

AAT Level 4
Applied Management Accounting

Chapter 6

Calculating Forecasts

Comprehensive Study Guide

| Assessment Criteria | Learning Outcome |
|---|------------------|
| Calculate forecasts | LO 4.4 |
| Uncertainty in the budget setting process | LO 1.6 |

Key Topics Covered:

- Understanding and analysing time series data
- Calculating and interpreting moving averages
- Identifying trends and seasonal patterns
- Using linear regression for forecasting ($y = a + bx$)
- Working with index numbers
- Understanding expected values and forecast limitations

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

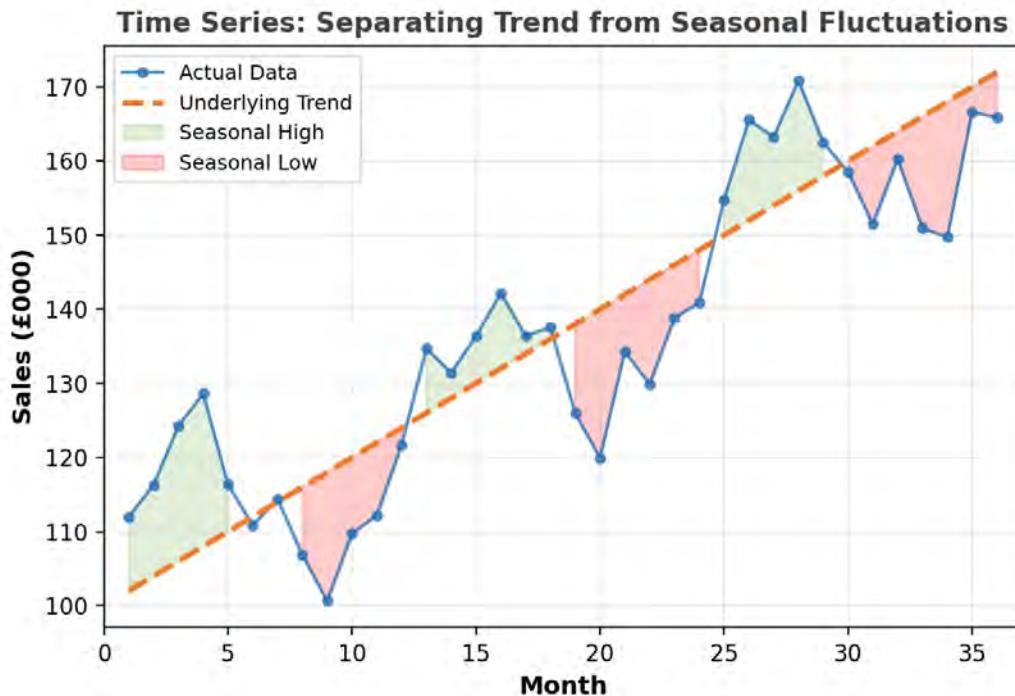
Business examples you might encounter:

- 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

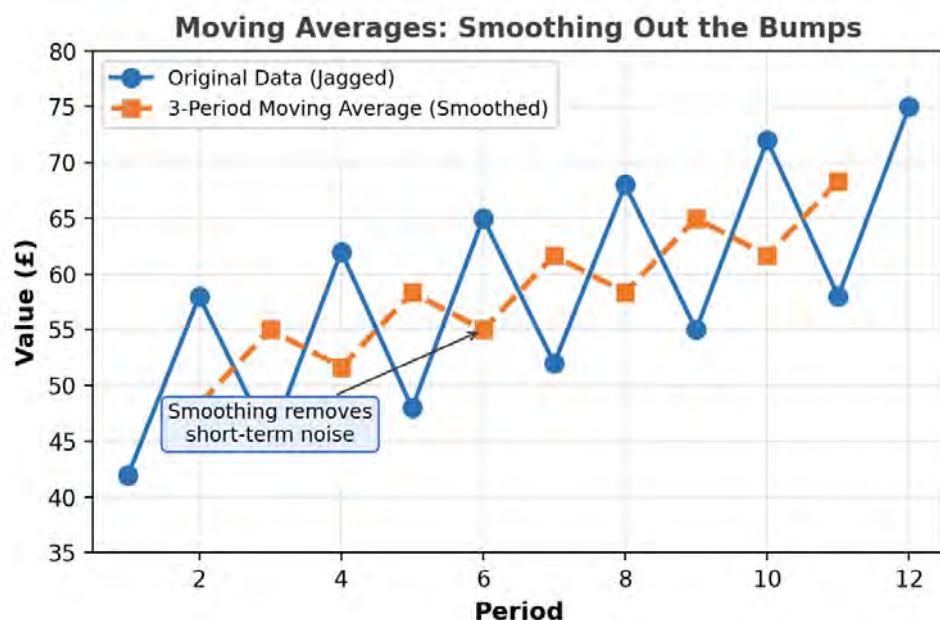
Exam Tip: In your assessment, you'll typically work with just Trend (T) and Seasonal variations (S). Cyclical and random elements are acknowledged but not calculated.

