STATISTICS

Statistics is the study of the collection, analysis, interpretation, presentation and organization of data. Statistics helps to present information using picture or illustration. Illustration may be in the form of tables, diagrams, charts or graphs.

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Pictograms

Information by Pictograms

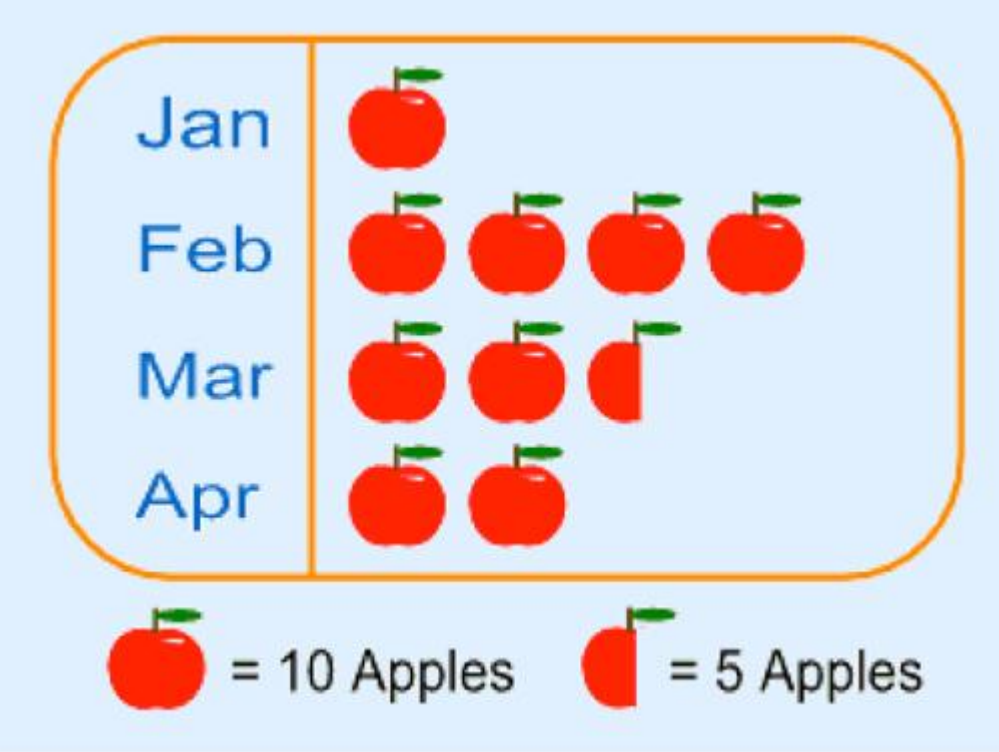
Display Information by pictograms

This is a way of showing information using images. Each image stands for a certain number of things.

Interpretation of Pictograms

Interpret pictograms

For example here is a pictograph showing how many apples were sold over 4 months at a local shop.



Each picture of 1 apple means 10 apples and the half-apple means 5 apples.

Note that:

- The method is not very accurate. For example in our example we can't show just 1 apple or 2 apples.
- Pictures should be of the same size and same distance apart. This helps easy comparison.
- The scale depends on the amount of data you have. If the data is huge, then one image can stand for large number like 100, 1000, 10 000 and so on.

Bar Charts

They are also called bar graphs. Is a graphical display of information using bars of different heights.

Horizontal and Vertical Bar Charts

Draw horizontal and vertical bar charts

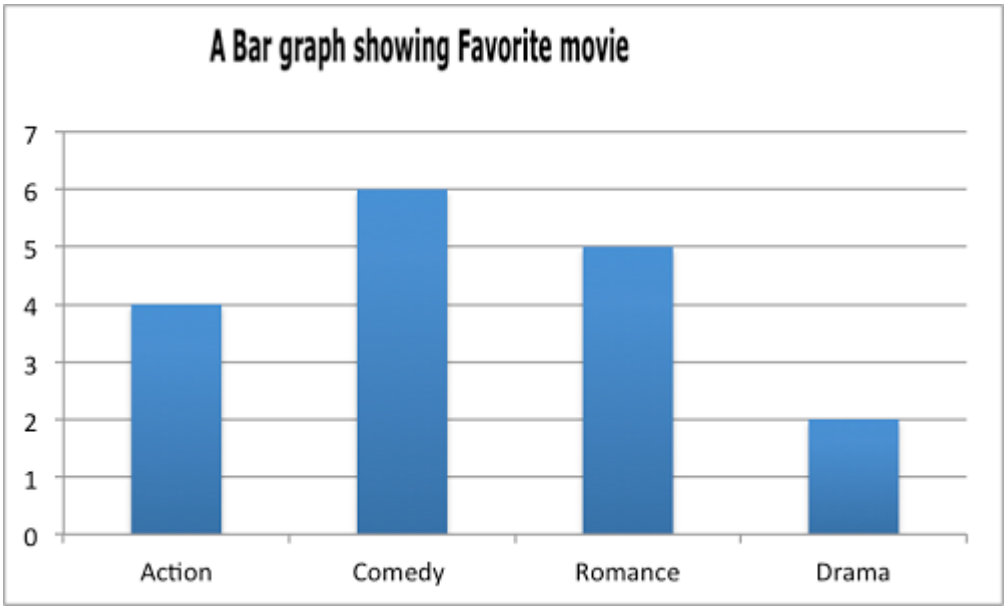
For example; imagine you just did a survey of your friends to find what kind of movie they liked best.

