Statistics: Power from Data!

Using graphs

What is a graph?

A graph is a visual representation of a relationship between, but not restricted to, two variables. A graph generally takes the form of a one- or two-dimensional figure such as a scatterplot. Although, there are three-dimensional graphs available, they are usually considered too complex to understand easily.

A graph commonly consists of two axes called the x-axis (horizontal) and y-axis (vertical). Each axis corresponds to one variable. The axes are labelled with different names, such as *Price* and *Quantity*.

The place where the two axes intersect is called the origin. The origin is also identified as the point (0,0).

A point on a graph represents a relationship. Each point is defined by a pair of numbers containing two co-ordinates (x and y). A co-ordinate is one of a set of numbers used to identify the location of a point on a graph.

Figure 1. Parts of a graph.

In the following section, you will learn how to determine both co-ordinates for any given point, and to correctly label the co-ordinates of a point.

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Identifying the x-co-ordinate

The x-co-ordinate of a point is the value that tells you how far the point is from the origin on the (horizontal) x-axis. In order to find the x-co-ordinate of a point on any graph, draw a straight line from the point to intersect at a right angle with the x-axis. The number where the line intersects with the x-axis is the value of the x-co-ordinate.

Figure 2 is a graph with two points, A and B. Identify the x-co-ordinate of points A and B.

Answer: The x-co-ordinate of point A is 50, and the x-co-ordinate of point B is 200.

Figure 2. X-co-ordinate.

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Identifying the y-co-ordinate

The y-co-ordinate of a point is the value that tells you how far away the point is from the origin on the vertical or y-axis. To find the y-co-ordinate of a point on a graph, draw a straight line from the point to intersect at a right angle with the y-axis. The number where the line intersects the y-axis is the value of the y-co-ordinate.

Identify the y-co-ordinate for point A and point B on Figure 3.

Answer: The y-co-ordinate of point A is 200, and the y-co-ordinate of point B is 50.

Figure 3. Y-co-ordinate.

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Identifying points on a graph

Once you have determined the co-ordinates of a point, you can label the points using ordered pair notation. This notation is simple—points are identified by stating their co-ordinates in the form of (x, y). Note that you must plot the x-co-ordinate first as in Figure 2. The x- and y-co-ordinates for each of points A and B are identified in Figure 4 below.

- The x-co-ordinate of point A is 50 and the y-co-ordinate of point A is 200. The co-ordinates of point A are therefore (50, 200).
- The x-co-ordinate of point B is 200 and the y-co-ordinate of point B is 50. The co-ordinates of point B are therefore (200, 50).

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Points on the axes

If a point falls on an axis, you do not need to draw lines to determine the co-ordinates of the point. In Figure 5 below, point C lies on the y-axis and point D lies on the x-axis. When a point lies on an axis, one of its co-ordinates must be 0.

- Point C lies on the y-axis and has an x-co-ordinate of 0. When you move along the y-axis to find the y-co-ordinate, the point is 200 from the origin. The co-ordinates of point C are therefore (0, 200).
- Point D lies on the x-axis and has a y-co-ordinate of 0. If you move along the x-axis to find the co-ordinate, the point is 100 from the origin. The co-ordinates of point D are therefore (100, 0).

Figure 5. Points on the axes.

Quick quiz!

Answer the following questions using Figure 6 below.

- Which points intersect with the y-axis?
- Which point would be labelled with the ordered pair notation of (100, 200)?
- Which points have a y-co-ordinate of 100?

Answers; 1. Point A 2. Point B 3. Point C

Figure 6. Quick quiz.

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Plotting points on a graph

There are times when you will be given the coordinates of a point and will need to find its location on a graph. This process is often referred to as plotting a point. The process for plotting a point is shown below.

Plot the point (200, 150) using the following step-by-step approach.

Step 1
First, draw a perpendicular line extending out from the x-axis at the x-co-ordinate of the point. In the example, the x-co-ordinate is at 200.

Step 2
Then, draw a perpendicular line extending out from the y-axis at the y-co-ordinate of the point, the y-co-ordinate is at 150.

Figure 7. Step 1.

Step 3
Finally, draw a dot where the two lines intersect. This is the point we are plotting (200, 150).

Figure 8. Step 2.

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Figure 9. Step 3.

Deciding on a scale

The scale of a graph is very important. It is determined by the data for each axis, and should be measured accordingly.

