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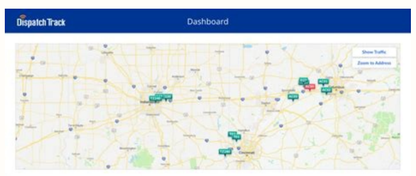
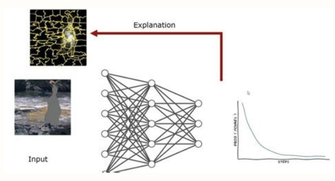


Leave the bedroom, and enter the kitchen. Walk forward, and take a left at the couch. Stop in front of the window.



Oce552 geographic information system.

VILLAGES 4. Watershed Applications • Estimate the magnitude of highflow events, the probability of lowflow events • Determine flood zones • Identify high-potential erosion areas • For example, BASINS, HEC-RAS, MIKE11 models integrated with GIS Fundamentals of GIS 38. Vector files are much smaller because a relatively small number of vectors can precisely describe large areas and a many attributes can be ascribed to these areas. DATA SOURCES • Existing data – digital – map and plan – paper files • low cost • acquisition – remote sensing – photogrammetry – field survey • high cost 68. In the purest sense Geographers have made use of such systems for many years, but these have been manually operated - card indexes with paper map overlays, atlases and similar systems. . CONCLUSIONS 1. Bd Basalt Dyke. Digital cartography The desire to use computers to replace manual cartographic processes, particularly for the more tedious tasks, was a focus in the 1970's. THANK YOU What is GIS? For example Each uniform area is surrounded by a set of straight line segments called vectors. This is a very simple definition of what GIS is, for older students you may want to use the next slide or both together. Parameter 5 PV1 10 Ruggedland (Volcanic uplands) 20 PV2 20 PV3 30 Wadi 50 Marab 70 Alluvium mudflat 5 Pleistocene sediments Geology (Lithology) Rating Mudflat Geomorphology Class 25 Basaltic dyke 40 Volcanic 40 Alluvium and Wadi sediments 70 Weight 0.1917 0.3487 98. GIS Process Capture Data Register Map Base Interpret Data Store Data in Computer Convert Data to Digital Format Process Data Display Results 12. 5. Modelling The groundwater potential index value: GPM= (Lw*Lr)+(Gw*Gr)+ (Sw*Sr)+(LDw*LDr)+ (Dw*Dr)+(Ew*Er)+(SLw*SLr)+(Rw*Rr) Where, L = Lithology , G=Geomorpholgy, S= Soil, LD=Lineament Density, D=Drainage Density, E= Elevation, SL=Slope, R= Annual Rainfall, W= parameter weight, r= rating. OBJECTIVES 1-To delineate the groundwater potential zones using relevant data (rainfall, topography, geology, soil, etc.) 2-To develop a GIS model that can identify groundwater potential zones based on the thematic maps 3-To validate the results of this study with data from the field 91. GIS: a formal definition The most commonly quoted definition in the UK comes from the Chorley Report "Handling Geographic Information" HMSO, 1987 which is described above. Safawi Group Rimah Group Asfar Group 110. Point Features o Spatially distributed entities, activities or events o Points have a single geographic coordinate such as: o Tree o Traffic accident o Lamp post 47. 83. • Data are stored in two files: – a file containing location information – a file containing information on the attributes • A third file contains information needed to link positional data with their attributes. Most of the very high potential areas represented stream channels and wadi sediments 118. This is normally considered to involve a spatially referenced computer database and appropriate applications software" 7 8. Geospatial analysis, using GIS, was developed for problems in the environmental and life sciences, in particular ecology and geology and It has extended to almost all industries including defence, intelligence, utilities, Natural Resources (i.e. Oil and Gas, Forestry etc.), social sciences, medicine and Public Safety (i.e. emergency management and criminology). Slope Stability Analysis • Derive physical characteristics – area, perimeter, flow path length, maximum width, average closing angle, watershed topology, soil data • Derive watershed characteristics – watershed boundaries, drainage network, slope & aspect maps Fundamentals of GIS 41. ERROR SOURCES (I) • data acquisition – device/instrument errors – data entry errors – image interpretation error • data conversion – instrument inaccuracies – device/instrument operator – manuscript used 80. Parameter Class 0-0.5 20 1.5-2 30 2-2.5 40 2.5-3 50 3-3.5 60 3.5-3.8 70 >10 10 5-10 Slope (degrees) 10 1-1.5 Drainage density (Km/Km) 5 0.5-1 2 Rating 25 2-5 30 0.5-2 35 0-0.5 40 Weight 0.1917 0.0905 99. AT Aritayan Volcaniclastic Formation. Comparison of Raster and Vector Formats Raster Vector • Raster formats are efficient when comparing information among arrays with the same cell size. QUERY ON DATABASE AND GRAPHICS DATABASE A B DATABASE TO QUERY GRAPHIC DATABASE DATABASE A B GRAPHICS TO GRAPHICS QUERY DATABASE DATABASE GRAPHICS TO THEME QUERY DATABASE A B 69. 