

AAT Level 4
Applied Management Accounting

Chapter 6
Calculating Forecasts

Study Guide

Assessment Criteria Covered

Reference	Assessment Criteria
LO 2.1	Use sampling and index numbers appropriately
LO 2.2	Apply a range of statistical techniques to calculate forecasts

PART ONE: Foundation Knowledge

Section 1: Why Businesses Need to Predict the Future

Every business decision involves some element of guessing what will happen next. When a shop owner decides how much stock to order, they're making a prediction about future sales. When a factory manager plans next month's production schedule, they're forecasting demand. Getting these predictions right can mean the difference between profit and loss.

This chapter equips you with practical tools to make educated predictions rather than wild guesses. We'll explore techniques that transform historical data into useful forecasts, helping managers make better decisions about everything from staffing levels to raw material purchases.

Forecast

A prediction about future events or values based on analysis of historical data and patterns. Unlike budgets (which set targets), forecasts aim to predict what will actually happen.

1.1 What is a Time Series?

Before we can forecast, we need data to work with. The raw material for most forecasting techniques is something called a time series - and understanding this concept is fundamental to everything that follows.

Time Series

A sequence of data points collected at regular intervals over time. Each observation is recorded at a specific point in time, creating a chronological record that can reveal patterns and trends. Examples include monthly sales figures, weekly production output, daily share prices, and quarterly profit reports.

What makes a time series different from other data? Three key characteristics:

- Chronological order matters: The sequence of observations is important - January comes before February, Q1 before Q2. You can't shuffle the data randomly.
- Regular intervals: Observations are taken at consistent time gaps - every day, every week, every month. Irregular gaps make analysis much harder.
- Single variable focus: A time series tracks one measure (like sales or costs) across time, allowing us to spot how that measure behaves over different periods.

Examples of Time Series Data

Business examples you might encounter:

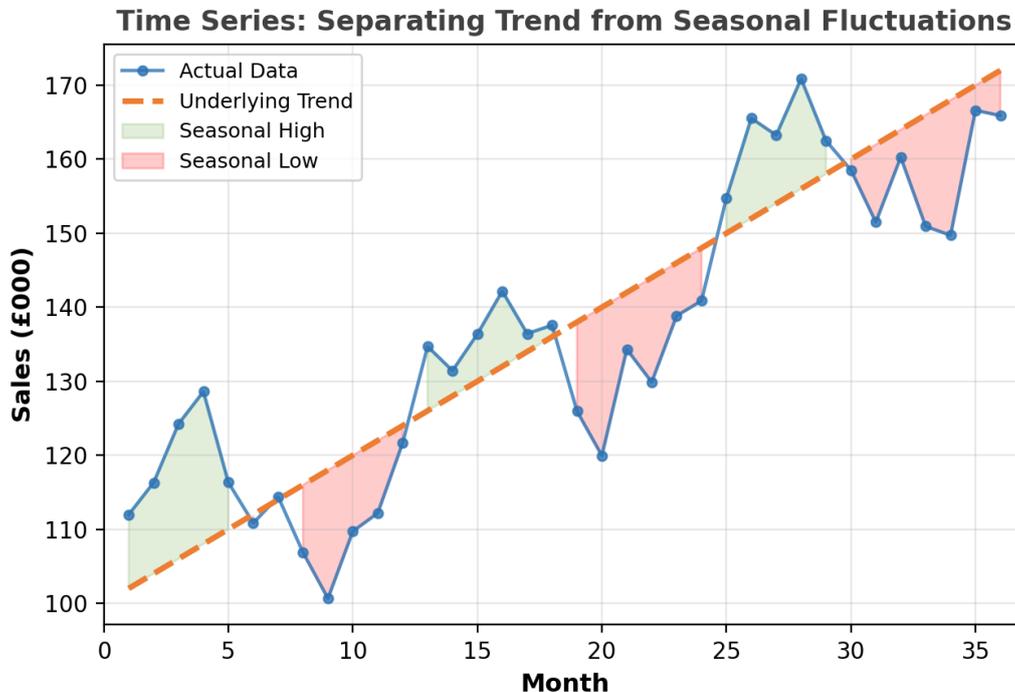
- Monthly revenue for a retail chain (12 observations per year)
- Quarterly electricity costs for a factory (4 observations per year)
- Weekly customer footfall in a shopping centre (52 observations per year)
- Daily website visitors for an online business (365 observations per year)

Each of these can be plotted on a graph with time on the horizontal axis, revealing patterns

that help predict future values.

1.2 The Building Blocks of Forecasting

Before diving into calculations, let's understand what we're working with. Most business data that changes over time contains several hidden patterns layered on top of each other:



The Four Ingredients of Business Data

Imagine you're looking at a company's monthly sales figures over three years. The numbers bounce around, but there's method in the madness:

- **The Underlying Trend (T):** This is the general direction - is the business growing, shrinking, or staying flat? Think of it as the 'big picture' movement when you blur out all the month-to-month noise.
- **Seasonal Swings (S):** Predictable patterns that repeat each year. Ice cream sales surge in summer; heating oil sales spike in winter. These patterns are like clockwork once you spot them.
- **Economic Cycles (C):** Longer waves lasting several years, often tied to broader economic conditions. These are harder to predict and typically ignored in short-term forecasting.
- **Random Wobbles (R):** Unpredictable events - a viral social media post, unexpected weather, or a competitor's surprise announcement. By definition, these can't be forecast.

Actual Data = Trend + Seasonal + Cyclical + Random

The additive model: each component adds or subtracts from the total

□ **Exam Tip:** In your assessment, you'll typically work with just Trend (T) and Seasonal variations (S). Cyclical and random elements are acknowledged but not calculated.

□ **Knowledge Check 1**

Which of the following is NOT a component of a time series?

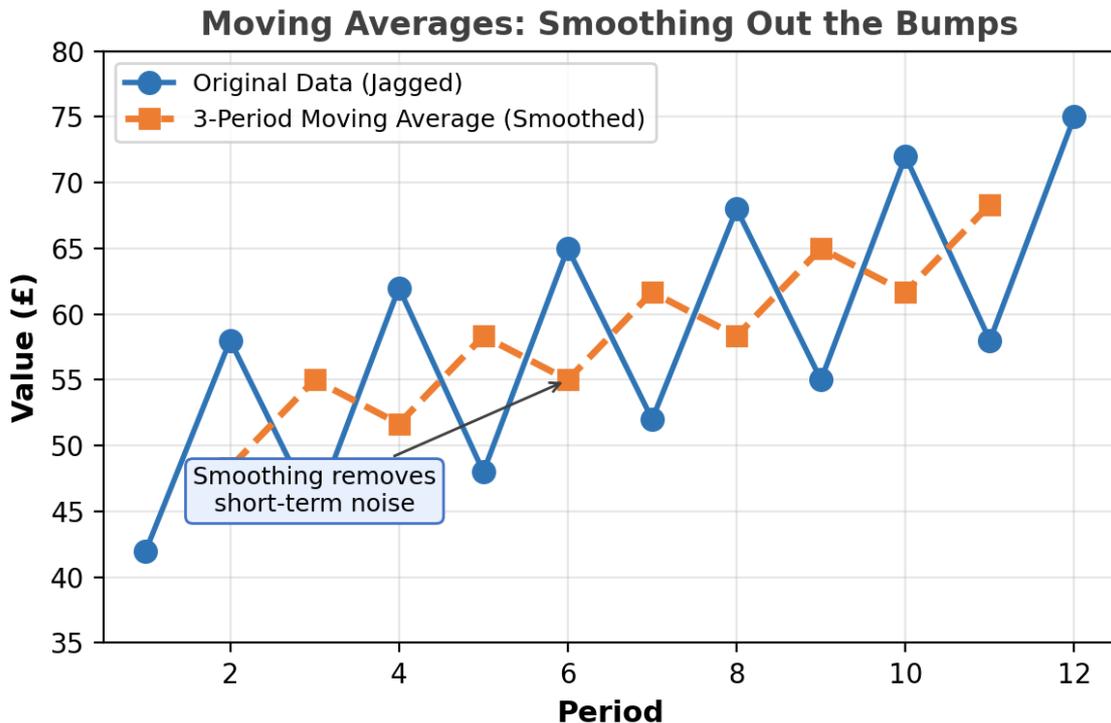
- A) Trend
- B) Seasonal variation
- C) Random variation
- D) Standard deviation

Section 2: Smoothing Out the Bumps - Moving Averages

Raw business data is messy. Sales figures jump up and down from month to month, making it hard to see if you're actually growing or shrinking. Moving averages are like putting on glasses that blur out the short-term noise so you can see the underlying trend clearly.