Table: favorite type of movie			
Action	Comedy	Romance	Drama
4	6	5	2

We can show that on a bar graph as here below:

Scale: vertical scale: 1cm represents 1 kind of movie

Horizontal scale: 1 cm represents 1 movie they watched.



Interpretation of Bar Chat

Interpret bar chart

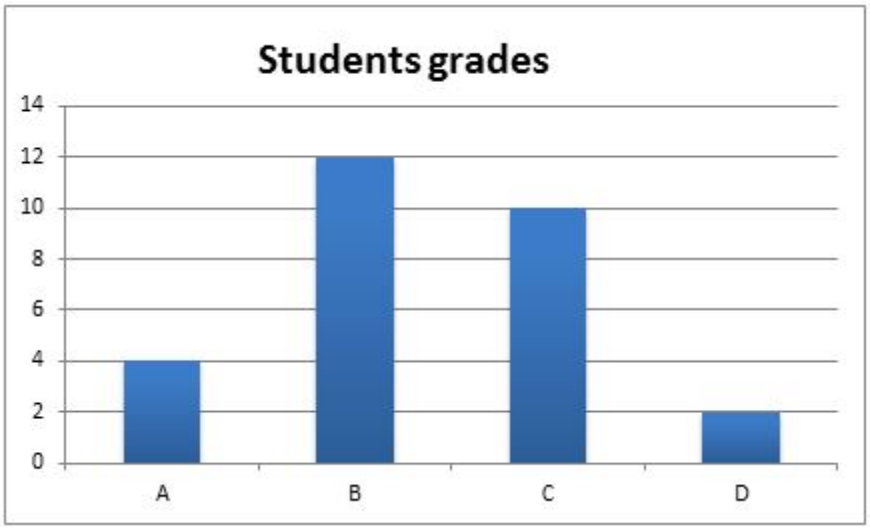
in a recent math test students got the following grades:

Grade:	A	B	C	D
Students:	4	12	10	2

And this is a bar chart.

Scale: vertical scale: 1 cm represents 1 grade

Horizontal scale: 1 cm represents 2 students



Line Graphs

These are graphs showing information that is connected in some way. For example change over time.

Representing Data using Line Graphs

Represent data using line graphs

Example 1

you are learning facts about mathematics and each day you do test to see how Good you are.

These are results.

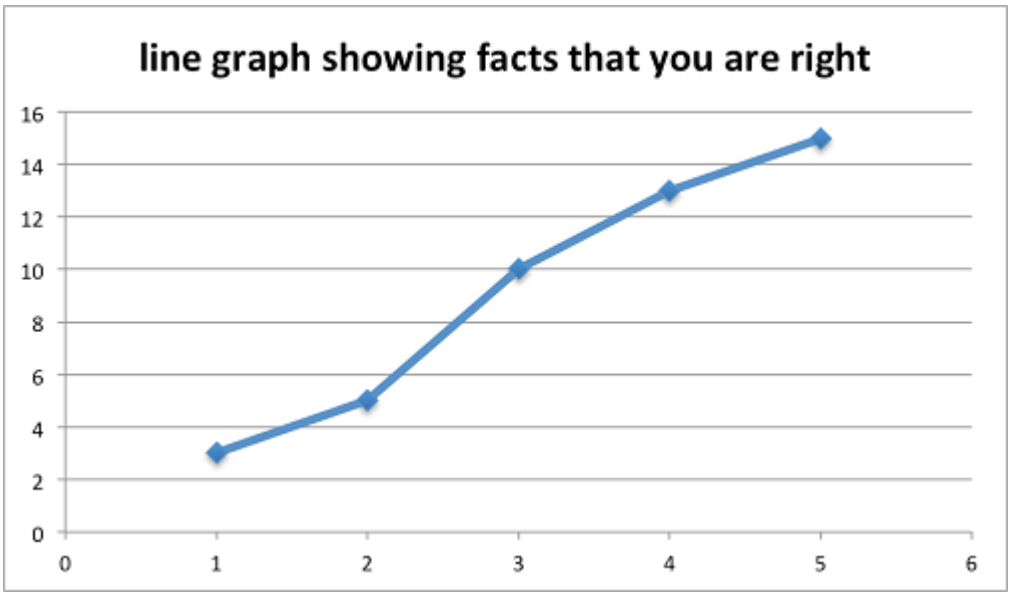
Facts that you are right				
Day 1	Day 2	Day 3	Day 4	Day 5
3	5	10	13	15

Solution

We need to have a scale that helps us to know how many Centimeter will represent how many facts that you were correct.

