Time Series Data

WALT Read and Draw line graphs

Success Criteria I know the time is always on the x axis and the frequency of the time measured is on the y axis.

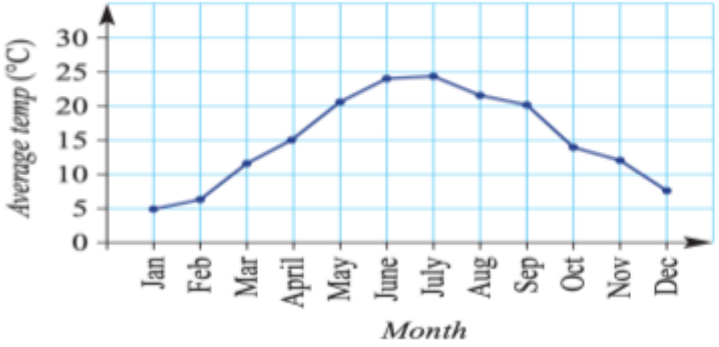
- I can measure trends over a period of time.
- There are two types of trends 1) Short Term (what happening over a month) 2) Long Term (what is happening over a decade)

A time series is a sequence of data values that are recorded at regular time intervals. Examples include temperature recorded on the hour, speed recorded every second, population recorded every year and profit recorded every month. A line graph can be used to represent time series data. This can help to analyse the data, describe trends and make predictions about the future.

Video on time series trends

Let's start: Changing temperatures

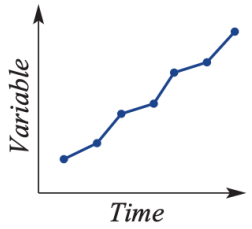
The average monthly maximum temperature for a city is illustrated by this graph.



- Describe the trend in the data at different times of the year.
- Explain why the average maximum temperature for December is close to the average maximum temperature for January.
- Do you think this graph is for an Australian city? Explain.
- If another year of temperatures was included on this graph, what would you expect the shape of the graph to look like?
- Do you think this city is in the northern hemisphere or the southern hemisphere? Give a reason.

1 Describe the following time series plots as having a linear (straight line) trend, non-linear trend (a curve) or no trend.

a



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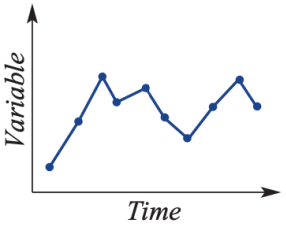
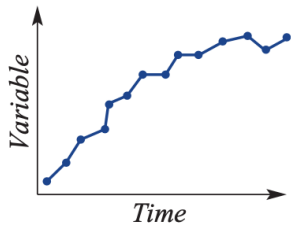
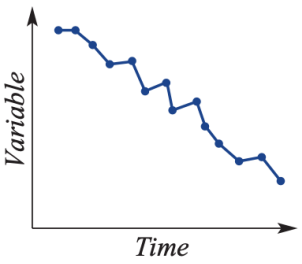


c



d



2 This time series graph shows the temperature over the course of 8 hours of a day.

a State the temperature at:

i 8 a.m. **ii** 12 noon

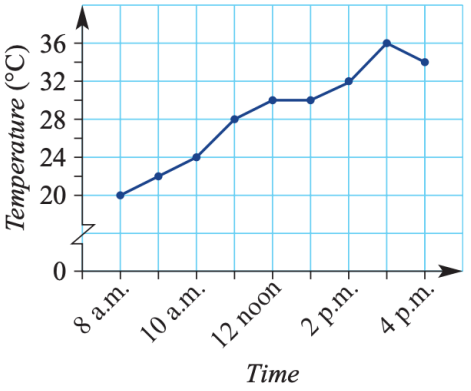
iii 1 p.m. **iv** 4 p.m.

b What was the maximum temperature?

c During what times did the temperature:

i stay the same? **ii** decrease?

d Describe the general trend in the temperature for the 8 hours.



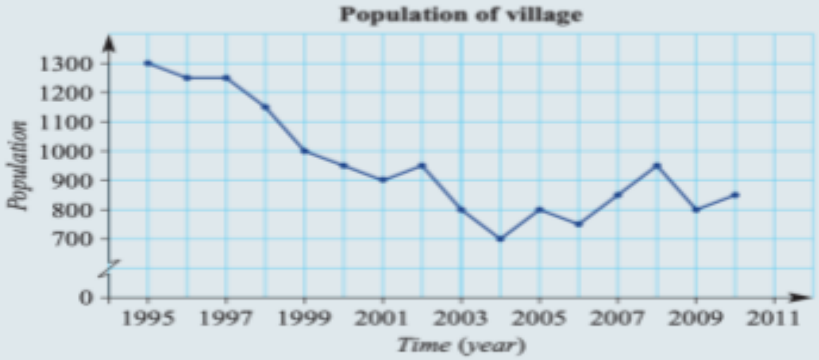
Plotting and interpreting a time series Plot

Population	1300	1250	1250	1150	1000	950	900	950	800	700	800	750	850	950	800	850

a Plot the time series.
b Describe the trend in the data over the 16 years.

