Profits earned by each product at Méndez Ltd using the absorption costing method for indirect costs based on relative sales revenue.

	Chairs ($)	Tables ($)	Bed frames ($)
Total revenue	1 500 000	2 000 000	2 300 000
Total direct costs	750 000	1 200 000	1 500 000
Allocated indirect costs	260 000	340 000	400 000
Profit	490 000	460 000	400 000

Notice that the total profit for producing chairs, tables and bed frames is still $1 350 000. In **Table 2**, where contribution costing was used, it looked like tables and chairs were making the largest contribution to covering the indirect costs. However, using absorption costing based on relative sales revenue, the data shows that chairs are making the largest contribution to the profits of Méndez Ltd. This might have an influence on how the business makes decisions on allocating financial, human or physical resources moving forward.

Student view

However, using different absorption costing criteria, Méndez Ltd may see a different outcome. If Méndez Ltd decided to allocate the $1 million indirect costs to the different products based on the percentage of employees, then the indirect costs would be allocated as below:

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Indirect costs for chairs = $1 000 000 × 0.30 = $300 000

Indirect costs for tables = $1 000 000 ×0.40 = $400 000

Indirect costs for bed frames = $1 000 000 × 0.30 = $300 000

You can see the impact of this allocation of indirect costs in the profit calculations in **Table 5.**

Table 5. Profits earned by each product at Méndez Ltd using the absorption costing method for indirect costs based on relative number of employees.

	Chairs ($)	Tables ($)	Bed frames ($)
Total revenue	1 500 000	2 000 000	2 300 000
Total direct costs	750 000	1 200 000	1 500 000
Allocated indirect costs	300 000	400 000	300 000
Profit	450 000	400 000	500 000

Notice that the total profit for producing chairs, tables and bed frames is still $1 350 000. In **Table 4**, where the relative sales revenue was used to allocate costs, it looked as though chairs were contributing the most to profit. However, using absorption costing based on relative employees, the data shows that bed frames are contributing the most to the profits of Méndez Ltd. Again, this might have an influence on how the business makes decisions on allocating financial, human or physical resources moving forward.

Evaluation of contribution analysis

You have already been introduced to a number of uses of the contribution tool. **Table 6** also outlines some limitations.

Table 6. Uses and limitations of contribution analysis for business decision-making.

Uses of contribution analysis	Limitations of contribution analysis
Break-even. Contribution calculations are part of the break-even analysis that is needed to determine the viability of a business.	**Assumptions.** Contribution analysis is based on many assumptions about conditions in the internal and external environment, and how indirect costs may be integrated. If assumptions change, the result of the contribution analysis may be different. The calculations might also change depending on the time period used.

Student view

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Uses of contribution analysis	Limitations of contribution analysis
Choosing work (orders). When a business has more work or orders than it can take on, it should choose the work or orders that have the largest contribution value.	**Only one tool among many.** Contribution analysis is a valuable quantitative tool, but it is only one of many tools for decision-making. Businesses should consider both quantitative and qualitative information, including ethics concerns.
Make or buy. Contribution analysis is a quantitative tool used to determine whether a business should make or buy a product or component.	

Activity

Consider the following information about Company Z, which comprises two centres (Centre A and Centre B).

Centre A

Price of product: $120
Quantity sold: 1500
Variable costs: 50% of the price

Centre B

Price of product: $130
Quantity sold: 1350
Variable costs per unit: $80

Indirect costs of Company Z: $20 000

Questions

1. Calculate the total contribution for Centre A and Centre B separately.
2. Calculate the total profits for Company Z.
3. Assume that Company Z decides to use absorption costing to get a more accurate picture of the contribution of each centre. It decides to allocate indirect costs as follows: Centre A 80% and Centre B 20%. Calculate the profits earned by Centre A and Centre B separately using absorption costing. Double check your work by confirming that the sum of these two profits equals the profit you calculated in question 2.
4. Comment on the different results for questions 1 and 3.

