

STATISTICS

Statistical graphs

1. Simple line graph/ simple bar graph
2. Comparative / group/ multiple line graph
3. Compound / cumulative / divided line graph
4. Divergent line graph
5. Comparative/ group / multiple bar graph
6. Divergent bar graph
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STATISTICS

SIMPLE LINE GRAPH

Advantages of a simple line graph

- It is easy to draw / construct
- Clearly shows the trend of production (rise and fall)
- Gives good visual impression
- Consumes less space
- Easy to interpret

Disadvantages

- Represents only simple data (does not represent multiple data)
- Difficult to get a convenient vertical scale

COMPARATIVE / GROUP LINE GRAPH

This graph involves more than one line drawn on the same statistical graph. It is therefore sometimes called a ***multiple line graph***.

This method is particularly useful for comparison purposes and it is preferred when the comparison of trends is significant.

Construction procedure

1. The lines should be clearly and easily distinguishable from each other by using different colours or methods of drawing (or any variation of these)
2. The maximum number of lines that can be drawn on one statistical graph is probably 5 or 6, but this depends on the space available.
3. It is advantageous to write essential information on each line, but this should not exceed one or utmost two words per line (since there is need to draw attention to comparisons and to reduce dependence upon the key).
4. Crossing of lines should be avoided as much as possible, since it may lead to confusion and increased difficulty in interpretation.
5. Study the data carefully in order to choose a convenient scale (by considering the highest and lowest figures given)

Advantages of group line graph

1. Easy to compare the trend / fluctuations over a given period
2. Gives good visual impression
3. Easy to interpret
4. Does not involve much tedious calculations
5. Consumes less space unlike the group bar graph
6. Simple/ easy to draw
7. Portrays/represents multiple data

Disadvantages of group line graph

1. Consumes a lot of time
2. Difficult to assess the actual values from the graph unlike the group bar graph

3. If many lines are drawn and criss-cross each other , it becomes complicated to interpret / assess
4. Difficult to get a convenient vertical scale (*in case of very small and very large figures*).

Example:

COMPOUND / CUMULATIVE / DIVIDED LINE GRAPH

Like the compound bar graph, this method shows the component parts of a particular total. A compound line graph gives the impression of continuity; rise and fall (trend) in total production / quantities.

(It is also called a composite line graph).

Construction procedure

1. The totals for particular years (or independent variable) should first be established/ determined.
2. Draw a cumulative table showing the progressive totals of the given totals of the given items/ variables. (This helps you to get a scale and even to plot accurately).
3. Determine a convenient scale which can effectively show the smallest individual value and the highest total value (*the scale is based on the various totals established*)
4. Usually the largest component or one that shows the least fluctuation/ variation is drawn first; and a second component drawn above this for any particular year (descending order). Accordingly, the total corresponds to the upper most line graph for any particular year.
5. Due to the cumulative method, the lines cannot cross each other.
6. It is advisable to colour or shade the component parts distinctively for easy interpretation (shade the area between individual line graphs).
7. It is advisable to put on the writings on the graph but should be one or two words for each segment for easy interpretation. (*However, you may choose to use a key*).

Note:

- When drawing , maintain the continuity of years as given in the table
- When plotting , use the cumulative table not the original table given
- Do not confuse the compound line graph with comparative line graph. (for the compound line graph , all lines represent cumulative totals; yet for the comparative line graph the value of each individual item is determined from the zero line).

Advantages of compound line graph

1. Represents total values / quantities successfully
2. Good/ suitable for comparison purposes
3. Easy to draw / construct
4. It is relatively easy to interpret
5. Represents a wide range items
6. Consumes less space unlike other methods
7. Gives good visual impression if well drawn
8. Clearly shows the trend (fluctuations over time)

Disadvantages of compound line graph

1. Difficult to determine the actual value of each item for any particular year (due to cumulated values)

2. Consumes a lot of time when drawing
3. Involves a lot of tedious calculations.
4. Difficult to determine a convenient scale (where very large and very figures are involved)

Example: cumulative table

	Production 000 tonnes		
Year	2010	2012	2014
Maize			
Cow peas			
Cassava			
Others			

DIVERGENT LINE GRAPH

This category of graphs is intended to show divergence or fluctuations (increase or decrease) from the normal or mean value. It can also be used to show the profit or loss, increase or decrease in population as a result of migration among others.

A line graph is drawn with values plotted in relation to a zero line which can represent either the average of the period chosen or a particular year selected for comparison purposes.

Construction procedure

1. Calculate / determine the standard value / the mean / average (show the working and the units)
2. Draw a divergence table by subtracting the average from the individual values (x-mean). The figures above average become positive (+) and those below average become negative (-).
3. For interpretation purposes or emphasis, the zero is usually thickened.
4. Determine a suitable /convenient scale by considering the divergence values (*taking them as absolute values*). Avoid exaggeration of the scale.
5. Draw a thick line and mark it zero (average).
Note: the horizontal axis representing the independent variables should not be confused with the zero line but should occupy its normal place at the base of the graph.
6. Values below average (shortfall values) are plotted below the zero line while values above average (increases) are plotted above the zero line.
7. Join the fluctuation values using a line.
8. The significance of the zero line should be stated on or below the graph

Note:

- (a) This particular graph does not normally show production, exports, population etc absolute totals, but rather it shows divergences as positive and negative from some particular value or average.
- (b) Because of the possibility of confusion arising from crossing of lines, this graph usually drawn for one commodity only/ simple data.
- (c) This graph is usually restricted to line rather than curve graphs; and it should not be used as a compound or comparative line graph.

Advantages of divergent line graph

1. Easy to draw / construct

2. Easy to read/ interpret
3. Consumes less time when drawing
4. Clearly shows the trend (increases or decreases in a given variable over time)
5. Gives good visual impression
6. Used for comparison purposes

Disadvantages of divergent line graph

1. represents only simple data i.e. one commodity
2. only shows divergences not actual values , hence a bit confusing
3. involves tedious calculations
4. difficult to get convenient vertical scale
5. consumes a lot of space

Example:

Year	x-mean / average	Divergent value

SIMPLE BAR GRAPH

Advantages of a simple bar graph

- It is easy to draw / construct
- Gives good visual impression
- Consumes less space
- Easy to interpret

Disadvantages of a simple bar graph

- Represents only simple data (does not represent multiple data)
- Difficult to get a convenient vertical scale
- Does not clearly show the trend unlike the line graphs

Example:

COMPARATIVE/ GROUP BAR GRAPH

Bars are usually drawn touching each other to give an impression of totality in a given group. Attention is drawn towards quantities rather than rise and fall or fluctuations. *It is also called a multiple bar graph.*

Construction procedure

1. The method of construction is similar to the simple bar except that groups are used.
2. The bars are grouped together for purposes of comparison
3. Bars are drawn touching each other without a gap between them, but the groups of bars are separated using a uniform space.

4. It is advisable to draw the longest bar on the left, proceeding in descending order to the right. However the bar representing '**others**' is placed on the extreme right of the group.
5. The same order of the items must be adopted for all the groups.
6. All bars must be of the same width and drawn at right angles to the horizontal axis.
7. Use of distinctive colours or shadings for different items for purposes of easy comparison (and the same colour should indicate the same item throughout).
8. A key is very necessary for easy interpretation.
9. Study the data carefully and choose a convenient vertical scale; considering the highest and lowest figures given in the table.
10. For the horizontal scale, consider the gap occupied by the whole group for one year or region (depending on the data).

Advantages of comparative bar graph

1. Good for comparison purposes
2. Gives good visual impression
3. Shows totality and individual contribution of each item
4. Easy / simple to draw
5. Easy to interpret
6. Does not involve tedious calculations
7. Represents a wide range of items (multiple data)

Disadvantages of comparative bar graph

1. Consumes a lot of space
2. Consumes a lot of time when drawing
3. Difficult to get a convenient scale
4. Does not show the general trend of production (unlike line graphs)
5. It is of less value when comparison of totals is important

Example:

COMPOUND/ CUMULATIVE/ DIVIDED BAR GRAPH

Also called composite bar graph

DIVERGENT BAR GRAPH

Procedure

Similar to the divergent line graph

Shading of the bars is necessary for easy interpretation

Note: Divergent graphs using trade balance or net migration

Divergent graphs may also deal with imports and exports of a given region/ country, in which case the trade balance is obtained and plotted. Alternatively they deal with immigration and emigration, in which case the net migration is obtained and plotted.

Example1

- Study the table below showing Kenya's balance of visible trade (K£ million) 1992—1996 and answer the questions that follow:

(a) **Calculate the balance of trade for Kenya for each year.** (05mks)

Year	Exports—imports	Balance of trade
1992	718.6—1100.3	--381..7
1993	802.2—1105.6	--303.4
1994	926.9—1297.2	--370.3
1995	961.4—1396.2	--434.8
1996	1136.9—1537.9	--401

(b) **A divergence line graph to represent kenya's balance of visible trade 1992—1996.** (8mks) to page 2

(c) (i) **Identify the years in which the balance of visible trade was:**

—favourable —none. (1mk)

—unfavourable—1992, 1993,1994,1995,1996 (2mks)

(ii) **Justify the use of a divergent line graph.**

(03mks)

- Easy to draw / construct
- Easy to read/ interpret
- Consumes less time when drawing
- Clearly shows the trend (increases or decreases in a given variable over time)
- Gives good visual impression
- Used for comparison purposes

A divergence line graph to represent Kenya's balance of visible trade 1992—1996. (8mks)

(d) **Examine the impact of import and export trade on the economy of Kenya.** (06mks)

Positive

- Foreign trade enables countries to get goods which they cannot produce.
- Promotes understanding and cooperation between and among countries.
- Enables the country to dispose-off surplus output
- Generates foreign exchange for the country.
- Creates more employment opportunities.
- Generates more government revenue, through import and export duties.
- Improves the social and economic infrastructure of a country

Negative

- Undermines the development of local industries
- Encourages dumping of commodities
- It subjects the economy to imported inflation.
- Some imported goods have adverse/ negative effects on the citizens of a country.
- Undermines a country's political and economic independence.
- Leads to over exploitation of natural resources.

- Encourages brain drain and its negative effects.
- Limits employment opportunities in the home industries.
- Erosion/ loss of cultural values

SIMPLE BAR AND CURVE GRAPH

CIRCULAR GRAPH (POLAR GRAPH/ CLOCK GRAPH)

A circular graph comes out as the best statistical method for representing cyclic geographical variables / information. They are normally used to represent geographical variables such as temperature, rainfall etc

It basically shows information that follows a year calendar. A vertical scale is calculated and shown on one of the radii (usually the 12 o'clock radius).

Procedure:

1. Draw a circle of convenient size not very small and not very large.
2. Bisect/ divide the circle into 12 segments of equal size, each segment equivalent to 30° . The 12 o'clock represents January and the rest named up to December clockwise.
3. As the graph usually represents climatic data (rainfall or temperature or both), determine the scale and indicate it on either the 12 o'clock line or 6 o'clock line.
4. If both rainfall and temperature are available, one scale should be put on the 12 o'clock line and the other scale on the 6 o'clock line.
5. Temperature variations are indicated by a circular thick line where as rainfall by bars drawn on the inner radius.
6. Avoid congestion in the centre especially when drawing rainfall bars, and hence a circle is always drawn towards the centre. *(It is advisable that the inner circle is 2—3 cm radius, and the outer circle is about 8cm radius).*
7. This polar graph can also be used to portray seasonal activities done in a year such as the farmers' calendar, apart from climatic statistics. The outer circle represents climatic statistics while the inner circle shows the seasonal activities done in a certain month using circular bars shaded differently or using line designs. A key is used for easy interpretation.

