The big picture

Lego is a Danish toy-making company based in Billund in Denmark. It is famous for its plastic building blocks and bricks. Recently, Lego announced plans to invest more than a billion US dollars in building its first carbon neutral factory in the main business hub of Ho Chi Minh City. Furthermore, Lego has decided to open 150 new stores worldwide, 80 of which will be in China. This decision has been taken due to an increase in demand, sales revenue and growth in 2019. A revenue of 30 billion USD has been estimated by the group for between 2019 and 2025. Construction of these new stores should start in 2024 and will help to create up to 4000 jobs over the next 15 years. However, there a few questions that arise from these plans:

- Why does Lego think it will grow so quickly?
- When forecasting its growth, did Lego consider the ongoing disturbances in the supply chain due to the COVID-19 pandemic or other global disruptions, such as climate change or increased regulation on plastic materials?
- Which business management tools did Lego use to come up with the number of 30 billion USD in increased sales revenue from 2019 to 2025?

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Figure 1. Lego is planning to build a new factory in Ho Chi Minh City and expand its sales into China.

Credit: Ho Ngoc Binh, Getty Images

Making connections

Business Management is not the only IB subject that uses trend analysis. IB Mathematics and IB Physics also use trend analysis to make predictions. The process is exactly the same. So the steps that you learn in this subtopic can be used to help you in your other IB classes.

Concept

Change

The external environment (STEEPLE factors, Section 1.1.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-business-plan-id-36505/)) in which businesses operate changes all the time. With these changes in mind, the Lego group is preparing to meet increased consumer demand for its building blocks and bricks. Lego is planning to increase global investments in production and retail.
Businesses need tools to help predict and plan for change in the external environment. While studying this section, think about the concept of change that underlies all business activities and planning.

- How do possible future changes in the external environment determine the marketing, human resources, financial and operations planning of a business?

This subtopic will focus on the importance of sales forecasting (predicting sales in the future). Both the benefits and limitations of using sales forecasting will be examined. You will learn how past trends can be used to make sales predictions, by extrapolating data using a line of best fit. And in Section 4.3.3 (/study/app/business-hl/sid-351-cid-762729/book/tool-simple-linear-regressions-id-38740/) you will learn about some different tools that specialists use to forecast sales.

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

Student view

- **Examine** the benefits and limitations of sales forecasting (AO3)

- **Apply** simple linear regression in a given context (AO2, AO4)

Sales forecasting

Sales forecasting (HL)

Sales forecasting is a quantitative technique used by businesses to predict the levels of sales that they may expect in future years. These sales may be forecast either in quantity of products, or in total revenue earned. If sales forecasting is done well, the business can enjoy some benefits. If sales are expected to grow, then the business can take steps to ensure this extra demand is met. For example, inventory levels can be expanded, additional staff can be recruited if necessary, or production capacity can be increased. If companies feel they will not be able to meet their expected demand, then prices can be increased so that profits can be maximised.

If a decline in sales is forecast, then a company may choose to reduce production. Staff may be made redundant and spare land and capital may be reallocated or sold. However, a company may want to react to lower sales forecasts by increasing marketing budgets, in an attempt to fight off the predicted decline.

Businesses may also use sales forecasts to evaluate the performance of staff. Managers can use regular sales forecasts to set targets for employees. However, businesses should remember that sales forecasts do not always predict the future accurately. Businesses must remain flexible in order to react to changes in the external environment. It is also preferable to use both qualitative and quantitative analysis when making business decisions.

Managers or specialists who forecast sales use three types of sales forecasting methods. The different methods are based on the type of input data used in forecasting demand.

The three types of sales forecasting methods that specialists use are:

- causal models
- time series analysis
- qualitative techniques

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Causal models

There are a number of both internal and external factors that affect sales. Internal factors that affect sales include costs of production (spending on resources), labour turnover, and product pricing, among others. External factors include economic factors such as incomes, or sociocultural factors such as demographic changes (see STEEPLE factors, Section 1.1.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-business-plan-id-36505/)).

When businesses try to find a causal relationship between one of these factors (independent variable) and sales (dependent variable), they are using a causal model. These models are constructed with data on each variable to create a scatter diagram. Then a line of best fit is used to understand the relationship between the two variables. Finally, extrapolation can be used to make predictions. You can read a full explanation of how to plot causal data, draw a line of best fit and extrapolate in Section 4.3.3 (/study/app/business-hl/sid-351-cid-762729/book/tool-simple-linear-regressions-id-38740/).

Time series analysis and moving averages

Time series analysis is a statistical technique used by businesses to identify trends in historical data, such as sales revenue figures of previous years. By assuming that past trends will continue, businesses can forecast sales in the future.

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-38737/print/) Assign

In time series data, sales are recorded by year, month, week or another time interval. Like causal models, it is useful to graph time series data so that you can see patterns. In this case, time is considered the independent variable and sales is the dependent variable. Sometimes a simple line of best fit can be drawn with time series data to see the trend and extrapolate to make a prediction.

However, there are very often significant variations in time series data. When this occurs, the data needs to be smoothed out by plotting ‘moving averages’. The smoothed data is then given a line of best fit, which can be extrapolated to make a sales forecast. The process of calculating and graphing moving averages is explained in detail in Section 4.3.3 (/study/app/business-hl/sid-351-cid-762729/book/tool-simple-linear-regressions-id-38740/).

There are three main types of variations in this data: seasonal, cyclical and random variations.

Student view

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Seasonal variations

Seasonal variations in data occur when products have higher sales volumes at certain times of the year. One example of a product with seasonal variation in sales is children's toys, for which sales peak at major gift-giving holidays in particular countries. Other products may experience a peak in the summer months, such as sunscreen, certain clothes and holidays. Understanding and calculating seasonal variations helps businesses to improve their sales forecasts.

Cyclical variations

Cyclical variations in sales data occur when sales are affected by the economic cycle (Section 1.1.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-business-plan-id-36505/)). Sales of certain goods, such as cars and televisions, increase when the economy is growing and employment is high. Sales of the same items may decline during recessions, when incomes decline and unemployment increases.

Figure 1 shows the business cycle – the regular changes in real GDP over time.

