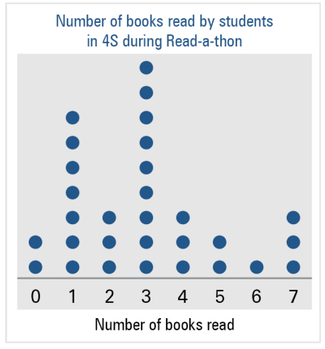
Common graphical representations

ACiQ v9.0

Encountered by students in Years 7–10

Representation type	Graphing conventions	Common difficulties	Considerations for use	Possible teaching and learning strategies
Table				
Comparison of fixed deposit interest rates across financial institutions **Fixed deposit interest rates** **Name of bank** / **180 days – 1 year** / **1–3 years** / **3–5 years** / **5 years or more** State Bank / 8.50% / 10.25% / 9.75% / 10.00% Empire Bank / 8.00% / 9.25% / 9.75% / 9.75% Community Bank / 10.10% / 10.50% / 9.75% / 9.00% Bank of KBR / 9.40% / 9.00% / 9.00% / 8.75% **Introduced in the Australian Curriculum** • Commonly used across Economics and Business, Geography, Mathematics and Science to collect and organise information, and make inferences	• includes a title • uses labels for individual categories • presents data in a one-way table for one categorical variable (observed number or frequency), e.g. 'Comparison of interest rates available at the State Bank' • presents data in a two-way table for two variables (rows are one category and columns are the other category), e.g. 'Comparison of interest rates across financial institutions'	• requires students to use a grid-referencing strategy (row, column) to be able to read and interpret the information in two-way tables	• provides an easy method for gathering and organising both categorical and numerical data • shows frequencies for categories in a one-way table • examines relationships between categorical variables in a two-way table	• conduct directed activities related to texts (DARTs), e.g. – provide a table without a title, without some of the category labels or with information missing for students to complete and justify their choices – demonstrate the types of questions that could be answered with the data, then ask students to construct their own questions • provide unorganised information in a two-way table and ask students to sort the information and discuss any trends • explore newspaper articles with statistics relevant to the students
Dot plot				
 **Introduced in the Australian Curriculum** • Year 2 Mathematics: construct and interpret simple dot plots • Year 7 Mathematics: construct, interpret and compare variation and distribution of data	• includes a title • has one axis labelled • can be constructed horizontally or vertically — horizontal is usually preferred • presents dots evenly spaced so they can be clearly delineated • lists ordinal data along the axis • the dots represent the total number of observations	• uses unordered data to construct a graph • requires correct alignment of dots either vertically and/or horizontally • presents possibility for placement of data in wrong column	• offers an easy method for finding the mode, range and median • is used to represent – discrete numerical data – both types of categorical data	• construct a class graph using students or objects as 'pictures'; photograph and discuss • conduct directed activities related to texts (DARTs), e.g. – provide a dot plot without a title or an axis label and ask students to predict what it could be and justify their choices – demonstrate the types of questions that could be answered from the data and then ask students to construct their own questions • expose students to vertical and horizontal graphs • demonstrate the link to column graphs by drawing boxes around the columns