Note:

- Writing / printing on the graph should as much as possible vertical/ normal, not to compel the reader to turn the graph continuously which is a difficulty. Do not continue writing around the graph, turning it through 360° as you write (avoid information written upside down).
- If there are many seasonal activities to be shown, the size of the inner circle is slightly adjusted. Care must be taken when drawing the circular bars for those activities in the inner circle since a number of activities may fall within the same period/ overlap.

Advantages of circular graphs

1. Represents many variables and much information
2. Gives good visual impression if properly drawn
3. Clearly shows the variation of seasonal activities
4. Conveys the impression of cyclic or continuous progression in information better than any other method (shows the idea of continuity)
5. Shows comparison between 2 or more variables on the same graph

Disadvantages of circular graphs

1. Difficult to determine the exact figures on particular months that are far from the scale.
2. Bars do not stand on a straight line and are not parallel to each other, which makes comparison of their values difficult.
3. Writing/ printing on the circular graph is generally a problem.
4. Consumes a lot of time when drawing (especially with a lot of information)
5. Consumes a lot of space and it is a bit complicated to draw.
6. Generally less successful in representing monthly values and fluctuations than the combined bar and line graph.

Example:

1. The table below shows the climatic statistics for station X and answer the questions that follow :

Months	J	F	M	A	M	J	J	A	S	O	N	D
Temp(⁰ c)	24.8	24.8	24.3	23.7	22.6	20.5	19.4	20.5	22.6	24.3	25.5	25.4
R/Fall(mm)	155.9	110.2	145.8	44.2	6.1	0	0	0	2.6	6.1	31.5	97.5

- (a) Draw a circular graph to portray the information above
- (b) Determine the:
 - (i) Annual temperature range
 - (ii) Mean annual temperature
 - (iii) Mean annual rainfall, for station x
- (c) Describe the climate characteristics of station x
- (d) Giving a reason for your answer, state the hemisphere where the above station is located.

2. Study the table and passage below showing the rainfall patterns of Soroti and the activities done in a year

Month	J	F	M	A	M	J	J	A	S	O	N	D
R/fall(mm)	19	65	82	184	207	126	118	174	138	113	77	26

Activities done:

Harvesting of cotton and rice, and planting of finger millet and maize is done between December, January and early February. In the rains of April, May, and June potatoes and cassava are also planted. Cotton planting follows from May to September. Through June and July weeding of cotton, and planting of sorghum and beans.

- (a) Construct a suitable graph to illustrate the information above
 - (b) Explain the influence of climate on the farmer's calendar in Soroti
 - (c) Discuss the likely problems facing farmers of the area
3. Study the table below showing the farmer's calendar in Teso region (Uganda) and answer the questions that follow:

Month	Rainfall (mm)	Planting	Harvesting
Jan	15	--	---
Feb	33	Millet	Cotton
Mar	76	---	---
Apr	165	Maize	---
May	183	Cotton	---
Jun	152	Cotton	---

Jul	137	---	Millet
Aug	216	Cow peas	Maize
Sep	145	---	---
Oct	127	---	---
Nov	91	---	Cow peas
Dec	23	---	---

- Draw a circular graph (clock graph) to represent the information in the table
- Explain the influence of climate on farmer's activities in Teso region
- With reference to the table and graph drawn, outline the problems faced by the farmers in Teso region.

4. Study the information below showing wheat growing in the prairies (Canada)

- From mid-November to the end of March the ground is frozen and cattle indoors
- Beginning of April to mid-April, it is the thaw/melt period
- From mid-April to mid-May, it is the sowing period/season
- Growing season—mid-May to mid-August
- Harvest period --from mid August towards end of September
- Ploughing follows up to mid-November
- this cycle continues year after year

- Draw a suitable graph to portray the above information
- Outline the merits and demerits of the above method
- what are the likely problems facing wheat growing activities in the prairies?

5. Study the table below showing cocoa growing activities in Ghana

Month	Season	Activity
Jan	DRY SEASON	Preparing land
Feb		
Mar		
Apr	SEASON OF THE BIG RAINS	Little harvest
May		
Jun		
Jul	SEASON OF THE LITTLE RAINS	Farm improvements
Aug		
Sep		
Oct	DRY SEASON	Pruning trees
Nov		
Dec		

- Draw a circular graph to represent the above information
- Comment of the information given in the table and graph above
- Describe the likely problems facing the cocoa farmers in Ghana

6. Study both the passage (which describes the activities of the farmers of Kasama, northern Zambia in a year) and the table showing the annual rainfall, and answer the questions that follow:

The main tree-cutting season is May and June and after the branches have dried, they are carried and piled on the cleared land. This is a skillful task since the wood must be piled evenly to form a circular layer about two feet high.

The branches are fired in late September and November when a general signal is given, since a stack set ablaze may accidentally set the bush on fire and burn the branches of a neighbour before he had finished piling them up. The bed of ash which is formed has a high potash content and free from weeds and on this, seed is sown.

The millet crop is not sown until December when the ground is softened by the rain. The seed is broadcast without preliminary hoeing and it is then covered with a thin scatter of earth. A little sorghum and maize may have been sown over the field before the millet.

The maize ripens in February and March and the millet and sorghum in April and May. Reaping is done labouriously by the women who cut each millet head separately with a small reaping knife. It is then stored in the granaries.

Table showing Annual rainfall for Kasama:

Month	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall (mm)	280	245	255	65	10	0	0	0	20	46	145	265

- Construct a graph to illustrate the information in both the passage and the table
- Discuss the likely problems facing the farmers in the area
- Suggest possible solutions to the problems in (b) above

Solution (c)

The likely problems facing the farmers of the area:

- The cutting of trees and uprooting the stump before cultivation is a very difficult activity
- Storage in local granaries is not very safe for such produce
- Burning destroys the humus content in the soil
- Harvesting by cutting each head separately is very labourious and time consuming
- Rudimentary tools are very difficult to use such as small harvesting knife
- Possibility of famine in one season of the year
- Fire is likely to catch neighbouring bushes and destroy farm lands
- The clearing of forests, results in soil erosion during the wet season
- Water shortage during the long dry period between May and October
- Pests and diseases during the wet season destroying the crops
- etc

DIVIDED RECTANGLES (RECTANGULAR GRAPH)

In this method, a rectangle replaces a circle for representing statistical information. This means that the rectangle is sub-divided into components to indicate the constituent parts.

There are two types:

- simple divided rectangle
- compound divided rectangle

SIMPLE DIVIDED RECTANGLE

Construction procedure

- 1) A rectangle is drawn with its area proportional to the total quantity / value of all parts.
- 2) The rectangle is then subdivided into components uniform in height (the vertical scale is usually constant, preferably 1:10)
- 3) Variation in the component parts are indicated by the sub-divisions along the horizontal scale.
- 4) Show what the horizontal scale represents in values or percentages (*horizontal scale is the most important scale*).
- 5) Rectangular graphs are best constructed on a graph paper base.
- 6) Remember to obtain cumulative figures before plotting for quick division and it is advisable to plot in descending order (biggest first).

Advantages of divided rectangles

1. Gives good visual impression
2. Easy to construct/ draw (*especially the simple divided rectangle*)
3. Shows many variables / a variety of information (especially the compound divided rectangle)
4. Useful for comparison purposes
5. Does not involve many tedious calculations
6. Generally easy to read and interpret

Disadvantages of divided rectangles

1. Choosing a suitable horizontal scale is difficult
2. Occupies a lot of space
3. Difficult to use for location purposes on a map
4. Consumes a lot of time when drawing
5. Where very small figures are involved it becomes a bit complicated to draw
6. Many variables make the graph congested
7. Does not show actual values / area of different items but rather cumulative values

COMPOUND DIVIDED RECTANGLE

This method represents more complex data, where the divisions of the rectangles themselves are sub-divided, that is, divisions are done on both the horizontal and vertical scales

SIMPLE POPULATION PYRAMID/ AGE SEX GRAPH

This is the best method of illustrating the age—sex structure of the population. The graph is made up of a series of horizontal bars arranged on each side of the vertical axis, each bar representing the numbers of percentage of the population in a certain age group.

Note: population pyramids show the demographic characteristics of a given country or region, males on one side and females on the other side.

Procedure:

1. It is conventional to show the males on the left side and females on the right (resulting into a pyramidal lay out of the graph)
2. The base of the pyramid represents the youngest people while the apex shows the oldest group.
3. The graph is made up of a series of horizontal bars on each side of the vertical axis, which represent numbers or percentage of the population in a certain age group and sex.
4. Use an appropriate / convenient scale, avoiding graphs that are either too narrow or too wide. The horizontal scale should be written on both the male and female sections (in the same pattern/ order for easy comparison).
5. Shade / colour the bars to improve the visual appearance of the graph.

Note: there are two methods in pyramid construction:

- (a) Absolute method—where the base line gives the actual population of each age group.
- (b) Comparable method—where the baseline gives the percentage of the total population in each age group.

Advantages of age-sex graph

1. Gives a good summary of population structure/ composition in terms of age and sex
2. They are useful for comparison purposes
3. Gives good visual impression if well drawn
4. Represents a lot of information especially the super imposed pyramid (multiple data)
5. Easy to construct and interpret
6. Does not involve a lot of tedious calculations

Disadvantages of age-sex graph

1. Suitable for only population statistics
2. Occupies a lot of space
3. Consumes a lot of time when drawing
4. Difficult to obtain an appropriate scale for the pyramid

COMPOUND/ COMBINED/ SUPER IMPOSED PYRAMID

Age-sex graphs can be super-imposed for purposes of comparison of areas/ regions or time period. This means that the pyramid can represent two (2) sets of data. This makes it easier to compare population pyramids for different countries or the same country but at different censuses.

Super imposed pyramids can be used to examine changes in population composition over time. Here one base line is used for more than one set of data.

Note: in case of super-imposed pyramids, a good method of shading / colouring should be used for clear comparison.

DIVIDED CIRCLES /PIE CHART/ PIE GRAPHS

Divided circles are the most common statistical methods used to represent geographical information. Pie charts are used for a variety of purposes unlike other methods

In this method total quantity is represented by a circle divided into segments proportional in size to the components (i.e. the bigger the segment, the larger the value being represented). The target of this method is normally to allow comparison between various components.