A survey was conducted of the Grade 9 students at Elm High. The students were asked which of the following four team sports they preferred.

The results were:

1. Soccer – 45 students
2. Football – 55 students
3. Hockey – 75 students
4. Baseball – 25 students

In Figure 10, these four preference categories have been placed on the x-axis, each representing the grouped data collected. Because the categories are nominal (names, not numbers) and describe qualitative (not quantitative) distinctions, the groups can be placed in any order on the axis.

On the y-axis, the data values range from 0 to 80 students. As mentioned earlier, your origin should be located at 0 where the x-axis and y-axis meet. Since the largest group of students by sport preference is 75, then it would be appropriate to end the scale at 80, resulting in a scale that ranges from 0 to 80. Depending on how the scale is arranged, the graph will not change, but its visual appearance might be altered.

The interval of the scale is the amount of space along the axis from one mark to the next. If the range of the scale is small, the general rule is to take the range of the scale and divide it by 10. Make this your interval. For ranges that are larger, the interval is typically 5, 10, 100, 500, 1,000, etc. Use numbers that divide evenly into 100, 1,000 or their multiples in order to provide a graph that is easy to understand.

In this case, if you take 80 and divide it by 5, you will get 16. However, it might be better to use 10 because it is easier to analyse. This provides a scale that is smaller, but still easy to use.

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Rules for good graphs

Knowing how to convey information graphically is important in presenting statistics. The following is a list of general rules to keep in mind when preparing graphs.

A good graph

- accurately shows the facts
- grabs the reader's attention
- complements or demonstrates arguments presented in the text
- has a title and labels
- is simple and uncluttered
- shows data without altering the message of the data
- clearly shows any trends or differences in the data
- is visually accurate (i.e., if one chart value is 15 and another 30, then 30 should appear to be twice the size of 15).

Why use graphs to present data?

Because they...

- are quick and direct
- highlight the most important facts
- facilitate understanding of the data
- can convince readers
- can be easily remembered

There are many different types of graphs that can be used to convey information, including:

Knowing what type of graph to use with what type of information is crucial. Depending on the nature of the data some graphs are more appropriate than others. For example, categorical data like favorite school subjects are best displayed in a bar graph or circle graph while continuous numeric data such as height are illustrated by a line graph or histogram. For more information on appropriate graph types, see "Types of data" in *Teacher's Guide to Data Discovery*.

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When is it not appropriate to use a graph?

A graph is not always the most appropriate tool to present information. Sometimes text or a data table can provide a better explanation to the readers—and save you considerable time and effort.

You might want to reconsider the use of a graph when

- the data are very dispersed

- there are too few data (only one, two or three data points)

Figure 12. Number of students enrolled in Greenfield Secondary School.

- the data are very numerous

- the data show little or no variations

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Graphs: four guidelines

If you have decided that using a graph is the best method to relay your message, then there are four guidelines to remember:

1. **Define your target audience.**

   Ask yourself the following questions to help you understand more about your audience and what their needs are:

   1. Who is your target audience?
   2. What do they know about the issue?
   3. What do they expect to see?
   4. What do they want to know?
   5. What will they do with the information?

2. **Determine the message(s) to be transmitted.**

   Ask yourself the following questions to figure out what your message is and why it is important:

   1. What do the data show?
   2. Is there more than one main message?
   3. What aspect of the message(s) should be highlighted?
   4. Can all the messages be displayed in the same graphic?

3. **Use appropriate terms to describe your graph.**

   Consider the following appropriate terms when labelling the graph or describing features of it in accompanying text:

Use appropriate terms to describe your graph

If your graph...	Use the following terms...
describes components	share of, percent of the, smallest, the majority of
compares items	ranking, larger than, smaller than, equal to
establishes a time series	change, rise, growth, increase, decrease, decline, fluctuation
determines a frequency	range, concentration, most of, distribution of x and y by age
analyses relationships in data	increase with, decrease with, vary with, despite, correspond to, relate to

4. **Experiment with different types of graphs and select the most appropriate.**

1. circle graph/pie chart (description of components)
2. horizontal bar graph (comparison of items and relationships, time series)
3. vertical bar graph (comparison of items and relationships, time series, frequency distribution)
4. line graph (time series and frequency distribution)
5. scatterplot (analysis of relationships)