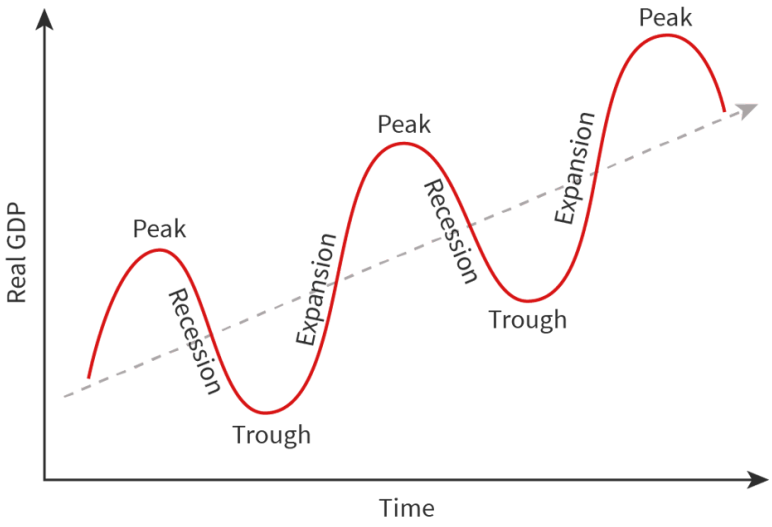

Figure 1. The economic cycle can lead to cyclical variations.

More information for figure 1

The image is a graph illustrating the economic cycle with a wavy line representing fluctuations in real GDP over time. The X-axis is labeled "Time," and the Y-axis is labeled "Real GDP." The graph shows repeating cycles consisting of peaks and troughs. The cycle phases are labeled as "Peak," "Recession," "Trough," and "Expansion." The first cycle starts with a peak, followed by a recession leading to a trough, then an expansion back to another peak. This pattern repeats, illustrating cyclical variations in the economy. The dotted line shows a general upward trend over time, despite the fluctuations.

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Random variations

Random variations are marked changes to sales data caused by unpredictable events. Such events could include a natural disaster, a major sporting event or political unrest. Such significant events can affect sales of various products in unpredictable ways.

Concept

Change

Businesses need to react to changes in the external environment when they make business decisions. Some of those changes are regular and relatively easy to include in sales forecasts. But often the external environment changes in unpredictable ways. This was true during the COVID-19 pandemic. Most businesses were not prepared for the sudden decline in sales revenue as businesses were closed and people were ordered to stay at home.

Activity

Random variations — events affecting sales forecasts

Because of the occurrence of random unpredictable events, it can be very difficult for businesses to make accurate sales forecasts. Random events can seriously decrease sales revenue for businesses, and such events cannot be predicted. Moreover, there is no direct methodology to identify such trends and deviations from the trend. Below are four examples of external events that have affected sales revenues for businesses. Consider how each of these cases could represent random variations for an organisation's sales forecasting.

1. In 2020, the COVID-19 pandemic impacted businesses globally. Supply chains were impacted, and millions of people lost their jobs.
2. In 2022, BFG North Carolina recalled 1380 chests of drawers due to tip-over and entrapment hazards.
3. In 2018, Asian businesses (in particular) lost 54.7 billion USD to natural disasters, according to CNBC. That year, economic losses in North America also totalled 80.5 billion USD.
4. In 2010, British Petroleum lost control of 3.19 million barrels of oil due to a massive oil spill in the Gulf of Mexico. The company was fined a record 14 billion USD for the oil spill.

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The reasoning behind the case study is to highlight the importance of different scenarios where the sales forecasts carried out by businesses can become inaccurate due to random events.

1. The COVID-19 pandemic caused businesses to shut down, and demand for goods and services decreased at a global level. People lost jobs and overall economic growth decreased.
2. The recall, due to an unforeseen event, must have cost the company.
3. Natural disasters cause havoc and are a reason for small and medium businesses shutting down. Floods, for example, can wipe away entire areas.
4. The oil spill would have caused a decrease in the sales revenue of BP as their inventory levels decreased. The company was also fined for the spill.

Qualitative analysis: market research

Businesses cannot rely only on past quantitative data to make sales forecasts and decisions about their marketing mix. Businesses must also ensure that they understand broad trends in the external environment that might affect product sales. They also need to identify and forecast the buying preferences and behaviours of consumers. Thus, businesses should use qualitative analysis, such as market research (Subtopic 4.4 (/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-38995/)) before forecasting sales. A business that relied only on quantitative data from past sales to make decisions during the COVID-19 pandemic, for example, would have failed very quickly.

Uses and limitations of sales forecasting

Theory of Knowledge

Identifying sales trends is an important source of information for making business decisions. Trends can alert businesses to opportunities and threats in the external environment, and businesses can react accordingly. However, the world is an unpredictable place and the future is always uncertain. This raises the issue of how much businesses should rely on past experience to guide decision-making. Consider the following questions:

- To what extent is the past a reliable guide for the future?
- Are predictions in the human sciences inevitably unreliable?

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Sales forecasts rely on past trends to predict the future. While these forecasting techniques can provide useful information for business decisions, they are not always accurate. As mentioned above, random variations such as the COVID-19 pandemic had an enormous impact on businesses as well as individuals. Demand for goods and services declined, many physical stores closed and supply chains were disrupted. Because of all this, many businesses have had decreased revenues from 2020 onwards.

In addition to random events like pandemics, some businesses simply do not have enough information to make sales forecasts. New businesses, for example, have to use other methods to forecast sales. In general, however, all businesses must use a variety of tools to make forecasts. In addition to quantitative sales forecasting, businesses should use market research and a variety of tools like the product life cycle (Section 4.5.1 (/study/app/business-hl/sid-351-cid-762729/book/product-life-cycle-id-39005/)), the BCG matrix (Section 4.1.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-bcg-matrix-id-37441/)), STEEPLE analysis (Section 1.1.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-business-plan-id-36505/)) and others to help make decisions about the marketing mix. **Table 1** captures the uses and limitations of sales forecasting.

Table 1. The uses and limitations of sales forecasting.