The divided circles are categorized as follows:

- a) Simple divided circle
- b) Comparative divided circles
- c) Proportional divided circles
- d) Proportional semi-circles

SIMPLE DIVIDED CIRCLE

1. Draw a circle of convenient size, that is, avoid too small circles and very big circles
2. The circle is divided into segments which are proportional to the value of the individual components (the larger the value represented, the larger the segment).
3. Calculate the size of the segments (clearly showing your working).
Method 1—segments are calculated as percentages of the total (1% of the whole circle is equivalent to 3.6°)
Method 2—components expressed as a fraction of the total and the formula used is:

$$\frac{\text{Component value}}{\text{Total}} \times 360^\circ$$

The calculations should be organized according to the information given

4. The segments are drawn after the calculations accordingly using a protractor.
5. When measuring the segments, we move in a clockwise direction. The largest component is usually placed to the right of the 12 o'clock line.
6. The smallest segments are often placed last. They present a problem in drawing and are best grouped together around the 9 o'clock if possible.
7. Note: the small segments should not be placed last as any error that accumulates such as due to the width of the pencil line will be more noticeable in small segments. Such errors can be absorbed into the larger segments without affecting the accuracy of the whole.
8. To reduce the errors to a minimum angles should be measured on a cumulative basis, the second angle should be added to the preceding one and so on. By working clockwise from the vertical radius, one is most likely to accumulate an error arising from the thickness of the pencil or otherwise). Therefore it is advisable that after the first segment one should draw in anti-clockwise direction (i.e. starting with the smallest).
9. The segment representing 'others' should be placed last irrespective of its size.
10. All writing on the pie chart should be in block / capital letters and as far as possible horizontal. Do not write around the pie graph turning it as you write. In case of very small segments, information can be added outside the chart and an arrow drawn from it to the relevant section.
11. It is advisable that absolute values or percentage values be marked / shown on the relevant segment and colour the segments distinctively. (It is not advisable to write too much information on the pie chart).
12. A key may be used for easy interpretation.
13. Different segments should be shaded/ coloured differently / distinctively so as to portray the difference in the segments.
14. Note: small segments should be coloured with a bright colour or shaded with some distinctive means.
15. The number of segments will be dictated by the nature of statistics given. 7 or 8 segments would seem to be the maximum. However the bigger the number of segments, the bigger the circle should be.

Advantages of pie charts

1. Easy to construct
2. Shading or colouring gives a good visual impression.
3. Consumes less space
4. Shows the contribution of different sectors to production (good for comparison purposes)
5. Consumes less space and time unlike other methods
6. Easily used alongside maps for location purposes

Disadvantages of pie charts

1. involves tedious calculations
2. very small segments lead to loss of visual effect
3. lacks the exactness of a bar graph, mainly because it is not drawn to scale (reference can not be made to a scale)

Example 1:

COMPARATIVE DIVIDED CIRCLES

The method of construction is similar to the simple pie chart.

Two or more simple divided circles of the same size are used for purposes of comparison provided the emphasis lies on the comparison of components rather than comparison of totals.

Procedure:

1. The pie charts drawn should be of the same size
2. The two or more pie charts should be drawn on the same page side by side to emphasize comparison of the elements/components
3. The same order of items should be followed in the various pie charts for easy comparison
4. Accordingly, the shading of the individual items should be followed for all the pie charts.

PROPORTIONAL DIVIDED CIRCLE

Proportional divided circles are used where comparison of totals is of greater importance in representing statistics. It may involve two or more circles each being proportional to the totals given.

Procedure

1. Two or more divided circles are drawn for comparison purposes. The size of the circles drawn depends on the totals given as they must be proportional.
2. The radius of each circle is determined by the formula

$$Area = \pi r^2$$

$$Total = \pi r^2$$

3. For each circle components must be expressed as percentages or fraction of the whole as in the simple pie charts.
4. Therefore the angles of the segments are calculated as before (as in the simple pie chart), clearly showing your working.
5. For purposes of comparison, the segments should be arranged in the same order in all the circles.
Note: proportional divided circles also mostly apply when totals are more than two such that proportional divided semi-circles do not apply.
6. This method can also be used in conjunction with a map provided alongside the data, in which case various proportional divided circles are drawn in particular positions/locations.

Advantages of proportional divided circles

1. They are simple to construct/ draw
2. Accommodate/ represent multiple data
3. Easy to interpret
4. Good for comparison purposes
5. They can be used alongside a map for location purposes
6. Give good visual impression

Disadvantages of proportional divided circles

1. Consumes much space unlike semi-circles
2. Drawing many pie charts consumes a lot of time
3. Comparing relative areas is always difficult and lacks the exactness of a bar graph
4. Involves many tedious calculations

PROPORTIONAL DIVIDED SEMI-CIRCLES

These are also drawn for purposes of comparison as the case in the proportional divided circles.

The two semi-circles are drawn adjacent to each other, each semi-circle being proportional to the quantity to be represented.

Construction procedure:

1. Determine the radius of each semi-circle using the formula

$$Total = \pi r^2$$

Note: you can use a scale value get a manageable radius

2. The method of construction is the same as for the proportional divided circles. However the difference lies in the fact that calculations of degrees are based on half circles.

$$\frac{\text{Component}}{\text{Total}} \times 180^\circ$$

3. Reference is made to a key for clear identification of the components.
4. For easy comparison, the segments should be arranged in the same order.
5. Segments should be expressed as percentages or decimals or fractions of the whole /totals

Advantages of proportional divided semi-circles

1. Occupies relatively less space unlike proportional pie charts
2. Good for comparison of different items
3. Easy to draw and interpret
4. Accommodates multiple data
5. Gives good visual impression

Disadvantages of proportional divided semi-circles

1. Difficult evaluating individual segments since actual values are not shown
2. Involves many tedious calculations
3. Difficult to represent very small values

4. Drawing and shading semi-circles consumes a lot of time

PROPORTIONAL DIVIDED CIRCLE (ON A MAP)

PROPORTIONAL CIRCLES

This statistical method is almost similar to the proportional divided circles, only that the proportional circles are not divided. These circles have an area proportional to the quantity represented i.e. the bigger the circles, the bigger the value/ quantity being represented and vice versa.

Note: Proportional circles can be drawn independently or in conjunction with a map.

Procedure:

1. The size of the circles depends on the radius which is determined by the scale chosen.
2. The total (T) is represented by the area of the circle (πr^2) and this gives the formula $T = \pi r^2$.
However since π a constant is it can be omitted in the calculations, and in this case the radius is proportional to the square root of the quantity to be represented.
3. Determine a scale to convert the rooted values to a manageable radius for each circle.
4. Calculate/ determine the radius from the rooted values by dividing the values by the scale. (To determine a convenient/ suitable radius consider the largest and smallest values).
5. Draw the circles in ascending order or descending order, that is, beginning with either the smallest or the biggest. (*This implies that the circles must be drawn on the same baseline*).
6. If it is necessary to colour the circles, the colour must be one.
7. When using a map, the size of the circles drawn depends on the map scale/ size and the density or closeness of the number of circles. Over lapping of the circles should be avoided as much as possible.
8. Draw proportional circles directly on the base map in their respective boundaries or when their centres are on the point to which the data refers.
9. Use a distinctive colour (e.g. red) to avoid confusion with the black map lines.

Advantages of proportional circles

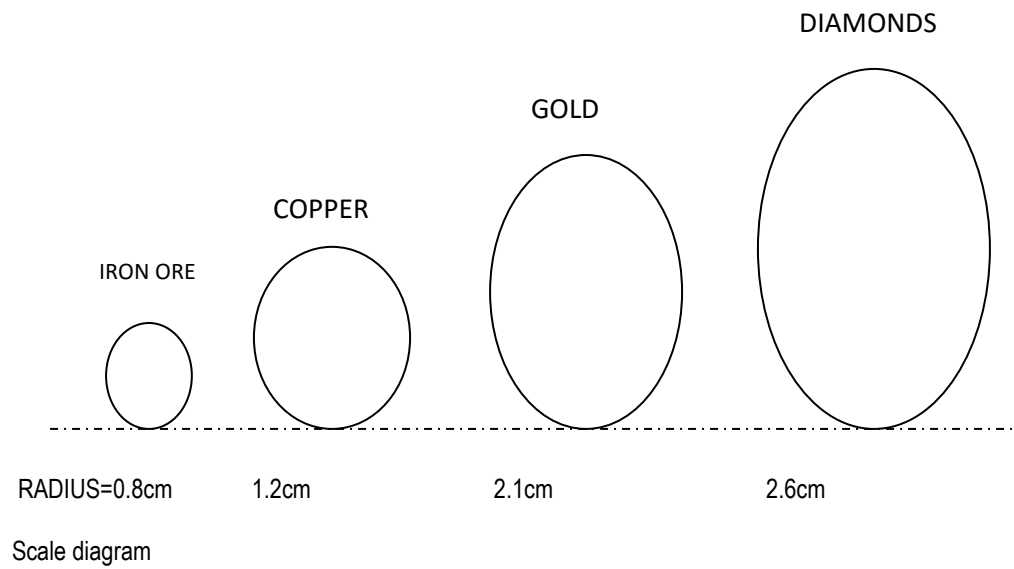
- They are simple/ easy to construct
- They are easy to interpret
- They can be used in conjunction with a map for locational purposes.
- Gives good visual impression.
- Involves less calculations unlike the proportional divided circles.

Disadvantages of proportional circles

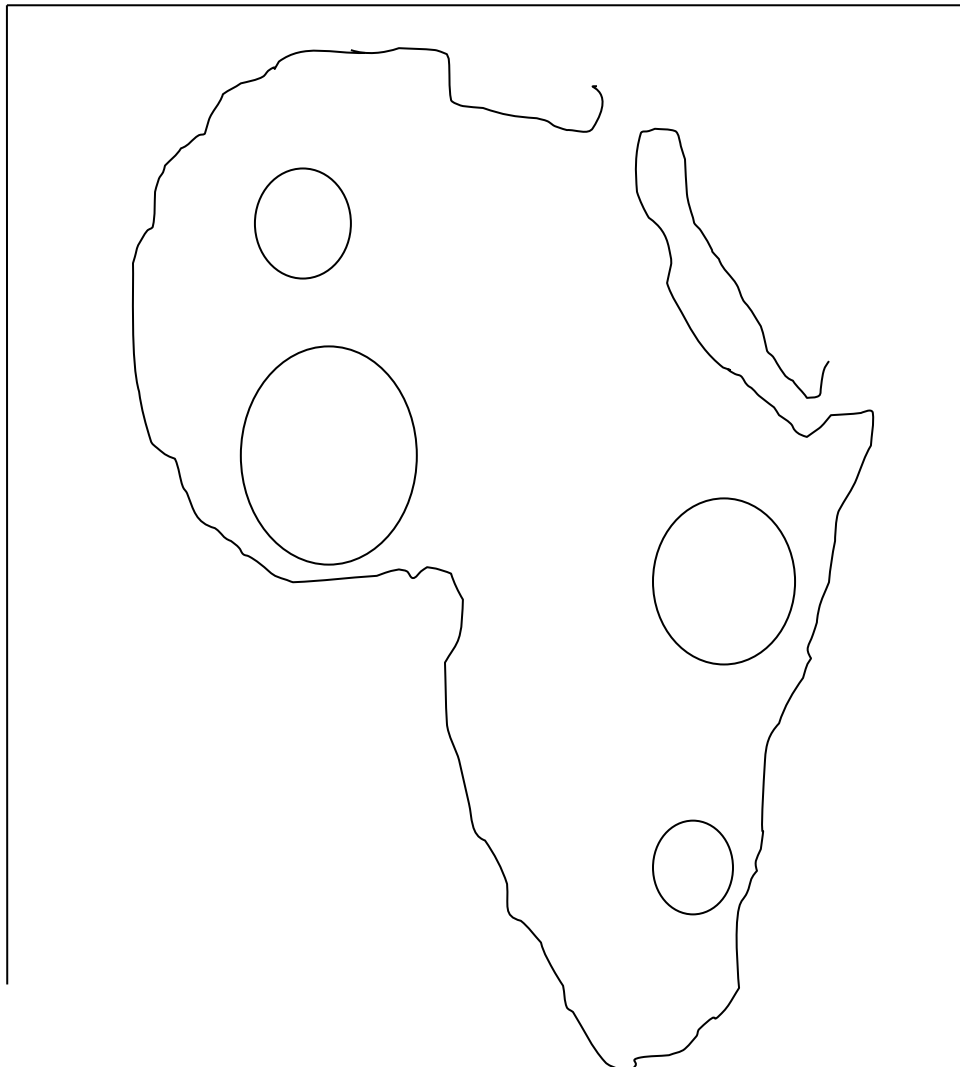
- They represent less information unlike proportional divided circles
- Difficult to get a convenient scale to represent all values
- Overlapping brings problems in drawing and interpretation where it is unavoidable.
- Consumes a lot of space.