101. Planning and Economic Development • • • • • • Land Use/Zoning Emergency Preparedness Population Forecast Market Analysis Property Tax Assessment Transportation 23. 55. Why is GIS unique? Comparison of Raster and Vector Formats Raster • Raster representations are relatively coarse and imprecise Vector • Vector representations of shapes can be very precise. Vector and Raster Representation of Area Map Features Map Feature GIS Vector Format GIS Raster Format 59. What distinguishes GIS from other information systems? Study Area: Tulul al Ashaqif highlands a NW-SE ridge, part of the Badia region, NE Jordan 660 m -1050 m asl arid, and erratic rainfall spatially and Temporally with annual average 60-100 mm/yr 92. SYSTEM implies that a GIS is made up from several inter-related and linked components with different functions. 5. A system is a group of connected entities and activities which interact for a common purpose. LocationAllocation • Finding a subset of locations from a set of potential or candidate locations that best serve some existing demand so as minimize some cost • Locate sites to best serve allocated demand • Application areas are warehouse location, fast food locations, fire stations, schools Fundamentals of GIS 30. NATURE OF SPATIAL DATA (GEOGRAPHIC OBJECTS) • spatial component – relative position between objects – coordinate system • attribute component – explains spatial objects characteristics • spatial relationship – relationship between objects • time component – temporal element 63. Asfar Group/Rimah Group UM/AT Ufayhim Xenolithic Basalt Formation/Aritayan Volcaniclastic Formation. • A technology – hardware & software tools • An information handling strategy • The objective: to improve overall decision making 6 7. The following is one example: In the London Cholera epidemic of 1854 Dr. John Snow was able to locate the source of the the outbreak by plotting the locations of fatal cases. Straight line segments called vectors are displayed to indicate line based data (roads rivers wells) The x-y coordinates at the end of each vector can be digitized and stored. SPATIAL DATA CRITERIA: • X-Y Coordinate System • Shape • Area/Size • Perimeter • Distance • Neighborhood 65. ROADS 5. The development of relational DBMS was particularly significant with examples such as Oracle being widely used today. Only a limited number of programs can analyze both types of data or make raster type analyses in vector formats. • Perhaps the most common example of raster data is a digital image. MEFGI, Rajkot 2. Social Factors Biodiversity Engineering Land Use Environmental Considerations …Means Seeing the 85. SOILS 87. These developments are closely related to the enormous growth in power, and the corresponding reduction in the cost of computer technology, since the late 1960's. Alm Alluvium Mudflat. Al Alluvium. Firstly and most importantly a GIS is an information system. GIS as infrastructure • Data is greatest expense – Previously: Data scattered in multiple departments, not coordinated – Future: Data accessible anywhere, GIS portal and Web services facilitate sharing • Libraries / Data Centers key – GIS data has unique characteristics 27. Developments in digital cartography often resulted from developments in the larger Computer Aided Design (CAD) field. Geomorphology 108. What is GIS? the ridge defines the boundary between the Azraq and the Hamad hydrographic basins the ridge is of volcanic origin and Neogene in age 93. Pl Pleistocene Sediments. Location-Allocation Inputs • Customer or demand locations • Potential site locations and/or existing facilities • Street network or Euclidean distance • The problem to solve Fundamentals of GIS 31. AI The Ali Doleritic Trachytic Basalt. Vector and Raster Representation of Line Map Features Map Feature GIS Vector Format GIS Raster Format 58. 6. • Areas or polygons are described by a series of vectors enclosing the area. • GIS handles SPATIAL information – Information referenced by its location in space • GIS makes connections between activities based on spatial proximity 8 9. Vector Format • Any number of factors or attributes can be associated with a point line or polygon. SPATIAL DATA SPATIAL NON-SPATIAL ADDRESS 9, JALAN JAYA JALAN JAYA 9 10 MAP 10, JALAN JAYA NAME HAMID LUKE DATABASE 64. 