

# Spatial Decision Making

- Ability to Select for Multiple Criteria Enables
  - shortest path
  - least cost route
  - siting
  - efficient parcel selection

# Spatial Decision Making

- Steps
  - Identify the Issue
  - Identify & Collect Appropriate Data
  - Identify specific ‘problem’ rigorously
    - objectives
    - assumptions
    - constraints
  - If more than 1 objective, are objectives related
    - create same value system (for example, dollars)
  - Create solution strategy
  - Find optimal site

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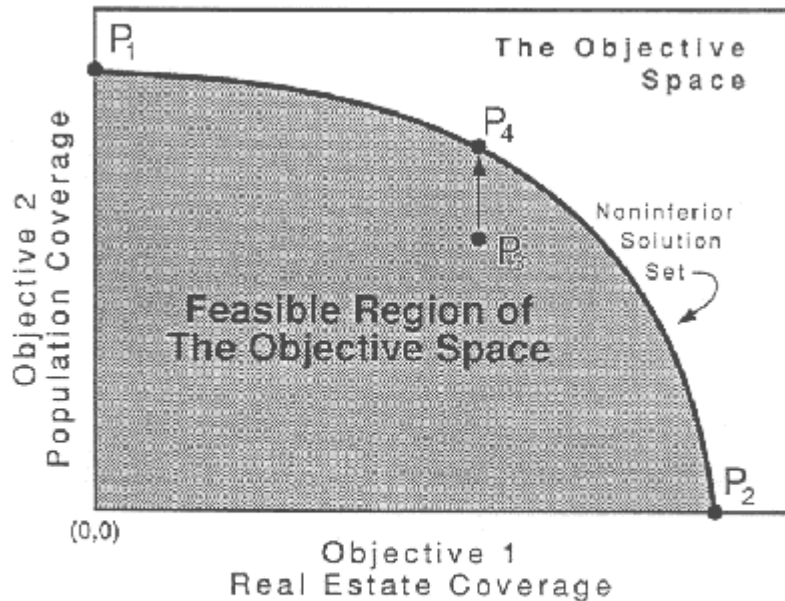
# Spatial Decision Making

- Spatial Decision making assumes
  - objectives are commensurate
  - problem can be ‘collapsed’ spatially
  - relative importance of objectives shared by all
- “Old” Software Package SPANS based on the above assumptions
  - site selection for many ‘cell’ based criteria
    - Hospital Case in Maryland
  - Reality stakeholders seldom agree on criteria

# Spatial Decision Making

- Two Approaches: **Goal & Non-Inferiority**
- Goal Programming identifies a single or small set of preferred sites
  - assumes goal is known
    - leaves few options
  - assumes criteria are shared by all
- Non-Inferiority Programming results in equally appropriate sites leaving the decision to others
  - leaves many possible options
  - ‘weights’ criteria

# GEO 448 GIS APPLICATIONS



$P_1$  optimal solution when covering for population

$P_2$  optimal solution when covering for real estate only

Criteria	Alternate Sites				Weights
	A	B	C	D	
1	4	3	2	1	0.1
2	3	4	1	2	0.1
3	4	3	1	2	0.1
4	1	2	4	3	0.2
5	4	4	2	2	0.2
6	1	4	3	2	0.1
7	4	3	2	1	0.1
8	3	4	2	1	0.1
					1.0

1 = excellent, 4 = poor

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Class slides are based on readings, the current NCGIA Core Curriculum for GIS(systems) and GIS(ience), Kemp & Goodchild (1991), the NCGIA Core Curriculum Project at UBC, and Foote & Heubner's *The Geographer's Craft*

# GEO 448 GIS APPLICATIONS

All sites are feasible--but this approach ranks non-inferior sites

Concordance Matrix

	A	B	C	D	Row
A		0.6	0.3	0.3	1.2
B	0.4		0.2	0.2	0.8
C	0.7	0.8		0.3	1.8
D	0.7	0.8	0.7		2.2

row is first in pair, column is second

Site D > Site C > Site A > Site B

Site D is most preferred and Site B is least preferred

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# Location-Allocation

- Service provision/delivery to spatially distributed clients
  - assumes impossible to provide service at all sites (like schooling)
    - sometimes total possible locations is known
    - other times goal of GIS application is to identify optimal number of sites
- Two Parts
  - location-where to site service center
  - allocation-who to assign to which center

# Network Problems

- Networks based on Arc-Node topology
  - implementing these GIS applications requires special extensions or software
- A large number of network problems can be addressed
  - "shortest path problem"
  - "traveling salesman problem"
  - "transportation problem"
  - "traffic assignment problems"

# Spatial Decision Support Systems (SDSS)

- A larger collection of techniques beyond GIS
- SDSSs are a more flexible approach
  - many GIS databases have been designed solely for cartographic display of results
  - the set of variables or layers in the database may be insufficient for complex modeling (perhaps qualitative)
  - data may be at insufficient scale or resolution
- SDSS provide a framework for integrating: 1. analytical modeling capabilities 2. database management systems 3. graphical display capabilities 4. Tabular reporting capabilities 5. the decision-maker's expert knowledge
  - GISs normally provide 2, 3 and 4

## SDSS

- Three Levels of SDSS Technology
  - 1. a specific DSS is a system being used to address a specific problem
  - 2. a DSS generator is a set of mutually compatible hardware and software modules used to implement the specific DSS
  - 3. a DSS toolbox is a set of individual hardware and software items which can be used to build both DSS generators and specific DSS

## SDSS

- Five Functions to be Performed
  - the decision-maker choose, implement and manage the solution
  - intermediary interacts physically with the system
  - the DSS builder configures the specific DSS from the modules in the DSS generator
  - the technical supporter adds capabilities or components to the DSS generator
  - the DSS expert develops new hardware and software tools

## SDSS

- GIS is closer today to SDSS
  - Most GIS packages can generate results in numerous formats