Example 1

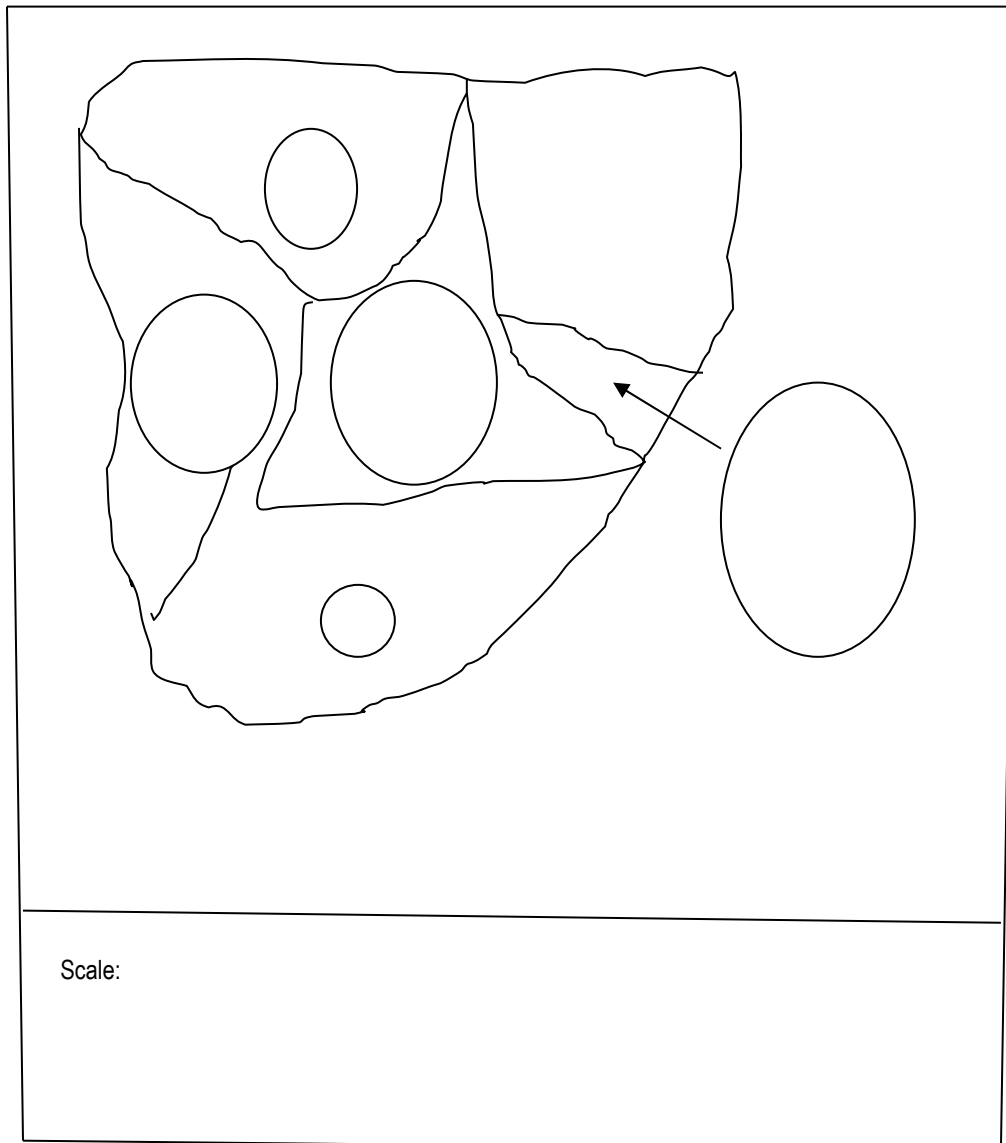
PROPORTIONAL DIVIDED CIRCLES SHOWING MINERAL PRODUCTION IN JOHANNESBURG (SOUTH AFRICA) FOR 1993
(METRIC TONS)



Example 2



Example 3



Assignment:

PROPORTIONAL SQUARES

Proportional squares can be used in the same way as proportional circles. The area of the square is proportional to the quantity it represents, and hence the side of the square is directly related to the square root of the quantity / number to be represented.

Proportional squares are useful when there is a wide range of numbers to deal with, as the use of square roots reduces the range of values to manageable units/ levels.

Procedure:

1. Calculate the square root of the total to be represented.

2. Determine the scale from the rooted values, which gives you the length of the side of the square.
3. Draw the square accordingly and shade them (if drawn individually, a graph paper is more useful).
4. A key is drawn for easy interpretation.
5. Sometimes it necessary to show part of a whole (sub division), the same process will be followed.
6. If drawn individually it is advisable to draw the squares in ascending or descending order. When drawn on a map the squares are drawn in the respective positions, with their areas proportional to the values they represent.

Note: Proportional squares are generally sited on a map in such a way that the south west corner or north west corner of the square locates the position of the town to which refers or in the respective boundaries.

As a general rule overlapping of the squares should be avoided.

Advantages of proportional squares

1. They can be super imposed on a map for location purposes
2. They are used for purposes of comparison
3. Their relative sizes are easier to assess than circles
4. Squares can be super imposed on each other to show different items or part of a whole

Disadvantages of proportional squares

1. Consumes a lot of space
2. Squares are more difficult to draw than proportional circles
3. Difficult to get an appropriate scale to represent all the values
4. Assessing small differences in total values represented is more difficult than in the case of bar graphs.

Example 1:

.....

Example 2:

PROPORTIONAL CUBES

These can also be drawn independently or given locational significance by being located on a base map to show quantitative distribution / production.

Their main advantage is that they introduce a third dimension, and are capable of representing statistics which have an even greater range of values.

Whereas the length of the side of a proportional square varies directly with the square root of the quantity being represented, the side of the cube is directly related to the cube root of the quantity.

Procedure:

1. Calculate the cube root of the quantity to be represented (may use calculators or cube root tables)
2. If drawn independently, the cubes should stand individually on a straight line for comparison purposes.
3. When drawn on the base map, the cubes must be drawn to the same pattern.
4. A key should be provided and the cube root values are plotted on the baseline.

Note: However due to difficulty in evaluating the quantities represented by the cubes it is sometimes advisable to write/ print the relevant quantity below the cube.

Advantages of proportional cubes

- Easy to compare information
- Gives a good visual impression
- Can be super imposed on maps
- Involves simple calculations

Disadvantages of proportional cubes

- Consumes a lot of space
- The cube cannot be sub-divided to show components
- Comparison of quantities represented by cubes is extremely difficult unless statistical information is written on or below the cube.
- A cube is generally less pleasing visually than a sphere

Example 1:

Example 2:

PROPORTIONAL SPHERES

The proportional sphere is similar in concept to the proportional cube. It serves the same purpose as the cube in that the introduction of a three-dimensional figure allows a very wide range of values to be represented, the volume of the sphere being proportional to the quantity being represented.

Construction procedure:

1. Determine the radius by calculating the cube root of the quantity to be represented.
Note: The volume of a sphere is $\frac{4}{3}\pi r^3$. But when calculating the radii of more than one sphere, $\frac{4}{3}\pi$ being a constant can be ignored and the cube root only considered. (*Working must be clearly shown*)
2. The sphere is then drawn in its correct position/ location on the map (*proportional spheres are normally used for locational purposes*).
3. Selection of various sizes of spheres with information relating to the value of each is done.

Note: the size of the spheres drawn depend on the size of the map. However you may consider maximum radius (1cm) and hence maximum diameter (2cm).

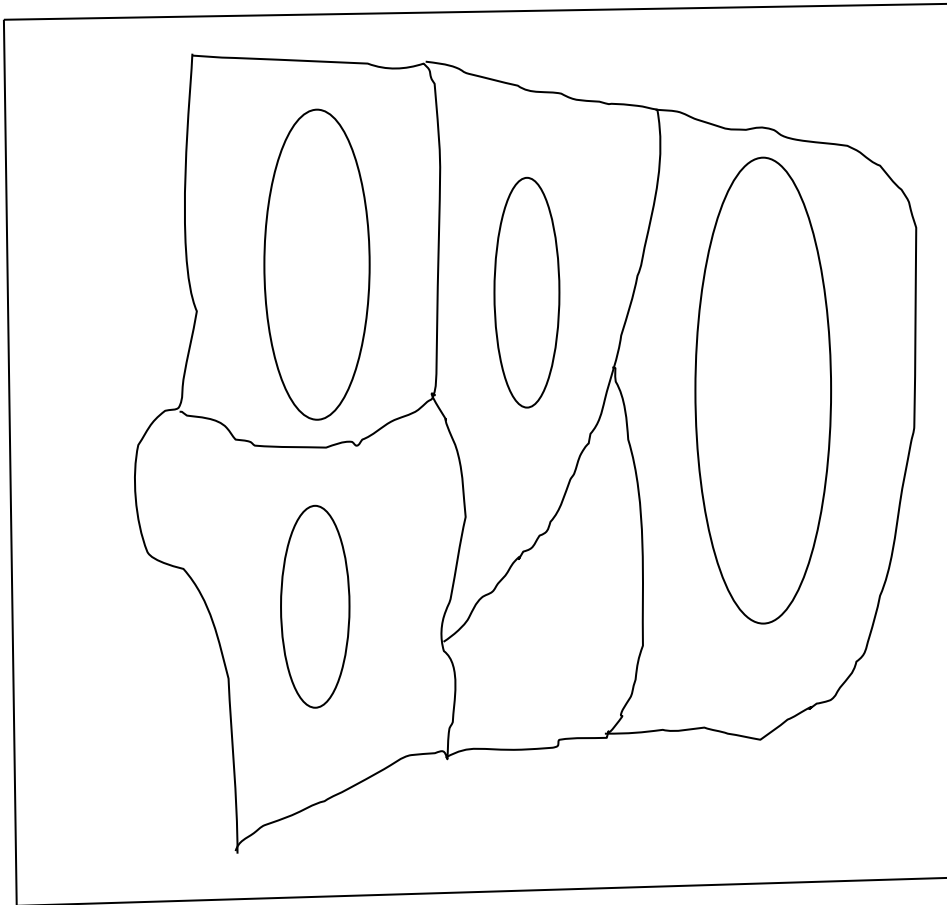
Advantages of proportional spheres

- They more visually impressive
- Good for comparison purposes
- useful when the range of statistics is so great that other methods are difficult
- can be drawn on maps for locational significance
- can be used in conjunction with other methods such as proportional circles to avoid over crowding

Disadvantage of proportional spheres

- they present difficulty in drawing (especially with smaller value spheres)
- involves tedious calculations when determining radius (by referring to cube root tables/ calculators)
- difficulty in assessing the relative volumes / values of different spheres
- a sphere cannot be sub-divided to show constituent parts unlike the pie charts / circles
- writing on a sphere presents much difficulty unlike other methods (like cubes)

Example:



Assignment

REPEATED SYMBOL MAP

Geographical/ statistical information can be represented on a map by the repetition of one symbol of uniform size or character, or by a variety of symbols. Location is expressed by placing the symbol in its 'correct' place on the map.