Vertical scale: 1 cm represents 2 facts that you were right

Horizontal scale: 2 cm represents 1 day.

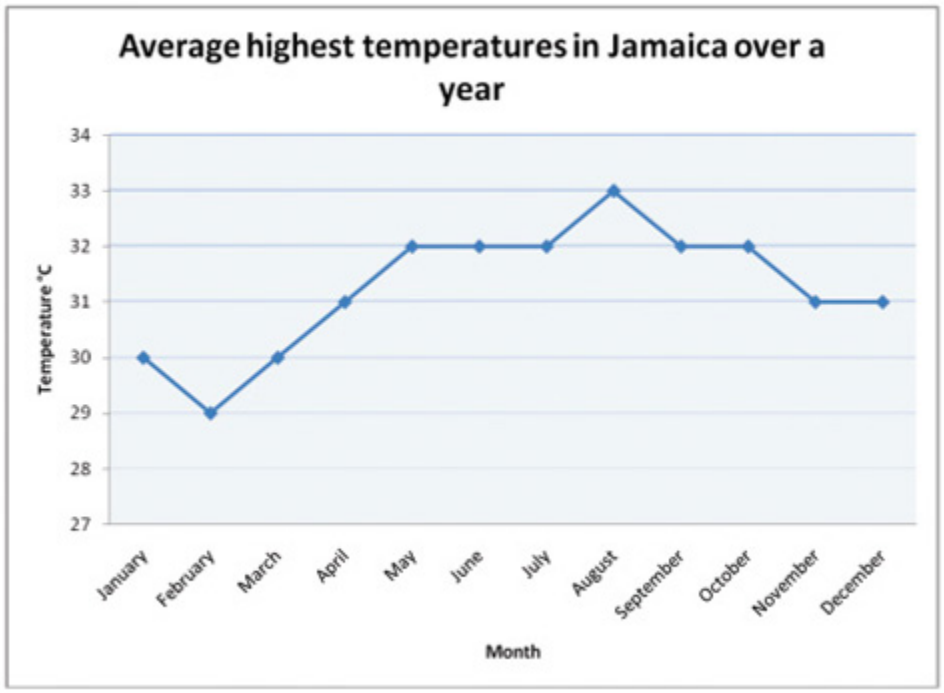


Interpretation of Line Graphs

Interpret line graphs

Example 2

The graph below shows the temperature over the year:



From the graph we can get the following data:

1. The month that had the highest temperature was August.
2. The month with the lowest temperature was February.
3. The difference in temperature between February and may is $(32^0\text{-}29^0)=3^0$C.
4. The total number of months that had temperature more than 30^0C was 9.

Pie Chart

This is a special chart that uses "**pie slices**" to show relative size of data. It is also called Circle graph.

Data using Pie Charts

Display data using pie charts

Example 3

The survey about pupils interests in subjects is as follows: 30 pupils prefer English, 40 pupils refer French and 50 pupils prefer Kiswahili. Show this information in a pie chart.

How to make them?

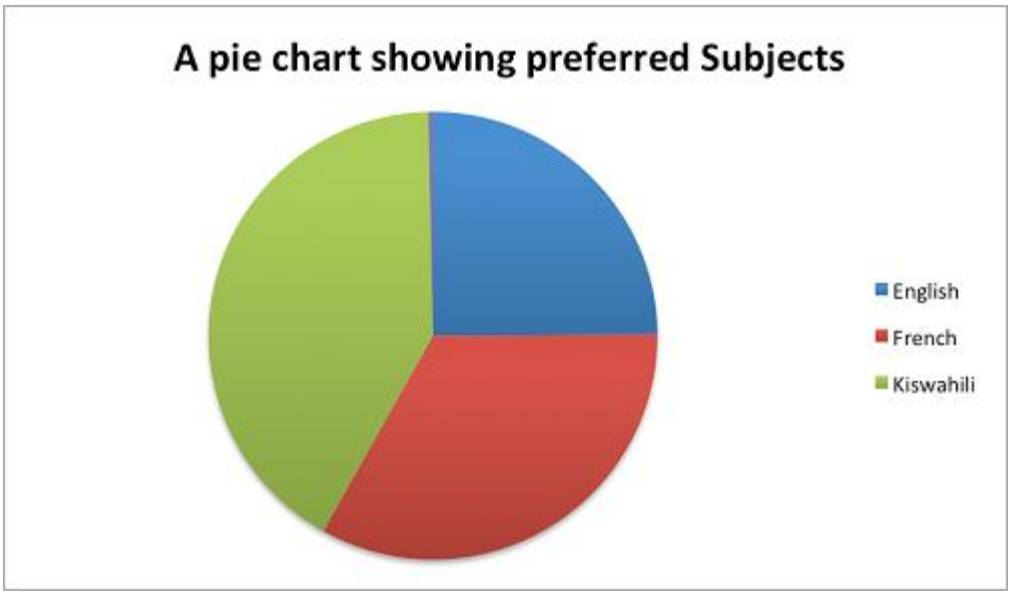
Step 1: put all you are data into a table and then add up to get a total.

