Memetics and the A Series (2)

We hope to establish the concept of a model or series of models which can be developed mathematically and lead to consequences which, as well, can relate to mathematically predictable facts, ideas, results or further enquiries.

We can look at points in the A series (or its derivations) which may be disjunct mathematically but can have some relationships which can up to a point be defined within themselves. Crudely, at each point in the A series or its derivations, for each individual point we may want to write down a past, a present, and a future,

Perhaps the obvious things to look at are the logistic map, (or some extension thereof) and the Hurst exponents which should lead to some temporal inequalities within the A series. The classical case of the Hurst exponents is that developed by Hurst himself and concerns flood levels on the river Nile. The historical structure led to the construction of the Aswan high dam and ecological problems ensuing from it, these facts and the UK/French/Israeli Suez invasion 50 years ago. All these matters need to be considered if the historical context has to be properly explored, though we'll leave them aside for now.

We leave historical context aside for the moment and bear in mind the exposition in Peters (1991) (Note 4). Fig 9.7 in this book, for instance, shows how R/S and the Hurst exponent vary with time for the Standard and Poor’s 500 index. It is important to remember that the R/S is time dependent and in theory (depending on how we scale the exponent) a value of 0.5 is a noisy value, between 0.5 and 1.0 means future dependence on past and between 0 and 0.5 means some kind of de-correlated future and past. Thus the Hurst coefficient in principle should allow us to set up a series of scalars - and we could start at one time and work to a future time or start at a distant future time and work towards an earlier time or a present time, merrily graphing the Hurst exponents as we do so. In this way we could in principle reverse future and past.(Note 6 and beware Note 5)

Another point perhaps worth referring to at this juncture is that, as Schlather's (e.g.2001) work clearly shows, there is no equation relating the Hurst exponent H to the fractal dimension D for all systems although some people seem to assume that the two things are necessarily simply related by
$D = n + 1 - H$
(n being the normal dimension of the space). Hurst exponent is not the same as a kind of rescaled fractal dimension. (see Note 3)

Now Ian Posgate's Lloyds Syndicates, for example, give instances of contrived statistics which will have a different (or 'human') element to those of flood measurements on the River Nile. In one case nature gives us a set of statistics and in the other clearly human revisions will have given us the figures. The same is even true in something as simple as stock options, where the person holding the book (however bad a mathematician he may be) will have taken great pains to ensure that his commissions should compensate for any inadequacies in the system, making it plain that any mathematical computation in advance of say, stock options or casino odds is a losing venture, even if for no other reason than that large winners at casinos are usually banned unless for some such reason like the winners are simply shills. So money making ventures using Ruelle-Takens methods, for example, as Packard apparently did, are unlikely to be useful from our viewpoint and indeed are just part of the system, now in large part human, which we need to consider.

This does not mean that human enterprises cannot come under our scrutiny of course, quite the opposite as we are considering memetics not winning at casinos. In fact I take the view that the work of Ian Posgate and Nick Leeson come, as memes, directly and very appropriately under our aegis ! (This does not imply that we are looking for such things as economic prevention of such practices - or indeed the reverse - but rather that we see a *meme qua meme*). But it is possibly easier to begin by considering natural physical processes or events resulting from more humble living creatures than humans. This does not imply that humans are the only creatures capable of rational thought as some memeticists would like to claim, the question is still open at this point. Here we are just plain that a bird, a dog, or a slug seems to act more like a human than a drop of rain does, and that the statistical laws and other behaviour of such creatures will likely seem more 'human' than those of a drop of rain. This does not of course mean either that we are trying to outsmart non-human creatures, more that because their attitudes are different their attitudes are possibly less likely to conflict with our experiments. (Note 2).

To calculate Hurst exponents and interpret them should be child's play with the aid of a great deal of free software (Note 1) already on the market. One might also expect that the human or animal Hurst exponents might reveal a lot of information as to differences from simple 'physical' results (perhaps along the lines of Velman's philosophical postulates), a good meme leading to survival giving one result and an unsuccessful meme leading to another. One could also traverse the time scales from past to future or from future to past and obtain Hurst tables which by the way they are written could obtain different results forward in time' to those taken 'backwards in time'.

