

Geography 38/42:477  
Advanced Geomatics

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Topic 3:  
Spatial Modeling

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What is a Model ?

- # Simplified representation of the real world
  - # Physical, Schematic, Mathematical
  - # Map
  - # GIS database
  
- # Reduce complexity and help us understand how things work

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What is a GIS Model

- # A set of ordered "map" operations applied to solve a problem
  
- # Map operations = spatial analysis
  
- # May include a variety of geomatics technologies, but created in a GIS

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## Elements of Models

# What do models consist of?

- ▣ Geospatial data
- ▣ Operations
- ▣ Analysis
- ▣ Results

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## Classification of GIS Models

1. Descriptive vs. Prescriptive
2. Deterministic vs. Stochastic
3. Dynamic vs. Static
4. Deductive vs. Inductive

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## An Alternative Classification

1. Description
  2. Explanation
  3. Prediction
  4. Problem Solving
    - Expert systems
  5. Decision Making
    - Spatial decision support systems
- # A hierarchical classification

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## The Modeling Process

- # Similar to project management
  1. Define problem/goals
  2. Deconstruct model
  3. Implementation & Calibration
  4. Validation

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## Why GIS Models?

- Unique ability to:
  1. Work with discrete (vector) or continuously distributed (raster) geospatial data
  2. Seamlessly integrate aspatial/spatial data in analysis
  3. Perform rigorous objective spatial analysis using special tools
  4. Establish linkages with other modeling tools/software and geomatics technologies

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## Binary Models

- # Results are 0 or 1, true or false
- # Component maps contain nominal, ordinal, interval or ratio values
- # Results based on logical expressions or mathematical operations
- # Commonly used for MCSSA
  - One strike and you're out rule

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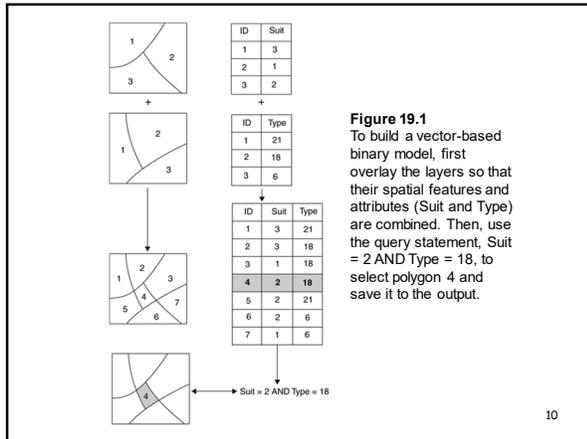
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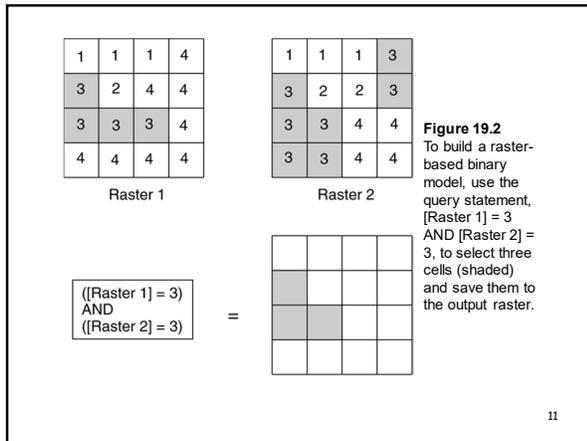
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## Index Models

- # Result is ranked suitability
- # Frequently, component maps are assigned index values
- # Results based on evaluation of index values or mathematical operations
- # Component maps often weighted
- # Commonly used for MCSSA
  - ▣ Voting tabulation rule

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# Weighting Index Models

- # Weight is function of importance
  - ▣ Assigned and calculated using table
- # Index values standardized
  - ▣ To account for different ranges
- # Resulting rank or index calculated

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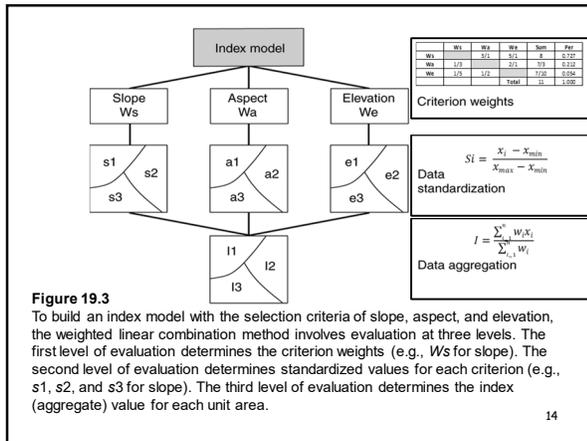
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**Figure 19.3**  
 To build an index model with the selection criteria of slope, aspect, and elevation, the weighted linear combination method involves evaluation at three levels. The first level of evaluation determines the criterion weights (e.g., Ws for slope). The second level of evaluation determines standardized values for each criterion (e.g., s1, s2, and s3 for slope). The third level of evaluation determines the index (aggregate) value for each unit area.

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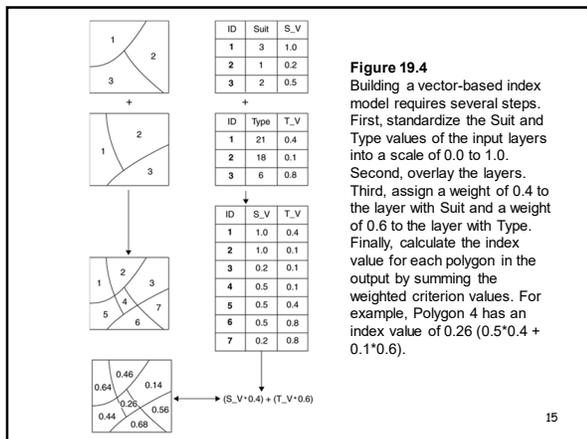
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**Figure 19.4**  
 Building a vector-based index model requires several steps. First, standardize the Suit and Type values of the input layers into a scale of 0.0 to 1.0. Second, overlay the layers. Third, assign a weight of 0.4 to the layer with Suit and a weight of 0.6 to the layer with Type. Finally, calculate the index value for each polygon in the output by summing the weighted criterion values. For example, Polygon 4 has an index value of 0.26 (0.5\*0.4 + 0.1\*0.6).

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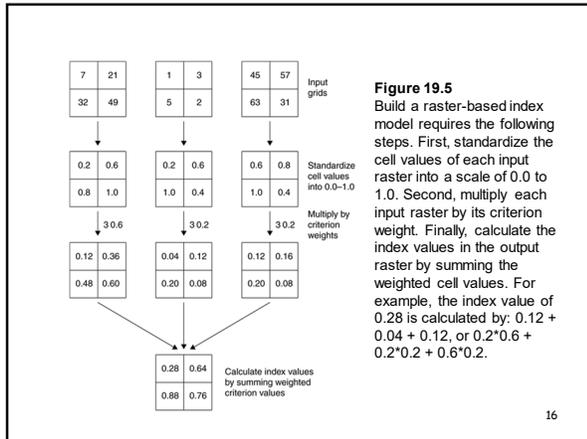
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## Regression Models

- # Relates a dependent variable to one or more independent variables
- # Once relationship is established, used for prediction, "what if" scenarios
  - # Linear
  - # Local
  - # Logistic

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## Process Models

- # Model representing a physical or environmental process
- # Often based on equations derived from measured data (inductive)
- # Or physical laws (deductive)
- # Typically predictive and dynamic

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