Preferred Subjects			
English	French	Kiswahili	Total
30	40	150	120

Step 2: divide each value by the total and then multiply by 360 degrees to figure out how many degrees for each "pie slice" (we call pie slice a sector) We multiply by 360 degrees because a full circle has a total of 360 degrees.

Preferred subjects			
English	French	Kiswahili	Total
30	40	50	120
30/120 360 = 90	40/120 360 = 120	50/120 360 = 150	360

Step 3: draw a circle of a size that will be enough to show all information required. Use a protractor to measure degrees of each sector. It will look like the one here below:



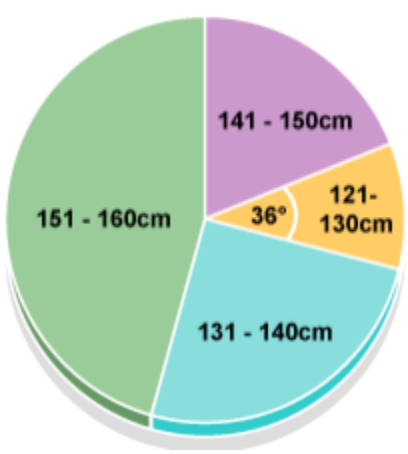
Interpretation of Pie Charts

Interpret pie charts

Example 4

Interpreting the pie charts.

The pie chart below shows the heights (in cm) of 30 pupils in a class.



The biggest slice of the pie chart contains the most people - 151-160cm.

How many pupils are between 121-130cm tall?

The angle of this section is 36 degrees. The question says there are 30 pupils in the class. So the number of pupils of height 121 - 130 cm is:

$^{36}/_{360}$ x 30 = 3

Frequency Distribution Tables

Frequency is how often something occurs. For example; Amina plays netball twice on Monday, once on Tuesday and thrice on Wednesday. Twice, once and thrice are frequencies.

By **counting frequencies** we can make **Frequency Distribution table.**

Frequency Distribution Tables from Raw Data

Make frequency distribution tables from raw data

For example; Sam's team has scored the following goals in recent games.

2, 3, 1, 2, 1, 3, 2, 3, 4, 5, 4, 2, 2, 3.

How to make a frequency distribution table?

•Put the number in order i.e. 1, 1, 2, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 5

•Write how often a certain number occurs. This is called tallying

1. how often 1 occurs? (2 times)
2. how often 2 occurs? (5 times)
3. how often 3 occurs? (4 times)
4. how often 4 occurs? (2 times)
5. how often 5 occurs? (1 times)

•Then, wrote them down on a table as a Frequency distribution table.

Scores	Frequency
1	2
2	5
3	4
4	2
5	1

From the table we can see how many goals happen often, and how many goals they scored once and so on.

Interpretation of Frequency Distribution Table form Raw Data

Interpret frequency distribution table form raw data

Grouped Distribution Table

This is very useful when the scores have many different values. For example; Alex measured the lengths of leaves on the Oak tree (to the nearest cm)

9, 16, 13, 7, 8, 4, 18, 10, 17, 18, 9, 12, 5, 9, 9, 16, 1, 8, 17, 1, 10, 5, 9, 11, 15, 6, 14, 9, 1, 12, 5, 16, 4, 16, 8, 15, 14, 17.

How to make a grouped distribution table?

Step 1: Put the numbers in order. 1, 1, 1, 4, 4, 5, 5, 5, 6, 7, 8, 8, 8, 9, 9, 9, 9, 9, 9, 10, 10, 11, 12, 12, 13, 14, 14, 15, 15, 16, 16, 16, 16, 17, 17, 17, 18, 18,

Step 2: Find the **smallest** and the **largest** values in your data and calculate the **range**.

The smallest (minimum) value is 1 cm

The largest (maximum) value is 18 cm

The range is 18 cm – 1 cm = 17 cm

Step 3: Find the size of each group. Calculate an approximate size of the group by dividing the range by how many groups you would like. then, round that group size up to some simple value like 4 instead of 4.25 and so on.

Let us say we want 5 groups. Divide the range by 5 i.e. 17/5 = 3.4. then round up to 4

Step 4: Pick a **Starting value** that is less than or equal to the smallest value. Try to make it a multiple of a group size if you can. In our case a start value of **0** make the most sense.

Step 5: Calculate the list of groups (we must go up to or past the largest value).

In our case, starting at 0 and with a group size of 4 we get 0, 4, 8, 12, 16. Write down the groups. Include the end value of each group. (must be less than the next group):

Length (cm)	Frequency
0 - 3	
4 - 7	
8 - 11	
12 - 15	
16 - 19	

The largest group goes up to 19 which is greater than the maximum value. This is good.

Step 6: Tally to find the frequencies in each group and then do a total as well.