700 measured calculated 600 Flow (m3/sec) 500 400 300 200 100 0 11/1/1998 2/9/1999 5/20/1999 8/28/1999 Time (date) 03231500 12/6/1999 3/15/2000 40. Field data were valuable in validating the GPM output. The basic data unit is a cell or Pixel Each cell/Pixel is assigned only one value An array of Pixels form the entity-Point, Line, Area and surface The shape and size of the array determines the basic Resolution Polygons can be formed indicating areas of homogeneous characteristics 53. In GIS the common purpose is decision making for managing any spatially distributed activity. •largely covered by pavement overlying an eolian sedimentary mantl(94. Business Computer Science Environmental Science Engineering Journalism Military Science Natural Resource Management Geography Geology Meteorology Oceanography Law Enforcement Public Health History Sociology Urban/Regional Planning 20. Synergy between spatial data and analysis • Imagine you are a national retailer • You need warehouses to supply your outlets • You do not wish the warehouses to be more than 1000 km from any outlet (Example from, ESRI) Fundamentals of GIS 34. o Maps provide two types of information o Locational information o Spatial Relationships 45. GIS: historical background This technology has developed from: – Digital cartography and CAD – Data Base Management Systems ID X,Y 1 1 ID 1 2 2 3 CAD System 2 3 ATTRIB 3 Data Base Management System 10 11. 8. Geographical Information System o • • • • • A set of tools for Collecting Storing Manipulating Retrieving Transforming and Display of Spatial Data from the Real World 4. Most GIS software can display both raster and vector data. Attribute #n Attribute Component 75. Most spatial features can be displayed as: -PointsLine- Polygons 56. 60. Natural Resource Management • • • • • Forestry Ecology Mining Petroleum Water Resources 22. Homes School Districts Streets Zip Codes Cities Counties 86. Thematic Overlay 1. 7. Agriculture – – – – – Farm management Pest/Disease tracking Crop monitoring Yield prediction Soil analysis 21. GIS as Infrastructure • Because GIS is used in many departments, coordination is needed – Software licensing – Instruction – Data 26. Cost Quality Data Quality 78. GEOGRAPHIC implies that locations of the data items are known, or can be calculated, in terms of Geographic coordinates (Latitude, Longitude) INFORMATION implies that the data in a GIS are organized to yield useful knowledge, often as colored maps and images, but also as statistical graphics, tables, and various on-screen responses to interactive queries. GIS as infrastructure Mobile GIS PC, PDA Phone Desktop GIS ArcInfo ArcEditor Network ArcView Virtual Globes ArcGIS Explorer ArcReader Server GIS ArcGIS Server Google Earth Virtual Earth Portal Toolkit Geodatabases Files DBMS XML 28. Where can I find things with characteristic 'Y'? 8 thematic layers are selected: geomorphology, soil texture, lithology, elevation, slope, annual rainfall, drainage density, and lineament density thematic layers were combined using weight index overlay method weights assigned to the data layers to reflect their relative importance determined using analytical hierarchy principle (AHP) classes in each theme arranged in decreasing order of rating (0-100) based on previous work and experts 96. DATA QUALITY (I) • misconception that data from GIS is of higher quality – GIS uses the latest technology • quality of GIS information depends on quality of data – 'garbage in garbage out' (GIGO) • conventional method, users decide for their own – GIS? Maps And Map Elements o Maps are graphic representation of our perception of the world around us. In a vector based system every point is recorded by a pair of x and Y coordinates. 54. 3. Civil Engineering Applications • Transportation • Watershed analysis • Remote sensing Fundamentals of GIS 29. 77. GPM classes Theoretical weights vs Effective weights 90 76.35 80 70.93 70 60 50 40 30 18.56 12.75 20 10 1.85 0.32 6.85 5.66 2.2 4.53 0 Very Low Low Moderate High Very High 117. Attribute Attributes can be numeric or alfa-numeric Data a point, line or area data that is assigned to spatial features Example Attributes… Stand ID, Compartment No., Vegetation type, Name of the Forest Block, Types of Road, VSS code etc., 62. GIS Data Formats • There are two formats used by GIS systems to store and retrieve geographical data: – Raster – Vector 50. ATTRIBUTES: • Explains about spatial data • Relevant non-spatial data • Words or Numbers • Qualitative methods • Quantitative methods 66. Sensitivity Analysis of GPM 1. Line Features o Spatially distributed entities, activities or events o Lines (Arcs) are a series of geographic coordinates joined to form a line such as: o Road o Stream o Railway 48. Rainfall 111. Internal users input