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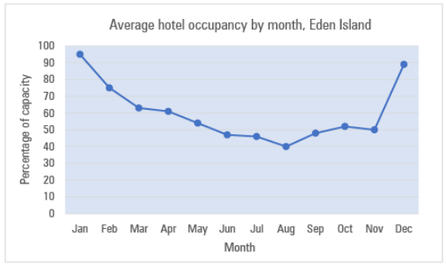
Line graph				
 **Introduced in Australian Curriculum** • Year 5 Mathematics: construct and interpret line graphs • Year 6 Mathematics: construct and interpret stacked line graphs • Commonly used in Years 8 and 9 Geography: represent and interpret • Year 7 Science: construct and use	• often uses time as the independent variable • plots the independent variable on the *x*-axis (horizontal) • places the dependent variable on the *y*-axis (vertical) • creates suitable scale increments based on range of data • connects points with a line	• requires – that order of *x*- and *y*-coordinates are not confused when plotting – that independent and dependent variables are placed on the correct axes – an appropriate choice of scale to fit the data range – an appropriate choice of scale increments to accurately reflect trends in the data	• is used to represent changes to a variable over time • time is always plotted on the *x*-axis	• construct a class graph — students use coordinates to position themselves on a graph, connect the points with a string, photograph and discuss • conduct directed activities related to texts (DARTs), e.g. – provide a graph with missing information for students to complete and justify their choices – demonstrate the types of questions that could be answered from the data, then ask students to construct their own questions • ask students to analyse a line graph in groups and discuss possible scenarios matching the line trajectory before whole-class sharing • examine the effect of changing the scale increments; discuss how this affects the apparent message of the graph
Stem-and-leaf plot				
Maximum heart rate during a 20-minute exercise routine **Stem** | **Leaf** 12 | 8 9 13 | 0 1 2 3 6 14 | 1 2 3 7 8 15 | 0 3 4 4 5 6 9 16 | 0 2 2 2 3 6 **Key** 12 | 8 = 128 beats per minute **Introduced in Australian Curriculum** • Year 7 Mathematics: construct and compare	• divides data values into a stem (the first digit or digits) and a leaf (consisting of the remaining digit or digits after the stem) • uses the stem to group the scores and each leaf shows the individual scores within a particular group • usually lists stem values vertically and lists the leaf values horizontally to either the right or left of the stem values • records values as whole numbers or decimals	• requires understanding of how to use place value to create the stem and the values in the leaf • is open to misconception that the median is always represented by the middle value in the leaf that belongs to the middle stem value	• is used to represent numerical data • can be created quickly by hand to inspect data patterns when the dataset is reasonably small • shows the shape and distribution of the data for comparison with other datasets • is useful in calculating quantities such as the median, mode and range as all individual data values are represented • becomes unwieldy when used for larger datasets	• construct a class graph — students record personal data (e.g. length of breath hold). Prompt students to – form groups (leaves) based on their data – order themselves within a group – order groups sequentially – use the common part of each dataset as a stem • demonstrate plot construction using imagery of a plant stem with leaves coming off one side — add data points sequentially to demonstrate graph construction

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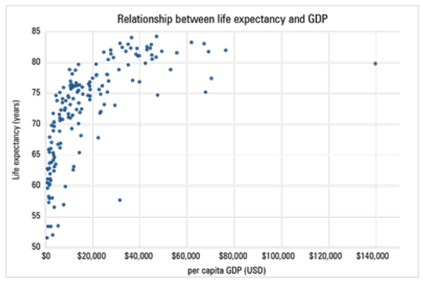
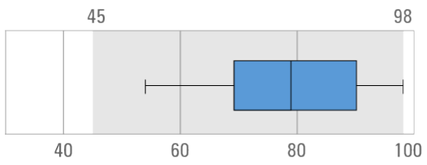
Histogram				
Gross weekly income of 14–17-year-old students attending Silver Skies High  **Introduced in Australian Curriculum** • Year 7 Geography: represent and interpret data in back-to-back histograms (population pyramids) • Year 9 Mathematics: construct and describe	• plots the independent variable on the *x*-axis (horizontal) • plots the dependent variable on the *y*-axis (vertical) • considers the range of observations and splits them into a logical series of intervals or bins • marks the lower value of each interval on the *x*-axis • draws a bar extending from the lower value of one interval to the lower value of the next • makes the height of each bar equal to the frequency of its corresponding bin • places a value that falls into two bins in the upper bin • requires a half-column width before the first column of the histogram if the *x*-axis doesn't start at zero	• requires the data to be split into logical series (ranges) of intervals to create the bins • is open to the mistake of counting in increments to create intervals and interpret graphs • is open to the mistake of a half-column width before the first column if the *x*-axis does not start at zero • presents the possibility of misinterpreting bimodal and skewed data	• provides a summary graphical presentation showing the shape and distribution of the data • is used for displaying large datasets • represents relative frequencies of value intervals • conceals the original data, i.e. the observations that lie in the range of each bin cannot be seen, making it impossible to calculate mean, median, mode and range of data	• conduct directed activities related to texts (DARTs), e.g. – provide a graph with missing information for students to complete and justify their choices – demonstrate the types of questions that could be answered from the data, then ask students to construct their own questions – explore cases where the scaling of the *y*-axis has been used to create a particular message • present histograms using data from increasingly large datasets to highlight that the larger the dataset, the more accurate the picture provided by a histogram • examine the effect of changing the bin size and discuss best choices to represent particular datasets
Scatter plot				
 **Introduced in Australian Curriculum** • Year 9 Economics and Business: represent, interpret and analyse • Year 10 Mathematics: use to investigate and comment on relationships	• is constructed in a similar way to a line graph – plots the independent variable on the *x*-axis (horizontal) – plots the dependent variable on the *y*-axis (vertical) • plots pairs of data points on a Cartesian plane (*x*, *y*) • leaves plots unjoined by a line • adds a line of best fit where appropriate • uses a 'scale break' (a zigzag on the line of the *x*- or *y*-axis) to indicate the omitted portion where an axis scale does not start at zero	• requires – that the order of *x*- and *y*-coordinates are not confused when plotting – that independent and dependent variables are placed on the correct axis – an appropriate choice of scale to fit the data range – an appropriate choice of scale increments to accurately reflect trends in the data – the ability to establish 'true' outliers • is open to the mistake of assuming one variable caused the other. However, there is need to consider that both may be influenced by a third variable	• displays large datasets to explore relationships and/or trends between variables • illustrates the degree to which one variable is influenced or affected by another	• conduct directed activities related to texts (DARTs), e.g. – provide a graph with missing information and ask students to complete it and justify – demonstrate the types of questions that could be answered from the data and ask students to construct their own questions – explore ways in which variables might be linked, i.e. causation or association • provide students with data tables and a similar number of scatter plots with no title or labels – ask them to match each table with one of the scatter plots and then label the axes for each scatter plot • discuss which type of representation is more effective