Length (cm)	Frequency
0 – 3	3
4 – 7	7
8 – 11	12
12 – 15	7
16 – 19	9
Total	**38**

Done!

Upper and Lower values

Referring our example; even though Alex measured in whole numbers, the data is **continuous**. For instance 3 cm means the actual value could have been any were between 2.5 cm to 3.5 cm. Alex just rounded numbers to whole numbers. And 0 means the actual value have been any where between -0.5 cm to 0.5 cm. but we can't say length is negative. **3.5 cm** is called **upper real limit** or **upper boundary** while **–0.5 cm** is called **lower real limit** or **lower boundary**. But since we don't have negative length we will just use 0. So regarding our example the lower real limit is 0.

The limits that we used to group the data are called limits. For example; in a group of 0 – 3, **0** is called **lower limit** and **3** is called **upper limit**.

See an illustration below to differentiate between Real limits and limits.

Length (cm) or Limits(cm)	Real limits	Frequency
0 – 3	0 – 3.5	3
4 – 7	3.5 – 7.5	7
8 – 11	7.5 – 11.5	12
12 – 15	11.5 – 15.5	7
16 – 19	15.5 – 19.5	9
	Total	**38**

Class size is the difference between the upper real limit and lower real limit i.e**. class size = upper real limit – lower real limit**

We use the symbol **N** (capital N) to represent the total number of frequencies.

Class Mark of a class Interval

This is a central (middle) value of a class interval. It is a value which is half way between the class limits. It is sometimes called mid-point of a class interval. Class mark is obtained by dividing the sum of the upper and lower class limits by 2. i.e.

Class mark =

$$: \frac{\text{upper class limit+lower class limit}}{2}$$

Referring to our example class marks for the class intervals are;

$$\frac{0+3}{2} = 1.5$$

$$\frac{4+7}{2} = 5.5$$

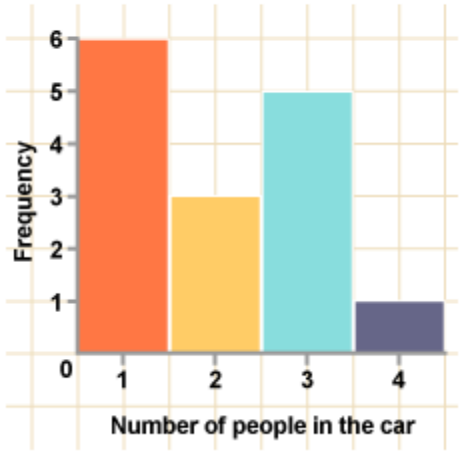
Interpretation of Frequency Distribution Tables

Interpret frequency distribution tables

Example 5

interpretation of frequency distribution data:

A survey was conducted to determine the number of people in cars during rush hour. The results are shown in the frequency diagram below.



total number of cars in the survey:

6 + 3 + 5 + 1 = 15

There are 6 cars with one person in, 3 cars with two people, 5 cars with three people, and 1 car with four people.

the most likely number of people in a car:

Cars in the survey are most likely to have 1 person in them as this is the tallest bar - 6 of the cars in the survey had one occupant.

Frequency Polygons

This is a graph made by joining the middle-top points of the columns of a frequency Histogram

Drawing Frequency Polygons from Frequency Distribution Tables

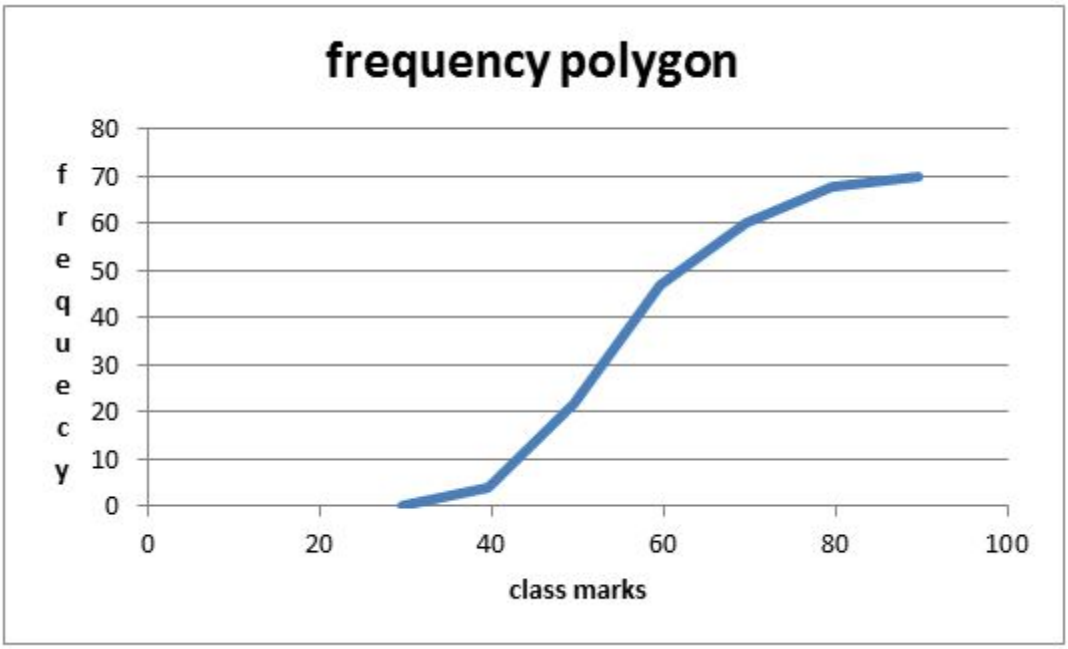
Draw frequency polygons from frequency distribution tables