Internal data base External management External user External data base Internal management analysis Data management GIS data base output 18. Spatial statistics typically result primarily from observation rather than experimentation. GPM-effective weights GPMtheoretical weights 116. Data Structure GIS GRAPHIC ALPHA NUMERIC NON-SPATIAL/ SPATIAL ATTRIBUTE VECTOR RASTER CO-ORDINATE NON-SPATIAL/ ATTRIBUTE IMAGE SYSTEM AREAL REMOTE SENSED PHOTOGRAPH SCANNED IMMAGES 44. GIS integrates spatial* and other kinds of information within one system: it offers a consistent framework for analysing space GIS makes connections between activities based on spatial proximity GIS provides the mechanisms for undertaking the manipulation and display of geographic knowledge *Spatial data will be described in much greater detail in the next lecture. 6. Topography 105. They represent cartographic interpretation and simplification of reality. Where is the highest concentration of 'X'? Watershed Characterization • Relate physical characteristics to water quality & quantity • Data – land use & land cover, geology, soils, hydrography & topography – related to hydrological properties Fundamentals of GIS 37. • GIS = Geographic Information System – Links databases and maps – Manages information about places – Helps answer questions such as: • • • • • Where is it? Rimah Group/ Asfar Group HN/HA B Hassan Scoriaceous Formation/Hashimyya Aphanitic Basalt. Geography matters Today's challenges require geographic approach • Climate Change • Urban Growth • Sustainable Agriculture • Water Quality and Availability • International and National Security • Energy • Epidemiology/Disease Tracking • Natural Hazards: Seismicity, Weather Events 25. Remember that: An information system is a set of processes, executed on raw data to produce information which will be useful in decision making A chain of steps leads from observation and collection of data through to analysis An information system must have a full range of tools to handle observation, measurement, description, explanation, forecasting and decision making Finally it is important to remember that GIS can also help to achieve the overall objective of improving the decision making process, whether in an organisation, or within a project. SPATIAL COMPONENT FROM MAPS AND PLANS • need to be changed into digital format – scanning – digitizing – keyboard entry • coordinates • field survey data • the quality of data is known and controlled 71. GIS: A Framework for Understanding and Managing Our Earth Geographic Knowledge Creating Measuring Organizing Analyzing Modeling Applying Planning Managing Acting Holistic Comprehensive Systematic Analytic Visual 24. • Vector formats are efficient when comparing information whose geographical shapes and sizes are different. Maps and Plans Digital data Paper files Data GIS Data Data Photogrammetry Interviews Data Field survey Remote Sensing GIS Data Sources 67. Soil Unit Name Symbol Area (Km2) Texture NUJ/17 7.8 Silty clay loam to clay Ruweished RUW/17 10.41 Silty clay loam to clay and sandy clay Nubi 139.62 Stony and very stony silty clay loam to silty clay Nujayil UBI/16 Shurafa SHA/16 246.89 Often very gravelly, structured silty clay loam Humaylan LAN/16 249.25 Very stony silty clay loam Safawi AWI/16 276.39 Silty clay loam Dhunat NAT/16 279.1 Silty clay loam Jawa JAW/16 631.19 Silty clay loam 107. GIS concepts are not new! The concepts used in GIS are not new to Geographers. 6. HN Hassan Scoriaceous Formation. (See example in hand-outs.) • data maybe built for different purposes – quality of data not known 70. Network analysis — examining the properties of natural and man-made networks in order to understand the behaviour of flows within and around such networks; and locational analysis. of Civil Engg. Slope 106. Area Features o Spatially distributed entities, activities or o events o Areas (Polygons) are a series of geographic coordinates joined together to form a boundary such as: o Lake o Soil types 49. 84. Raster Format • Data are divided into cell, pixels, or elements • Cells are organized in arrays • Each cell has a single value • Row and Column Numbers are used to identify the location of the cell within the array. Groundwater Potential Model (GPM) GPM Potential Very Low Class Area % 1.85 Low Moderate High Very High 6.85 76.35 12.75 2.2 112. Portage River Basin, Ohio DEM with drainage network Watersheds Land use Hydrologic models USGS empirical method TR55 Area- Discharge method ADAPT model ADAPT's Hydrological Output for Needles Creek at County Line Rd for 2001 ADAPT Pressure Transducer Total daily runoff (in) 0.70 types Soils 0.60 0.50 0.40 0.30 0.20 0.10 0.00 120 140 160 180 200 Days 220 240 260 42. 