The repeated symbols can be non-quantitative or quantitative.

(a) Non-quantitative repeated symbol map

This **non-quantitative type** is basically pictorial (such as diagram a cow for ranching, picture of log for forestry /timber production) or descriptive (such as the initial or other letter R-rubber, M-for maize, X—copper, O—oil). It can also involve geometric shapes such as triangles, squares etc. It just recognizes presence or production of an item by placing a symbol in the respective boundary or position on the map. This implies that specific production data is considered.

Example 1 and example 2

(b) Quantitative repeated symbol map

The **quantitative type** is the most informative and it involves grouping symbols together and seeks to represent totals in a given production unit/ zone or area. It also employs pictures, letters and Geometric shapes to indicate the different categories or types.

Procedure

1. Determine a symbol value/ scale to represent quantitative symbols. The scale is very important since the symbols are representing the same value.
2. Remember that each value should be represented by at least one symbol. The symbols must also be organized in given order.
3. Determine the appropriate but simple symbols to represent the different items given.
4. We must use full symbols and use a small number of symbols on the map for easy interpretation (*by choosing a convenient scale*).

Note: Repeated symbols form one of the simplest methods of representing statistical information and common on map dealing with agricultural products, minerals, maps and guides produced for tourists etc

Advantages of repeated symbol maps

- shows the relative values by adjusting the size of the symbol
- used for comparison purposes
- gives a good visual impression
- easy to interpret
- does not involve a lot of calculations
- can be used to represent a wide range of items on the same map
- When the symbols are grouped together, their total number is proportional to the total quantity being represented. (*The total quantity is easily obtained by just counting the symbols when they are very few*).

Disadvantages of repeated symbol maps

- Difficult to represent wide range of values on such maps
- Drawing of the repeated symbols is often a tedious and difficult task.
- There is over simplification, since the symbol or group of symbols rarely coincides with the area of production.
- Pictorial representation / repeated symbols results into suppression of statistical accuracy.
- They cover a lot of space and congestion may occur where places are close together

Example 1 (sketch)

Example 2 (sketch)

DOT MAP (DISTRIBUTION MAP)

Dot maps are also widely used to portray geographical information distributed over a given area. Dot maps are somehow similar to the repeated symbol maps and in these maps dots are used to represent a certain quantity and these dots are supposed to be distributed within a given area.

Dot maps are a combination of two ideas i.e. the repeated symbol (dot) and the dispersion map (base map) on which the dots are placed.

Procedure:

1. One needs to have the statistics and an outline map (base map) showing the boundaries of divisions. The map is either provided or drawn first.
2. Choose the dot value considering the information given i.e. how much does each dot on your map represent?
3. When choosing the dot value consider the lowest and highest figures so as to arrive at the suitable value which does not give too many dots or again too few dots. Then state the dot value on your map such as one(1) dot represents 10,000 people
4. Choose the dot size. But this will always depend on the size of the base map and the number of dots to be placed.
5. Calculate the number of dots to be plotted onto the base map (show your working)
6. Place the dots on the map. But you should determine how exactly each dot will be distributed in a given area (dot density/ distribution). However it is advisable to use objective/ even distribution of dots over the statistical map i.e. the dots arranged in a given uniform order.
7. The dots as much as possible **must** be of the same size.
8. Avoid running short of dots before you cover that area you want to cover.
9. Do not shy away from putting dots near boundaries of the area on the maps.

Advantages of dot maps

1. Dot maps are very flexible i.e. easy to draw unlike other maps
2. Dot maps are used to portray geographical distribution of phenomena satisfactorily / successfully.
3. They can be used with other methods such as showing the relationship between relief and people
4. Many variables can be represented on the dot map using dots of different sizes.
5. They give the impression of accuracy i.e. just multiplying to get actual figures.
6. Give the impression of comparative densities
7. Several items can be represented using different dot colours

Disadvantages of dot maps

1. Difficult to find a suitable dot value to show both the big figures and small figures
2. Dots give a wrong impression that where a dot exists , a given number of items/ people (equivalent to the dot value) is found which is unrealistic
3. The dots spread over evenly over a given area does not reflect the true distribution (e.g. a dot may be put where there are no people or in a valley, water body)
4. It consumes a lot of time when dotting.
5. Difficult to maintain uniform dot size

Example 1 (sketch)

Example 2

Scale: 1 dot represents 1,000,000 people

Country	Population ÷ scale	Number of dots

SHADING MAP (CHOROPLETH MAP/ POPULATION DENSITY MAP)

The shading map uses a system of shading, the intensity of which varies according to the density of items per unit area such as per square km or per square mile within a selected boundaries i.e. an increase in density implies increased intensity of shading.

The term '*choros*' is a Greek word meaning area/ space while '*plethos*' means multitude/ number. Therefore these maps show the relationship between quantities and area. The shading maps are mostly used to show population density and hence the name population density maps. However they can also be used to show other items (such as crop production, animal population).

Note: A population density map must not be used to show absolute numerical figures such as population size but rather should show density values.

Procedure:

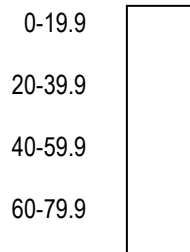
1. Obtain a base map of the region/ country showing the boundaries of the divisions. (*This can be already drawn or should be drawn first*).
2. Showing your working, calculate the density values per unit area by dividing the total number of items by the area of that division such as;

$$\text{Population density} = \frac{\text{Total population}}{\text{Total area}}$$

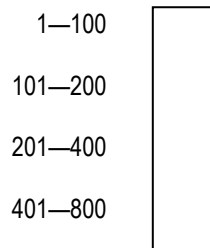
The answer must have units such as =122.4 people per km²

3. Choose a suitable scale to divide the range of values into a number of classes. Care must be taken such that no one shading dominates the final map and try to avoid empty classes on the map by having too many classes.
4. Shading should follow a progressive increase in density.
5. Several methods can be used to determine the range of classes/ groups such as:
 - (a) Linear progressive classification (arithmetic progression)
This is used when there is a small range between the highest and lowest density for example 1—10, 11—20, 21—30, 31—40 **OR** 0—49, 50—99, 100—149, 150—199.
 - (b) Geometric progression
The values are doubled for each successive class. This method is useful when dealing with a large range of values/ numbers (i.e. considers both very large and very small values). For example 1—50, 51—100, 101—200, 201—400 **OR** 1—80, 81—160, 161—320, 321+.
6. A scale composed of too few grades gives a wrong impression of comparative uniformity while too many grades may be confusing. Therefore it is advisable to use a maximum 4 to 5 classes/ grades.
7. Examples of shadings are given below:

Population density per km²



Population density per km²



8. Do not combine shading with symbols such as crosses, circles and the like.
9. Do not attempt to show variations in density merely by drawing lines different angles (*such as horizontal, vertical, diagonal*)
10. Use of the key can be made easier if the boxes are drawn individually.
11. The key should be complete i.e. all the grades of shading should be included on the key.

Advantages of choropleth /shading maps

1. They are relatively easy to construct (especially with a low range of values)
2. Gives a good visual impression
3. Easy to interpret (especially for population data)
4. Useful for comparison purposes
5. Shows quantitative analysis (relates data to area)
6. Some other information can be included on the map

Disadvantages of choropleth maps

1. Variations of density within each boundary are not shown, giving a wrong impression of uniform density.
2. Boundary lines between the density zones give a wrong impression of sudden change in density (assumes abrupt change in density which is unrealistic).
3. Difficult to get appropriate grades or classes especially if a large range of values are involved.
4. Consumes a lot of time when shading
5. Many grades/ classes make the map congested
6. Involves tedious calculations to obtain the density values
7. Does not reflect the true population figures, but just densities.

Example1 (sketch):

Example 2 (assignment)

Study the table below showing the population in the regions of southern Ghana

Country	Population ÷ Area	People per sq km

FLOW MAPS AND FLOW CHARTS

Flow maps portray linear movement i.e. normally used to represent information that stresses movement of goods (direction of trade), movement of people or traffic.

Examples include:

- Movement from area of production to market places
- Exports from one country to another
- Immigrations and emigrations of people to and from other places
- Traffic flow in specific areas and directions such as along railway lines, roads, water etc

There are two (2) types:

- (a) Those flow maps that only symbolize the direction of flow by means of a line or lines usually with an arrow head
- (b) Those that show varying amounts of flow by varying the design / width of the line. This type is more informative.

Note:

When drawing flow maps note that:

- The direction of the flow is indicated by an arrow at the end of the line
- The amount of flow is indicated by the width of the arrow
- The type of the flow is indicated by the shading or colouring used

Construction procedure:

1. Choose the scale to be used and to be able to choose an appropriate scale consider the lowest and highest quantities involved in addition to the complexity of the outline map (base map) available. (Work out the width of the lines showing your working).
2. Draw the flow arrow proportional to the quantity being represented and avoid drawing very thick or too thin lines.
3. The width of the line is the most important and therefore must be determined using a scale. It is advisable that the widest line is 1cm (or 1.5 cm depending on the data)
4. In case flow lines are required to be drawn on a base map, it is not necessary to follow all the corners and twisting as they are on the base map but a generalized impression (*this prevents colliding or over lapping of low lines*)
5. Lines may be drawn along the actual route or connecting the origin and destination using straight lines or curved lines. Arrows at the end of the arrow/ line used to show the direction of movement. The lines drawn should be parallel.
6. Shading of the flow diagrams creates a good visual impression. Different colours can be used to represent categories of commodities such as to distinguish imports and exports (or generally to supply further information).
7. In case of different colours, a key should accompany the flow arrows in order to emphasize easy interpretation.

8. The terminal or collecting point of several flow lines should be represented as a circle or square, such that total values of individual components moving towards or from the collecting centre are clearly shown.
9. Factual information may be written on the flow line or alongside it.

Advantages of flow maps

1. It is the best and only method of representing movement in common use
2. Relatively easy to interpret the direction of flow
3. Gives good visual impression
4. Good for comparison purposes
5. Clearly shows the variations in traffic or flow of an item
6. Does not involve complicated mathematical calculations
7. They can be superimposed on other maps and diagrams

Disadvantages of flow maps and flow charts

1. Consumes a lot of time in drawing
2. They lack immediate or exact interpretation especially for actual quantities
3. Drawing of parallel double track flow lines (even along curved sections) is difficult.
4. It may be confusing in case of many lines
5. The generalization of movement by flow lines is a bit unrealistic
6. Difficult to determine a convenient/ suitable/ appropriate scale

Examples of flow maps and flow charts

(Sketches)

Assignment 1:

WIND ROSE

As the name suggests, this method is used to show wind-related data i.e. the average frequency and direction of the wind at a given place. Like other methods, it can be given location significance by being drawn in its correct place on a map.