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): $(45 + 62 + 48) \div 3 = 51.7$

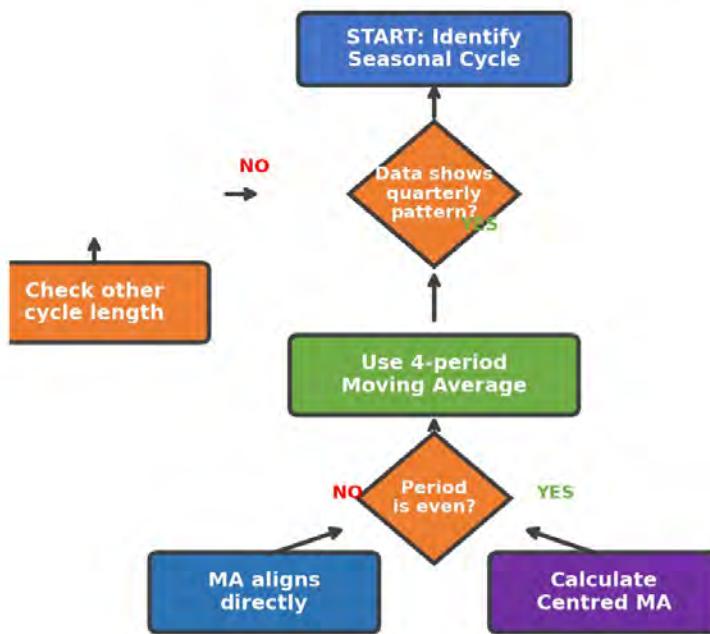
Notice how the moving averages (48.3, 55.0, 51.7) are less jumpy than the original data!

2.2 Choosing the Right Period

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

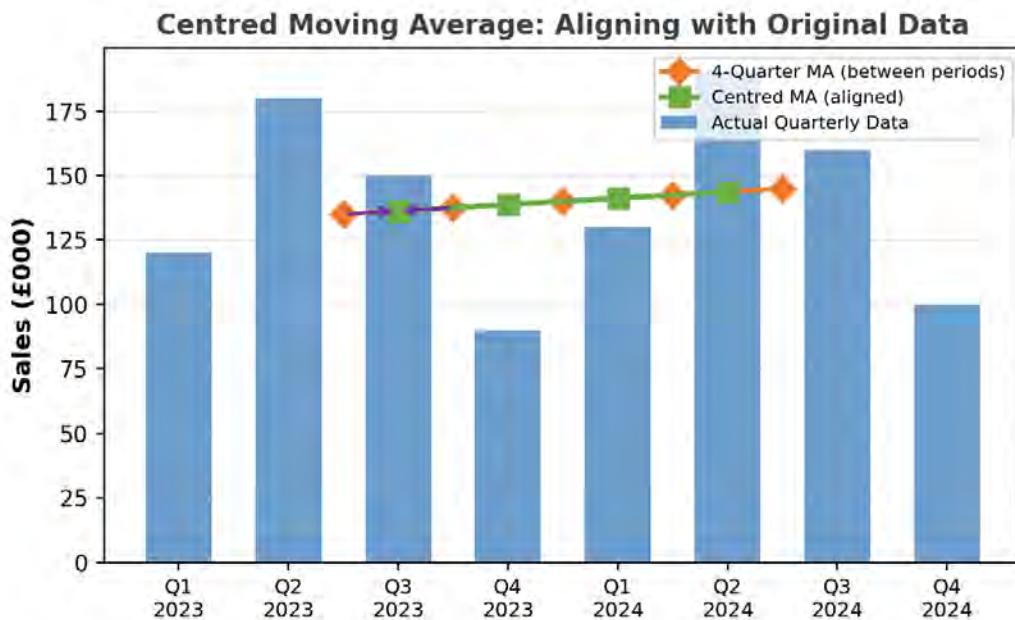
| Data Type | Seasonal Cycle | Moving Average Period |
|-----------------------------|---------------------|-----------------------|
| Quarterly figures | 4 quarters = 1 year | 4-period MA |
| Monthly figures | 12 months = 1 year | 12-period MA |
| Weekly figures (5-day week) | 5 days = 1 week | 5-period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