82. Cross sections Boundary conditions • cross sections • gaging station • assumed cross sections • water treatment plant • boundary conditions • wastewater treatment plant 39. Thematic Overlay VILLAGES STREETS LAKES LAND USE SOILS ELEVATION 88. RH Rimah Group. SPATIAL DATA Raster Vector Data Model And Structure RASTER MODEL VECTOR MODEL 51. DATA ENTRY • involves 75% of total implementation cost • majority of data entry methods require a lot of time • data sharing enables lower data costs i.e. existing data 76. Not everyone agrees with this definition. Attribute #1 Attribute #2 Attribute #3 . Lithology Group Symbol Formation Name AOB Abed Olivine Phyric Basalt Formation. 89. Scanning Keyboard entry Producing Digital Data Digitizing 72. GIS ARC INFO ArcGIS MapInfo GRASS Geomedia Geoconcept WIN GIS Microstation AutoCAD Softwar es Digital Image Processing ERDAS Imagine ER Mapper ILWIS ENVI PCI Geomatica ArcView image analysis TNTMIPS Ecognition 16. GIS concepts • London cholera epidemic 1854 Soho +Cholera death Water pump 9 10. ERROR SOURCES (II) • data storage – digital representation limits – disk storage limits • used by huge raster formats • data processing – rounding off error • digital representation – error propagation law • information derived by mathematical operations no more accurate than original information 81. Vector Format • Data are associated with points, lines, or boundaries enclosing areas • Points are located by coordinates • Lines are described by a series of connecting vectors (line segments described by the coordinates of the start of the vector, its direction, and magnitude or length). 2- Drainage 104. • • Raster files are generally very large because each cell occupies a separate line of data, only one attribute can be assigned to each cell, and cell sizes are relatively small. BOUNDARIES 3. At the same time the 1960's quantitative revolution in Geography encouraged the development of computer programs that could undertake map analysis operations that would be difficult or too time-consuming to undertake by hand. SPATIAL ACCURACY • Precision - indicates how closely several positions fall in relation to each other • Accuracy - is a measure of the closeness of one or more positions to a position that is known and defined in terms of an absolute reference system. DRAINAGE 6. Geovisualization — the creation and manipulation of images, maps, diagrams, charts, 3D views and their associated tabular datasets. Transportation – Emergency Operations • Transportation maps are critical • Disaster response plans can be developed • Outside computer models used for advance warnings • Land use maps enhance emergency operations Fundamentals of GIS 36. GIS: a formal definition "A system for capturing, storing, checking, integrating, manipulating, analysing and displaying data which are spatially referenced to the Earth. GIS Areas Geo Sciences Civil Engineering Transportation Natural resources Geology & Geophysics Environment Planning Administration Management Business Remote Sensing Image processing Urban & Rural Development Floods , Disasters Oil exploration Mines Surveys Watershed management Tourism Communications 15. Parameter 70 81 60 75 50 1000 but 1 7 3 villages of numbers no school 8,5and 3 are having population more than 1000 3 2 5 7 Report and with out a school. 4. Remote sensing images were very important input to groundwater exploration -the aridity and sparseness of vegetation in the study area -mapping of drainage from satellite imagery is more effective than the automated derivation by the GIS software 2. Most of the promising areas are found below 800 m in elevation 4. Model Validation Well No. No.1 No.2 No.3 No.4 No.5 Index Value 52.05 44.84 30.12 37.2 33.73 113. METHODOLOGY 95. ATTRIBUTE COMPONENT • retype from maps, plans or hardcopy files • copied from existing digital data 74. Vector and Raster Representation of Point Map Features Map Feature GIS Vector Format (X,Y) Coordinate in space GIS Raster Format Cell Located in an Array 57. GIS DATA AND SOURCES 43. Muflats are finegrained playa deposits that are almost totally devoid of vegetative cover Marabs are broad reaches filled with coarse sand and gravel typically have a relatively rich vegetative cover 109. Maps contains features such as…….. Point, Line, Area and Surface o Maps contain POINT features, LINE features and AREA features o Point Features :- wells, control points, sample sites, fire stations o Line Features :- roads, hydro lines, rivers, contour lines, o Area Features:-urban areas, water bodies, soil/rock units, forest areas 46. Geospatial analysis is an approach to applying statistical methods and other informational techniques to data which has a geographical or geospatial aspect. Results and Discussion 102. HAB Hashimyya Aphanitic Basalt. Application of Geospatial analysis Case study Integrated GIS and Remote Sensing for Mapping Groundwater Potential Zones in NE Jordan 90. An Introduction to Geographic Information System Prof. Wisad Group WD Wisad Group. 