□ **Moving Average**

A calculation that takes the average of a fixed number of consecutive data points, then 'moves' forward through the data set, creating a smoother series that reveals the underlying trend.



2.1 How Moving Averages Work

Picture a window that slides along your data. The window shows, say, three months at a time. For each position, you calculate the average of what's visible through the window. Then you slide the window forward by one month and calculate again. Keep sliding and averaging until you reach the end.

Riverside Bakery - Monthly Bread Sales

Riverside Bakery tracks weekly bread sales (in hundreds of loaves):

Week 1: 42 | Week 2: 58 | Week 3: 45 | Week 4: 62 | Week 5: 48

To calculate a 3-week moving average:

First MA (centred on Week 2): $(42 + 58 + 45) \div 3 = 48.3$

Second MA (centred on Week 3): $(58 + 45 + 62) \div 3 = 55.0$

Third MA (centred on Week 4): $(45 + 62 + 48) \div 3 = 51.7$

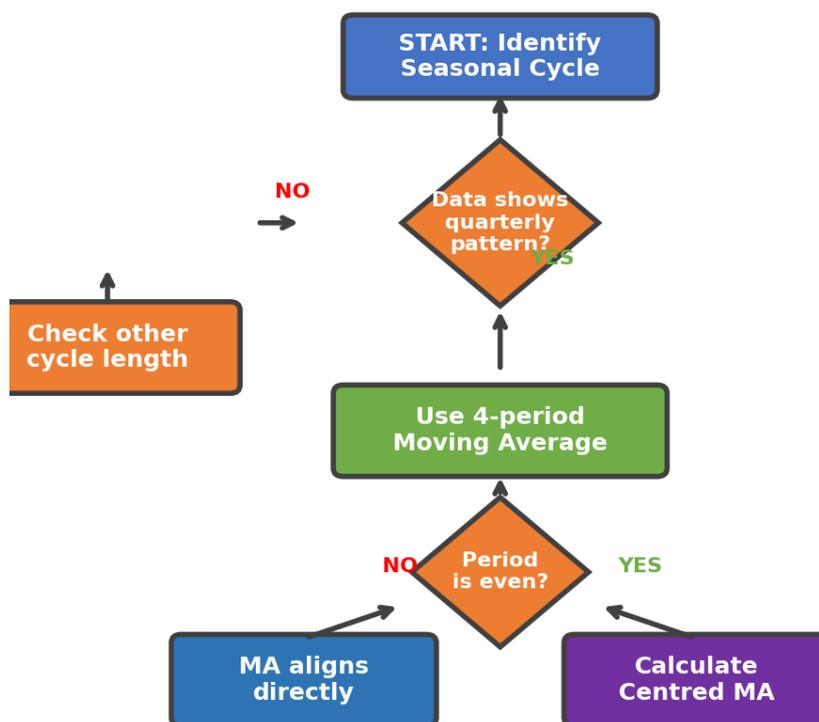
Notice how the moving averages (48.3, 55.0, 51.7) are less jumpy than the original data!

2.2 Choosing the Right Period

The number of periods in your moving average should match your seasonal cycle:

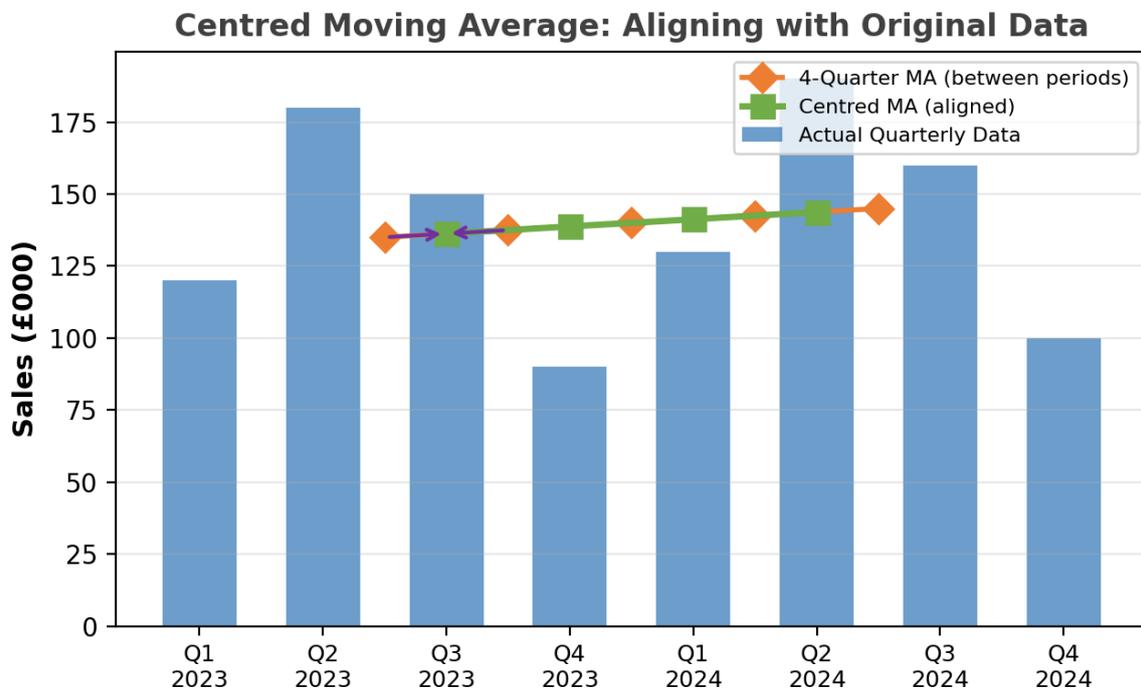
Data Type	Seasonal Cycle	Moving Average Period
Quarterly figures	4 quarters = 1 year	4-period MA
Monthly figures	12 months = 1 year	12-period MA
Weekly figures (5-day week)	5 days = 1 week	5-period MA
Daily figures (7-day week)	7 days = 1 week	7-period MA

Selecting Moving Average Period



2.3 The Alignment Problem: Centred Moving Averages

Here's a wrinkle that catches many students out. When your moving average uses an odd number of periods (like 3 or 5), the average naturally lines up with the middle period. But with an even number of periods (like 4 or 12), the average falls between two periods - which isn't very useful.



The solution? Calculate a second moving average of your moving averages! This 'centred' moving average lines up neatly with your original data points.

