

Seasonal variation and prediction

About 50 minutes Calculator allowed 41 marks



Hints online, answers free with an account:
mathswariz.uk/worksheets/stats-seasonal-variation-and-prediction/

Date _____

A Do Now

The first question is what today's lesson needs. The others bring back earlier topics.

- A1** Needed today [2 marks] **A2** From chapter 4 [2 marks]
- Over 7 school days in a row, starting on a Monday, the visits to a school nurse were 71, 76, 62, 60, 70, 76 and 80. Work out the three 5-point moving averages.
- A bar chart of the price of a ticket (in pence) has a vertical axis that starts at 300. The 2022 bar is 375 and the 2024 bar is 450, so the 2024 bar looks twice as tall. Work out the real percentage increase from 2022 to 2024.

Answer

Answer

- A3** From chapter 7 [2 marks] **A4** Maths skill [2 marks]
- Pia scored 40 in Maths (mean 41, standard deviation 11) and 44 in English (mean 54, standard deviation 4). In which subject did Pia do better compared with the rest of the group? Give a reason.
- A length, L cm, is 80 cm correct to the nearest 10. Write down the error interval for L .

Answer

B Examples, then your turn

Your teacher works through each example with you. Then try the one beside it.

EXAMPLE 1

A cafe's sales in Q3 were £58 thousand, and the trend value for that quarter was £49 thousand. In Q1 sales were £32 thousand and the trend value was £45 thousand. Work out the seasonal variation for each quarter.

Hint Seasonal variation = actual value – trend value.
Keep the sign.

- B1** A hotel had 245 bookings in Q2, when the trend value was 230. It had 196 bookings in Q4, when the trend value was 236. Work out the seasonal variation for each quarter. [2 marks]

Answer

EXAMPLE 2

The seasonal variations for Q4 in three years were -12 , -15 and -9 . Work out the mean seasonal variation for Q4, and say what it means.

Hint Add the three and divide by 3. Keep the signs.

EXAMPLE 3

A 4-point moving average of 150 is plotted between Q2 and Q3 of year 1, and one of 166 between Q2 and Q3 of year 3. Assume the trend is a straight line. Estimate the trend value for Q3 of year 4.

Hint The two averages are 8 quarters apart. How much does the trend change each quarter?

EXAMPLE 4

The trend value for Q4 of year 3 is 175, and the trend rises by 2 each quarter. The mean seasonal variation for Q2 is -11 . Predict the value for Q2 of year 4.

Hint Find the trend value for Q2 of year 4 first, then add the mean seasonal variation.

EXAMPLE 5

A firm uses its trend line and mean seasonal variations to predict its sales for Q3 of next year. Give two reasons why the prediction might not be accurate.

Hint What does the method assume about the future?

B2 The seasonal variations for Q1 in four years were 8, 11, 6 and 7. Work out the mean seasonal variation for Q1, and say what it means.

B3 A 4-point moving average of 312 is plotted between Q2 and Q3 of year 1, and one of 288 between Q2 and Q3 of year 2. Assume the trend is a straight line. Estimate the trend value for Q1 of year 3.

Answer

B4 The trend value for Q2 of year 4 is 96, and the trend rises by 1.5 each quarter. The mean seasonal variation for Q4 is 7. Predict the value for Q4 of year 4.

Answer

B5 A gym predicts how many members it will have in Q1 two years from now, using its trend line and mean seasonal variations. Give two reasons why this prediction might not be reliable.

C Practice

- C1** A town used 412 thousand litres of water in Q3, when the trend value was 437 thousand litres. Work out the seasonal variation for Q3 and say what it means. [2 marks]
- C2** The seasonal variations for Q2 in three years were -4 , -7 and -1 . Work out the mean seasonal variation for Q2. [2 marks]

Answer

- C3** A 4-point moving average of 86 is plotted between Q2 and Q3 of year 1, and one of 102 between Q2 and Q3 of year 3. Assume the trend is a straight line. Estimate the trend value for Q4 of year 3. [3 marks]
- C4** The trend value for Q4 of year 2 is 120, and the trend rises by 3 each quarter. The mean seasonal variation for Q2 is 18. Predict the value for Q2 of year 3. [3 marks]

Answer

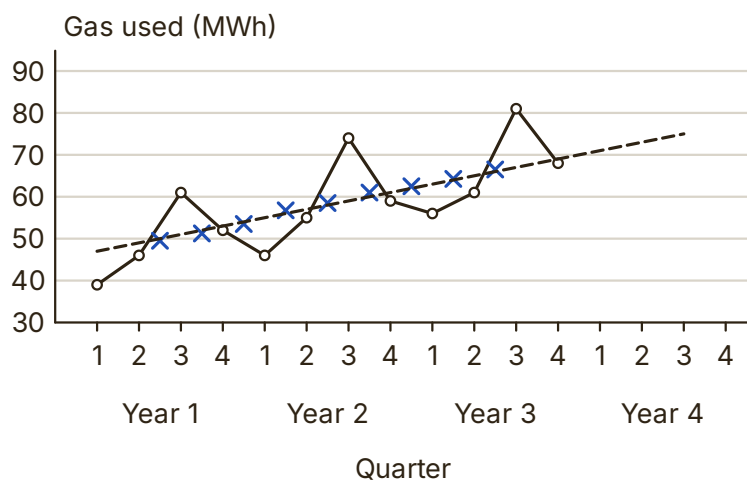
Answer

D Exam-style questions

- D1** For a shop's quarterly sales, the trend estimate for Q1 next year is £71 thousand and the mean seasonal variation for Q1 is -8 (£ thousand). Last year's Q1 sales were £56 thousand. Omar says, "Sales in Q1 next year will be £56 thousand, the same as last year." [3 marks]

Is Omar correct? Give a better prediction.

- D2** The graph shows the gas used by a school (MWh) each quarter for three years. The crosses are the 4-point moving averages, and the dashed trend line has been extended to year 4. The trend value for Q3 of year 3 is 67. The seasonal variations for Q3 in years 1 and 2 were 10 and 15.



- (a) In Q3 of year 3 the school used 81 MWh. Work out the seasonal variation for Q3 of year 3. [1 mark]

Answer

- (b) Work out the mean seasonal variation for Q3. [2 marks]

Answer

- (c) Use the trend line and your answer to (b) to predict the gas used in Q3 of year 4. [2 marks]

Answer

- (d) Give one assumption your prediction makes. [1 mark]

Total for D2: 6 marks

E Extension

No route is given. The hints are at the end of the sheet. Use one at a time.

- E1** For a firm's quarterly sales, the mean seasonal variations for Q1, Q2 and Q3 are -9 , 4 and 12 . The trend estimate for Q4 next year is 120 . Predict the sales for Q4 next year. [3 marks]

Answer

Extension hints

Cover these with paper. Uncover one at a time.

- E1** **Hint 1** The trend is the average of the four quarters, so the four seasonal variations balance out.
- Hint 2** The four mean seasonal variations add up to 0, so Q4's is $-(-9 + 4 + 12) = -7$.
- Hint 3** Prediction = $120 + (-7)$.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

I can work out a seasonal variation from the trend and say what it means. ☐ ☐ ☐

I can predict a value from a trend estimate and a mean seasonal variation. ☐ ☐ ☐

I can say what a prediction assumes and why it may not be reliable. ☐ ☐ ☐