

Advances in Geographical and Environmental Sciences

Swapan Kumar Maity

Essential Graphical Techniques in Geography



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Advances in Geographical and Environmental Sciences

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Dedicated to my Parents

Preface

Geography is a scientific discipline that emphasizes how and why different geographic features vary from one place to another and how spatial patterns of these features change with time. Geographers always concentrate on the explanation of how physical and cultural features are distributed on the earth surface and what kinds of factors and processes are responsible for their spatial and temporal variations. Geographical data need appropriate, systematic and logical presentation for a better understanding of their cartographic characteristics. Suitable, accurate and lucid demonstration and visualization of geographical data become helpful for their correct analysis, explanation and realization. Therefore, various types of primary and secondary data are used voluminously to explain and analyze the spatial distributions and variations of different geographical events and phenomena.

Graphs, diagrams and maps are three unique and distinctive techniques of visualization of geographical data. In narrow sense, graphical representation means the depiction of data using various types of graphs but in a wider sense, all types of graphs, diagrams and mapping techniques are included in graphical methods of portraying the data. Graphical representation of various kinds of geographical data is very simple, attractive and easily understandable not only to the geographers or efficient academicians but also to the common literate people. It is the key for geographers and researchers to recognize the nature of data, the pattern of spatial and temporal variations and their relationships and the formulation of principles to accurately understand and analyze features on or near the earth's surface. These modes of representation also enable the development of spatial understanding and the capacity for technical and logical decision making.

In this book, attempts have been made to analyze and explain different kinds of graphs, diagrams and mapping techniques, which are extensively used for the visual representation of various types of geographical data. The book has broadly been divided into four main chapters. Chapter 1 emphasizes the discussion of the concept and types of geographical data, major differences between them, sources of each type of data, methods of their collection, classification and processing of the collected data with special emphasis on frequency distribution table, methods and appropriateness of representation of data and advantages and disadvantages of using these methods.

It includes the discussion of the concept of attribute and variable, types of variables and differences between them. It also explains different types of measurement scales used in geographical analysis.

Chapter 2 includes the detailed classification of all types of graphs and types of co-ordinate systems with illustrations as an essential basis of construction of graphs. Different types of Bi-axial (Arithmetic and Logarithmic graph, Climograph etc.), Tri-axial (Ternary graph), Multi-axial (Spider graph, Polar graph etc.) and special graphs (Water budget graph, Hydrograph, Rating curve, Lorenz curve, Rank-size graph, Hypsometric curve etc.) have been discussed with suitable examples in terms of their appropriate data structure, necessary numerical calculations, methods of construction, proper illustrations and advantages and disadvantages of their use. Concept of arithmetic and logarithmic graphs has been explained precisely with pertinent examples and illustrations. Different types of frequency distribution graphs have been explained with suitable data, necessary mathematical and statistical computations and proper illustrations.

Chapter 3 focuses on the detailed discussion of various types of diagrams classified on a different basis. All types of one-dimensional (Bar, Pyramid etc.), two-dimensional (Triangular, Square, Circular etc.), three-dimensional (Cube, Sphere etc.) and other diagrams (Pictograms and Kite diagram) have been discussed with suitable examples in terms of their appropriate data structure, necessary numerical (geometrical) calculations, methods of construction, appropriate illustrations and advantages and disadvantages of their use.

Chapter 4 explains the basic Cartographic terminologies like Geodesy, Geoid, Spheroid, Datum, Geographic co-ordinate system, Surveying and levelling, Traversing, Bearing, Magnetic declination and inclination etc in a lucid manner with suitable illustrations. It includes the detailed classification and discussion of all types of maps based on their scale and purposes (contents) of preparing the map with special emphasis on Indian Topographical Sheets. All pictorial and mathematical methods of representation of relief have been explained in detail with suitable examples and illustrations. Various types of distributional thematic maps have been analyzed with suitable examples emphasizing their suitable data structure, necessary numerical calculations, methods and principles of their construction, proper illustrations and advantages and disadvantages of their use. It also explains different techniques of measurement of direction, distance and area on maps.

The methods of construction of all types of graphs, diagrams and maps are explained step-by-step in a systematic way for easy and quick understanding of the readers. The book is unique of its kind as it reflects an accurate co-relation between the theoretical knowledge of various geographical events and phenomena and their realistic implications with suitable examples using proper graphical techniques. The book will be helpful for the students, researchers, cartographers and decision-makers in representing and analyzing various geographical data for a better, systematic and scientific understanding of the real world.

