# Map Overlay: Rules to Combine Attributes

Objectives of Lecture:

1. A system of rules for combining attributes in map overlay
    - Enumeration rules
    - Dominance rules
    - Contributory rules
    - Interaction rules

Overlay uses geometric processing to assemble a bunch of attributes that refer to the same place (a raster cell used as control or a polygon grouping similar contiguous values). Then the some *combination* of these values gives a result. The central question is: which combinations make sense for the application in question. (How to make sense when combining disparate sources. This is a BIG science problem: "commensurability".)

### Thinking about attribute combinations: truth tables

**Enumeration** rules enumerate all the possibilities. This would include the various operations treated as "Direct Analysis of Overlay" in the first edition of the textbook. In the lecture on Attribute-based rules,

**Crosstabulation** appears as a method to treat pairs of nominal values,

**Change Analysis** does the same thing, except that you know the matrix will be square (same categories used in time 1 and time 2). These remain different from interaction rules because there is no evaluation placed on the pairs, just that each pair is recognized.

Direct analysis includes the change detection kinds of operations done in Exercise 3. On the face of this, you use subtraction for two nominal measures. This shouldn't mean anything EXCEPT that you can figure out what each value means. As long as the complete "truth table" of the operation can be figured out, this is just the use of subtraction (addition, etc.) to support a given Boolean function (in this case time 1 *not equal to* time 2).

**Examples of Truth Tables**

**BOOLEAN**

| **AND** function | *True* | *False* |
|---|---|---|
| *True* | True | False |
| *False* | False | False |

| | *True* | *False* |
|---|---|---|
| *True* | True | True |
| *False* | True | False |

**ALGEBRA**
(limited to 0,1 input) Notice that you can't distinguish between cases that have one "1" and one zero. BUT if you change the representation, you can enumerate all the distinct combinations with addition...   with (0,1) + (0,2). Thus, if you represent *nominal* data as numbers, it MIGHT just work to use addition, **IF** you understand how the operation works...

| + function | *1* | *0* |
|---|---|---|
| *2* | 3 | 2 |
| *0* | 1 | 0 |

| + function | *1* | *0* |
|---|---|---|
| *1* | 2 | 1 |
| *0* | 1 | 0 |

| **Table 5-1: Map Combination Methods** | |
|---|---|
| **Enumeration Rules** (all combinations recognized) | |
| Crosstabulation | New categories from each unique combination |
| Change analysis | Complete matrix of all changes |
| **Dominance Rules** (one value wins) | |
| Exclusionary screening | One strike and you're out. |
| Exclusionary ranking | Extreme value from rankings (usually worst wins) |
| Highest bid | Extreme value from continuous data maximum profit at that site (best alternative); could be worst - highest |

| | |
|---|---|
| | risk |
| Highest bidder | Records identity of extreme value |
| **Contributory Rules** (all values contribute without regard for the others) | |
| Voting tabulation | Sum of binary exclusions |
| Linear combination | Sum of `ratings' (mean, etc.)> |
| Weighted linear combination | Weighting and rating game |
| Product | Multiplication of factors |
| **Interaction Rules** (pairs [or more] of values are consulted to yeild the result) | |
| Contingent weighting | Linear combination where the weights depend on some OTHER attribute value |
| Gestalt (Integrated Survey) | Informal judgement; expert opinion |
| Rules of combination | Formal interaction tables |

Rules of Combination might be discussed, but rarely considered in all the depth of handling all interactions. Rules emerge from the science of the layers studied - no magic bullets (no procedures that will solve all problems).

"Linear Combination" - the Weighting and Rating Game

Vj = [[SUM]]i wi rij /[[SUM]]i wi

- influence of roundoff (integer values) on ratings and weights
- standardized ratings make weights easier to understand
- Independence of factors

When the variables are continuous, suitability might have some functional form; total cost, elapsed time, ... which is not simply an average; it could be a total.

A presentation given at AAG 1997 (not updated to include "enumeration")

Index from Here:
**Next Lecture** | **Schedule of Lectures** | **Labs and Due Dates | Resources for this lecture** | **How to reach us**