For example; use the frequency distribution table below to draw a frequency polygon.

Class Interval	Class Mark	Frequency
25 – 29	27	6
30 – 34	32	12
35 – 39	37	10
40 – 44	42	16
45 – 49	47	20
50 – 54	52	14
55 – 59	57	16
60 – 64	62	18
65 – 69	67	8
70 – 74	72	4

Solution

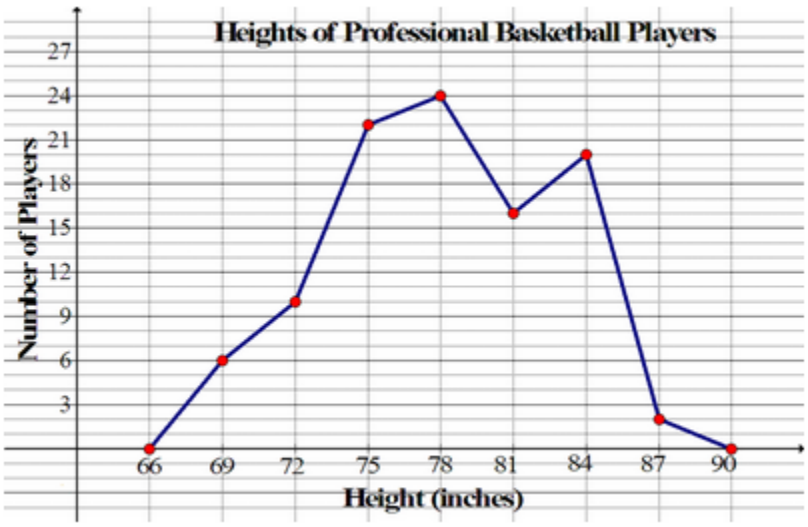
In a frequency polygon, one interval is added below the lowest interval and another interval is added above the highest interval and they are both assigned zero frequency. The points showing the frequency of each class mark are placed directly over the class marks of each class interval. The points are then joined with straight lines.



Interpretation of Frequency Polygons

Interpret frequency polygons

The frequency polygon below represents the heights, in inches, of a group of professional basketball players. Use the frequency polygon to answer the following questions:



the number of players whose heights were measured 100.

Histograms

Is a graphical display of data using bars of different heights. It is similar to **bar charts**, but a Histogram groups numbers into **ranges (intervals)**. And you decide what range to use.

Drawing Histograms from Frequency Distribution Table

Draw histograms from frequency distribution table

For example; you measure the height of every tree in the orchard in Centimeters (cm) and notice that, their height vary from 100 cm to 340 cm. And you decide to put the data into groups of 50 cm. the results were like here below:

Height (cm)	Frequency
100 – 150	5
150 - 200	30
200 - 250	28
250 - 300	50
300 - 350	10

Represent the information above using a histogram.

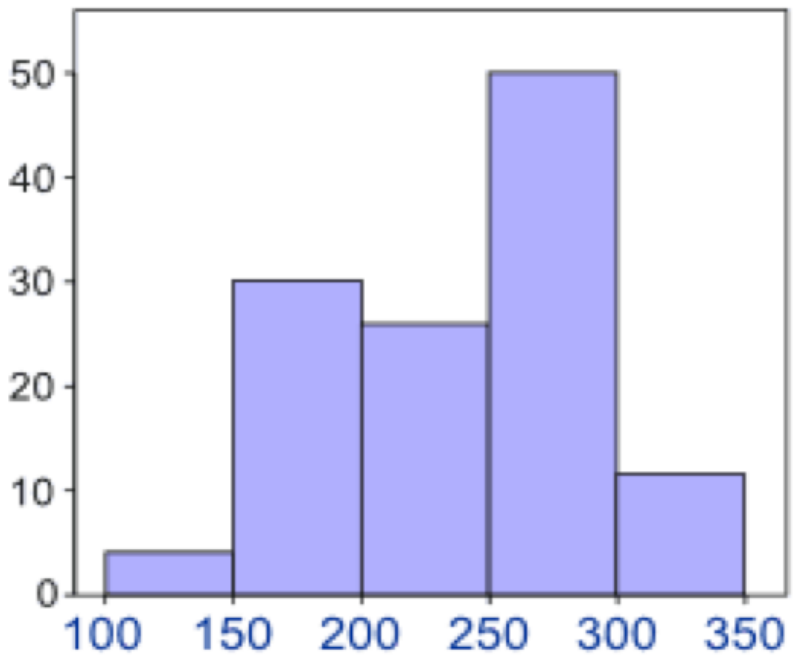
Solution

In order to draw histogram we need to calculate class marks. We will use class marks against frequencies.

