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COMMENT AND DISCUSSION

AN APPROACH TO THE STUDY OF NODAL GROWTH: COMMENT

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Goodchild, Lam, and Radke [1] address a fundamental problen whether process can be inferred from form, and their paper valuable for demonstrating a rigorous way of answering the question. But their results lack the significance claimed for them becaus the simulation model on which they are based is inappropriate in several respects.

The authors conclude that in the case of nodal systems it is not possible to infer process from form. For the most general situation, where we know nothing of the processes involved, and especially if we are willing to forget Occam's razor, their conclusion is undoubtedly correct. But the more interesting and realistic situations are those in which we have at least some knowledge of the processes involved. For example, in the case of nodal growth we can reasonably assume, as the authors in fact do, that the growth process involves a distance decay factor. The question then becomes much more context dependent: To what degree, under a given set of circumstances, is it possible to make the inference from form to process? If the answer is to be useful, it is crucial that the specified set of circumstances be the relevant one; otherwise, we have the right answer to the wrong question.

The simulation model which forms the basis of the study is essentially an iterated randomly disturbed gravity model. Nodes grow and decline as a result of migration flows, where the flow from i to j during time t is given by

(1) [illegible]

where G and b are constants
Δ_t is an adjustment term[1]
P_{it} is the population of i at the beginning of period t
A_{ij} is the attraction of j
D_{ij} is the distance from i to j

G, Δ and P play a passive role in the simulation. The crucial quantities are b, the parameter which controls the role of space in the migration process, and A. A, the attractiveness of the destination, is a random variable with a mean value equal to the population of the node and a standard deviation determined by a second parameter, σ :

$$(2) \quad A_{jt} = P_{jt}\, \varepsilon_t^{1-c}\, \varepsilon_{t-1}^{c}$$

where ε is a log normal random deviate with standard deviation (in log form) σ
$c = 0.3$.

With the variations in process now represented by variations in b and σ , the question is specifically to what degree it is possible to infer values for these two parameters given the values of the various aggregate measures of system form.

The major problem with the model as a tool for investigating this question is that its stochastic element overides any homeostatic properties it may have. Thus, as the authors point out, the system must sooner or later collapse to a single node. Since early states of the system must largely reflect the arbitrary initial conditions, and late states resemble the collapsed, equilibrium state, it is only for intermediate periods that the state of the system might be expected to reflect primarily the particular values of the process parameters. But the values of σ which have been used in the simulation are apparently such as to cause the model to move in very large jumps to equilibrium,[2] and under such circumstances any simulation model is likely to behave erratically.

These are the formal reasons that the model gives the results it does; but is there any reason to use a model with these properties? It would seem not. While a few activities characterized by a nodal distribution exhibit a tendency to collapse to progressively fewer and larger nodes, most, like fast-food outlets, bottling plants, and cities,

1. The authors' explanation of the role of Δ_t implies that its value decreases as the number of centres decreases. However, according to their definitional formula, the opposite is the case. Either the formula or the explanation must be in error.

2. I assume this to be the case. Otherwise the simulation should have been carried beyond six iterations.

do not. In reality, nodes are extinguished, but they are also born. Furthermore, most nodal systems, and certainly urban systems, evolve in a more or less continuous manner, not in the large discontinuities seen in the behaviour of the simulation model. In other words, it seems likely that all values of σ used were too large,[3] and that to make the model more appropriate it would be necessary to use much smaller values for this parameter, perhaps while rewriting the perturbation equation (e.g., 2) to increase the number of periods each disturbance persists.

In citing a simulation study by White [2; but see also 3] based on a model similar in many respects to their own, the authors imply that in this case also the process parameters have very little to do with the state in which the system is found [1, p.67]. In fact, however, that study showed that the state of the system depended clearly and fundamentally on the process parameters, with the space-descriptive parameter analogous to b playing by far the most important role. This is an additional reason for believing that if the authors' model were changed in the ways suggested above, the relationship between the form of the system and the process parameter b, already weakly apparent in the simulation results, would be revealed much more clearly.

References

1. Goodchild, Michael F., Nina Siu-ngan Lam, and John D. Radke. "An Approach to the Study of Nodal Growth", *Canadian Journal of Regional Science,* II, 1 (Spring 1979), 67-76.
2. White, Roger. "Dynamic Central Place Theory: Results of a Simulation Approach", *Geographical Analysis,* IX (July 1977), 226-243.
3. White, Roger. "The Simulation of Central Place Dynamics: Two Sector Systems and the Rank-Size Distribution", *Geographical Analysis,* X (April 1978), 201-208.

Editor's Note

Professor Goodchild elected not to prepare a reply to these comments.

3 While the values for σ were apparently selected arbitrarily, values for b were obviously chosen to reflect the range of values established empirically in the calibration of numerous gravity models. Without this prior knowledge of the range of b (if, for example values ranging from 1 to 100, rather than 1 to 4, had been tried), the results would undoubtedly have looked much worse.