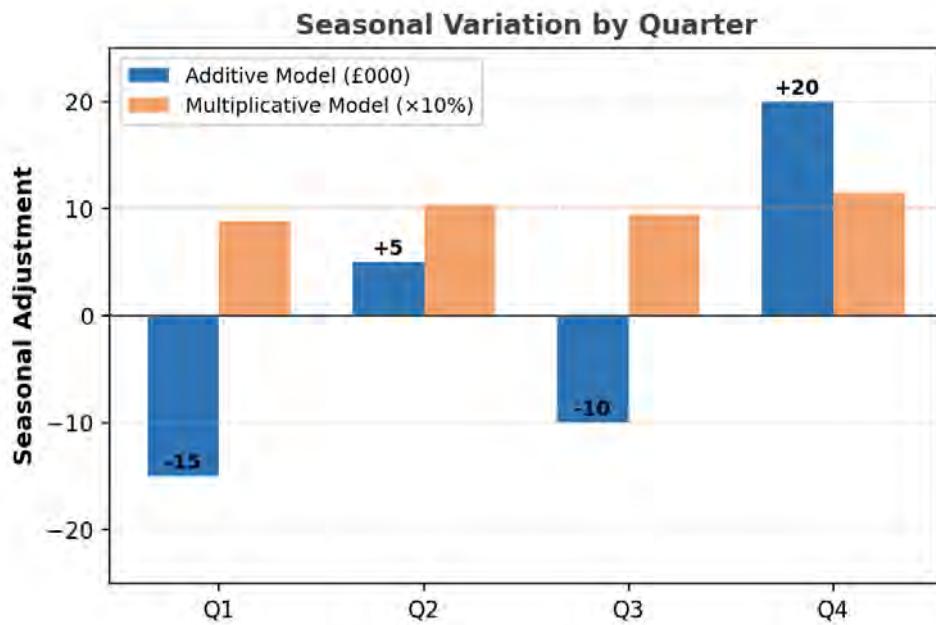
⚠️ Watch Out: Always check whether your period is odd or even. With even periods (4, 12, etc.), you **MUST** calculate centred moving averages to get figures that align with your original data.

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) |

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

Forecast = Trend \times (1 + 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:

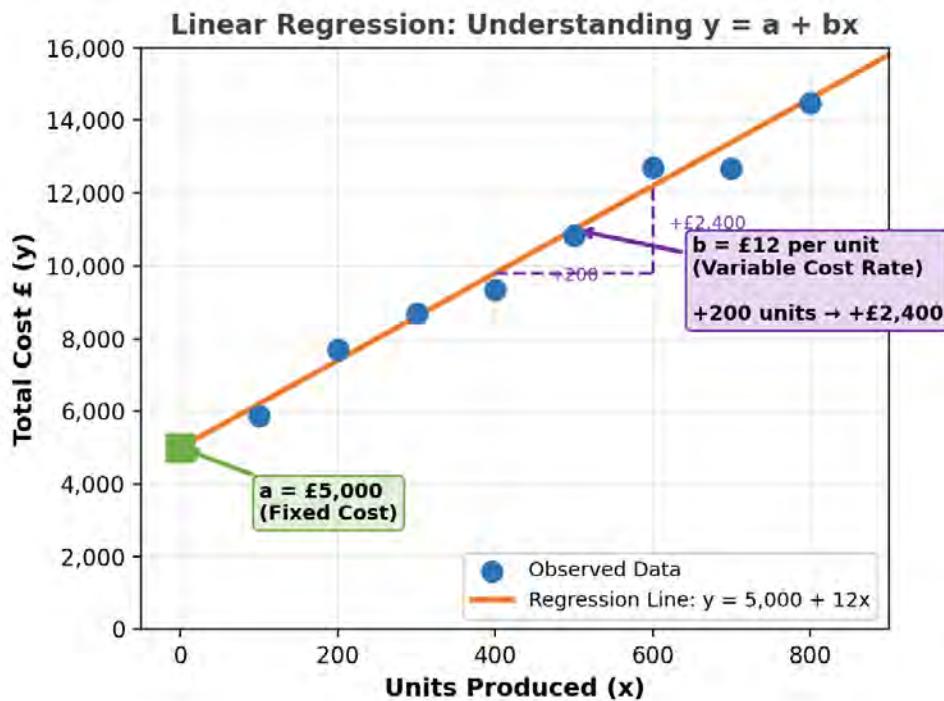
| Season | Trend Revenue | Seasonal Factor | Forecast |
|--------|---------------|-----------------|----------------------------------|
| Spring | £450,000 | +8% | 450,000 \times 1.08 = £486,000 |
| Summer | £465,000 | +25% | 465,000 \times 1.25 = £581,250 |
| Autumn | £480,000 | -5% | 480,000 \times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

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:

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

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.

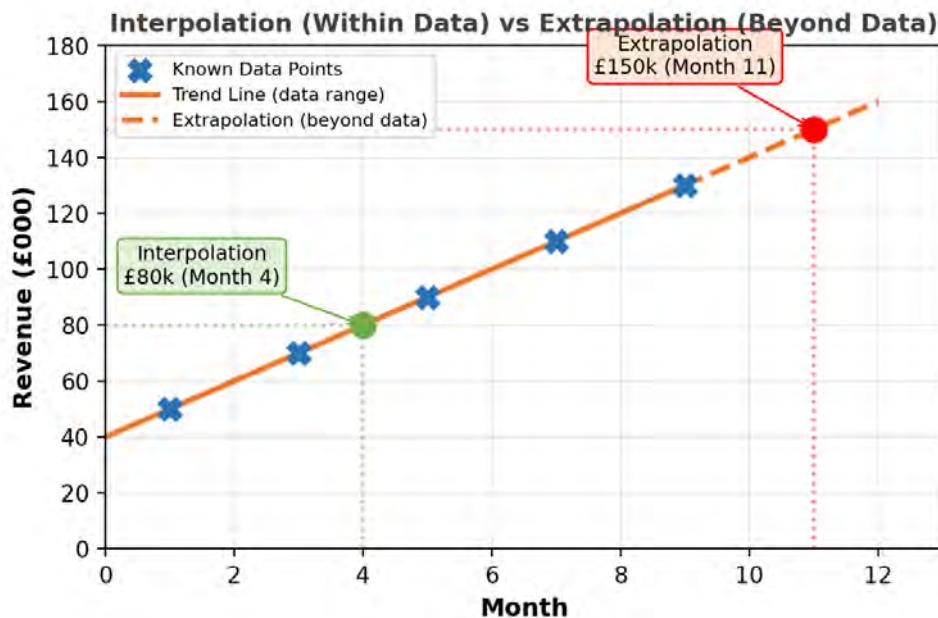
4.3 When Regression Works Best

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.

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.

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!