Uses of sales forecasting	Limitations of sales forecasting
Based on past data. The forecast is based on past sales data, which should add some validity to the results. **Effective future planning.** If correct, forecasts can help companies to plan for the future. New equipment, staff and inventories can be secured to meet increased demand. **Increase budgets to increase sales.** If a drop in sales is forecast, companies can react to this with increased marketing budgets, in an effort to increase sales. **Better ability to decide.** If forecasts are extremely negative, a company may decide to withdraw a product from the market before it becomes a drain on resources.	**Not enough data.** New companies do not have previous data upon which to draw. **Changing markets.** Rapidly changing markets can lead forecasts to be invalid. **Flexibility.** Forecasts should only be seen as a guide. Managers need to remain flexible rather than following plans blindly. **Use of different methods to predict.** Sales forecasting is just one method of predicting future sales. Companies should also be mindful of market research results and product life cycle analysis.

Student view

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Exam tip

When they appear in examinations, sales forecasting questions often come in one of two formats. One type of question will ask you to analyse and/or graph data to make a sales forecast. You may need to graph data, draw a line of best fit and extrapolate. Another type of question may ask you to evaluate the uses and limitations of sales forecasting.

4 section questions

Question 1

Which of the following is **not** true about sales forecasting?

1. Sales forecasting can help new companies predict initial sales. ✓
2. Sales forecasting can help companies plan for the future.
3. Extra staff can be recruited if sales are forecast to grow.
4. A sales forecast is based upon actual sales data.

Explanation

Sales forecasts are based on sales figures from previous months and years. This makes them useless for new companies, which do not have any previous sales data to base predictions on.

All the other options are advantages of using sales forecasting for an existing company.

Question 2

Which of the following is a limitation of using sales forecasting?

1. The rapidly changing external environment can lead to forecasts becoming invalid. ✓
2. Forecasts can help companies to plan for the future. New equipment, staff and inventories can be secured to meet increased demand.

Student view

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

3 If a drop in sales is forecast, companies can react to this with increased marketing budgets, in an effort to increase sales.

4 The forecast is based upon actual sales data and therefore cannot change.

Explanation

If markets are changing rapidly, it can lead to incorrect forecasts being made for the future. This can lead to a decrease in sales revenue.

Question 3

Which of these terms refers to sales figures that change at different times of the year?

1 Seasonal variations ✓

2 Random variations

3 Cyclical variations

4 Annual variations

Explanation

The term 'seasonal variations' refers to products that experience higher sales volumes at certain times of the year, so are said to be seasonal. One example is children's toys, whose sales peak at certain times of the year, such as during gift-giving holidays. Other products may experience a peak in the summer months, such as sunscreen, certain clothes and hotel stays.

Cyclical variations are those that are the result of economic fluctuations. Random variations are those that occur randomly for any reason. Annual variations is not a term you need to learn.

Question 4

Which of the following is **not** a statistical technique used by businesses to forecast sales?

1 Scatter diagram ✓

2 Mean

3 Median

4 Mode

Student view

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

Explanation

A scatter diagram is a special type of graph designed to show the relationship between two variables. With simple regression analysis, you can use a scatter plot to see if the data given in terms of X and Y are linearly related. It is not a statistical tool to calculate the trends in sales. Mean, median and mode are all statistical tools used to calculate sales.

4. Marketing / 4.3 Sales forecasting (HL)

Terminology exercise

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/terminology-exercise-id-38739/print/) Assign

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

Businesses use a quantitative technique called to predict the levels of sales they may expect in future years. If this can be carried out accurately, the company can enjoy some benefits. If sales are expected to grow, then steps can be taken to ensure this extra demand is met.

Businesses can use a to graph past sales over time. This is called a analysis. A then passes through a scatter diagram of data points. This best expresses the relationship between those points. Once the line of best fit is drawn, the business can identify trends using past data and thus this information to predict future sales.

sales forecasting | extrapolate | time series | line of best fit | scatter diagram

Check

Interactive 1. Key Concepts in Sales Forecasting.

4. Marketing / 4.3 Sales forecasting (HL)

Tool: Simple linear regression

Student view

Tool: Simple linear regression (HL) Tool: Simple linear regression (HL)

What is linear regression analysis?

Imagine that you are the national sales manager of a clothing business and you are trying to predict next month's sales figures. There might be several factors that can impact your predictions, from changes in the weather to competitors' marketing strategies, or unforeseen events such as COVID-19.

Simple linear regression analysis provides a mathematical way to sort out the possible factors that might impact future sales, or other elements of a business. Regression models describe the relationship between two variables by fitting a line of best fit. The simple linear regression tool allows businesses to estimate how a dependent variable changes as the independent variable changes.

Simple linear regression can also be used to analyse how effective the marketing strategies of some businesses have been. For example, the analysis can show to what extent the spending on marketing has been successful in generating sales.

Features of simple linear regression include:

- The dependent variable: the main factor that the business is trying to predict. For example, the dependent variable could be monthly sales.
- The independent variable: the factor that the business suspects has an impact on its dependent variable (for example, monthly sales).

Simple linear regression involves the following steps:

1. Creating scatter diagrams to plot data from two variables.
2. Sketching a line of best fit.
3. Extrapolating the data to make predictions.

Scatter diagrams

A scatter diagram is a special type of graph designed to show the relationship between two variables. With simple regression analysis, you can use a scatter diagram to see if the data given in terms of X and Y are linearly related.

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Example: Suppose Business A wants to know the relationship between its online advertising costs (spending) and its e-commerce sales. The business has been able to get the survey results from its seven online stores for the last year. **Table 1** represents the survey results from the seven online stores.

Table 1. Business A's online advertising costs versus monthly e-commerce sales (in thousands of $), showing a positive relationship.

Online stores for Business A	Online advertising costs (in thousands of $)	Monthly e-commerce sales (in thousands of $)
1	1.9	379
2	1.6	335
3	2.4	595
4	4.5	785
5	1.5	350
6	2.7	525
7	1.1	310

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/sales-forecasting-id-38738/print/) Assign

From the table above, it can be seen that there is a positive correlation between the online advertising costs and monthly e-commerce sales. In simple terms this means that, as the value of the independent variable (advertising costs) increases, the value of the dependent variable (e-commerce sales) also increases. With this data, the business can predict that, as the advertising costs increase, so do the monthly e-commerce sales.