It is essentially a linear method, the direction and length of the line or column representing the direction and frequency of wind respectively. (*In case of a compound wind rose the width of the column may also be adjusted to indicate wind speed*).

Wind roses are categorized as:

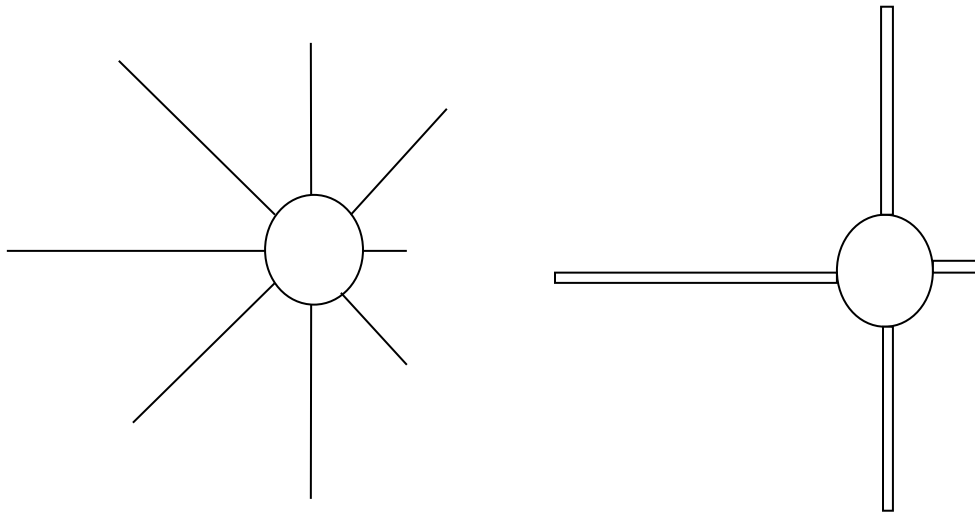
- (a) Simple wind rose
- (b) Compound wind rose

SIMPLE WIND ROSE

This method is for simple data most especially direction of wind and its frequency (in a month).

Construction procedure

1. Draw a circle of convenient size to be the centre of the wind rose
2. The number of days of calm (when there is no wind) are represented separately. They are usually indicated by a figure which is printed / written inside the circle.
Note: if percentage values are used in calculating the length of the columns or arms, then calms also should be represented by a percentage scale written inside the circle.
3. Eight (8) points of the compass are usually sufficient (although 16 points can be used if greater detail is required).
4. Determine a scale to enable you determine the length of the bars. Remember that the longer the bar the more frequent the wind is in that direction. (*such as 1cm represents 1 day*)
5. Draw bars of uniform width but different length i.e. the length of the bars drawn is proportional to the actual number of days.
6. Alternatively the frequency of the wind from each point of the compass may be calculated as a percentage of the whole and a percentage scale added.
Note: for a percentage scale, the total number of days in a month or year is considered as 100% including the days of calm.
7. Columns can be represented by straight lines of correct relative lengths, the number of days being represented by an equivalent number of small bars drawn at right angles to the line and equally spaced along it.



Example:

Advantages of simple wind rose

- Easy/ simple to construct
- Shows instantly and accurately the average direction and frequency of wind in a given period
- Gives good visual impression
- Used for comparison purposes
- Can be used alongside a map for locational purposes

Disadvantages

- *Difficult to obtain a convenient scale*
- *Represents only simple data*
- *They obscure seasonal patterns and movements of wind*

COMPOUND WIND ROSE

This method represents more complex data than the simple wind rose i.e. it does not only indicate wind direction and frequency but also the speed of wind.

Construction procedure

1. The basic method is identical to the simple wind rose , whether actual or percentage values are used
2. The speed of wind is indicated by varying the width of the column i.e. an increase in width signifies an increase in wind speed.
3. The divisions usually chosen are:

Less than 4 mph

4—12 mph

13—24 mph

More than 24 mph

Wind speed may also be recorded in knots or in metres per second: (1mph=0.8684 knots, 1 knot =1.152 mph, 1m/sec= 0.447 mph, 1mph=2.237 m/sec)

4. Winds with least velocity are represented nearest to the centre
5. Colouring or shading of the different sections of the column makes interpretation easier
6. A key must be included/ added

Advantages

1. It the most suitable method to show average direction and frequency of wind over a period of time
2. Gives good visual impression
3. Good for comparison purposes such as the variation in wind speeds
4. Shows a variety of items such wind direction, frequency and varying speed

Disadvantages

1. A bit complex to interpret /assess
2. Consumes a lot of time when drawing
3. Difficult to determine a convenient scale
4. It is not versatile / cannot be used for other items
5. Involves a lot of tedious calculations
6. They do not show seasonal patterns and movement of winds

Assignment 1:

ISOLINE MAP / ISOPLETHS MAPS

This is one of the most widely used methods of representing geographical information. Isolines are lines drawn connecting / joining places/ points of equal value (resulting into a pattern of lines showing the nature of distribution).

Note: other terms used for this method are isarithms and isometric lines. However the word isoline (*from the greek word 'isos' meaning equal*) is commonly used since it is the simplest and easiest to understand.

Examples of isopleths maps include:

- Contour maps (altitude/ height)—contour lines
- Atmospheric pressure—isobars
- Rainfall distribution —isohyets
- Temperature distribution—isotherms
- Sunshine amount—isohels
- Cloudiness—isonephs
- Ocean depth / depth of water—isobaths
- Salinity—isohalines

The main purpose of isopleths is to act as a visual guide to the interpretation of trends and tendencies which the plotted values indicate.

The isoline method like the shading method begins with a average density or a value similarly expressed for each unit (this value is regarded as typical rather than exactly confined to that area).

Each quantity is plotted on the map within its area as a spot-height' value and in between the 'spot heights' lines are drawn to show the trends of the figures. The method assumes that between any pair of spot heights there will be found only intermediate values and never anything larger or smaller than either of them. For example a contour line for 400m will be found between 300m and 500m. A line for 200m or 600m cannot be found between 300m and 500m.

Method of construction

1. Statistics/ data for as many stations/ points as possible are plotted on the base map in their correct places/ positions
2. Critical values are carefully chosen to emphasize significant features and also take into account the extent/ range of the statistics to be represented. Value intervals chosen can be based on a regular increase such as 50,60,70.... Or on a geometrical progression (often used for population maps) such as 40, 80, 160, 320.....
3. Draw isolines (in pencil) in accordance with the intervals chosen joining points of equal value.

Note:

- Lines showing altitudes and weather data usually have even values and intervals while lines showing population , crop production, land values etc may have geometric progression as determined by the cartographer/ student.
- If it is necessary to insert an isoline when statistics are not available on the map, interpolation is possible—where it is generally assumed that the increase or decrease between the two adjacent points is at a uniform rate.
- 4. Isolines cannot cross each other

5. To improve the visual appearance of the map, the zones between the successive isolines can be shaded and this also assists in interpretation of the map i.e. it serves to draw attention to the spaces or areas between the lines rather than the lines themselves.

Note: the shades becoming progressively heavier as the values increase

6. Isolines should be numbered if colouring is not employed. Values can be written either in a break in the isoline or on the line, but the figures should be as much as possible horizontal.
7. Isoline maps can also be used to represent averages, percentages or ratios. *(An average density figure which has been calculated for a particular area or region, may be regarded as applying to the centre of that area).*

Advantages of isoline maps

1. Clearly represents places or points of equal value especially in mapping climatic data
2. Isolines indicate small differences within a statistical unit, especially if careful choice of value intervals is made
3. The intervals between isoline maps suggest a gradual not abrupt change unlike shading maps
4. Isoline maps can be combined with other data such as population and crop distribution related to isohyets (isoline maps can be super imposed on other types of maps)
5. Gives a good visual impression
6. Shows quantitative analysis because it relates data to area

Disadvantages of isoline maps

1. Interpolation of value points is subjective, depending on the judgment of an individual.
2. Consumes a lot of time in construction
3. They occupy a lot of space
4. Difficult to choose a suitable / appropriate intervals between isolines
5. Isoline maps give a wrong impression that increase or decrease between one isoline and the next is at a uniform rate.

Example 1:

Using the base map of West Africa provided,

Example 2:

Using the outline map provided, draw an isoline map to show the pressure belts over North America during winter

Example 3:

Using the outline map of Uganda provided, produce an isopleth map showing the mean annual rainfall (in mm).

Example 4:

Use the outline map of Kenya showing the mean annual rainfall received and draw an isoline map.

GRADUATED RANGE OF SYMBOLS

It is also possible to use a range of symbols which do not depend on a close mathematical relationship to the quantities being represented. Such symbols may be in form of circles or squares, each symbol representing a definite range of values. By an increase in size or its appearance, it indicates increase in quantities.

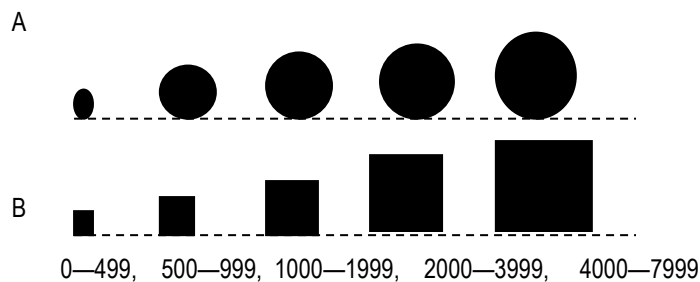
Note: This method is often used in connection with population maps depicting location and relative sizes of towns and cities.

Procedure:

1. Determine the number of symbols to be used and the range of values each symbol will represent and this is determined by the total range of the statistics given.
2. Note: all values from zero to the maximum should be included, and do not have gaps in the scale.
Much as it depends on the scale of the map, about 5 or 6 symbols will preferably be adequate.
3. Symbols can range from a small circle or dot to large circle or square. If it is necessary to increase the range of symbols, intermediate values can be represented by the addition of an outer circle or square to the previous symbol.

Note: The range of symbols should give the impression / appearance of increasing values.

Example:



4. If a graduated range of circles is used (where the number of symbols to be used is small), they should not be confused with proportional circles
5. Indicate both the key and the symbols clearly and accurately.

Note: As the case with the shading / choropleth maps, it is advisable to prepare the range of symbols which can be readily used when necessary.

Advantages

1. It avoids mathematical calculations such as square roots or cube roots
2. Useful where other methods (such as dots) may result in over crowding
3. The number of symbols used can be adjusted to cover a small or large range of values
4. This method can be used in conjunction with other methods (other statistical maps) to provide additional information on the same map.

Disadvantages

1. Requires constant reference to the key which is tedious
2. It has no direct relationship between the size or the character of the symbol used to represent a particular quantity and the quantity itself (in effect, it is a pictorial or descriptive method with no mathematical basis).