Phoenix Electronics - Quarterly Sales Trend

Phoenix Electronics has the following quarterly revenue (£000):

Q1: £120 | Q2: £180 | Q3: £150 | Q4: £90 | Q1: £130 | Q2: £190 | Q3: £160 | Q4: £100

Step 1: Calculate 4-quarter moving averages (these fall BETWEEN quarters):

Between Q2 & Q3 (Year 1): $(120+180+150+90) \div 4 = 135.0$

Between Q3 & Q4 (Year 1): $(180+150+90+130) \div 4 = 137.5$

Step 2: Calculate centred moving average (to ALIGN with Q3):

Centred MA for Q3: $(135.0 + 137.5) \div 2 = 136.25$

This centred figure of £136,250 represents the underlying trend for Q3.

Watch Out: Always check whether your period is odd or even. With even periods (4, 12, etc.), you MUST calculate centred moving averages to get figures that align with your original data.

2.4 Strengths and Weaknesses

Advantages	Limitations
Simple to calculate and understand	Loses data at the start and end of the series
Effectively smooths out random fluctuations	All periods given equal weight (oldest same as newest)
Works well with regular seasonal patterns	Can create artificial patterns not in original data
Widely accepted in business	Sensitive to extreme values (outliers)

Knowledge Check 2

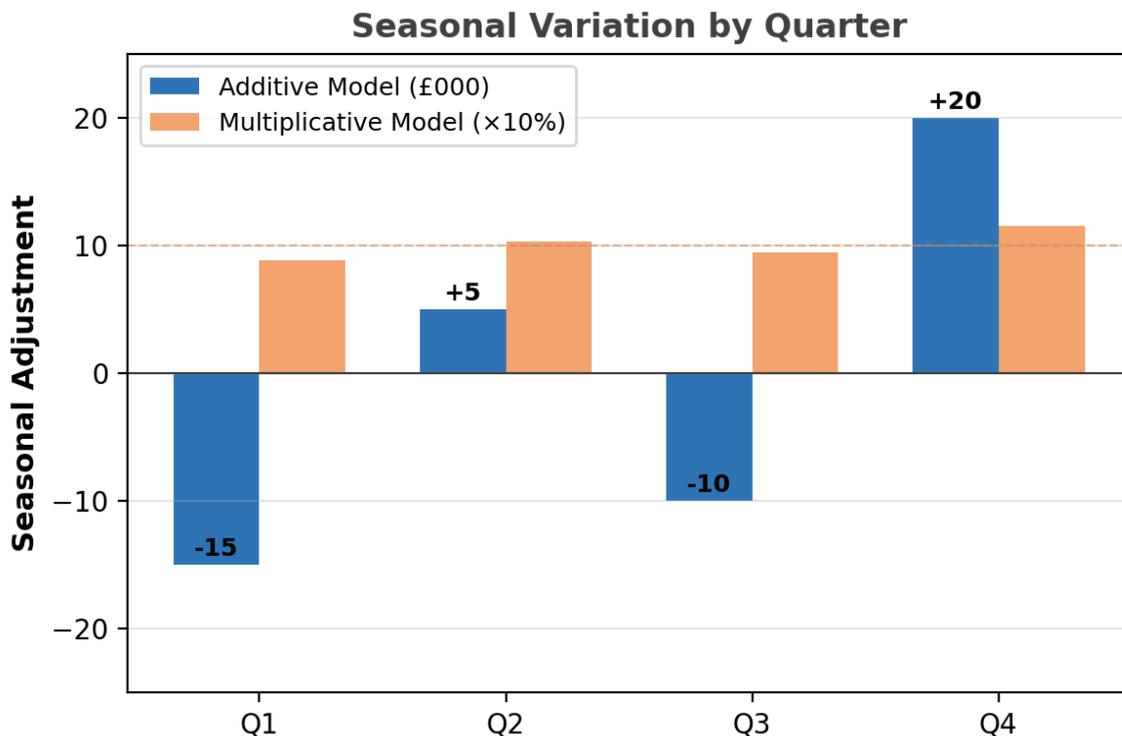
A company uses a 4-period moving average. Sales for the last 4 quarters were:
Q1: £120,000 Q2: £140,000 Q3: £160,000 Q4: £180,000

What is the moving average?

- A) £140,000
- B) £150,000
- C) £160,000
- D) £600,000

Section 3: Capturing the Seasonal Rhythm

Once you've found the trend using moving averages, the next step is to measure how much each season typically differs from that trend. These differences - the seasonal variations - are the key to making accurate forecasts.



3.1 Two Ways to Think About Seasonal Effects

There are two approaches to measuring seasonal impact, and your exam will tell you which one to use:

The Additive Approach

Think of seasons as adding or subtracting a fixed amount from the trend. If Christmas typically adds £50,000 to sales regardless of your overall size, that's additive thinking.

$$\text{Seasonal Variation} = \text{Actual Data} - \text{Trend}$$

Additive model: variations measured in absolute amounts (£)

$$\text{Forecast} = \text{Trend} + \text{Seasonal Variation}$$

To forecast: add the seasonal adjustment to the projected trend

The Multiplicative Approach

Here, seasons multiply the trend by a percentage. If summer sales are typically 120% of trend (or 20% above), that percentage stays constant even as your business grows.

$$\text{Seasonal Variation} = \text{Actual Data} \div \text{Trend}$$

Multiplicative model: variations measured as percentages or ratios

$$\text{Forecast} = \text{Trend} \times (1 + \text{Seasonal \%})$$

To forecast: multiply trend by the seasonal factor

☐ Suncoast Surf Shop - Additive Model

Suncoast has calculated their quarterly trend and now needs seasonal variations:

Quarter	Actual Sales	Trend	Seasonal Variation
Q1 2024	£85,000	£100,000	85,000 - 100,000 = -£15,000
Q2 2024	£115,000	£103,000	115,000 - 103,000 = +£12,000
Q3 2024	£140,000	£106,000	140,000 - 106,000 = +£34,000
Q4 2024	£82,000	£109,000	82,000 - 109,000 = -£27,000

Interpretation: Q3 (summer) adds £34,000 above trend; Q4 subtracts £27,000.

☐ Highland Hotels - Multiplicative Model

Highland Hotels uses percentages for seasonal adjustment:

Season	Trend Revenue	Seasonal Factor	Forecast
Spring	£450,000	+8%	450,000 × 1.08 = £486,000
Summer	£465,000	+25%	465,000 × 1.25 = £581,250
Autumn	£480,000	-5%	480,000 × 0.95 = £456,000
Winter	£495,000	-15%	495,000 × 0.85 = £420,750

Note: +25% means multiply by 1.25; -15% means multiply by 0.85

□ **Exam Tip:** Read the question carefully to identify which model to use. If you see percentages (like +15% or -8%), use the multiplicative model. If you see pound amounts (like +£5,000 or -£3,000), use the additive model.