Solution

a



b The population declines steadily for the first 10 years. The population rises and falls in the last 6 years, resulting in a slight upwards trend.

Explanation

Use time on the horizontal axis. Break the y-axis so as to not include 0–700. Label an even scale on each axis. Join points with line segments.

Interpret the overall rise and fall of the lines on the graph.

3 The approximate population of a small town is recorded from 2000 to 2010.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population	550	500	550	600	700	650	750	750	850	950	900

a Plot the time series graph. Break the y-axis so it does not include 0–500.
b Describe the general trend in the data over the 11 years.
c For the 11 years, what was the:
i minimum population? **ii** maximum population?

The year will be on the horizontal axis. Place population on the vertical axis.

The vertical axis will need to range from 500 to 950. A scale going up in 100s would suit.

4 A company's share price over 12 months is recorded in this table.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Price ($)	1.30	1.32	1.35	1.34	1.40	1.43	1.40	1.38	1.30	1.25	1.22	1.23

The scale on the vertical axis will need to include from $1.20 to $1.43. Choose an appropriate scale.

a Plot the time series graph. Break the y-axis to exclude values from $0 to $1.20.

b Describe the way in which the share price has changed over the 12 months.

c What is the difference between the maximum and minimum share price in the 12 months?

5 The pass rate (%) for a particular examination is given in a table over 10 years.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pass rate (%)	74	71	73	79	85	84	87	81	84	83

a Plot the time series graph for the 10 years.

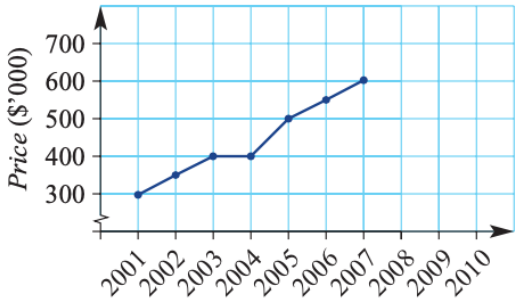
b Describe the way in which the pass rate for the examination has changed in the given time period.

c In what year was the pass rate a maximum?

d By how much had the pass rate improved from 2000 to 2004?

Problem-solving and Reasoning

6 This time series plot shows the upwards trend of house prices in an Adelaide suburb over 7 years from 2001 to 2007.



Recall that a linear trend has the points on or near a straight line.

a Would you say that the general trend in house prices is linear or non-linear?

b Assuming that the trend in house prices continued for this suburb, what would you expect the house price to have been in:

i 2008? **ii** 2010?

7 The following data shows the monthly sales of strawberries ($'000s) for a particular year.

$'000s means 22 represents $22 000

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sales ($'000s)	22	14	9	11	12	9	7	9	8	10	18	25

a Plot the time series graph for the year.

b Describe any trends in the data over the year.

c Give a reason why you think the trends you observed may have occurred.

8 The two top-selling book stores for a company list their sales figures for the first six months of the year. Sales amounts are in thousands of dollars.

	July	August	September	October	November	December
City Central ($'000)	12	13	12	10	11	13
Southbank ($'000)	17	19	16	12	13	9

a What was the difference in the sales volume for:
i August? **ii** December?

b In how many months did the City Central store sell more books than the Southbank store?

c Construct a time series plot for both stores on the same set of axes.

d Describe the trend of sales for the 6 months for:
i City Central **ii** Southbank

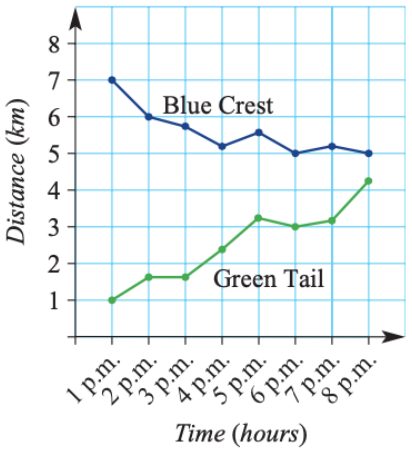
e Based on the trend for the sales for the Southbank store, what would you expect the approximate sales volume to be in January?

9 Two pigeons (Green Tail and Blue Crest) each have a beacon that communicates with a recording machine. The distance of each pigeon from the machine is recorded every hour for 8 hours.

a State the distance from the machine at 3 p.m. of:
i Blue Crest **ii** Green Tail

b Describe the trend in the distance from the recording machine for:
i Blue Crest **ii** Green Tail

c Assuming that the given trends continue, predict the time when the pigeons will be the same distance from the recording machine.