Assignment:

SAMPLE ANSWERS IN STATISTICS

Wind rose

1. Effects of wind on human activities

Positive

- Moist winds cause heavy rainfall which supports crop farming
- Moist winds cause high humidity which supports forestry and crop growing
- Winds promote wind energy which is used for domestic use
- Facilitate navigation since the sailors move according to the direction of wind at a given time
- Promote tourism due to wind formed features such as desert sand dunes.

Negative

- Dry winds lead to dry conditions which discourages crop growing
- Wind erosion leads to loss of productive soils, hence low crop yields
- Winds lead to dust that causes deadly diseases
- Dust storms due to winds discourage visibility causing accidents/ discouraging transport. Also strong winds discourage water transport by causing strong waves.
- Strong winds lead to the destruction of farmlands, property and life.

2. Examine the effect of wind systems on the climate of Africa

- North east trade winds
- South east trade winds
- Westerlies
- Dry Harmattan winds
- South west monsoon winds
- Etc (explain each)

3. Examine the role/ significance of the electricity production in the economy of any one country in the table (06mks)

- Generation of employment opportunities
- Promoted the development of urban centres/ urbanization
- Promotes the development of infrastructure
- Promotes the development of technology and research
- Has promoted the development of industries
- Generation of government revenue (04mks)

Negatives

- Accidents leading to loss of life / electric shocks

- Pollution of the environment such as thermal power
 - The growth of urban centres is associated with problems such as over crowding
 - Destruction of vegetation to get distribution poles
 - Strains the government budget
- (02mks)

4. Explain the role of power and energy in the development of industries in any one country

- Running machines in industries
- Mixing chemicals and substances/ boiling and heating.
- Lighting/ security in industries
- Promotes transport of raw materials, workers and finished goods (fuel and electricity)
- Promotes urbanization and hence providing market for industries

5. ***Examine the importance of import and export trade in the economy of Kenya (06mks)***

Positives include:

- Promotes competition leading to efficient production
- Generates government revenue through taxation
- Enables the country to acquire a variety of commodities
- Enables the country to overcome shortages, hence better standards of living
- Promotes international relationship with the trade partners (and regional cooperation)
- Generates employment opportunities hence standard of living
- Encourages capital inflow and this more investment
- Facilitates technological development

Negatives include:

- Results into dumping of commodities into the economy
- Leads to economic dependence on other countries
- Results into imported inflation
- Encourages importation of dangerous and harmful products
- Encourages brain drain
- Leads to under development of local industries
- Leads to cultural erosion due to foreign influence
- Encourages smuggling of goods into the country—loss of revenue
- etc

6. ***Explain the effects of export trade to the economy of Liberia***

(06mks)

Positives include:

- Promotes competition leading to quality production
- Generates government revenue through taxation of exports.
- Generates foreign exchange from the exports.
- Reduces wastage of surplus output by exporting it.
- Promotes international relationship with the trade partners (and regional cooperation)
- Generates employment opportunities hence standard of living

- Encourages investment to produce more for export.
- Promotes technological development (any 4mks)

Negatives include:

- Leads to economic dependence on other countries for market.
- Encourages brain drain
- Leads to cultural erosion due to foreign influence
- Encourages smuggling of goods out of the country—loss of revenue
- Results into domestic shortages as goods are taken to other countries.
- Results into over exploitation of local natural resources
- Increases social costs such pollution by industries producing for export
- Etc

7. Examine the impact of urbanization in the Netherlands (08mks)

Positive effects

- The increased population widens the market potential for goods and services
- The increased population increases the labour potential which promotes industrial production.
- Results into cultural integration and unity due to transmission/ diffusion of ideas/information
- Promotes acquiring of skills which can be used for rural transformation
- Creation of more employment opportunities in the urban areas
- Leads to technological development due to increased investment
- It increases government revenue through imposing taxes
- Results into development of social services such as education, health
- Promotes international relationship due to increased number of foreign investors
- Promotes tourism since urban activities are major attractions

Negative effects (Problems resulting from urbanization)

- Urbanization results into unemployment which in turn leads to high crime rate
- Strains the social economic infrastructure such as roads, medical facilities
- Leads to the growth of slums due to inadequate housing in the urban centres.
- Results into traffic congestion in the urban
- Pollution of the environment such as air pollution and water pollution
- Expansion of towns results in deforestation/ vegetation destruction
- There is increased swamp reclamation and hence high rate of flooding in some areas
- Expansion of urban activities leads to the displacement of people
- Over exploitation of natural resources in the surrounding areas
- Leads to break down of traditional/ social norms and values
- Threat of terrorism in the urban areas

8. (i) Explain the problems facing the livestock industry in either Netherlands or France (04mks)

- River flooding leading to the destruction of farm lands.
- Shortage of fresh water during drought periods.

- Salination of soils due to underground seepage of water from salty sea waters. This reduces the productivity of the land, and calls for continuous use of fertilizers and manures to enrich the soils for pasture growth. Too much use of fertilizers in turn pollutes the soils.
- Over production of animal products, leading to a fall in prices.
- High costs of production especially during winter, because the cattle are kept in-door throughout winter.
- High land rent on the polders which is costly to the farmers. This in turn promotes intensive dairying on the polders.
- The infertile sandy soils in a large area less fitting for farming practices such as pasture growth.
- Excessive water logging and high costs of pumping out of excess water from the polders.
- Inadequate labour supply which limits production.
- Sea incursions.

(ii) What measures have been taken to solve the problems in (d) (i) above? (03mks)

- Use of fertilizers and manures to improve soil fertility
- Building of dykes or concrete walls to control flooding
- Exportation of excess products to the other countries to reduce wastage.
- Emphasizing high quality production for high prices, hence offsetting high costs of production.
- Continuous pumping out of excess water from the polders.
- Mechanization to reduce the problem of limited labour
- Subsidizing the farmers to enable them compete favourably with other producing countries
- Carrying out intensive farming to offset the high land rent.
- Reclamation of more land from the sea and Rivers to increase agricultural land.
- Creation of fresh water lakes to supply water required for farming activities.
- Use of glass houses where humidity and temperature are artificially controlled.

9. Explain the factors influencing tea production in any one country in the table above

Choose one country

- Presence of heavy rainfall which is well distributed over the growing period.
- Presence of deep, acidic and well drained fertile soils for growing of tea.
- Presence of warm to hot temperatures for growing
- Availability of abundant cheap labour
- Availability of adequate capital
- Availability of ready market
- Availability of improved/ developed transport routes
- Supportive government policy such as encouraging investors.
- Etc

(any 6mks)

10. Examine the physical factors for the growth of the fishing industry in any one named country in the Atlantic fishing zone. (06mks)

- Presence of a broad and shallow continental shelf
- Presence of a highly indented coastline
- Presence of many offshore islands
- Presence of extensive/ large forests
- Presence of a variety of commercial fish species
- The mountainous and rugged nature of the mainland
- Presence of many streams and rivers
- The temperate climate experienced in the area

- Influence of the cold and warm ocean currents
- Presence of a smooth ocean floor

11. Account for the trend in copper production for the country identified in (c) above between 1980 and 1990
Zambia registered a decline in production due to:

- Exhaustion of some mines since mining has taken place for long
- Fluctuation of copper prices on the world market leading to uncertain incomes. (especially fall in prices)
- Many accidents occur during mineral exploitation leading to loss of life such as due to falling rocks, collapsing roofs.
- Decline in power supply for the mines
- Political instability especially in the neighbouring countries such as Zimbabwe, Angola
- Increasing costs of mining due to increasing depth of the copper bearing rocks (seams/layers).
- Stiff competition from other countries producing copper such as USA, USSR, DRC and South Africa
- Decline in labour supply to work in the mines
- Use of depreciated/ outdated machinery in some mines, which limits efficiency in mining sector.

(Any 4 mks)

12. Account for the increase in iron ore production in any one country in the table

Name country first

- Discovery of more deposits of iron ore/ increased mineral survey/ research/ exploration
- Expansion of the market for iron ore and its products
- Improvement in transport system such as railway
- Increase in capital investment
- Increase in the supply of skilled and unskilled labour
- Reduction of taxes by the government on mining
- Development of many iron ore processing industries/ factories

13. Assess the contribution of the copper mining industry to the development of any one country given in the table
Name country first

Positive contribution

- generation of foreign exchange through exports
- promotion of industrial development
- generation of employment opportunities
- promotion of urbanization
- facilitation of capital accumulation from sale of minerals
- generation of government revenue through taxation
- promotion of international relationship with the importing countries
- promotes diversification of the economy
- promotes technological development (4mks)

Negative contribution

- disfiguring of the landscape/ dereliction
- pollution of the environment
- mining accidents
- emergence of ghost towns after mineral exhaustion
- urban-related problems such as high crime rate

- discovery of minerals increased foreign influence
- regional imbalance in development in terms of infrastructure
- diversion of labour from other sectors of the economy/ neglect of agriculture (3mks)

14. Account for the variations in the population distribution in the region shown on the map

- Variations in climate
- Variations in soil fertility
- Variations in altitude
- Variations in relief
- Variations in vegetation cover
- Variations in biotic factor
- Variations in drainage and presence of water bodies
- Variations in economic activities such as industry, trade and commerce.
- Variations in Level of urbanization.
- Variations in Level of development of transport routes.
- Variations in government policy such as infrastructural development, discouraging settlement
- Variations in political climate/situation.

Note: however it recommended to be specific in answering

15. Explain the positive impacts of high population for South Africa

- Results into increase in market potential/demand for goods and services.
- Increases/ widens the labourforce of the country and this encourages investors.
- Increases pressure on government to undertake development programs.
- Promotes investment/setting up of more production units to cater for the requirements of the population.
- Promotes hard work, innovation and invention among the population.
- Encourages exploitation of idle resources such as minerals, water resources, in order to sustain the increasing population.
- Reduces the social overhead costs per person in the country or it becomes more economically cheaper to provide social services since they are utilized by many
- Increases the tax potential, thus increasing government revenue
- Encourages urbanization / development of towns as population increases.

16. Comment on the information as given in the table above and diagram drawn (4mks)

- New Mexico has the highest population in both 1990 and 2000
- Tokyo has the second highest population in 1990
- Bombay has the highest population in 1990
- Shanghai has the second highest population in 2000
- Tokyo has the lowest population in 2000
- Tokyo registered a fall in population between 1990 and 2000
- New Mexico registered a rise in population between 1990 and 2000
- Bombay registered a rise in population between 1990 and 2000 etc.

17. With reference to either Bombay or Shanghai, account for the population change observed (5mks)

Choose a case study

The increase in city population was due to:

- Availability of developed social services in urban areas such as health services, education services, and recreation services.