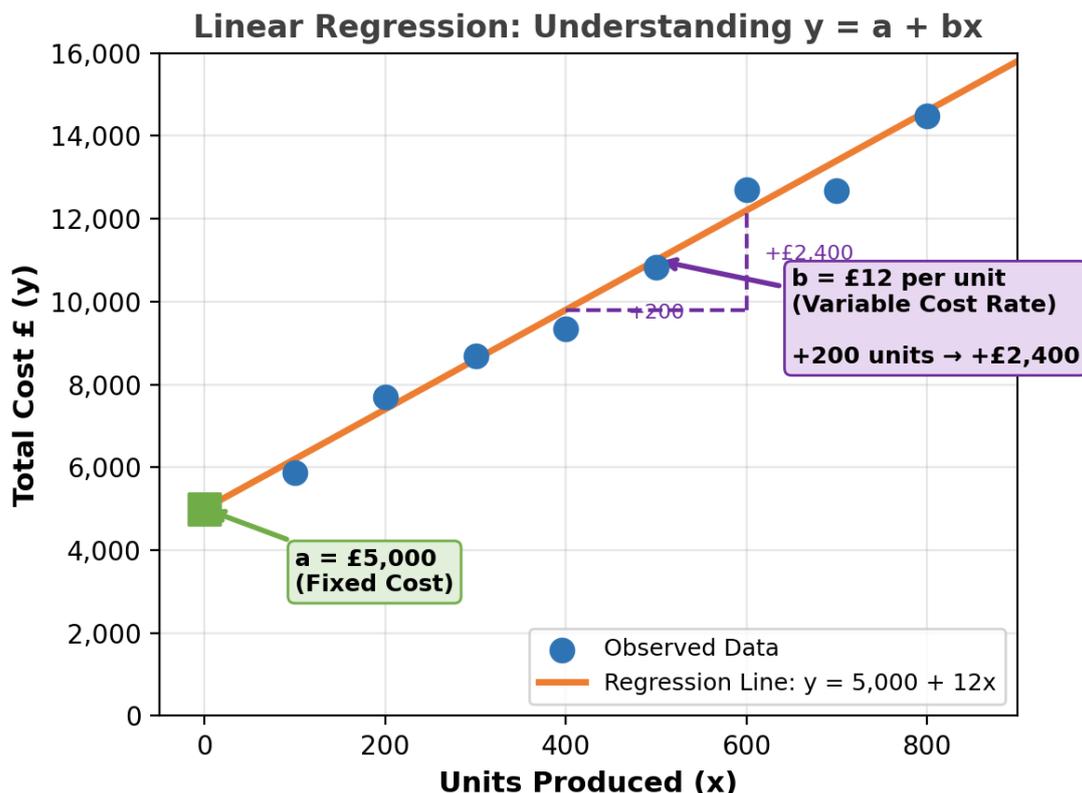
□ **Knowledge Check 3**

In the additive model, if the trend value is £50,000 and the seasonal variation is -£3,000, what is the forecast?

- A) £47,000
- B) £50,000
- C) £53,000
- D) £150,000

Section 4: The Straight-Line Relationship - Linear Regression

Sometimes the relationship between two things is beautifully simple: as one goes up, the other goes up by a predictable amount. Production costs rise with output. Sales increase with advertising spend. When this relationship forms a straight line on a graph, we can capture it in one powerful equation.



□ **Linear Regression**

A statistical technique that finds the best straight line through a set of data points. 'Best' means the line that minimizes the overall distance from the line to all the points - technically called the 'least squares' method.

4.1 Decoding the Equation: $y = a + bx$

This simple equation is one of the most useful tools in management accounting. Let's break it down piece by piece:

$$y = a + bx$$

The linear regression equation

Symbol	Name	What It Means	Example (Cost Analysis)
y	Dependent Variable	What you want to predict	Total production cost
x	Independent Variable	What you know or can control	Number of units made
a	Intercept (Constant)	Value of y when x equals zero	Fixed costs (rent, salaries)
b	Slope (Gradient)	How much y changes for each unit of x	Variable cost per unit

Maple Manufacturing - Cost Prediction

Maple Manufacturing has analysed their production data and found:

$$y = 15,000 + 8x$$

Where y = total monthly cost (£) and x = units produced

Interpretation:

- Fixed costs (a) = £15,000 per month (rent, insurance, salaries)
- Variable cost (b) = £8 per unit (materials, direct labour)

Predicting costs for 2,500 units:

$$y = 15,000 + (8 \times 2,500) = 15,000 + 20,000 = \text{£}35,000$$

4.2 Understanding Independent and Dependent Variables

The key question is: which variable causes which? The independent variable (x) is the driver - it causes changes in the dependent variable (y).

Scenario	Independent Variable (x)	Dependent Variable (y)
Factory costs	Production volume	Total cost
Umbrella sales	Rainfall	Units sold
Heating bills	Temperature	Energy cost
Revenue forecast	Quarter number	Sales revenue

Watch Out: Remember: x causes y, not the other way around. High umbrella sales don't cause rain! If you mix these up, your equation will give nonsense predictions.

4.3 When Regression Works Best

Linear regression makes two key assumptions. When these hold true, your forecasts will be reliable. When they don't, treat results with caution:

- The relationship really is linear: Check by plotting the data. If points curve rather than forming a rough line, linear regression isn't the right tool.
- Past patterns continue into the future: This is forecasting's Achilles heel. Economic conditions change, competitors disrupt markets, and technology evolves. Historical patterns are a guide, not a guarantee.

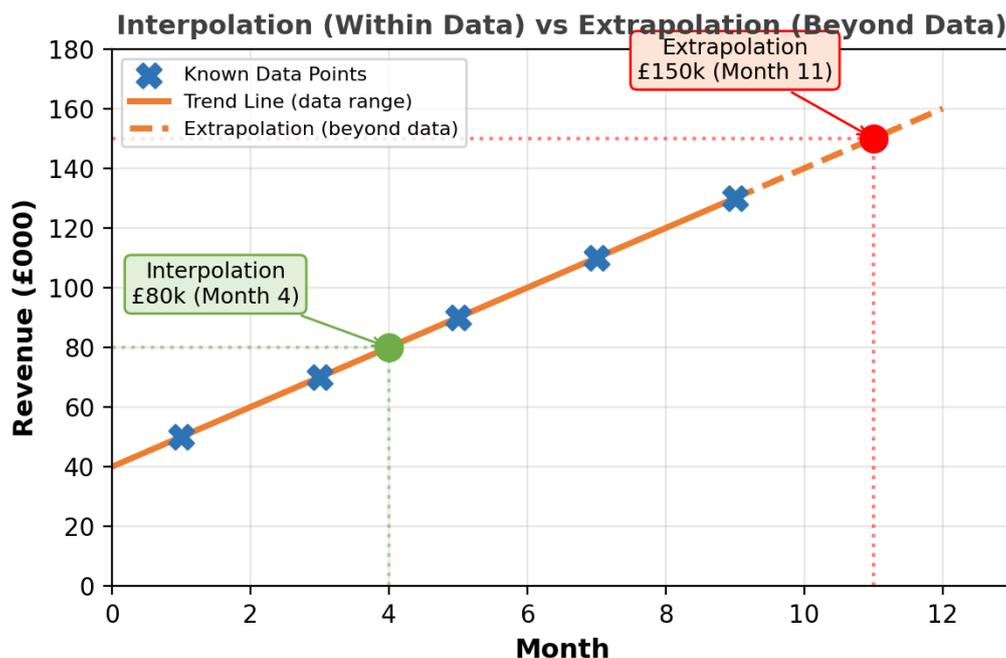
Knowledge Check 4

In the equation $y = a + bx$, what does 'b' represent?

- A) The fixed cost element
- B) The variable cost per unit (slope)
- C) The dependent variable
- D) The total cost

Section 5: Looking Backward and Forward - Interpolation vs Extrapolation

Once you have a trend line, you can use it in two ways. Understanding the difference between these uses - and their reliability - is crucial for your assessment.



5.1 Interpolation: Filling the Gaps

Interpolation

Estimating a value that falls WITHIN the range of your known data points. Like filling in a missing puzzle piece where you can see all the surrounding pieces.

If you have sales data for months 1, 3, 5, 7, and 9, interpolation lets you estimate what month 4 might have been. You're making an educated guess within familiar territory - relatively safe.