Height (cm)	Class mark	Frequency
100 – 150	125	5
150 - 200	175	30
200 - 250	225	28
250 – 300	275	50
300 - 350	325	10
	Total	**123**

Scale: vertical scale: 1 cm represents 5 trees

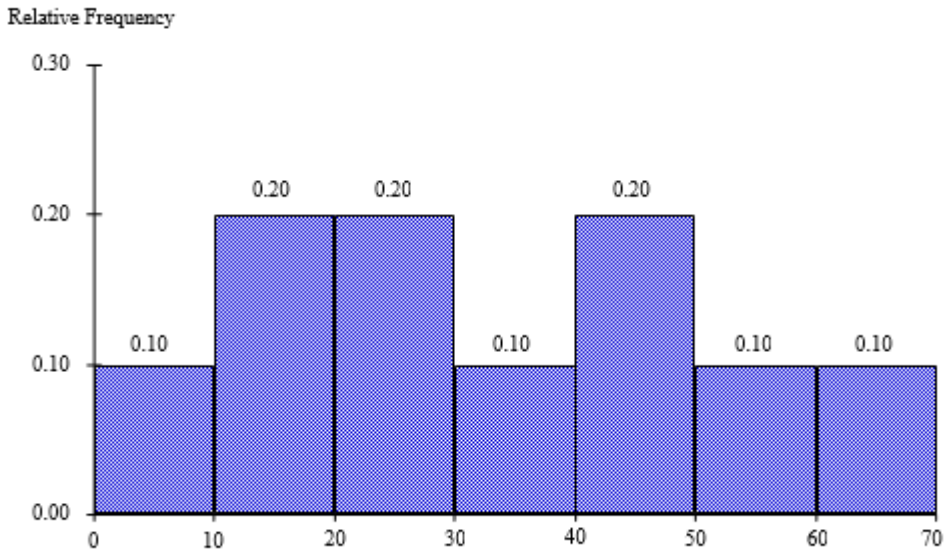
horizontal scale: 1 cm represents 50 cm (range of trees heigths).



Interpretation of Histograms

Interpret histograms

The histogram below represents scores achieved by 250 job applicants on a personality profile.



1. Percentage of the job applicants scored between 30 and 40 is10%
2. Percentage of the job applicants scored below 60 is90%
3. Job applicants scored between 10 and 30 is100

Cumulative Frequency Curves

Cumulative means "**how much so far**". To get cumulative totals just add up as you go.

Drawing Cumulative Frequency Curves from a Cumulative Frequency Distribution Table

Draw cumulative frequency curves from a cumulative frequency distribution table

For example; Hamis has earned this much in the last 6 months.

Month	Earned (Tsh)
January	12 000
February	15 000
March	13 000
April	17 000
May	16 000
June	20 000

How to get cumulative frequency?

The first line is easy, the total earned so far is the same as Hamis earned that month.

But, for February, the total earned so far is Tsh 12 000 + Tsh 15 000 = Tsh 27 000.

Month	Earned (Tsh)	Cumulative (Tsh)
January	12 000	12 000
February	15 000	27 000

for March, we continue to add up. The total earned so far is Tsh 12 000 + Tsh 15 000 + Tsh 13 000 = 40 000 or simply take the cumulative of February add that of March i.e. Tsh 27 000 + Tsh 13 000 = Tsh 40 000.

Month	Earned (Tsh)	Cumulative (Tsh)
January	12 000	12 000
February	15 000	17 000
March	13 000	40 000

The rest of the months will be:

April: Tsh 40 000 + Tsh 17 000 = Tsh 57 000

May: Tsh 57 000 + Tsh 16 000 = Tsh 73 000

June: TSh 73 000 + Tsh 20 000 = Tsh 93 000

The results on a **cumulative frequency table** will be as here below:

Month	Earned (Tsh)	Cumulative (Tsh)
January	12 000	12 000
February	15 000	27 000
March	13 000	40 000
April	17 000	57 000
May	16 000	73 000
June	20 000	93 000