- Availability of developed commercial services such as banking, insurance, warehousing, and advertising.
- Increase in employment opportunities in the urban areas such as in industries and trade
- Availability of better security/ improved stability in the urban areas.
- Favorable/ positive government policies towards the development of the city such as access to finance, power supply, encouraging research.
- Presence of more efficient/ modern transport in the urban areas such as road, railway, air and water transport.
- Easy accessibility due to coastal location/ strategic position as a port with a rich hinterland
- Relatively flat landscape
- Industrial inertia in the urban areas/ increase in industrialization.
- Increased immigration of people into the city due to relaxed migration laws.
- Political stability of the region

NB: No case study, zero marks

18. Describe the population density pattern shown on the map above

- Nigeria has the highest population density
-
-
- Mauritania has the lowest/ least population density
- Generally the southern areas of west Africa have a high population density
- Generally the northern parts of west Africa have a low population density

19. Account for the population density pattern displayed on the map above

The high population density in countries like Nigeria, Ghana is due to:

- Heavy rainfall supporting crop growing
- Presence of deep and fertile soils favoring crop growing
- Nearness/ presence of water bodies supporting various human activities
- Accessibility to the coast/ developed transport network
- High level of industrialization offering jobs
- Long duration of settlement, with ancient kingdoms
- Growth of urban centres, attracting trade
- Political stability encouraging settlement and human activities

The low population density in areas like Mali, Senegal, and Niger is due to:

- Little and unreliable rainfall discouraging farming
- Presence of infertile soils (such as sandy) discouraging crop farming
- Absence of large water bodies in the interior, limiting activities
- Low level of industrialization, limiting jobs
- Presence of few urban centres, limiting trade
- Slave trade depopulated the area
- Nature of livelihood dominated by pastoralism
- Political insecurity discouraging settlement

20. Account for the trend in area under forest cover as shown in the table above

Developing countries had a decline due to:

- Rapid population increase –need for settlement and cultivation land
- Weak government regulations against forest encroachers
- Increased demand for timber and timber products
- Poor harvesting methods/ careless cutting of trees
- Limited alternative sources of energy
- Increased infrastructural and industrial development
- Forest/ wild fires especially in the dry season
- Poor farming methods such as bush burning

Developed countries had an increase due to;

- Expanded afforestation program
- Increased reafforestation program
- The need to control pollution due to rapid industrialization
- Forest protection against pests or fires using laws and sensitization/ technology
- Increased use of alternative sources of energy
- Government legislation against forest encroachment
- Low population growth rate due to population control measures
- Massive education about the value of the environment

21. Examine the causes of population migrations

The factors are categorized as push and pull factors:

a) Political factors

- Difference in political belief/ party.
- Political insecurity in some areas / war or civil strife which make people vacate the insecure area
- The attaining of independence in some countries, which caused many migrations
- Shift in ideology (capitalism versus socialism).
- The effect of slave trade.
- Government schemes lead to forced migration of people such as settlement schemes, gazettement of national parks and wildlife reserves to displace people.

b) Economic factors

- The search for employment opportunities.
- Shortage of land/ land conflicts.
- The declining productivity of land in some areas and prolonged drought
- Shortage of food/ famine
- Uneven distribution of economic opportunities between areas especially industrial concentration in the urban areas providing meaning that meaningful employment

c) Social factors

- Social pressures also force people to migrate such as evidenced by refugees (related to social oppression, political control, housing, health and education facilities)
- The presence of better social services in some areas like medical facilities, schools of better standards, recreation facilities, entertainment facilities.
- Cultural practices also force many people to run away from the rural areas such as rituals, compulsory circumcision by some societies, compulsory social obligations of marriage.
- Population pressure in some areas causes migrations to other areas which are less populated e.g. shortage of land and land fragmentation.
- Religious factors especially religious discrimination in particular areas.
- Racial discrimination is also common in particular areas, resulting into social conflicts and at times loss of life.

- Migration for leisure such as pilgrimages—journeys to certain places under religious devotion and many people do not come back. Even many tourists end up becoming migrants.
- Love for adventure and prestige
- d) Ecological factors/ environmental factors
 - Many people move because of environmental pressures such as drought, desertification, floods, landslides, volcanic eruptions, pests and diseases, earthquakes.
 - Landslides and earthquakes lead to great loss of life and property.
 - Many people move away from areas infested by pests and diseases such as tsetse flies, and epidemics outbreak.
 - Fertile soils induce people to migrate and settle in such areas especially near river valleys with alluvial soils yet the infertile soils in the semi-arid areas push people to migrate away.
- e) Behavioural factors
 - Minor issues like criminal tendencies—where criminals run away from their regions to go to other areas where their life may be a bit safe. Also misunderstandings such as between family members, law and order maintenance by authorities, AIDS scourge especially if patients are stigmatized.

22. Examine the impact of population migrations on the destination and sources areas

A. The impact of migration on the source areas

- The migrants remit money to their home country and this increases the national income
- Decline in labour supply because the able-bodied men move to the urban areas or other countries
- Accelerates poverty and insecurity especially in the countryside since the able bodied men are moving to urbanities.
- Results into social disintegration of cultural settings.
- Permanent migration reduces the total population and slows down the population growth rate in the source area.
- Reduces the problem of unemployment in the formerly over crowded areas.
- It also relieves pressure on land in the origin / source areas / reduces land conflicts
- Creates imbalance in the age-sex structure in the source area (because the migrants are usually young adults and mainly the male).
- It is a source of brain drain and repatriation of resources.
- Migrations also avail government with land for national parks, wildlife reserves, and other projects.
- Environmental protection as forests and bushes grow freely with less disturbance.
- Land consolidation is encouraged in the source areas which favours extensive farming.

B. Impact of migration on the receiving areas/ destinations

- Causes strain on the existing services and facilities in the receiving areas especially urban areas
- Leads to rapid urbanization with associated problems such as unemployment, prostitution, high crime rate, and political strife.
- External migration brings together people of different origins, races, language, and religion. Which integrates them into a new dynamic society. However it leads to plural societies associated with continuous underground conflicts which eventually may become violent.
- Migration leads to easy spread of diseases in the destination areas such as Ebola, SARS, Cholera, AIDS scourge, airborne diseases due to mixing of people from
- Population migration also changes the age-sex structure of the destination areas. (The number of young adults is raised and men may outnumber the women. This affects the birth rate and increases the incidence of prostitution and rape cases).
- Migrants often face prejudice and even violence in the destination area.
- Loss of social morals and cultural values due to mixing up of different groups of people.
- There is increased industrial growth due to the increase in the market size in the destination area and availability of land for expansion in the source area.
- Increase in labour supply and expansion of the tax base in the destination area.
- Improvement in infrastructure in the destination area.
- Shortage of land in the destination areas such as urban areas leading to conflicts and death.

- Increase in government expenditure in the urban areas
- Environmental degradation in the receiving areas

C. On the migrants themselves

- Restrains people from the vulnerable / risky areas such as war-torn areas, landslide areas, dry areas.
- Migrants acquire improved standards of living and chances of employment.
- Eradicates violence when the misunderstanding people separate to different areas/ locations.
- Difficult to get resettlement land/ Resettlement problems on part of government.
- Refugee problems--as misery on the refugees themselves increases
- Etc

23. (b) Describe the factors which have influenced rainfall distribution in China. (08mks)

- Latitudinal location (distance from the equator). China lies far north of the equator with most of the country being north of the tropic of cancer. This means that part of china lies within the tropics and most part lies in the temperate region. This makes the southern part to experience tropical climate and the northern part to experience sub-arctic climate.
- Relief. The north western region is dry because the surrounding highlands prevent rain from falling in this area. The little rain received in the region tends to fall mainly on the south eastern slopes of the uplands, leaving the north western region in a rain shadow.
- Distance from water bodies. Areas near water bodies are wetter than distant areas. The seas of eastern and south eastern china contribute moisture that brings wet conditions/ rainfall near the coast. The rainfall reduces as one moves away from the water bodies inland. This explains the lower rainfall in central china.
- Influence of air masses/ prevailing winds. The cold monsoon winds from central asia blowing towards the pacific ocean (especially in winter) spread dry conditions/ very little rainfall over most of western and northern china. The monsoon moist winds from the Pacific Ocean towards mainland (especially in summer) drop the moisture in form of rainfall in south east and eastern china.
- Influence of vegetation. Areas of the south east have tropical rain forests and eastern areas have temperate forests which lead to heavier rainfall due to the process of evapo-transpiration. However areas of western and North West china have scanty vegetation (cold desert and semi-desert areas),hence experience dry/ very dry conditions due to limited/ low levels of evapo-transpiration.
- Influence of human activities. Activities like animal rearing/ over grazing in western china have negatively affected the climate for example by reducing evapo-transpiration causing aridity/ dry conditions.

NB: *specific explanation is needed / how a given factor influences rainfall.*

(c) Explain the effects of climate on human activities in areas receiving mean annual rainfall of more than 1500mm. (06mks)

Positive effects on human activities

- Growing of crops/ arable farming due to heavy rainfall received such as corns, rice, tea, kaoliang, soya beans, sugar cane, and sugar beet.
- Livestock rearing such as piggery due to rainfall that supports the presence of animal feeds.
- Forestry and lumbering due to heavy rainfall favouring the growth of forests.
- Tourism due to forest vegetation and wild animals/ birds acting as tourist attractions supported by the heavy rainfall.
- Fishing due to the many water bodies facilitated by heavy rainfall received in these regions.
- The heavy rainfall also maintains the volume of water in rivers and lakes which promotes navigation/ water transport.
- The heavy rainfall facilitates the growth of pastures which promotes dairy farming and ranching.
- Growth of industries due to agricultural and forest raw materials which are supported by the heavy rainfall.
- Trade activities since heavy rainfall leads to dense settlement and many economic activities.

Negative effects on human activities

- Spread of Pests and diseases due to damp conditions which favour their breeding/ multiplication, hence destroying crops.
- The heavy rainfall in the south east discourages transport development. It is difficult to establish and maintain transport routes due to the heavy rainfall received.
- High rate of weed growth due to heavy rainfall which limits crop growing / increases the costs of farming.
- Presence of dangerous wild animals in the dense equatorial forests supported by hot temperatures and heavy rainfall, and these destroy crops.
- Loss of soil fertility due to leaching resulting from heavy rainfall, and hence poor crop performance.
- High rate of soil erosion where land has been cleared for farming due to heavy rainfall, and this leads low crop production.
- The heavy rainfall makes the forests dense and hence difficult to clear to carry out other activities such as farming.
- Severe floods especially in the low-lying areas/ river valleys (like yellow river, Yangtze and Xi Jiang river valleys), during heavy rainy seasons, hence destroying farmlands / settlements/ blocking roads.
- Very heavy rainfall leads to landslides in the hilly areas and this discourages settlement and crop farming.
- Heavy rainfall, Thunderstorms and hailstorms also discourage human activities such as destroying crops (like tea) and unroofing of houses.

(d)Outline the measures that should be taken to improve human activities in the areas mentioned in (c) above.
(03mks)

- Construction of various dams and canals to control the flow of rivers and hence minimize flooding.
- Develop various embankments/ dykes and barrages to control floods.
- Construction of modern roads and railways to connect the various areas of south east and eastern china to facilitate easy accessibility.
- Constant dredging of the rivers and canals to control flooding, and enable efficient navigation.
- Construction of numerous bridges and culverts for easy communication.
- Spray using chemicals to control pests and diseases in the surrounding areas, hence encouraging crop growing and settlement.
- Encourage soil management strategies like terracing, contour ploughing, use of ridges, use of cover crops
- Re-afforestation programmes in areas where forests have been depleted/exhausted to increase forest cover and control soil erosion.
- Gazetting areas as forest reserves to conserve forests/ vegetation and thus control environmental degradation/ promote tourism.
- Fore casting and pre-warning about extended rains and flooding to minimize the disastrous effects of floods and hail storms.