5.2 Extrapolation: Venturing Beyond

□ Extrapolation

Predicting values BEYOND the range of your known data. Like extending a road on a map past where surveyors have actually been - increasingly risky the further you go.

Forecasting next quarter's sales when you only have data through this quarter is extrapolation. You're assuming past patterns will continue - which becomes less reliable the further into the future you predict.

□ **Watch Out:** Extrapolation is the heart of forecasting, but it's inherently uncertain. A trend that's been rising for two years might level off, reverse, or accelerate. The further ahead you predict, the less confident you should be.

□ Comparing Reliability

Evergreen Consulting has quarterly revenue data from Q1 2022 to Q4 2023.

Interpolation (relatively reliable):

"What was likely revenue in Q3 2022?" - within known data range

Short-term extrapolation (reasonably reliable):

"What will Q1 2024 revenue be?" - just one quarter beyond data

Long-term extrapolation (highly uncertain):

"What will Q4 2026 revenue be?" - three years beyond data

The further you extrapolate, the more things can change to invalidate your forecast.

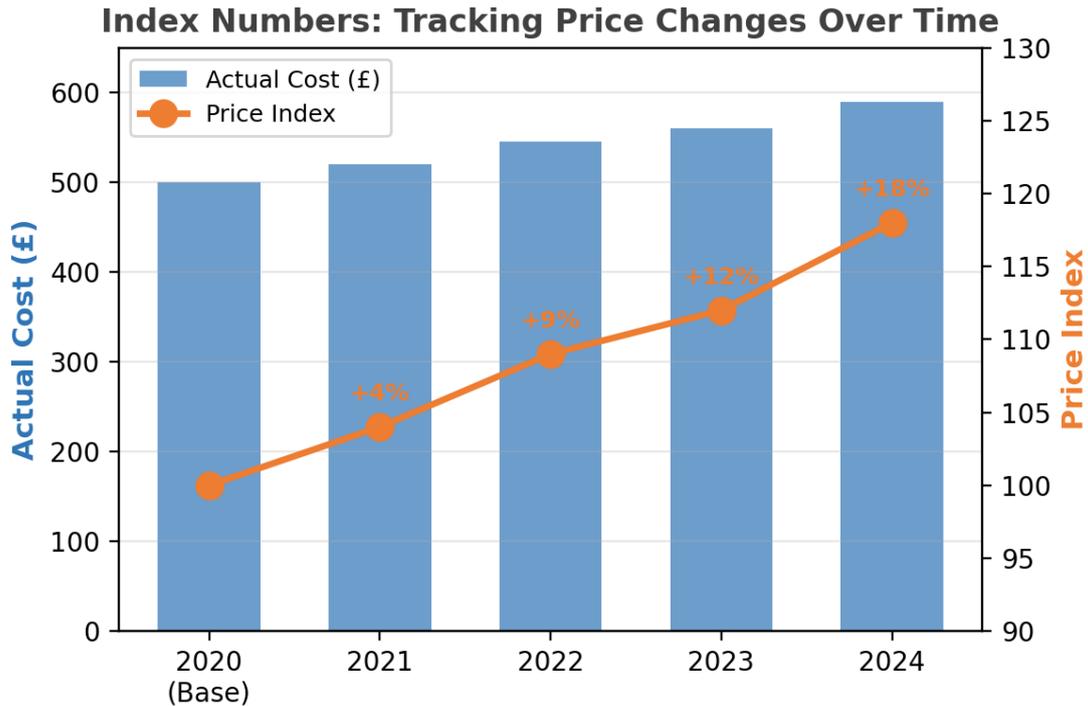
□ Knowledge Check 5

Which statement about interpolation and extrapolation is TRUE?

- A) Extrapolation is more reliable than interpolation
- B) Interpolation estimates values within the known data range
- C) Both methods give equally reliable results
- D) Interpolation predicts future values beyond the data range

Section 6: Tracking Changes Over Time - Index Numbers

Raw numbers can be deceiving. If sales were £500,000 last year and £525,000 this year, that's a £25,000 increase. But was that good? Bad? Average? Without context, it's hard to say. Index numbers provide that context by expressing changes relative to a starting point.



Index Number

A way of expressing a value relative to a base period, which is set to 100. Changes are then shown as movements above or below 100, making comparisons easy.

6.1 Calculating Index Numbers

$$\text{Index} = (\text{Current Period Value} \div \text{Base Period Value}) \times 100$$

The base period always equals 100

Northfield Manufacturing - Material Cost Index

Northfield tracks steel costs. January is the base month (Index = 100):

Month	Cost/Tonne	Calculation	Index
January	£800	Base period	100.0
February	£824	$(824 \div 800) \times 100$	103.0
March	£848	$(848 \div 800) \times 100$	106.0
April	£792	$(792 \div 800) \times 100$	99.0
May	£856	$(856 \div 800) \times 100$	107.0

Interpretation: By May, steel costs 7% more than in January (107 vs 100).

6.2 Adjusting for Inflation

Published indices like the Retail Price Index (RPI) and Consumer Price Index (CPI) measure general price changes in the economy. You can use these to convert historical figures into today's money, giving a fair comparison.

$$\text{Adjusted Value} = \text{Original Value} \times (\text{Current Index} \div \text{Original Index})$$

Converting past values to current prices

Real vs Nominal Revenue Growth

Coastal Crafts shows impressive revenue growth over five years:

Year	Revenue	RPI	Adjusted Revenue (to Year 5 prices)
Year 1	£400,000	142	$400,000 \times (162 \div 142) = £456,338$
Year 2	£420,000	147	$420,000 \times (162 \div 147) = £462,857$
Year 3	£445,000	152	$445,000 \times (162 \div 152) = £474,375$
Year 4	£470,000	157	$470,000 \times (162 \div 157) = £485,096$
Year 5	£500,000	162	£500,000 (current year)

Revelation: After adjusting for inflation, real revenue only grew from £456,338 to £500,000 - a much more modest increase than the raw figures suggest!

Exam Tip: Questions about index numbers often require you to work backwards too: if you know the index and the current value, you can calculate the base value using algebra.

Knowledge Check 6

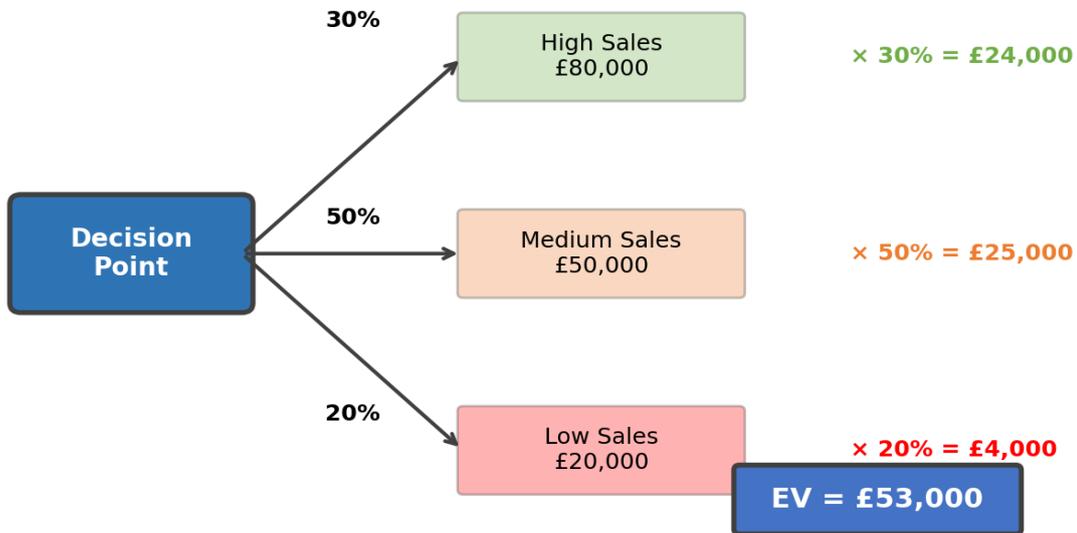
Base year index = 100, current year index = 125.
What percentage increase does this represent?