One clearly would expect living creatures to present a different showing of Hurst exponents to non-living ones. Unfortunately the figures are far from clear, even for blowflies. Nicholson's pioneering work on the ongoing population of flies in a bottle, for example, is described in particularly clear lay terms in Stewart (1989) (p263, 270 *et seq*). Miramontes and Rohani (1998) have a newer take on this matter. ("The ubiquity of 1/f dynamics is one of the major puzzles in contemporary physical science" also see Note 7).

Rohani (2002) now suggests using more advanced methods than the Hurst exponent which, also in my experience, carries a lot of perplexities with it. It is also hard to get enough useful and interpretable data. This and other similar matters will be discussed in "**Memetics and the A Series (3)**" being written now, and which contains further approaches to the statistical problems which a great many people from Edmonds (2002) through to myself and Rohani see as important, such as the relatively large amounts of data required and the relatively meagre and uncertain results obtained.

Gatherer (2005), and others such as Marsden and Lynch, suggests inclusion in a study of memetics items like terror and says it may help us to identify cases where our a priori thinking about a cultural phenomenon is inadequate. But he feels that the future of the real world can't be confirmed with a computer model. My own findings were, when I tried the more mundane statistics like London Tourism figures and the like, was that those tend to be tedious, similar and very often give the appearance of being massaged (though I reserve judgement on whether they are, or just look that way if one is seeking anomalies) there is certainly seems to be more to learn from the 'homebodies vs. the hellraisers' model which Gatherer seems to largely espouse. And I point out from my comments above on Leeson and Posgate that such matters should be important in the use of statistics. But in the cases of Leeson and Posgate it is unfortunately *prime facie* clear that statistics have been massaged and that is probably even true for some terrorist crime statistics. It is vaguely annoying when you think that you may be onto something good but find that quite a lengthy search for useful statistics in quite sane places seems to provide no useful results. ('We all knew that this figure or that one increased every year', someone may well say, and statistics correspond). I found US Bureau of Justice Statistics (2007) well worth considering though. They are worth running through the computer and quite easily I got Hurst values varying from about 0.51 for later homicide statistics (semi-random slaughter in statistical terms) to a more predictable 0.97 for earlier ones through 0.78 and .and 0.84. The interesting part of the murder figures is the dip between about 1940 and 1960 when the rise apparent earlier, appears again. On a cyclic basis maybe the rise should soon start again. If you reverse the statistics and start at the later end the Hurst figure tends to be very near unity. But here again there are only rough accounts possible.

These matters are proceeding - the A series is in rough lay terms something like a tensed theory of time as opposed to the (tenseless) block time of the B series which physics (up to a point) is so happy with. The idea of using scalar entities as various points in the A series representing (past-present-future) at different points in time is an approximation that we may have to live with for the moment. However to look into further steps to be considered, we can look at the work of Gabora ('strange attractors' and the like) on the one hand and Sprott (etc.) and Rohani on the other in our next instalment "**Memetics and the A Series (3)**".

References

Edmonds, B. (2002), "Three Challenges for the Survival of Memetics". Journal of Memetics - Evolutionary Models of Information Transmission", 6 , http://jom-emit.cfpm.org/2002/vol6/edmonds_b_letter.html

Gatherer, D. (2005). "Finding a Niche for Memetics in the 21st Century" Journal of Memetics - Evolutionary Models of Information Transmission, 6. http://jom-emit.cfpm.org/2005/vol9/gatherer_d.html

Miramontes O., Rohani P., (1998) "Intrinsically generated coloured noise in laboratory insect populations", Proc. R. Soc. Lond. B (1998) 265, 785-792

Miramontes O. Rohani P., (2002) "Estimating 1/f scaling exponents from short time-series" Physica D 166, 147–154

Peters E.R, (1991), "Chaos and Order in the Capital Markets", p62 et seq

Puu T., (2003) "Attractors, Bifurcations and Chaos - Nonlinear Phenomena in Economics" , Springer ISBN 3540-402268

Schlather M., Gneiting T., (2001) arXiv: physics/ 0109031 v1 13 "Stochastic models which separate fractal dimension and Hurst effect"

Sprott J.C. (2003), "Chaos and Time-Series Analysis", Oxford ISBN 019 8508 409

Stewart I, (1989) "Does God Play Dice ?", Penguin edn 1990.