Using the information from **Table 1**, the following scatter diagram can be made with advertising costs plotted on the x-axis and monthly e-commerce sales plotted on the y-axis.

Student view

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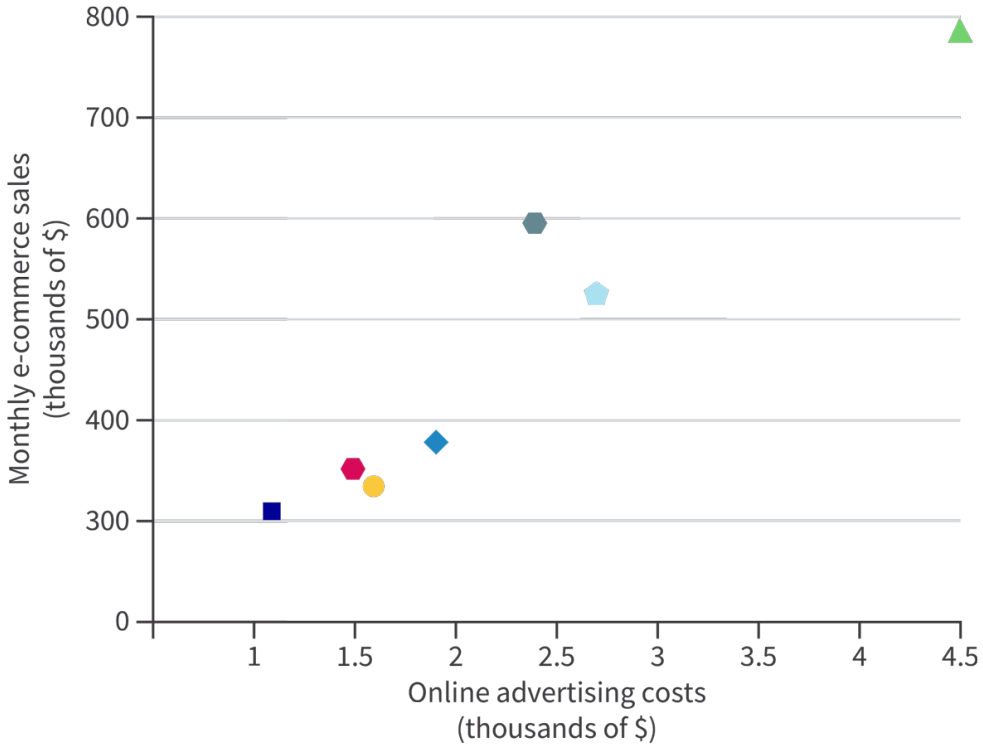

Figure 1. A scatter diagram showing data from advertising costs and e-commerce sales.

More information for figure 1

The scatter diagram shows the relationship between online advertising costs and monthly e-commerce sales. The X-axis represents online advertising costs, labeled in thousands of dollars, with a range from 0 to 4.5. The Y-axis represents monthly e-commerce sales, also in thousands of dollars, with a range from 300 to 800. Several data points are scattered across the graph:

1. At approximately $1,000 in advertising costs, sales are around $300,000.
2. At $1,500 in costs, sales slightly increase to about $330,000.
3. At $2,000, sales are around $400,000.
4. At approximately $3,500 in costs, sales rise to around $600,000.
5. Finally, at $4,500 in costs, sales peak at around $780,000.

Overall, the trend shows an upward trajectory where increased advertising costs correlate with higher e-commerce sales.

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A scatter diagram has both benefits and limitations, as shown in **Table 2.**

Table 2. The benefits and limitations of scatter diagrams.

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Benefits of a scatter diagram	Limitations of a scatter diagram
Scatter diagrams are easy to plot. A scatter diagram depicts the relationship between two variables, which is good for visual learners. Scatter diagrams show non-linear patterns with ease. It is easy to observe and interpret the pattern depicted in a scatter diagram. Maximum and minimum values are easily determined in a scatter diagram.	Scatter diagrams cannot give you the exact extent of correlation. A scatter diagram cannot take more than two variables into account. Only relationships between two variables can be illustrated. A scatter diagram only depicts quantitative data and cannot reflect qualitative data.

Line of best fit

A scatter diagram shows all the relationships between individual pieces of data for the independent and dependent variables. However, to be useful, a business needs to find a general relationship between the variables that can be used for predictions. A line of best fit will express this general relationship.

The line of best fit is a line through a scatter plot of data that captures the relationship between the independent and dependent variables. The line of best fit should be sketched in a way that is closest to the most number of points in the scatter diagram. It goes roughly through the middle of all the points on the scatter diagram.

To make the line of best fit even more accurate, it is important that you draw the line through a point that represents the mean of the independent data and the mean of the dependent data. Also, if possible, a roughly equal number of points should be above and below the line of best fit.

In **Figure 2** below, the same data from **Table 1** has been used. The diagonal line is the line of best fit, which is also called a line of regression. It illustrates the predicted relationship between each possible value of advertising costs and e-commerce sales.

