What is the difference between geometric centroid and mass centroid?

**What is the problem with the simple perimeter to area ratio?**

As its name indicates the measure is computed from dividing the perimeter length by its area (Equation 5).

S=PAS=PA      (Equation 5)

where P is the perimeter of the patch and A is the area of the patch. Typically the larger the S the more elongated the patch is. However there is a problem in interpreting this measure, *that is, there is no bench mark for its values because it is size dependent.* The same shape with different size will give us a different S. The best way to show this is to use two circles of different size, say one is 10 m in diameter and the other in 20 m in diameter.

**How does the corrected perimeter to area ratio fix the problem?**

The key problem associated with the simple perimeter/area ratio is th*at the numerator is in different dimension of the denominator, that is,*P*is one dimension and*A*is two dimensions.* To make these compatible, we convert the denominator into one dimension (Equation 6).

Sc=0.282PA√Sc=0.282PA      (Equation 6)

This will give us very nice property which allows us to interpreting its values a bit more easily, that is, S is 1 for a circle and S is infinity for a line.

**What is the difference between RCC and corrected perimeter to area ratio?**

RCC is such a measure which compares the patch with the smallest circle that circumscribes the patch

**How to interpret RCC?**

where d is the longest axis of the patch and a is the area of the region. RCC ranges from 0 to 1.0 with 0 for a line and 1 for circle. In this case, we now have a fixed range (0 to 1) for use to interpret the RCC value in relation to its shape. The smaller the value of RCC, the skinnier of the patch or closer to a line the patch is.

**What is the difference between CR and RCC?**

Clearly, CR still ranges from 0 to 1.0 with 0 for a line and 1 for circle but approaching 1 slower than RCC.

**When measuring shape for a patch class, what does the subscript i in the equation mean? What about at landscape level?**

Where *i* refers to the patches belonging to the same class (such as the same forest type). On the landscape level it refers to all of the patches not single class

**What is a fractal?**

A **fractal** is "a rough or fragmented geometric shape that can be subdivided in parts, each of which is (at least approximately) a reduced size copy of the whole". In other words, the shape one sees at one scale is approximately the same as that at another scale. The term was coined by Benoît Mandelbrot in 1967 and was derived from the Latin fractus meaning **broken or fractured** (Mandelbrot, 1967, 1982).

**What is Fractal dimension?**

A fractal dimension is an index for characterizing fractal patterns by quantifying their complexity as a ratio of the change in detail to the change in scale (Mandelbrot, 1975). Fractal dimension can be understood as follows. Suppose that we want to measure a curve with two different sizes of intervals, η0 and η, which can be seen as different scales. So there will be n0 number of intervals using interval η0 to measure and n number of intervals using interval η to measure the length of the curve. Clearly, with different interval sizes we can capture different level of details and thus the measured length of the curve is different with different size of interval. Thus the estimates of the shoreline length with the above two intervals are n0η0 and nη, respectively. Mandelbrot defines the fractal dimensionality (Fd) of the curve to be:

**How can one use F.D. to express the characteristic of patch shape across scales?**

 The implication is that the process creating the geographic features operates at similar modes across scales. This lends a convenience for geographers in understanding natural processes because understanding, even controlling, geographic processes becomes much easier if what we know at one scale can be simply applied to all other scales.

Geographic features display self-similarity only at a certain level. For example, sometimes coastal shorelines do display self-similarity but this self-similarity does not persist infinitely and across all scales. Thus, a number of geomorphologists rejected the notion of a constant Fd in the natural landscape as a principle (Hakanson, 1978 and Scheidegger, 1970) but they do acknowledge that the performance of Fd as a variable over various scales is useful in studying the nature of a real world linear feature. The ranges of scale over which the feature is self-similar provide a useful perspective.

**How would one interpret Shannon’s Evenness Index (entropy) value in the context of measuring diversity?**

H ranges from 0 to ln(n) with a value of 0 meaning dominance by one attribute (or species) and ln(n) meaning evenness, that is the area is equally occupied by several attributes (species). Clearly, there is a problem with this index because the up-bound is dependent on n so it is difficult to say what specific value will indicate evenness.

**Explain what Contagion measures and how to interpret its values.**

Contagion quantifies the degree to which the area is occupied by one attribute (Equation 20)

C=2\*ln(n)+∑i=1n∑j=1nPij\*ln(Pij)C=2\*ln(n)+∑i=1n∑j=1nPij\*ln(Pij)      (Equation 20)

where   
*Pij* is the percentage of times that attribute *i* is adjacent to attribute *j*.   
*C* has a range of *0* to *2\*ln(n)*. With 0 it means the landscape is dissected into many small patches. With *2\*ln(n)* it means that the sample area is occupied by one attribute (maximum clumping).

**In defining edginess, how would one define the weight associated with each edge?**

Juxtaposition is a measure of edginess (the weighted length of edges) surrounding a center patch (or pixel).

J=∑l=18ql\*wij12J=∑l=18ql\*wij12      (Equation 22)

where  
*wij* is the relative “quality” given to the edges between attributes *i* and *j*. The specific value of *wij* *very much depends on the ecology of the study*. For example, in the case of studying the habitat of eagles, you want to find out in the landscape the edginess which is preferred by the eagles. In this case, you might give edges between forest and lake a high weight because eagles like to have their nesting place (forests) close to food sources (fishes in lakes), a low weight for edges with urban areas.  
*q* is the ranking of adjacency. For patches, it can be the length of the shared boundary between attributes *i* and *j*. For pixels, *q* is 2 for two pixels with the horizontal or vertical connection and 1 for diagonal connection.

**What is MAUP? Why should we study it?**

Modifiable area unit problem (MAUP) refers to situation that different statistical results (characterizations) are obtained from the same set of data when the supporting area units are group differently.

**What are the two effects causing MAUP?**

There are two operations which cause MAUP. These two operations are often referred to as the effects in discussing MAUP. In fact these are not the effects rather they are the processes which created MAUP. These “effects” are: the scale effect and the zoning effects.

The ***scale effect***is the tendency for different statistical results to be obtained from the same set of data when the information is grouped at different levels of spatial resolution (e.g., enumeration areas to census tracts to cities to states) (The vertical direction in Figure 4).

The***aggregation or zoning effect*** is the variability in statistical results obtained as a function of the various ways these units can be grouped at a given scale (The horizontal direction in Figure 4). A good example of this is “gerrymandering” which the practioners try to rearrange the grouping of blocks to obtain different election outcomes.

**What are the ways to reduce the impact of MAUP?**

1 basic entity approach

As we can see, MAUP is really related to the division of the area or the grouping of spatial units. One basic way to minimize this problem is to use the natural boundaries of objects. For example, we are going to assess the evaporation of different land surfaces we certainly will delineate the objects based on the nature of their evaporation. In this case, we will separate the forests from the grasslands, and the lakes or rivers from land surfaces.

2 optimal zoning approach

Another approach, which might be useful in social science is that we try to minimize within zone variability and maximize between zone variability when we divide the area up or group the units into large ones. There are many statistical techniques out for this purpose (Zhu, 2008).

3 Sensitivity analysis approach

not always the last one to try, is to examine the variability of the results of different ways of grouping or dividing. This will provide us the sense of how variable the results are. In addition, one must assess the sensitivity of our decision to these effects based on these results and one must also understand its impacts on the outputs. I personally would suggest you do sensitivity analysis every time you encounter grouping or dividing units, which means that almost every time you work with spatial data, you need to do this. For examples of these types of analysis, see Smith et al. (2006) and Zhu (2008).