Question 1

Student view

Centre A
Contribution per unit = price — variable cost

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= $120 — $60
= $60

Total contribution = contribution per unit x quantity

= $60 x 1500
= $90 000

Centre B

Contribution per unit = price — variable cost
= $130 — $80
= $50

Total contribution = contribution per unit x quantity
= $50 x 1350
= $67 500

Question 2

Profit for Company Z = total revenue — total costs
= $355 000 — $218 000
= $137 000

The interim calculations are as follows:

Total revenue = price x quantity
Total revenue for Centre A = $120 x 1500 = $180 000
Total revenue for Centre B = $130 x 1350 = $175 000
Total revenue for Company Z = $355 000

Total variable costs = variable costs x quantity
Total variable costs for Centre A = $60 x 1500 = $90 000
Total variable costs for Centre B = $80 x 1350 = $108 000
Total variable costs for Company Z = $198 000

Total indirect costs for Company Z = $20 000
Total costs for Company Z = $198 000 + $20 000 = $218 000

Question 3

Indirect costs for Centre A = $20 000 x 0.80 = $16 000
Indirect costs for Centre B = $20 000 x 0.20 = $4 000

Profit for Centre A = total revenue Center A — total costs Center A
= $180 000 — ($90 000 + 16 000)
= $74 000

Profit for Centre B = total revenue — total costs
= $175 000 — ($108 000 + 4 000)
= $63 000

Question 4

Student view

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When only the variable costs are considered to calculate contribution for Centre A and B, Centre A appears to contribute $90 000 to Company Z's profit, while Centre B appears to contribute $67 500. However, when absorption costing is used to allocate indirect costs, the difference between the Centre A and Centre B declines significantly. This reveals the role and importance of the assumptions and data used to calculate contribution.

Checklist

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/checklist-id-39502/print/) Assign

What you should know

By the end of this subtopic, you should be able to:

- define the following terms: (AO1)
  - contribution per unit
  - total contribution
  - break-even quantity/point
  - margin of safety
  - target profit output
  - target profit
  - target price
  - contribution costing (HL)
  - absorption costing (HL)
  - make or buy analysis (HL)
- distinguish between total contribution and contribution per unit (AO2)
- calculate the break-even point and construct a break-even chart (AO4)
- analyse the effects of changes in price or cost on the break-even quantity, profit and margin of safety, using graphical and quantitative methods (AO2, AO4)
- discuss the uses and limitations of break-even as a decision-making tool (AO3)
- apply the contribution tool in a given context (AO2) (HL)

Student view

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5. Operations management / 5.5 Break-even analysis

Reflection

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/reflection-id-48338/print/) Assign

Teacher instructions

The goal of this section is to encourage students to pause at the end of the subtopic and to reflect on their learning. Students can use the questions provided below to guide their reflection. The questions encourage students to look at the bigger picture and to consider how the subtopic's contents might have impacted the way they view the subject.

The following table shows you how each prompt aligns to the DP *Business management guide*:

Prompt #	Syllabus alignment
1	**Concept:** Creativity
2	**Learner profile:** Thinkers
3	**Learner profile:** Reflective

Students can submit their reflections to you by clicking on 'Submit'. You will then see their answers in the 'Insights' part of the Kognity platform.

Reflection

In this subtopic you learned about break-even analysis.

Take a moment to reflect on your learning so far. You can use the following questions to guide your reflection. If you click 'Submit', your answers will be shared with your teacher.

1. Is the break-even point too simplistic? Which assumptions could make it more dynamic?
2. To what extent is margin of safety an appropriate metric to ensure profitability of a business?

Student view

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3. Should your school create its own database for student data management or buy a system that has already been developed? What are the advantages and disadvantages of each?

⚠ Once you submit your response, you won't be able to edit it.

0/2000

Submit

Rate subtopic 5.5 Break-even analysis

Help us improve the content and user experience.

☆ ☆ ☆ ☆ ☆

Student view