- A) 25%
- B) 125%
- C) 20%
- D) 80%

Section 7: Decision-Making Under Uncertainty - Expected Values

Real forecasting rarely produces a single definite answer. There might be several possible outcomes, each with different chances of occurring. Expected values help combine these possibilities into a single useful figure.

Expected Value: Probability-Weighted Average



Expected Value (EV)

The weighted average of all possible outcomes, where each outcome is weighted by its probability of occurring. It represents the average result you'd expect if you repeated the decision many times.

$$EV = \sum(p \times x) = \sum(\text{Probability} \times \text{Outcome})$$

Sum of each outcome multiplied by its probability

Westgate Ventures - Product Launch Decision

Westgate is deciding whether to launch a new product. Market research suggests:

Scenario	Probability	Profit/Loss	$p \times x$
Strong demand	25%	£200,000	$0.25 \times 200,000 = £50,000$
Moderate demand	55%	£80,000	$0.55 \times 80,000 = £44,000$
Weak demand	20%	-£40,000	$0.20 \times (-40,000) = -£8,000$

Expected Value = £50,000 + £44,000 - £8,000 = £86,000

Interpretation: On average, this launch would generate £86,000 profit. Since this is positive, the project looks worthwhile from a purely financial perspective.

7.1 The Good and Bad of Expected Values

Advantages	Limitations
Incorporates uncertainty into decision-making	Probabilities are often subjective guesses
Produces a single figure for easy comparison	The "expected" outcome may never actually occur
Simple to calculate and explain	Ignores the spread of possible outcomes (risk)
Useful for decisions that repeat over time	Less meaningful for one-off decisions

□ **Watch Out:** Expected value is an AVERAGE outcome. In Westgate's example, they'll never actually receive exactly £86,000 - they'll get either £200,000, £80,000, or lose £40,000. For a one-time decision, this averaging can be misleading.

□ **Knowledge Check 7**

A project has the following outcomes:
60% chance of £100,000 profit, 40% chance of £50,000 loss.

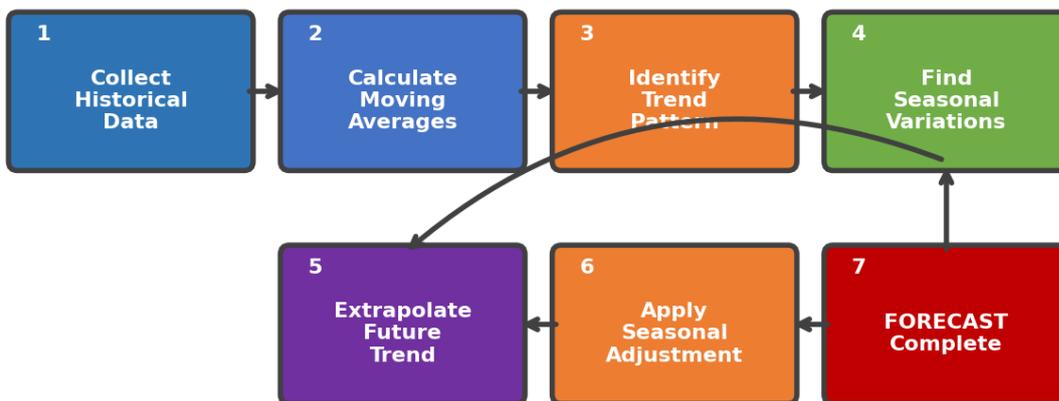
What is the expected value?

- A) £40,000
- B) £50,000
- C) £60,000
- D) £80,000

Section 8: Putting It All Together - The Forecasting Process

Now that you understand each tool individually, let's see how they combine into a complete forecasting workflow.

The Forecasting Process: From Data to Prediction



8.1 Seven Steps to a Forecast

1. Gather Historical Data: Collect at least 2-3 years of figures. The more data you have, the more confident you can be in patterns you identify.
2. Calculate Moving Averages: Smooth out short-term noise using an appropriate period (4 for quarterly, 12 for monthly). Remember to centre if using even periods.

3. Identify the Trend: Look at your moving averages. Are they rising, falling, or flat? By how much each period?
4. Extract Seasonal Variations: Compare actual figures to the trend. What's the typical difference for each season?
5. Project the Future Trend: Extend the trend line to your forecast period using either visual estimation or regression.
6. Apply Seasonal Adjustments: Add (additive) or multiply (multiplicative) the seasonal factor to your projected trend.
7. Review and Sense-Check: Does your forecast seem reasonable? Consider what might change and document your assumptions.

8.2 Why Forecasts Go Wrong

Even well-constructed forecasts often miss the mark. Understanding why helps you interpret forecasts wisely:

- The world changes: New competitors, technological shifts, economic downturns, or regulatory changes can invalidate historical patterns overnight.
- Historical data has limits: Your data might not include examples of unusual circumstances, making your forecast blind to possibilities.
- Seasonal patterns evolve: Consumer habits change, affecting what used to be reliable seasonal adjustments.
- Extrapolation compounds errors: Small inaccuracies in trend identification multiply as you project further ahead.
- Random events are random: By definition, you can't predict the unpredictable - strikes, natural disasters, viral trends.

Exam Tip: Your assessment may ask you to identify limitations of forecasting techniques. Remember: forecasts are educated guesses based on the assumption that past patterns continue. When conditions change, forecasts break down.

Knowledge Check 8

Which factor would NOT typically affect forecast accuracy?

- A) Quality of historical data
- B) Length of forecast period
- C) Colour of the spreadsheet cells
- D) Changes in market conditions

PART TWO: Practice Questions

Practice Questions

Test your understanding with these original practice questions covering all the key concepts from this chapter.

Question 1: Moving Averages (Odd Period)

Brightside Bakery records weekly sales (in £) as follows:

Week	1	2	3	4	5	6	7
Sales £	2,400	2,800	2,500	3,100	2,700	3,200	2,900

Required:

- (a) Calculate a 3-week moving average for weeks 2 to 6.
- (b) What does the trend suggest about Brightside's sales performance?

Question 2: Centred Moving Averages (Even Period)

Quartex Industries has the following quarterly production output (000 units):

Year	Q1	Q2	Q3	Q4
2023	48	72	60	40
2024	52	78	65	45

Required:

- (a) Calculate a 4-quarter moving average.
- (b) Calculate the centred moving average (trend).
- (c) Calculate the seasonal variation for each quarter where data permits.

Question 3: Forecasting with Additive Model

Lakeside Leisure has identified the following quarterly trend and seasonal variations:

Current trend: £180,000 per quarter, increasing by £5,000 each quarter

Quarter	Seasonal Variation
Q1	-£25,000
Q2	+£40,000
Q3	+£15,000
Q4	-£30,000

Required:

Forecast the revenue for each quarter of 2025, given that Q4 2024 trend was £180,000.