Student view

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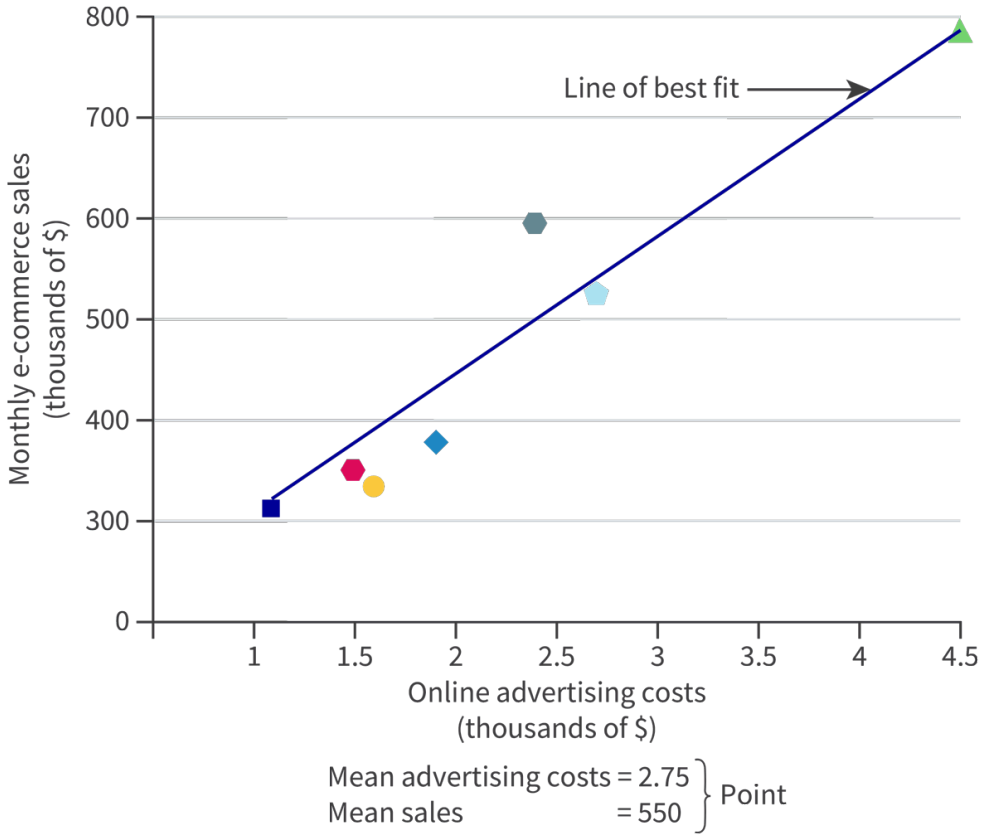

Figure 2. Line of best fit showing the relationship between advertising costs and e-commerce sales.

More information for figure 2

The image is a graph depicting the relationship between online advertising costs in thousands of dollars and monthly e-commerce sales in thousands of dollars. The X-axis represents online advertising costs ranging from 1 to 4.5 thousand dollars, while the Y-axis represents monthly e-commerce sales ranging from 300 to 800 thousand dollars.

A line of best fit runs diagonally across the graph, indicating a positive linear relationship; as advertising costs increase, so do sales. Several data points are plotted on the graph at various positions. Notably, the graph includes a mean advertising cost of 2.75 thousand dollars and a mean sales value of 550 thousand dollars. These means are labeled on the graph, providing a reference for understanding data distribution. Points of different shapes and colors are used to signify various data sets or categories, highlighting their respective positions in relation to both axes and the line of best fit.

[Generated by AI]

Now take the same example of advertising and e-commerce sales, but with data that shows a negative relationship between the two variables. This could be because the advertising is ineffective or is turning customers off. **Table 3** represents the survey results from the seven online stores.

Student view

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Table 3. Online advertising costs versus monthly e-commerce sales (in thousands of $), showing a negative relationship.

Online stores for business A	Online advertising costs (in thousands of $)	Monthly e-commerce sales (in thousands of $)
1	1.9	468
2	2.1	450
3	2.9	375
4	3.2	355
5	3.7	300
6	4.2	285
7	4.5	250

From the table above, it can be seen that there is a negative correlation between the online advertising costs (x-axis) and monthly e-commerce sales (y-axis). In simple terms, this means that as the value of the independent variable (advertising costs) increases, the value of the dependent variable (e-commerce sales) decreases. With this data, the business can predict that, as the advertising costs increase, the predicted monthly e-commerce sales decrease.

Student view

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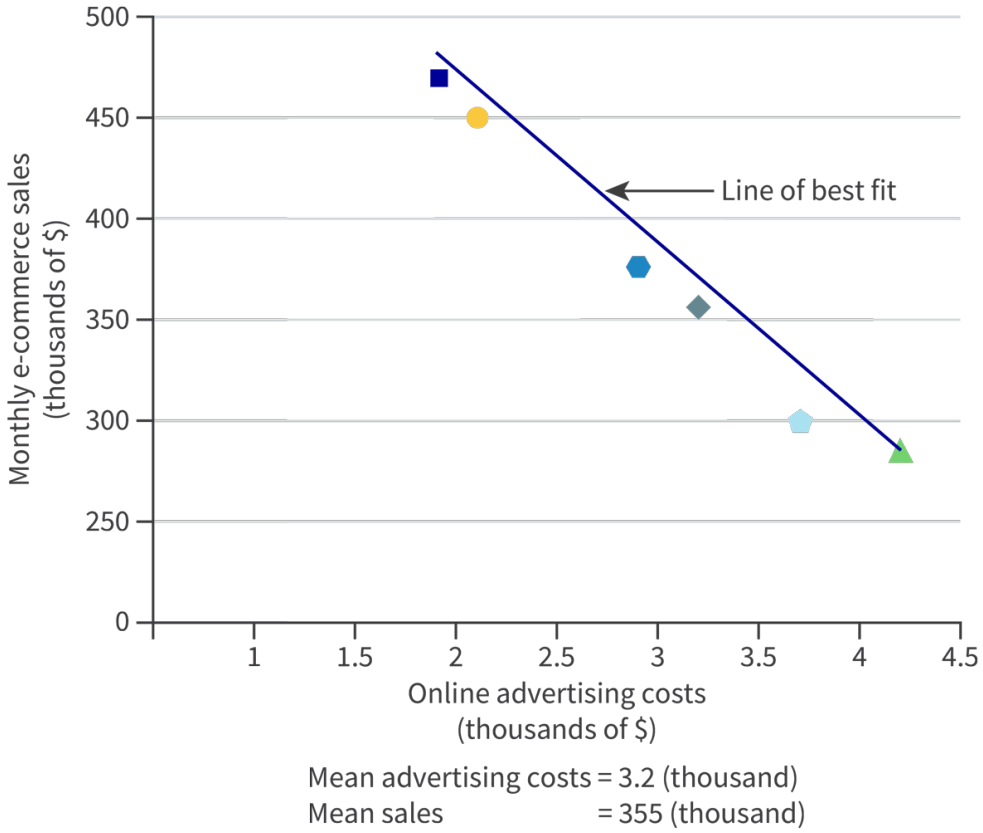

Figure 3. Line of best fit diagram.

