# Common graphical representations

Encountered by students in Years 7–10

<table>
<thead>
<tr>
<th>Representation type</th>
<th>Graphing conventions</th>
<th>Common difficulties</th>
<th>Considerations for use</th>
<th>Possible teaching and learning strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Comparison of fixed deposit interest rates across financial institutions</strong></td>
<td>includes a title</td>
<td>requires students to be fluent with using a grid-referencing strategy (Row, Column) to be able to read and interpret the information in two-way tables</td>
<td>provides an easy method for gathering and organising both categorical and numerical data</td>
<td>conduct directed activities related to texts (DARTs), e.g.</td>
</tr>
<tr>
<td><strong>Fixed deposit interest rates</strong></td>
<td>uses labels for individual categories</td>
<td>shows frequencies for categories in a one-way table</td>
<td>examines relationships between categorical variables in a two-way table</td>
<td>- provide a table without a title, without some of the category labels, or with information missing, for students to complete and justify their choices</td>
</tr>
<tr>
<td><strong>Name of bank</strong></td>
<td>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”</td>
<td>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”</td>
<td>- demonstrate the types of questions that could be answered with the data, then ask students to construct their own questions</td>
<td></td>
</tr>
<tr>
<td><strong>180 days – 1 year</strong></td>
<td>requires students to be fluent with using a grid-referencing strategy (Row, Column) to be able to read and interpret the information in two-way tables</td>
<td>requires students to be fluent with using a grid-referencing strategy (Row, Column) to be able to read and interpret the information in two-way tables</td>
<td>- provide unorganised information in a two-way table and ask students to sort the information and discuss any trends</td>
<td></td>
</tr>
<tr>
<td><strong>3–5 years</strong></td>
<td>shows frequencies for categories in a one-way table</td>
<td>is used to represent changes to a variable over time</td>
<td>- explore newspaper articles with statistics relevant to the students</td>
<td></td>
</tr>
<tr>
<td><strong>5 years or more</strong></td>
<td>examines relationships between categorical variables in a two-way table</td>
<td>time is always plotted on the x-axis</td>
<td>- construct a class graph — students use coordinates to position themselves on a graph, connect the points with a string, photograph and discuss</td>
<td></td>
</tr>
</tbody>
</table>

| **Line graph**      | often uses time as the independent variable | requires that order of (x, y) coordinates are not confused when plotting | is used to represent changes to a variable over time | construct directed activities related to texts (DARTs), e.g. |
|                     | plots the independent variable on the x-axis (horizontal) | that independent and dependent variables are placed on the correct axis | time is always plotted on the x-axis | - provide a graph with missing information for students to complete and justify their choices |
|                     | places the dependent variable on the y-axis (vertical) | an appropriate choice of scale range to fit the data range | - demonstrate the types of questions that could be answered from the data, then ask students to construct their own questions |
|                     | creates suitable scale increments based on range of data | an appropriate choice of scale increments to accurately reflect trends in the data | ask students to analyse a line graph in groups and discuss possible scenarios matching the line trajectory before whole-class sharing | - ask students to analyse a line graph in groups and discuss possible scenarios matching the line trajectory before whole-class sharing |
|                     | connects points with a line | | examine the effect of changing the scale increments, discuss how this affects the apparent message of the graph | - examine the effect of changing the scale increments, discuss how this affects the apparent message of the graph |

**Fixed deposit interest rates**

<table>
<thead>
<tr>
<th>Name of bank</th>
<th>180 days – 1 year</th>
<th>3–5 years</th>
<th>5 years or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Bank</td>
<td>8.50%</td>
<td>10.25%</td>
<td>9.75%</td>
</tr>
<tr>
<td>Empire Bank</td>
<td>8.00%</td>
<td>9.25%</td>
<td>9.75%</td>
</tr>
<tr>
<td>Community Bank</td>
<td>10.10%</td>
<td>10.50%</td>
<td>9.75%</td>
</tr>
<tr>
<td>Bank of KBR</td>
<td>9.40%</td>
<td>9.00%</td>
<td>9.00%</td>
</tr>
</tbody>
</table>

Introduction in the Australian Curriculum

- Commonly used across HPE, HASS, Languages, Mathematics and Science to collect and organise information, and make inferences
### Frequency histogram

<table>
<thead>
<tr>
<th>Gross weekly income of 14–17-year-old students attending Silver Skies High</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percentage of students</strong></td>
</tr>
<tr>
<td><strong>Gross weekly income</strong></td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

**Introductions in Australian Curriculum**
- **Year 7 Geography**: represent and interpret data in back-to-back histograms (population pyramids)
- **Year 9 Mathematics**: construct and describe

**Considerations for use**
- 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

**Possible teaching and learning strategies**
- 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

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### Stem-and-leaf plot

**Maximum heart rate during a 20-minute exercise routine**

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>8 9</td>
</tr>
<tr>
<td>13</td>
<td>0 1 2 3 6</td>
</tr>
<tr>
<td>14</td>
<td>1 2 3 7 8</td>
</tr>
<tr>
<td>15</td>
<td>0 3 4 5 6 9</td>
</tr>
<tr>
<td>16</td>
<td>0 2 2 2 3 6</td>
</tr>
</tbody>
</table>

**Key**
- 12 | 8 = 128 beats per minute

**Graphing conventions**
- 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
- Becomes unwieldy when used for larger datasets

**Common difficulties**
- 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
- Becomes unwieldy when used for larger datasets

**Possible teaching and learning strategies**
- Construct a class graph — students record personal data (e.g. length of breath hold)
- Promote students to
  - Form groups (leaves) based on their data
  - Order the leaves within a group
  - Use the common part of each dataset as a stem, etc.
- 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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| Scatter plot        | is constructed in a similar way to line graphs  
  - 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 \((x, y)\) coordinates are not confused when plotting  
  - that independent and dependent variables are placed on the correct axis  
  - an appropriate choice of scale range to fit the data range  
  - an appropriate choice of scale increments to accurately reflect trends in the data  
  - the ability to establish 'true' outliers | 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 |
| Box plot            | 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 weight order 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 |

**Introduced in Australian Curriculum**

- **Year 9 Geography:** represent, interpret and analyse
- **Year 10 Mathematics:** use to investigate and comment on relationships

**Mid-year test results for Year 10 Science**

- **Year 10 Mathematics:** construct, interpret and compare

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**Common graphical representations**

Encountered by students in Years 7–10

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Queensland Curriculum & Assessment Authority  
February 2022
### Variables

<table>
<thead>
<tr>
<th>Categorical variables</th>
<th>Numerical variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables whose values are categories, e.g. blood group is a categorical variable with the common categories being: A, B, AB or O.</td>
<td>Variables whose values are numbers, and for which processes such as calculating an average make sense.</td>
</tr>
</tbody>
</table>
| Categorical variables can be further divided into two sub-groups:  
  - Ordinal — an adjective describes the numerical position, e.g. satisfaction rating, report grades, Olympic medal colour  
  - Nominal — data is sorted into named categories, e.g. blood type, method of travel, hair colour, ice cream flavour. | Categorical 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 |

### DARTS

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 could be answered by the data.

### References


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