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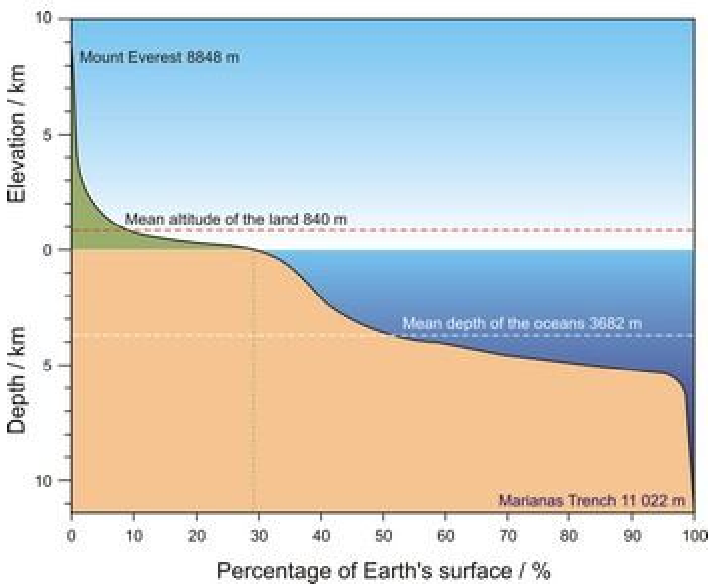
Cumulative Height Frequency Curve and its Uses

Subhash Yadav [1], Atul Garg[2]
[1]*Department of College Education, Jaipur, Rajasthan,*
[2]*Department of Mathematics, Government Bangur College, Didwana, Rajasthan*

Abstract: Cumulative height frequency curve for the Earth surface is known as hypsometric curve. Hypsometric curve is graphical representation used to show the share of the earth's land area that is at various heights above or below sea level. A curve is a continuous and smooth flowing line without any sharp turns. Mathematically it is a cumulative height frequency curve for the Earth surface or some part it. A hypsometric curve is a graph that shows the proportion of land area that exists at various elevations by bends and changes direction of the curve. In this we plot relative area against relative height.
Keywords: Cumulative frequency, Hypsometric curve, Geographical area, geosciences, bivariate graphs, x-y axis.

I. INTRODUCTION

Hypsometric curve shows the distribution of height of a given area (on land) and depth (at sea). The term originates from the Greek word hypos meaning height. The part of the curve that reflects the cross section of the ocean bottom is called the bathy graphic curve. A hypsometric curve is a cumulative distribution function of elevations in a geographical area of Earth. The curve shows the percentage of the Earth's surface above any elevation. In the Graph, x-axis shows 'Percentage of Earth's surface' while the y-axis denoted as 'elevation above or below sea level'. We can say that horizontal line (x-axis) indicate average height of the continents and average depth of the oceans below sea level. It is clear from graph that If all the land above sea level (green) was moved into the sea (blue), the oceans would still be 3 km deep.



In mathematics equation of the curve is defined as y = f(x). For a given value of one of these variables we can easily determine the value of the other. A curve on rectangular coordinates that shows the distribution of different elevations and depths at sea on the earth. This curve is obtained when the elevations (upward from the beginning of the coordinates)
and depths (downward from the beginning of the coordinates) are laid out along the y axis and the areas covered by the designated elevations and depths are laid out along the x-axis. The hypsometric curve shows that 80 percent of the earth's relief belongs to the ocean bottom, the low plains on land and on the continental shelf, and high level surfaces.

When data are given in percentage, we read it on the horizontal axis and go up until reach the curve. Draw a line across to the vertical axis, and read the answer, the elevation above which the given percent of the Earth's surface can be found. On the other hand, when given an elevation, draw a horizontal line to the curve, drop a line down to the bottom axis and read the percentage. This is easier to understand using an example. Horizontal dashed lines indicate average height of the continents at 840 meters above sea level, and average depth of the oceans at 3 682.2 meters below sea level.

Graphs are very useful tools in science. It helps in visualizing a set of data. With a graph, we can actually see what all the numbers in a data table mean. Since most of the data scientist collect is quantitative, data tables and charts are usually used to organize the information. Graphs are created from data tables. They allow the investigator to get a visual image of the observations, which simplifies interpretation and drawing conclusions. Geoscientists use graphs to illustrate all kinds of issues in the science. Data collection and graph making are very important in geosciences courses like rock compositions, topographic maps, streams and floods etc.

To determine percentage of Earth's surface above a given elevation we can figure out how much of the Earth's surface is above a certain elevation and determination of percentage of Earth's surface below a given elevation is slightly more complicated to determining the portion of the Earth's surface that is below a given elevation. We need only add one step to complete these types of problems. Just subtract the percentage above from 100% to get the percentage below. In other words, if a given percentage of the Earth's surface is above a given elevation, the rest of it must be below that elevation. Similarly determination of the amount of the Earth's surface that is between two elevations can solved by making determinations of two percentages and then subtracting them from one another.