52. Where is the closest 'Z' to my location? Lineaments Density 103. GIS: historical background GIS has developed from two independent areas: digital cartography and databases. AVAILABLE DIGITAL DATA • original format sometimes need to be changed into targeted format. 61. 1. Such analysis would typically employ software capable of geospatial representation and processing, and apply analytical methods to terrestrial or geographic datasets, including the use of GIS. There are those who believe GIS forms part of more established disciplines but these definitions tend to ignore the cross disciplinary nature of spatial data. FUNCTIONS OF GIS 19. Surface analysis —in particular analysing the properties of physical surfaces, such as gradient, aspect and visibility, and analysing surface-like data "fields". 3. Vector Data A vector system usually stores data as coordinates. Images Image Processing System Statistical Reports Maps Map Digitizing System Statistical Analysis System Spatial Attribute Data Data Base Base Database Management System Geographic Analysis System GIS System Cartographic Display System Maps Statistics Tabular Data 13. Sumanta Das Dept. Bishrihha Group BY Bishrihha Group. 1. TOPOGRAPHY 2. Major Services in GIS o GIS Application Software development o o o o o o o Remote Sensing Application Projects Thematic Mapping Digital Image Processing Services Engineering Application Software solutions Data Conversions Complete GIS Implementation Consultation 17. Weights and ratings Parameter Class Rating 660-750 40 850-950 20 950-1050 Elevation (m) 50 750-850 10 silty clay loam to clay 20 very stony silty clay loam 30 often very gravelly, structured silty clay loam 30 stony and very stony silty clay loam to silty clay 30 silty clay loam and sandy clay 35 0.0156 15 silty clay loam Soil Weight 0.0455 97. What is a GIS? Application of GIS • GIS used in multiple disciplines: Agriculture Archaeology Architecture/Landscape Arch. DATA ACQUISITION • spatial component can be obtained by – remote sensing – photogrammetry – survey • attribute component can be obtained by – remote sensing/photogrametry – interviews – field visit 73. Vehicle Routing (From , ESRI) Fundamentals of GIS 33. The model identified several locations suitable for further field geophysical investigation 119. single parameter sensitivity analysis. Database links The use of Data Base Management Systems (DBMS) is very important to the current concept of GIS which involves the integrating of spatial and non-spatial data. Sensitivity analysis indicates that all parameters are significant but the most effective parameters : lineaments density, geomorphology, drainage density and annual rainfall 5. What else is nearby? 79. Raster Data A grid (or raster) system stores data as a string of characters in which each character represents a location. Other Transportation Applications • Planning & locating new roadway corridors (from NCRST-E) Fundamentals of GIS 35. 2. map removal sensitivity analysis. GIS – Data Layers Stacking NDVI From Aerial Image Nitrogen Availability Estimate from Aerial Photo pH Layer Geographic Information System Courtesy of PPI 14. Location-Allocation Outputs • The best sites • The optimal allocation of demand locations to those sites • Lots of statistical and summary information about that particular allocation Fundamentals of GIS 32. P − P' V = ×100 P Variation index of the excluded parameter Variation index parameter E L G LD R 8.88 SL S D Min 13.23 11.82 13.05 13.50 10.39 13.10 11.93 Max 61.29 37.51 49.96 60.37 56.49 58.30 60.55 50.40 Mean 34.71 21.41 30.78 34.24 30.12 31.96 34.24 29.71 114. Thus, GIS have functional capabilities for data capture, input, manipulation, transformation, visualization, combinations, query, analysis, modelling and output. XwXs W= ×100 P Statistical analysis of the effective weights E Theoretical weight (%) Effective Weight Parameter L G LD R SL 1.56 34.87 19.17 2.58 9.05 9.05 1.75 38.78 12.48 3.11 15.12 9.76 S D 4.55 19.17 3.11 15.92 115.

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