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Midnapore, West Bengal, India

Swapan Kumar Maity

About This Book

Representation of geographical data using graphs, diagrams and mapping techniques is a key for geographers and for researchers in other disciplines to explore the nature of data, the pattern of spatial and temporal variations and their relationships and formulation of principles to accurately understand and analyze features on or near the earth's surface. These modes of representation also enable the development of spatial understanding and the capacity for technical and logical decision-making. The book depicts all types of graphs, diagrams and maps, explained in detail with numerous examples. The emphasis is on their appropriate data structure, the relevance of selecting the correct technique, methods of their construction, advantages and disadvantages of their use and applications of these techniques in analyzing and realizing the spatial pattern of various geographical features and phenomena. This book is unique in that it reflects an accurate correlation between theoretical knowledge of geographical events and phenomena and their realistic implications, with relevant examples using appropriate graphical methods. The book serves as a valuable resource for students, researchers, cartographers and decision-makers to analyze and represent various geographical data for a better, systematic and scientific understanding of the real world.

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About the Author

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Abbreviations

ADCP	Acoustic Doppler Current Profiler
AE	Actual evapotranspiration
BB	Backward Bearing
CI	Cropping Intensity
DMS	Degrees, Minutes, and Seconds
DSMs	Defence Series Maps
DST	Department of Science and Technology
EGM 96	Earth Gravitational Model 1996
EI	Erosional integral
FAO	Food and Agricultural Organization
FB	Forward Bearing
GCA	Gross Cropped Area
GCS	Geographic Co-ordinate System
GPS	Global Positioning System
GRS-80	Geodetic Reference System 1980
GSI	Geological Survey of India
GTS	Great Trigonometrical Survey
HI	Hypsometric integral
IMF	International Monetary Fund
IQR	Inter-quartile Range
ISI	Indian Statistical Institute
MSL	Mean Sea Level
NATMO	National Atlas and Thematic Mapping Organization
NCA	Net Cropped Area
NMP	National Map Policy
NRSA	National Remote Sensing Agency
OSMs	Open Series Maps
PE	Potential evapotranspiration
PWD	Public Works Department
QB	Quadrantal Bearing
RB	Reduced Bearing

RL	Reduced Level
SLR	Satellite Laser Ranging
SOI	Survey of India
UNO	United Nations Organization
USDA	United States Department of Agriculture
UTM	Universal Transverse Mercator
VLBI	Very Long Baseline Interferometry
WCB	Whole Circle Bearing
WGS 84	World Geodetic System 1984

Symbols

f_i	Class frequency
x_i	Class mark
w_i	Class width
f_{di}	Frequency density
Rf_i	Relative frequency
N	Total frequency
F	Cumulative frequency
r	Radial distance
θ	Azimuthal angle
ϕ	Polar angle or zenithal angle
δ	Latitude
P	Precipitation
T	Temperature
R	Soil moisture recharge
U	Utilization of water
D	Deficiency of water
S	Surplus of water
Q	Water discharge
G	Gini co-efficient
Q_1	Lower quartile
Q_2	Middle quartile
Q_3	Upper quartile
P_r	Population of r ranking city
P_1	Population of 1st ranking city
h_i	Mid-value of the contour height
H	Maximum height of the basin
a_i	Area between successive contours
A	Total basin area
S_k	Skewness
β_1	Skewness co-efficient
μ_3	Third central moment

σ	Population standard deviation
μ_1	First moment
$f(x)$	Probability density function
μ	Population mean
β_2	Kurtosis co-efficient
l_i	Length of side of equilateral triangle or square or cube
r_i	Radius of the circle or sphere
f	Flattening
e	Eccentricity of the ellipse
H	Topographic height or Orthometric height
h	Spheroid or ellipsoid height
N	Geoid height
I	Magnetic inclination or magnetic dip
Z	Vertical component
D	Map distance
S	Map scale
T	Total number of full squares

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Chapter 1

Concept, Types, Collection, Classification and Representation of Geographical Data



Abstract Geography is a scientific discipline which emphasizes on the collection, processing, suitable representation and logical and scientific interpretation of various types of primary and secondary data for better understanding and explanation of the spatial distributions and variations of different geographical features and phenomena on or near the surface of the earth. This chapter focuses on the concept and types of data used in geographical analysis, sources of each type of data, methods of their collection as well as the advantages and disadvantages of their use. Major differences between various types of data are discussed clearly with suitable examples. It includes the detailed discussion of the concept of attribute and variable, types of variables and differences between them. Different types of measurement scales used in geographical analysis, their characteristics and application in geographical study have been explained with numerous examples. Techniques of classification, tabulation and processing of the collected data on different basis (i.e. based on location, time etc.) are discussed properly with special emphasis on the preparation of frequency distribution table and related terminologies. Methods of representation of all types of geographical data, their appropriateness and advantages and disadvantages have been explained with suitable examples.

Keywords Geographical data · Primary data · Secondary data · Data collection · Measurement scale · Data processing · Data representation

1.1 Introduction

Geography is a scientific discipline in which various types of *primary and secondary data* are used voluminously to explain and analyse different geographical events and phenomena. Collected data are organized, represented and interpreted logically and scientifically using various techniques for better understanding and explanation of the spatial distributions and variations of different geographical features on or near the surface of the earth. *Geographical data* needs appropriate, systematic and logical presentation for better understanding of their cartographic characteristics. Suitable, accurate and lucid demonstration and visualization of geographical data becomes helpful for their correct analysis, explanation and realization.