Question 4: Multiplicative Seasonal Adjustment

Highland Hotels has provided the following forecast information:

Quarter	Trend Revenue	Seasonal Factor
Q1 2025	£320,000	-12%
Q2 2025	£335,000	+18%
Q3 2025	£350,000	+35%
Q4 2025	£365,000	-22%

Required:

Calculate the seasonally-adjusted forecast revenue for each quarter of 2025.

Question 5: Linear Regression

Precision Parts Ltd has established that its monthly production costs follow the equation:

$$y = 24,000 + 6.50x$$

Where y = total monthly cost (£) and x = units produced

Required:

- (a) State the fixed cost element and explain what it represents.
- (b) State the variable cost per unit and explain what it represents.
- (c) Calculate the total cost of producing 5,000 units.
- (d) Calculate the total cost of producing 12,000 units.
- (e) If the company budgets £90,000 for production costs, what is the maximum number of units they can produce?

Question 6: Index Numbers

Greenfield Grocers tracks the cost of their main produce lines. Using January as the base month (Index = 100):

Month	Cost (£)	Index
January	4,500	100.0
February	4,635	?
March	4,725	?
April	4,410	?
May	?	108.0

Required:

- (a) Calculate the index for February, March, and April.
- (b) Calculate the cost for May.
- (c) Explain what the April index tells us about price changes.

Question 7: Adjusting for Inflation

Vintage Motors has the following revenue figures and RPI data:

Year	Revenue (£000)	RPI
2020	850	120
2021	890	126
2022	940	134
2023	1,010	145
2024	1,080	152

Required:

- (a) Restate all revenue figures in 2024 prices.
- (b) Has Vintage Motors achieved real growth? Comment on your findings.

Question 8: Expected Values

Venture Capital Ltd is evaluating a potential investment with the following possible outcomes:

Economic Scenario	Probability	Return
Strong Growth	20%	+£500,000
Moderate Growth	45%	+£200,000
Stagnation	25%	+£50,000
Recession	10%	-£150,000

Required:

- (a) Calculate the expected value of this investment.
- (b) Should Venture Capital proceed with the investment? Explain your reasoning.
- (c) State two limitations of using expected values for this decision.

Question 9: Comprehensive Forecasting Exercise

Coastal Cruises operates boat tours. Data for the past two years (passengers in hundreds):

Year	Q1	Q2	Q3	Q4
2023	15	42	58	22
2024	18	48	65	25

Required:

- (a) Calculate the 4-quarter centred moving average (trend) for each applicable quarter.
- (b) Calculate the seasonal variation for each quarter using the additive model.
- (c) If the trend continues at its current rate, forecast passenger numbers for Q1, Q2, and Q3 of 2025.
- (d) State two reasons why this forecast might prove inaccurate.

Question 10: Using Indices in Contracts

BuildRight Construction signed a contract in 2022 with a materials cost of £250,000. The contract includes an inflation adjustment clause using a materials price index:

Year	Materials Price Index
2022 (base)	100
2023	108
2024	115
2025 (forecast)	121

Required:

- (a) Calculate the adjusted contract value for 2023.
- (b) Calculate the adjusted contract value for 2024.
- (c) Calculate the forecast adjusted contract value for 2025.
- (d) Explain why construction contracts often include index-linked adjustment clauses.

PART THREE: Answers and Explanations

Detailed Answers

Answer 1: Moving Averages

(a) 3-week moving averages:

Week	Calculation	Moving Average
Week 2	$(2,400 + 2,800 + 2,500) \div 3$	£2,567
Week 3	$(2,800 + 2,500 + 3,100) \div 3$	£2,800
Week 4	$(2,500 + 3,100 + 2,700) \div 3$	£2,767
Week 5	$(3,100 + 2,700 + 3,200) \div 3$	£3,000
Week 6	$(2,700 + 3,200 + 2,900) \div 3$	£2,933

(b) The trend shows a general upward movement from £2,567 to £2,933, suggesting Brightside's sales are growing over time despite week-to-week fluctuations.

Answer 2: Centred Moving Averages

(a) & (b) Complete working:

Quarter	Output	4-Qtr MA	Centred MA	Seasonal Var
2023 Q1	48			
2023 Q2	72			
		55.0		
2023 Q3	60		55.5	+4.5
		56.0		
2023 Q4	40		56.75	-16.75
		57.5		
2024 Q1	52		58.25	-6.25
		59.0		
2024 Q2	78		59.5	+18.5
		60.0		
2024 Q3	65			
2024 Q4	45			

Workings:

- 4-Qtr MA (between Q2 & Q3 2023): $(48+72+60+40) \div 4 = 55.0$
- 4-Qtr MA (between Q3 & Q4 2023): $(72+60+40+52) \div 4 = 56.0$
- Centred MA for Q3 2023: $(55.0 + 56.0) \div 2 = 55.5$
- Seasonal Variation Q3 2023: $60 - 55.5 = +4.5$

Answer 3: Additive Model Forecast

Quarter	Trend Calculation	Trend	Seasonal	Forecast
Q1 2025	$180,000 + 5,000$	£185,000	-£25,000	£160,000
Q2 2025	$185,000 + 5,000$	£190,000	+£40,000	£230,000
Q3 2025	$190,000 + 5,000$	£195,000	+£15,000	£210,000
Q4 2025	$195,000 + 5,000$	£200,000	-£30,000	£170,000

Total forecast revenue for 2025: £160,000 + £230,000 + £210,000 + £170,000 = £770,000

Answer 4: Multiplicative Model

Quarter	Trend	Factor	Calculation	Forecast
Q1 2025	£320,000	0.88	320,000 × 0.88	£281,600
Q2 2025	£335,000	1.18	335,000 × 1.18	£395,300
Q3 2025	£350,000	1.35	350,000 × 1.35	£472,500
Q4 2025	£365,000	0.78	365,000 × 0.78	£284,700

Note: -12% means multiply by $(1 - 0.12) = 0.88$; +35% means multiply by $(1 + 0.35) = 1.35$

Answer 5: Linear Regression

(a) Fixed cost = £24,000. This represents the costs that must be paid regardless of production volume - rent, depreciation, management salaries, insurance, etc.

(b) Variable cost = £6.50 per unit. This is the additional cost for each extra unit produced - materials, direct labour, power consumption, etc.

(c) At 5,000 units: $y = 24,000 + (6.50 \times 5,000) = 24,000 + 32,500 = £56,500$

(d) At 12,000 units: $y = 24,000 + (6.50 \times 12,000) = 24,000 + 78,000 = £102,000$

(e) Maximum units with £90,000 budget:

$$90,000 = 24,000 + 6.50x$$

$$66,000 = 6.50x$$

$$x = 66,000 \div 6.50 = 10,154 \text{ units (rounded down)}$$

Answer 6: Index Numbers

(a) Index calculations:

- February: $(4,635 \div 4,500) \times 100 = 103.0$
- March: $(4,725 \div 4,500) \times 100 = 105.0$
- April: $(4,410 \div 4,500) \times 100 = 98.0$

(b) May cost: If index = 108, then Cost = $4,500 \times (108 \div 100) = £4,860$

(c) The April index of 98.0 indicates that prices fell to 98% of the January level - a 2% decrease. This could be due to seasonal factors, market conditions, or supplier discounts.

Answer 7: Inflation Adjustment

(a) Adjusted revenue figures (at 2024 prices):

Year	Original £000	RPI Adjustment	Adjusted £000
2020	850	$850 \times (152 \div 120)$	1,077
2021	890	$890 \times (152 \div 126)$	1,073
2022	940	$940 \times (152 \div 134)$	1,067

Year	Original £000	RPI Adjustment	Adjusted £000
2023	1,010	$1,010 \times (152 \div 145)$	1,059
2024	1,080	Current year	1,080

(b) Real growth analysis: In real terms (adjusted for inflation), revenue has remained relatively flat, hovering around £1,060,000-£1,080,000. The apparent growth from £850,000 to £1,080,000 is almost entirely due to inflation rather than genuine business expansion.