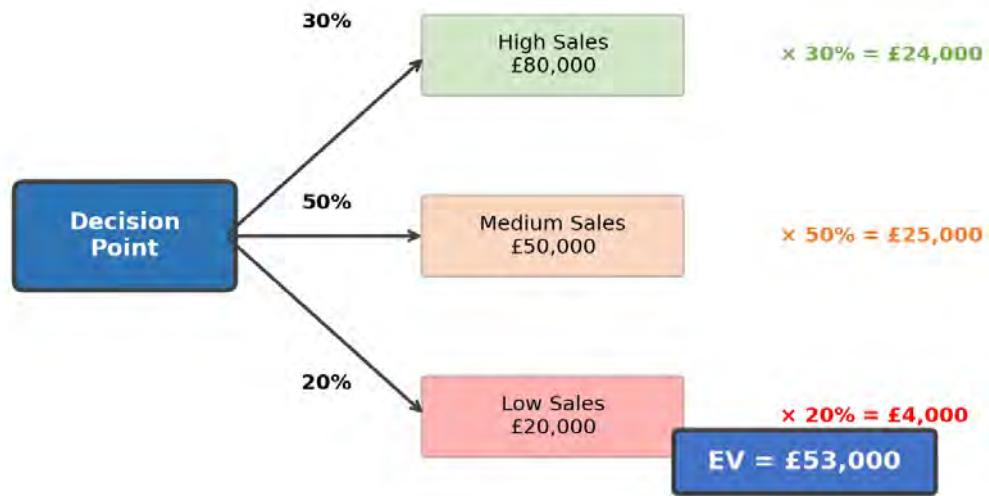


Exam Tip: Questions about index numbers often require you to work backwards too: if you know the index and the current value, you can calculate the base value using algebra.

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.

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

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 | $0.20 \times (-40,000) = -£8,000$ |

$$\text{Expected Value} = £50,000 + £44,000 - £8,000 = £86,000$$

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

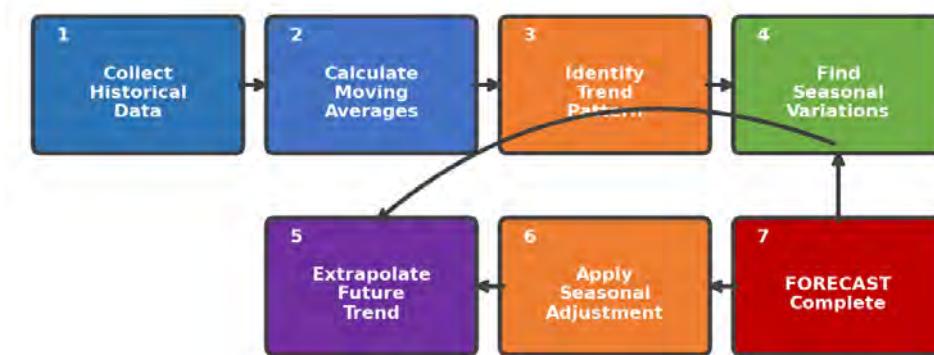
| Advantages | Limitations |
|---|---|
| Incorporates uncertainty into decision-making | Probabilities are often subjective guesses |
| Produces a single figure for easy comparison | The "expected" outcome may never actually occur |
| Simple to calculate and explain | Ignores the spread of possible outcomes (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.

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.

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 SOLUTIONS

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 | 56.0 | 55.5 | +4.5 |
| 2023 Q4 | 40 | 57.5 | 56.75 | -16.75 |
| 2024 Q1 | 52 | 59.0 | 58.25 | -6.25 |
| 2024 Q2 | 78 | 60.0 | 59.5 | +18.5 |
| 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 |

| Quarter | Trend Calculation | Trend | Seasonal | Forecast |
|---------|-------------------|----------|----------|----------|
| 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 | $320,000 \times 0.88$ | £281,600 |
| Q2 2025 | £335,000 | 1.18 | $335,000 \times 1.18$ | £395,300 |
| Q3 2025 | £350,000 | 1.35 | $350,000 \times 1.35$ | £472,500 |
| Q4 2025 | £365,000 | 0.78 | $365,000 \times 0.78$ | £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 |
| 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: $\text{£}250,000 \times (108 \div 100) = \text{£}270,000$

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

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

(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

CHAPTER SUMMARY

Key Formulas Reference

| Concept | Formula | When to Use |
|-------------------------|---|---------------------------------|
| Moving Average | Sum of n periods $\div n$ | Finding trend from raw data |
| Centred MA | $(MA_1 + MA_2) \div 2$ | Even-period moving averages |
| Additive Seasonal | Actual – Trend | Seasonal variations in £ |
| Additive Forecast | Trend + Seasonal | Predicting with £ adjustments |
| Multiplicative Seasonal | Actual \div Trend | Seasonal variations as % |
| Multiplicative Forecast | Trend \times 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 | Value \times $(\text{New Index} \div \text{Old})$ | Converting to current prices |
| Expected Value | $\Sigma(p \times x)$ | 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* —