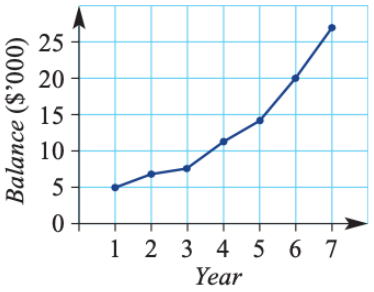


Non-linear trends

10 The balance of an investment account is shown in this time series plot.

a Describe the trend in the account balance over the 7 years.

b Give a practical reason for the shape of the curve that models the trend in the graph.



Year

11 A drink at room temperature is placed in a fridge that is at 4°C.

a Sketch a time series plot that might show the temperature of the drink after it has been placed in the fridge.

b Would the temperature of the drink ever get to 3°C? Why?

c Record the temperature at regular intervals of a drink at room temperature that is placed in a fridge. Plot your results and compare them to your answer in part **a**.

Check your answers

1 **a** Linear **b** No trend **c** Non-linear **d** Linear

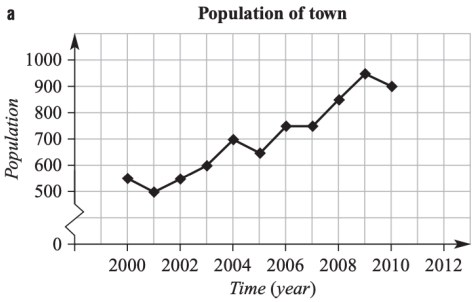
2 **a** **i** 20°C **ii** 30°C **iii** 30°C **iv** 34°C

b 36°C

c **i** 12 noon to 1:00 p.m. **ii** 3 to 4:00 p.m.

d Temperature is increasing from 8 a.m. to 3 p.m. in a generally linear way. At 3 p.m. the temperature starts to drop.

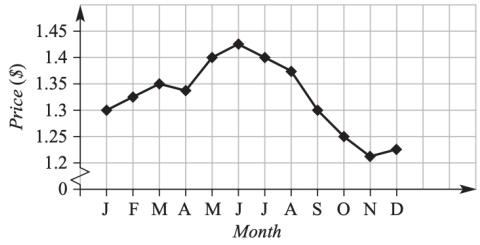
3 **a**



b Generally linear in a positive direction.

c **i** 500 **ii** 950

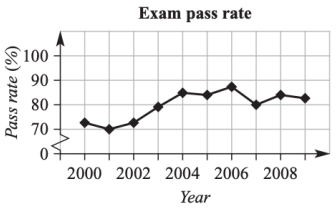
4 **a**



b The share price generally increased until it peaked in June and then continually decreased to a yearly low in November before trending upwards again in the final month.

c $0.21

5 **a**

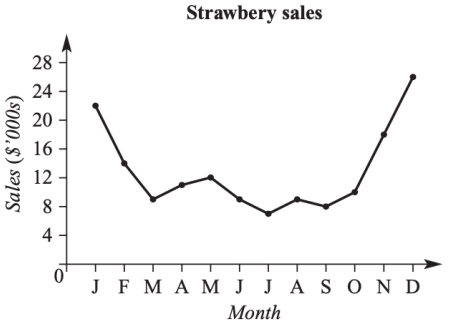


b The pass rate for the examination has increased marginally over the 10 years, with a peak in 2006.

c 2006 **d** 11%

6 **a** Linear **b** **i** $650 000 **ii** $750 000

7 **a**



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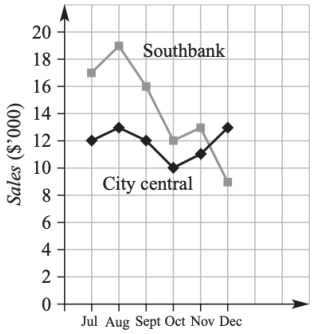
b The sales start high and decrease during the middle of the year, before increasing again towards the end of the year.

c Strawberries are in season in the warmer months, but not in the cooler winter months.

8 a i $6000 **ii** $4000

b 1

c



d i The sales trend for City Central for the 6 months is fairly constant.

ii Sales for Southbank peaked in August before taking a downturn.

e About $5000

9 a i 5.8 km **ii** 1.7 km

b i Blue Crest slowly gets closer to the machine.

ii Green Tail starts near the machine and gets further from it.

c 8:30 p.m.

10 a Increases continually, rising more rapidly as the years progress.

b Compound interest – exponential growth

11 a Graphs may vary, but it should decrease from room temperature to the temperature of the fridge.

b No. Drink cannot cool to a temperature *lower* than that of the internal environment of the fridge.