Answer 8: Expected Values

(a) Expected value calculation:

Scenario	Probability	Return	$p \times x$
Strong Growth	0.20	+£500,000	£100,000
Moderate Growth	0.45	+£200,000	£90,000
Stagnation	0.25	+£50,000	£12,500
Recession	0.10	-£150,000	-£15,000
		Expected Value:	£187,500

(b) With a positive expected value of £187,500, the investment appears financially attractive. However, the decision should also consider the company's risk tolerance and the 10% chance of a £150,000 loss.

(c) Limitations of expected values:

- The probabilities are subjective estimates and may be inaccurate
- The EV (£187,500) is not an actual possible outcome - you'll get one of the four specific results
- EV ignores the spread/risk - a risk-averse investor might reject despite positive EV
- It's a one-off decision, so the 'average over many repetitions' interpretation doesn't apply

Answer 9: Comprehensive Forecasting

(a) & (b) Full working table:

Quarter	Passengers	4-Qtr Total	4-Qtr MA	Centred MA	Seasonal Var
2023 Q1	15				
2023 Q2	42				
		137	34.25		
2023 Q3	58			35.00	+23.0
		143	35.75		
2023 Q4	22			36.50	-14.5
		149	37.25		
2024 Q1	18			38.00	-20.0
		155	38.75		
2024 Q2	48			39.50	+8.5
		161	40.25		
2024 Q3	65				
2024 Q4	25				

(c) Forecasts for 2025:

Trend is increasing by approximately 1.5 per quarter (from 35.0 to 39.5 over 3 quarters)

Q4 2024 trend estimate: $40.25 + 1.5 = 41.75$

- Q1 2025: Trend = 43.25, Seasonal = -20.0, Forecast = 23.25 (2,325 passengers)
- Q2 2025: Trend = 44.75, Seasonal = +8.5, Forecast = 53.25 (5,325 passengers)
- Q3 2025: Trend = 46.25, Seasonal = +23.0, Forecast = 69.25 (6,925 passengers)

(d) Potential forecast inaccuracies:

- Weather conditions could differ significantly from historical patterns
- External factors: fuel prices, economic downturn, competitor actions
- Capacity constraints may limit growth even if demand is higher
- Only two years of data provides limited basis for trend identification

Answer 10: Index-Linked Contracts

(a) 2023 adjusted value: $£250,000 \times (108 \div 100) = £270,000$

(b) 2024 adjusted value: $£250,000 \times (115 \div 100) = £287,500$

(c) 2025 forecast value: $£250,000 \times (121 \div 100) = £302,500$

(d) Reasons for index-linked clauses in construction:

- Construction projects often span multiple years during which material prices can change significantly
- Protects contractors from being locked into unprofitable contracts if costs rise unexpectedly
- Provides fair risk-sharing between client and contractor
- Enables more accurate initial pricing as contractors don't need to build in large contingencies
- Reflects the reality that material prices are largely outside the contractor's control

Knowledge Check Answers

Knowledge Check 1

Answer: D - Standard deviation

The four components of a time series are: Trend (T), Seasonal variation (S), Cyclical variation (C), and Random variation (R). Standard deviation is a measure of dispersion, not a time series component.

Knowledge Check 2

Answer: B - £150,000

Moving average = $(£120,000 + £140,000 + £160,000 + £180,000) \div 4 = £600,000 \div 4 = £150,000$

Knowledge Check 3

Answer: A - £47,000

In the additive model: Forecast = Trend + Seasonal variation = $£50,000 + (-£3,000) = £47,000$

Knowledge Check 4

Answer: B - The variable cost per unit (slope)

In $y = a + bx$: 'a' is the fixed cost (y-intercept), 'b' is the variable cost per unit (slope), 'x' is the activity level, and 'y' is the total cost.

Knowledge Check 5

Answer: B - Interpolation estimates values within the known data range

Interpolation estimates values within the range of known data (more reliable). Extrapolation predicts beyond the data range (less reliable as it assumes patterns continue).

Knowledge Check 6

Answer: A - 25%

Percentage change = $(125 - 100) \div 100 \times 100\% = 25\%$. The index has increased from 100 to 125, representing a 25% increase.

Knowledge Check 7

Answer: A - £40,000

Expected value = $(0.60 \times £100,000) + (0.40 \times -£50,000) = £60,000 - £20,000 = £40,000$

Knowledge Check 8

Answer: C - Colour of the spreadsheet cells

Forecast accuracy is affected by data quality, forecast horizon, and market conditions. The colour of spreadsheet cells has no impact on forecast accuracy.

PART FOUR: Chapter Summary

Key Formulas Reference

Concept	Formula	When to Use
Moving Average	Sum of n periods ÷ n	Finding trend from raw data
Centred MA	$(MA_{-1} + MA_{+1}) \div 2$	Even-period moving averages
Additive Seasonal	Actual – Trend	Seasonal variations in £
Additive Forecast	Trend + Seasonal	Predicting with £ adjustments
Multiplicative Seasonal	Actual ÷ Trend	Seasonal variations as %
Multiplicative Forecast	Trend × Factor	Predicting with % adjustments
Linear Regression	$y = a + bx$	Linear relationship forecasting
Index Number	$(\text{Current} \div \text{Base}) \times 100$	Measuring relative change
Inflation Adjustment	$\text{Value} \times (\text{New Index} \div \text{Old})$	Converting to current prices
Expected Value	$\sum(p \times x)$	Probability-weighted average

Memory Aids

TSRC - Time Series Components

Think 'TSRC' like a TV network: T-rend (the big picture direction), S-easonal (predictable patterns), R-andom (unpredictable noise), C-yclical (long economic waves).

$y = a + bx$ Decoder

Remember 'YABX' as 'Your Answer Begins with X':

- y = what You want to find (dependent)
- a = Always there (fixed cost, even when $x=0$)
- b = By how much (rate of change per unit)
- x = X-factor you know (independent variable)

Odd vs Even Periods

'Odd is Easy, Even needs Extra' - Odd periods align automatically; Even periods need the Extra step of centring.

Interpolation vs Extrapolation

'Inter' means within (between known data); 'Extra' means beyond (past your data). Think: 'Extra risk when you go Extra far!'

Common Mistakes to Avoid

Watch Out: Forgetting to centre even-period moving averages - always check if your period is odd or even!

Watch Out: Mixing up additive and multiplicative models - check whether variations are given in £ (additive) or % (multiplicative).

Watch Out: Confusing dependent and independent variables in regression - ask 'what causes what?' The cause is x.

Watch Out: Forgetting that extrapolation becomes less reliable the further ahead you forecast.

Watch Out: Using the wrong base period for index calculations - always identify which period = 100.

Exam Success Tips

Exam Tip: Show your workings clearly, especially for moving averages. Partial marks are available for correct method even if arithmetic slips.

Exam Tip: When asked about forecast limitations, think about the assumptions underlying each technique - what could change to invalidate them?

Exam Tip: For regression questions, always identify which variable is dependent (y) and which is independent (x) before calculating.

Exam Tip: Double-check your calculator work on index numbers - it's easy to divide when you should multiply or vice versa.

Exam Tip: If asked to comment on a forecast, consider both its usefulness (what decisions it helps with) and its limitations (why it might be wrong).

— End of Chapter 6 Study Guide —