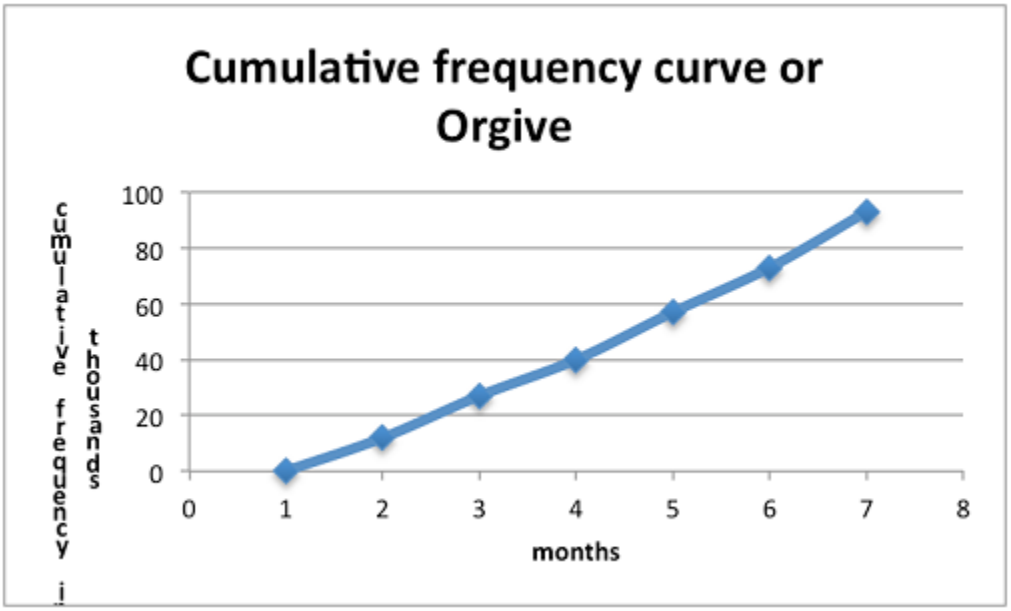
The last cumulative total should math the total of all earnings.

Graph for cumulative polygon is drawn with cumulative frequency on vertical axis and real upper limits on Horizontal axis.

Scale: Vertical scale: 1cm represents Tsh 20 000

Give number to months. i.e. January =2, February =3 and so on

Note: To draw an Orgive, plot the points vertically above the upper real limits of each interval and then **join the points by a smooth curve**. Add real limit to the lowest real limit and give it zero frequency.



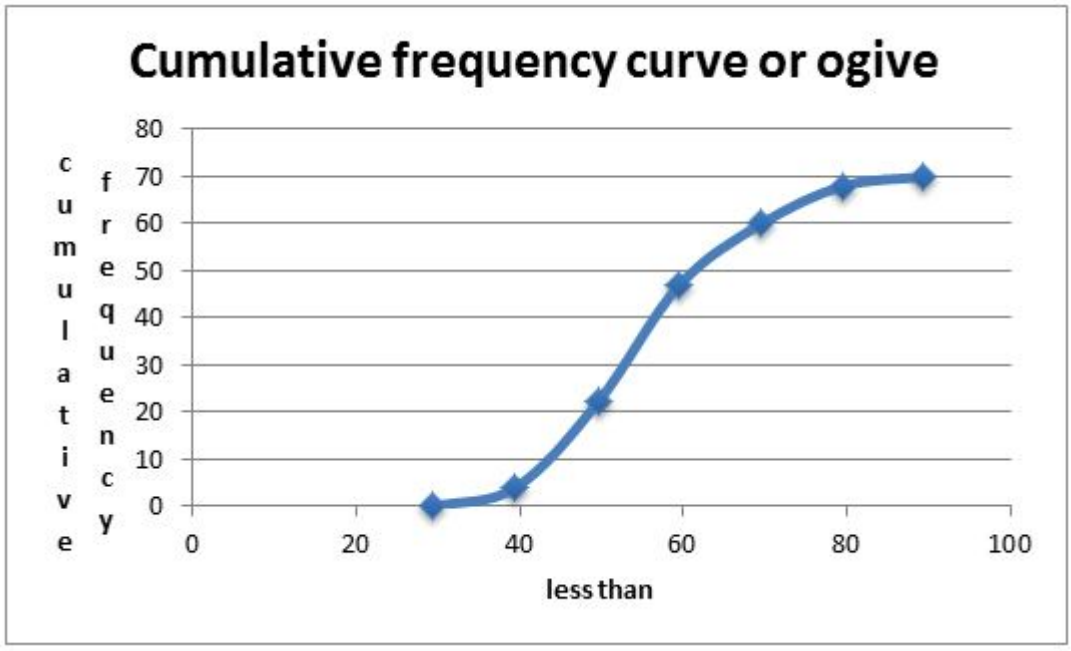
Interpretation of a Cumulative Frequency Curve

Interpret a cumulative frequency curve

Interpretation:

Class Interval	Upper Real limits (Less than)	Frequency	Cumulative Frequency
30 -39	39.5	4	4
40 - 49	49.5	18	22
50 - 59	59.5	25	47
60 - 69	69.5	13	60
70 - 79	79.5	8	68
80 - 89	89.5	2	70

Its Cumulative Frequency Curve or Orgive will be:



Exercise 1

1. Represent the data in the table below using pictures (pictograms)

Sacks of Rice	850	750	500
Region	Mbeya	Mwanza	Kilimanjaro

2. The following table represent the number of pupils with their corresponding height.