More information for figure 3

The image is a scatter plot graph depicting the relationship between online advertising costs and monthly e-commerce sales. The X-axis represents online advertising costs in thousands of dollars, ranging from 0 to 4.5. The Y-axis represents monthly e-commerce sales in thousands of dollars, ranging from 250 to 500. The plot includes several data points, each represented by different colored and shaped markers, showing individual data values on the graph.

A blue line of best fit runs diagonally across the graph from the top-left to the bottom-right, indicating a negative correlation between advertising costs and e-commerce sales. At the bottom of the graph, it notes: "Mean advertising costs = 3.2 (thousand)" and "Mean sales = 355 (thousand)," providing statistical context to the data presented. The graph is labeled as a "Line of best fit diagram," as seen in the visual.

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Activity

SaniaR is a fast fashion clothing retailer. It delivers a new range of clothing every two weeks in its over 1500 stores worldwide. SaniaR's unique selling point is the rapid changes to its clothing lines, achieved by launching new styles every two weeks. The

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company's sales depend on the number of different styles they launch every two weeks — the greater the number of styles, the greater the sales. Of course, introducing new lines of clothing affects costs of production.

Table 4 shows the relationship between SaniaR's production and marketing costs and their monthly sales. (The table uses fictional data for the purpose of understanding.)

1. Draw a scatter diagram with the line of best fit to illustrate the information given in **Table 4**. [2 marks]
2. Explain whether there is a positive or negative correlation between the two variables. [2 marks]

Table 4. SaniaR's production and marketing costs versus mean monthly sales per yea

Year	Production and marketing costs (in thousands of $)	Monthly sales (in thousands of $)
1	105	195
2	110	205
3	106	204
4	125	250
5	135	300
6	145	350
7	165	450

1. The following scatter diagram should be drawn.

Student view

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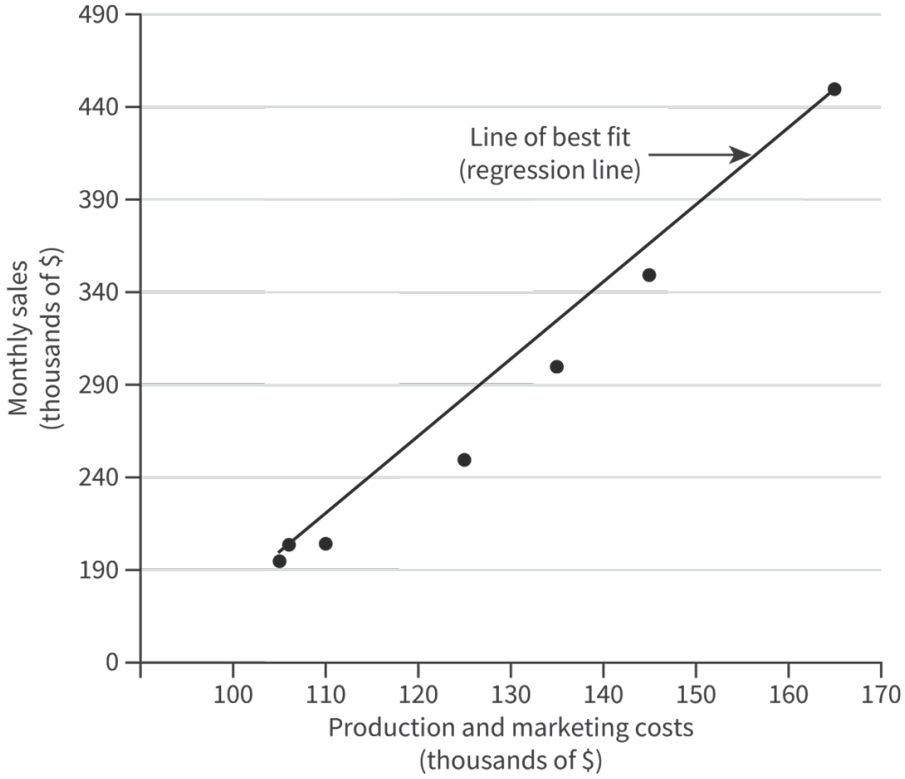

2. There is a positive correlation between both the variables. As production and marketing costs (independent variable) increase, the sales (dependent variable) increase.

Exam tip

In an exam question, your sketch of a line of best fit will not be precise. Thus, examiners will be instructed to accept reasonable attempts at drawing the line of best fit.

However, you must make sure to find the mean of the data for the independent and dependent variables, and make sure your line goes through that point. This is required to access full marks in exam questions asking for the line of best fit.

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Video 1. Using scatter plots to describe relationships between two variables, and using lines of best fit to make predictions.

Time series analysis: moving averages

In Section 4.3.1 (/study/app/business-hl/sid-351-cid-762729/book/sales-forecasting-id-38738/), you learned that sales data can vary over time quite significantly. When this happens, it can be difficult to see the overall trend and to draw the line of best fit. So it is important to smooth out the data by finding the mean of groups of data. Calculating a moving average can help you do that.

Analysing data using the trend analysis of time series data enables a business to understand a number of things. A trend is a pattern over time. Firstly, the business can know the trend of the sales it is making – in other words – whether this is rising or falling over time. Secondly, the business can understand any seasonal fluctuations. This is important for businesses that sell seasonal products such as ice creams, holidays or clothing. Thirdly, the business can pay attention to any cyclical fluctuations. This means those fluctuations that are the result of economic growth or recession in the broader economy.

The easiest way to understand this concept is by using an example. Imagine a business that specialises in selling second-hand cars. The business has a number of loyal customers, who on average replace their cars once every three years.

Step 1: Calculate the three-year moving average

The second-hand car business is thinking of expanding. However, it will only be profitable for it to do so if forecast sales for 2022 are above 100 cars a year. **Table 5** shows the company's sales figures and moving average for the last nine years. A moving average attempts to 'smooth out'

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any peaks or troughs in sales data so that underlying trends in data can be seen. Sales data goes through a three-year cycle. A three-part moving average can therefore be used. The three-year moving average is calculated in **Table 5**.

Table 5. Annual car sales from 2011 to 2022.