Representation type	Graphing conventions	Common difficulties	Considerations for use	Possible teaching and learning strategies
Box plot				
Mid-year test results for Year 10 Science  **Introduced in Australian Curriculum** • Year 10 Mathematics: construct, interpret and compare	• displays a dataset based on its five-number summary, that is – the minimum or smallest data point in the dataset (excluding any outliers) – lower or first quartile, the 25th percentile or the middle value between the median and the smallest number – the median or middle value in the dataset – upper or third quartile, the 75th percentile or the middle value between the median and the largest number – the maximum or largest data point in the dataset (excluding any outliers)	• requires correctly – determining the values for the five-number summary – establishing 'true' outliers	• provides an efficient and common way of representing a statistical summary of a dataset • is used to show overall patterns of response for a group • conceals individual data points • offers a compact way of comparing distributions between groups of datasets • collates datasets from groups/classes to illustrate how larger datasets provide more reliable results	• introduce box plots by constructing a whole-class graph, e.g. – place students' schoolbags in order by weight across the classroom – label the bags that are the minimum (lightest), maximum (heaviest) and median data points – jointly calculate the lower and upper quartiles and use coloured string to 'box' off students' bags between these two points – use a white string to create the 'whiskers' – take a photo of the resulting graph for later discussion • ask students to form two groups and create their own dataset (e.g. number of pets they have owned, how many words they can think of starting with V in one minute), then represent it with a box plot • model statements you could make based on the box plots • encourage students to create true or false questions relating to the data

Notes

Variables	DARTs
Two broad groupings of variables can be included in data collection — categorical and numerical. • Categorical variables are variables whose values are categories, e.g. blood group is a categorical variable with the common categories being: A, B, AB and O. Categorical variables can be further divided into two sub-groups – ordinal — data has a rank or numerical position, e.g. satisfaction rating, report grades, Olympic race placegetters – nominal — data is sorted into named categories, where there is no rank to the categories , e.g. blood type, method of travel, hair colour, ice-cream flavour. • Numerical variables are variables whose values are numbers and for which processes such as calculating an average make sense. Numerical variables can be further divided into two sub-groups – discrete — usually a whole number count, e.g. school population, cricket score, number in a family – continuous — usually a measurement, e.g. temperature, weight, volume, swim race times.	Directed activities related to texts (DARTs) are, in this context, activities designed to encourage critical analysis of representations. DARTs are used as a strategy for enhancing understanding of conventions and improving data comprehension, e.g. • reconstruction activities where students complete information that has been intentionally omitted from a graphical representation (title, labels, key, frequencies) and discuss their decisions • questioning activities that encourage a more critical examination of the data, its source and the type of questions that it could answer.

References

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British Council, *Interacting with Texts*: *Directed activities related to texts (DARTs)*, www.teachingenglish.org.uk/article/interacting-texts-directed-activities-related-texts-darts.