There are many areas in geosciences in which the hypsometric graph is used. With the help of it, we understand everything easily or collection of data's is easy to understand in the graph. Hypsometric graph are mainly used in the following areas of geosciences-

1) *Isostasy:* buoyancy of the oceanic crust, elevation changes due to temperature changes in the crust.
2) *Continental and Oceanic Crust:* determining the elevation of oceanic and continental crust, differentiating between oceanic and continental crust.
3) *Planetary Geology:* the examination of other planets to look for different surfaces, the examination of planetary surfaces for evidence of plate tectonics.

In addition to these, cumulative percent graphs like the hypsometric curve are used in a wide variety of contexts both in the geosciences and in many other fields. Other geological contexts that use cumulative percent graphs are:

a) *Igneous Rocks :* Igneous rock identification
b) *Sedimentology:* Grain size distributions etc.

II. USES OF GRAPHS IN THE GEOSCIENCES

A. *Visualize Numerical Data*

Large volumes of numerical data is collected in different fields of geosciences like- geochemical analyses of rocks, measurements of angles, the composition of the atmosphere etc in short periods of time. With this large collection of data we do not understand how to see these data together. Geoscientist's process data and plot graph in a plane with coordinate axis x-y. When two known quantities or data are given then to understand the relationship between them, we plot the graph. So the graph of two variables x and y, which has two axis, plotted and this graph is mainly stated the relationship between them. Suppose we want to study relationship between distance and elevation or velocity and depth or any other similar relation, we plot their graph in x-y plane. After plotting the whole data on graph, we can easily understand the relation between them. Some other examples in geosciences include topographic profiles showing what the land surface looks like, velocity of earthquake waves in the earth, the likelihood that a river will flood, the rate of glacial retreat etc.

B. *Using X-Y Graphs*

Bivariate x-y graphs help us to visualize and categorize large volumes of data without having tired to understand boring data tables. Suppose we have to analyze two data tables having 200 data each. It is very difficult to understand the relationship between the two variables that are used in them, without plotting the graph. For example, the relationship between wind speed and precipitation decides rainfall. Faster winds are associated with substantially more precipitation and shows that the wind speed–precipitation correlation is important. The slope of the curve for this relationship varies geographically and rapidly increases as the atmosphere becomes moister. This relation provides a test of large-scale forecast models.

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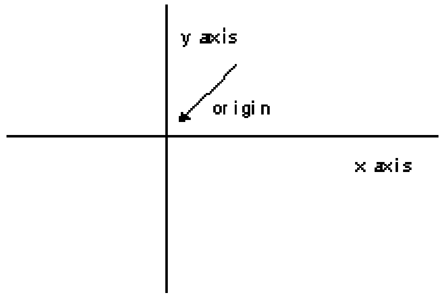
C. Plotting Points On A Graph

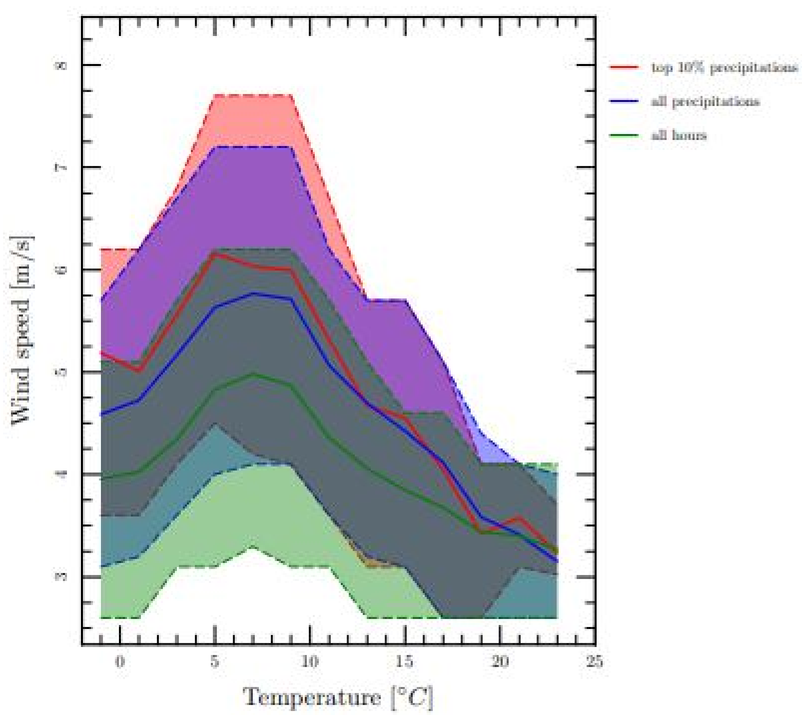
Geosciences deal with large volumes of data, both observational and measured. Data may be in the form of climate, rock chemistry, elevation measurements, wind velocity, pressure, seismic data, etc. Data are generally compile into tables and when we want to know the relationship between two variables, the best and easiest way to do that is to plot data on the graph.