Year	Car sales	Three-part moving average (trend)
2011	34	
2012	110	80
2013	96	83
2014	43	85
2015	116	86
2016	99	88
2017	49	90
2018	122	91
2019	102	**93**
2020	?	**94**
2021	?	**96**
2022	?	**98**

The three-part moving average is calculated using a mean. For example, the first figure of 80 was calculated by taking the average of the sales figures from 2011, 2012 and 2013 as follows:

$$\text{Three-part moving average} = \frac{(34+110+96)}{3} = 80$$

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Each figure for the three-part moving average is then graphed. This shows the overall trend, smoothing out the extreme variations in the data. This is shown graphically in **Figure 4**.

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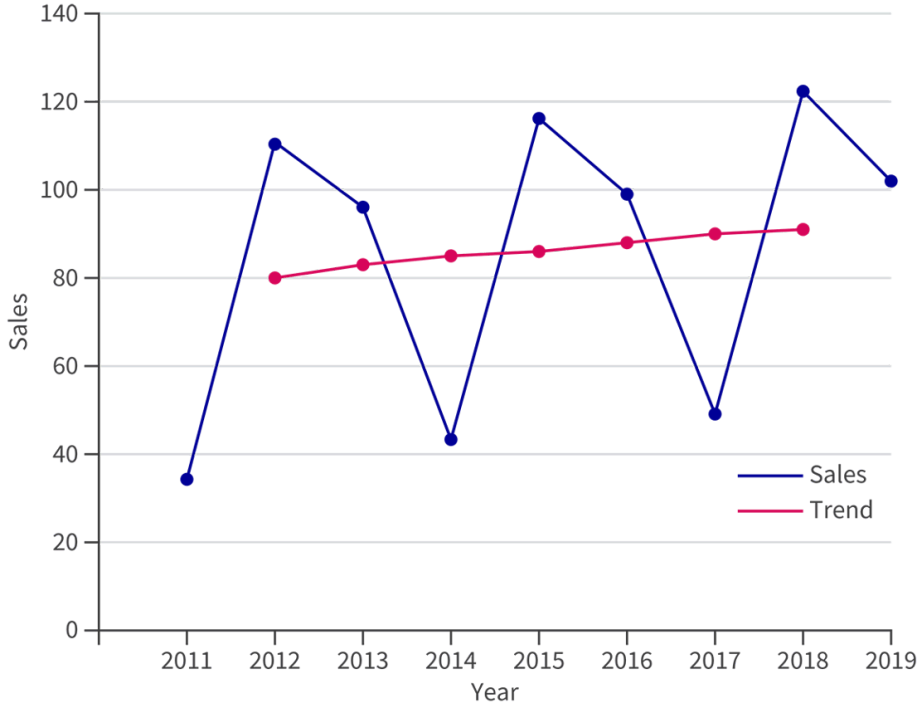

Figure 4. Three-part moving average $= \frac{(34+110+96)}{3} = 80$

More information for figure 4

The image is a graph illustrating the concept of a three-part moving average. The X-axis likely represents time units, while the Y-axis shows values such as production or consumption levels over that period. The graph consists of two jagged lines; one is dark blue and represents individual data points, and the other is a smoother red line, representing the calculated moving average over the same period. The blue line fluctuates more sharply, indicating variability in the data, while the red line appears more stable, showing the mean average trend. The graph suggests the use of a moving average to smooth out short-term fluctuations and highlight longer-term trends or cycles in the data.

[Generated by AI]

Step 2: Extrapolate the trend

Extrapolation of the trend is a forecasting method used by businesses to identify trends using past data, and extending this information and trend to be able to predict what future sales might look like.

Extrapolation is useful if the correlation between the two sets of data is clear, such as sales revenue over a period of time. Smoothing out the data using the three-point moving average (as above) helps make the overall trend in the data clearer. However, the data representing the three-point moving average is still not linear. To make a prediction into the future, a line of best fit needs to be added, as was done with the scatter diagram earlier in this section.

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From the example in **Figure 4**, a line of best fit can be added and extended to predict future sales. In **Figure 5**, the line of best fit has been added and extrapolated (extended) out as far as 2022.

As was mentioned earlier in this section, it is important that the line of best fit goes through the mean values of both the time data and the sales data.

Figure 5. The moving average or trend line extrapolated (extended) out as far as 2022.

More information for figure 5

The image is a line graph illustrating a trend over time. The X-axis represents the years, extending to 2022, while the Y-axis denotes an unspecified metric with numerical values. The graph features a fluctuating pattern, marked by large blue diamond-shaped datapoints connected by a blue line that oscillates with peaks and valleys. A yellow and red trend line runs steadily across the graph, indicating a moving average, which smooths out the fluctuations. This trend line is extrapolated, extending into the future, suggesting a projection based on past data. The graph also includes a legend on the bottom right corner differentiating between the elements of the graph, presumably the data points and the extrapolated trend line, using colors matching those in the graph. The overall trend shows stabilization towards the endpoint of the extrapolated line.

[Generated by AI]

You can now clearly see the difference between the blue sales line, and the red line that have been plotted with the three-period moving average data. The blue line is very jagged and moves up and down frequently. Every third year, sales drop quite dramatically. However the general trend for the business is still upwards over the period of time. Using the extrapolated line of best fit, the forecast sales figure for 2011 to 2022 have now been added to the graph above.

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You are now in a position to answer the original question: should the business expand? Based on the analysis, the business can predict that it will have sales of just 98 cars in 2022. This is less than the desired figure of 100. Therefore, based on the analysis, expansion would not be recommended at this time.

The same calculations can be made to work out the four-part moving average, where a mean of four years is taken into account, and a line of best fit is plotted and extrapolated.

Exam tip

In the exam, you will not be expected to calculate moving averages. The information above has been outlined so that you understand moving average data if it is given to you in a table in the exam.

However, you are expected to be able to:

- graph sales data
- graph given trend data, which may include moving averages
- sketch a line of best fit that goes through mean values for the independent and dependent variables
- extrapolate the line of best fit to make a sales forecast

Activity

Learner profile: Knowledgeable
Approaches to learning: Thinking skills (critical thinking); Communication skills

Marix produces a variety of sports shoes, such as running and walking shoes. Marix is a market leader that has dominated the sports shoe industry for a long time. Marix manufactures shoes in batches of different ranges.

As the sports shoe market is growing, so is the demand for Marix's sports shoes. Celebrity endorsements have helped increase sales. Recently, however, costs of production are increasing as resources are becoming more expensive. The business is experiencing diseconomies of scale.

The mean sales per month for Marix for the years 2015 to 2021 are given in **Table 6**.

Table 6. Marix's mean sales of shoes per month from 2015 to 2021.

Year	Mean sales of shoes per month
2015	185

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Year	Mean sales of shoes per month
2016	250
2017	400
2018	510
2019	700
2020	925
2021	950

Questions

1. Calculate the mean of the mean sales per month for Marix. (You have studied mean in Section 4.4.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-descriptive-statistics-id-39001/).)
2. Calculate the mean year (Section 4.4.6 (/study/app/business-hl/sid-351-cid-762729/book/tool-descriptive-statistics-id-39001/)).
3. Using graph paper, plot the mean sales of Marix per year from 2015 to 2021. Label your graph clearly.
4. On the graph, construct a line of best fit through the mean sales data obtained from question 2.
5. On the graph, extrapolate a value for mean sales in 2022 and 2023 from the line of best fit.

1. An average of 560 shoes are sold per month in each year over the time period. Total sales should be divided by the seven years of mean monthly data to get the mean monthly shoe sales per year.
2. The mean year is 2018. Add the years and divide by the number of years to get the mean year.

   Note: the mean sales and the mean year are needed so that the line of best fit goes through this point. This is necessary to score full marks for a question in the exam that asks for a line of best fit.

3. The following graph should be drawn.

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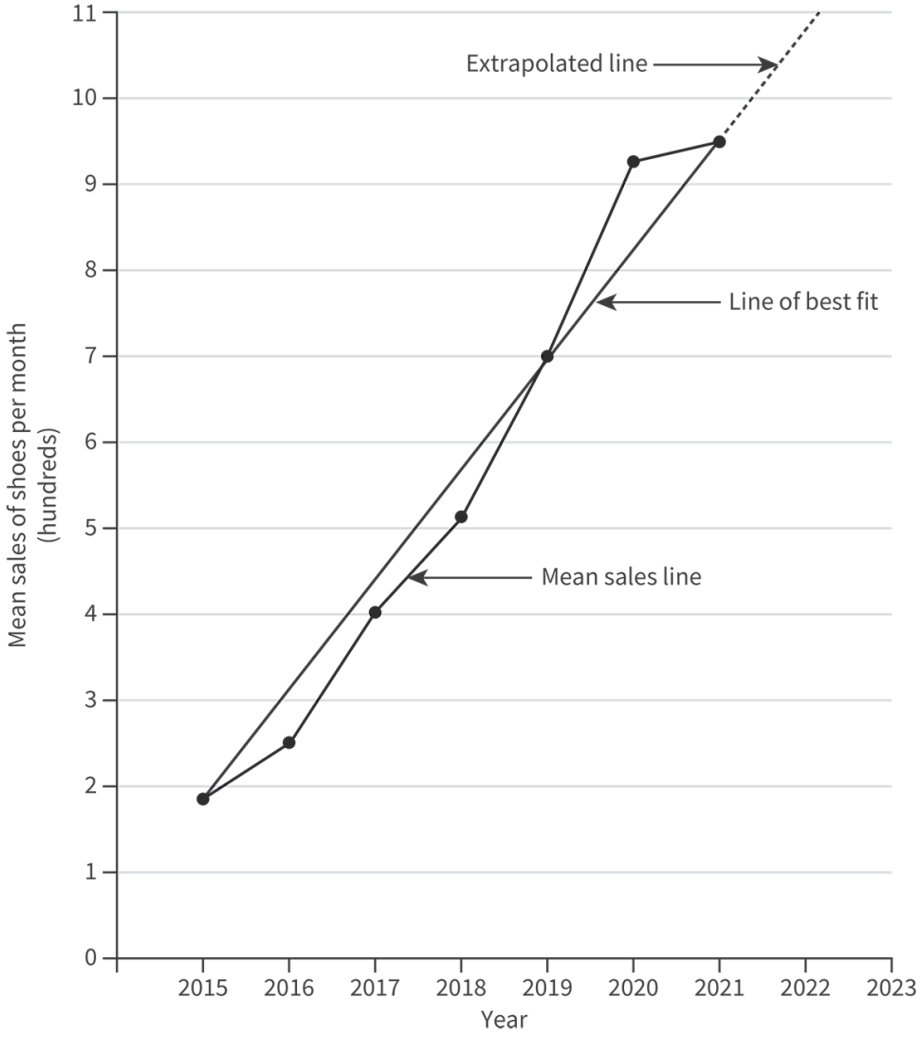

4. The line of best fit should go through the mean value of 560 shoes and the year 2018.
5. The extrapolated value of mean sales in 2022 is 1070 shoes (10.7) and for 2023 is 1200 shoes (12).

4. Marketing / 4.3 Sales forecasting (HL)

Checklist

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/checklist-id-38741/print/) Assign

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What you should know

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

- explain how businesses forecast sales (AO2)
- discuss the benefits and limitations of sales forecasting (AO3)
- apply simple linear regression in a given context (AO2, AO4)

Reflection

Section Student... (0/0) Feedback Print (/study/app/business-hl/sid-351-cid-762729/book/reflection-id-48330/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	**Tool:** simple linear regression
2	**Learner profile:** open-minded

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.

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Reflection

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In this subtopic you learned about sales forecasting and used regression 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. Simple linear regression analysis (see Section 4.3.3 (/study/app/business-hl/sid-351-cid-762729/book/tool-simple-linear-regressions-id-38740/)) can sometimes show a relationship between two factors where a relationship does not exist. Does this make it an invalid tool?
2. What are some limitations of using mathematical tools for projections? Does it eliminate or introduce bias into decision making?

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

0/2000

Submit

Rate subtopic 4.3 Sales forecasting (HL)

Help us improve the content and user experience.

☆ ☆ ☆ ☆ ☆

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