Graph is a useful device to establish relationship between the two variables. It is readily observable once the data are plotted. To represent a function graphically we use two perpendicular lines called axes. Their point of intersection is called the origin. This method of representation is called the Cartesian coordinate system or plane. The numerical value of one variable is measured along the bottom or horizontal axis. The horizontal axis is called the x axis. The numerical value of the other variable is measured along the side or vertical axis. The vertical axis is called the y axis. The four sections into which the graph is divided are called quadrants. Units of length are indicated along the two axes.



Coordinates x and y shows the relationship between pairs of numbers and points in the plane. Coordinates give the location of any point P on the plane. Let (x, y) represent the point P whose coordinates are the numbers x and y. Here the x coordinate comes first. The two coordinates tell us how far we must go first along the x axis and then along the y axis until the point is reached.

Relationship between wind speed and temperature resulting precipitation-



Wind speed as function of temperature. The lines are averaged values of temperature bins of 2◦C with a band around it bounded by the 25 and 75 percentiles of the temperature bin. The results for the 10% most extreme precipitations (red), all precipitations (blue) and all hours (green) are shown.

III. CONCLUSION

The most significant fact emerging from hypsometric curve was the discovery that the earth's surface is divided into two statistically distinct “levels” or steps, one is about 100 meters above sea level known as continental platforms and second is about 4700 meters below sea level known as deep-sea floor.

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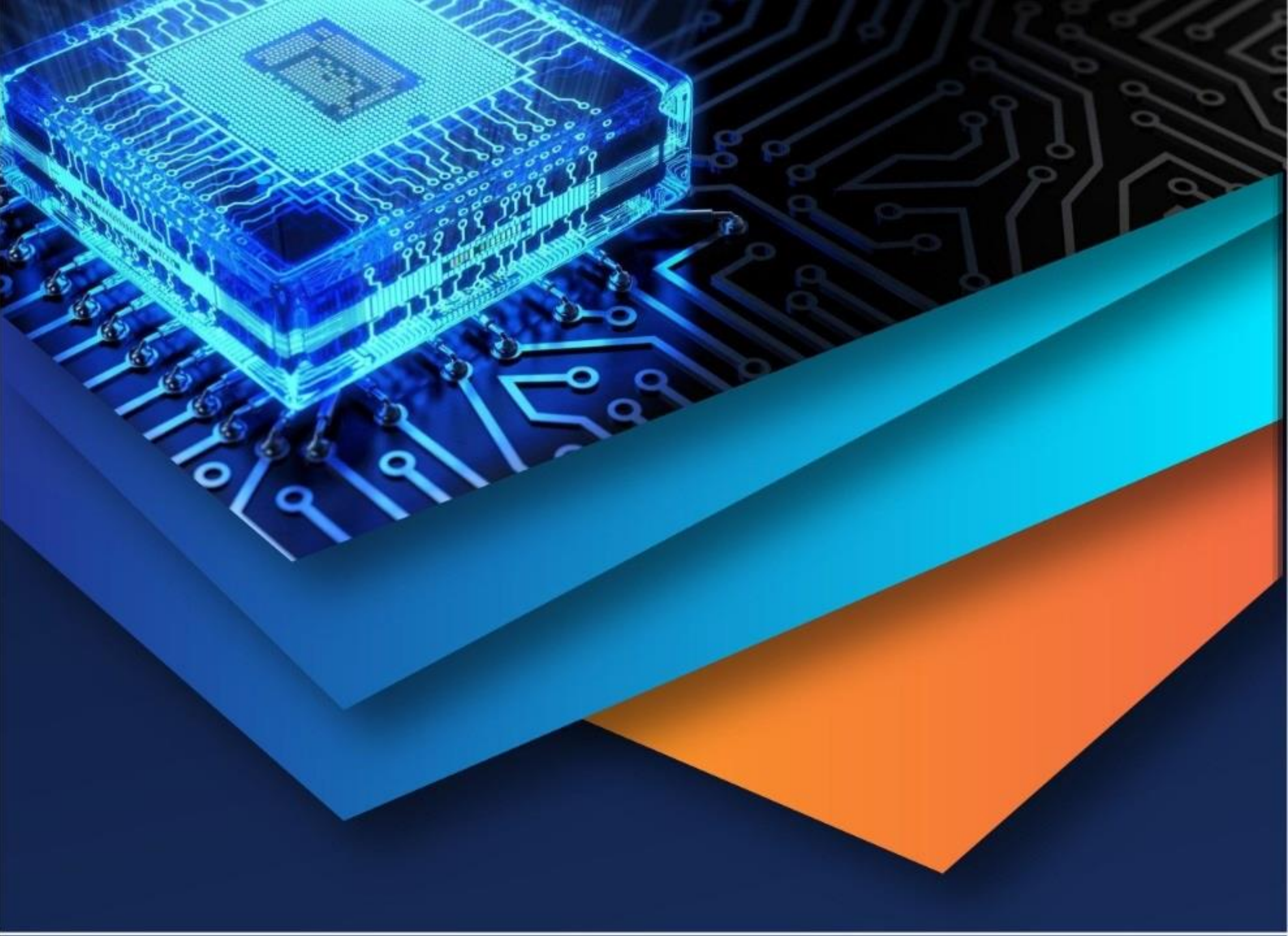

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