US Bureau of Justice Statistics (2007), "Homicide rates from the Vital Statistics", 1900-2002, http://www.ojp.usdoj.gov/bjs/glance/tables/hmrttab.htm

----

Notes

1. I favour particularly Gretl and use vers 1.60 (2006). [gretl.sourceforge.net/win32/]. Tisean is also pretty good and it could help to run R. In Gretl it is just necessary to type 'hurst' (without quotes) at the command line, having entered a suitable data set which can be done in many ways. But a lot of data is preferable to obtain results and Chebychev interpolation or alternatively imterpolation by

inspection may not be suitable.

2. Ask any keen and dedicated but perhaps nonexpert gardener whether it is easy to outsmart a slug. I think it is not. As for me, slugs are my friends and I get a great deal of pleasure from simply observing them.

3. This does not occur in many standard works, e.g. Sprott (2003) section 9.4.6 p226 which only mention a direct correlation between fractal dimension and Hurst exponent. Given Schlather (2001), for philosophical purposes, which can be relevant here, we may have to probe deeper.

4. Puu (3003) gives a more up to date account than Peters (1991) of economic chaos theory with some cogent observations on economic theory, relating clearly directly to a study of memetics. Basically Puu's book is a book dealing with chaos theory as it can be applied to economics as distinct from Sprott's book which is basically an advanced introductory book on mathematical chaos theory. But unfortunately Puu does not deal with Hurst exponents. Peters (1991) does. Peters (1991) is the classic book in the field, and deals with Hurst exponents in great detail but not as much detail as some would have liked.

5. Ian Kaplan says in a long useful URL "I thought that the Hurst exponent calculation would be easy .... Sadly things frequently are not as simple as they seem"
http://www.bearcave.com/misl/misl_tech/wavelets/hurst/index.html
I have to say I concur with this as so much of the data seems almost intractable from a Hurst function viewpoint. This is not just equities, which I have also looked at (mainly S. & P. 500 1946 - 2007 over various ranges) but blowflies as well, references as above. (Rohani etc.)

6. Using Gretl (Note 1) there are definite, but in the cases which I have dealt with quite small. differences in starting at a late time for (say a rainfall series - I used recent daily figures for Norman, Oklahoma as these are readily available on the internet - or a S. & P. 500 range) and working backwards or starting from an early time and working forwards, both forward Hurst and reverse Hurst tending to a similar result over a long period of course. But as yet there are no striking results AFAIK and possibly no reason to expect them at this early stage. There is a long way to go yet.

7. Rohani (1998) comments :"Hurst exponents fall in the range 0-1 and have intuitive interpretations. A value 0:5 < H =< 1 indicates what is commonly termed `statistically persistent behaviour'; that is, whatever the past trend in the series, it is likely to continue in the future, implying a strong degree of predictability. The most extreme case is H = 1 which represents a straight line with a non-zero slope. Here there are no changes along the line when passing from the past to the future; there is absolute predictability in the process. A value 0 <= H < 0:5 represents `anti-persistent behaviour': it is expected that whatever the current direction of change, it is unlikely to continue in the future and so predictability decreases. In the limit of H = 0, successive changes in the time-series are totally uncorrelated and prediction is not possible. In summary, white noise is characterized by H = 0, a value of H = 0:5 indicates Brownian motion, and 1/f noise is located in the range 0 < H < 0:5:
The Hurst exponents calculated for Nicholson and Utida's laboratory populations all lie in the range 0 =< H < 0:5. For Nicholson's blowflies, H is about 0:22 (the first and second halves of the data showed H about 0:46 and H about 0:37, respectively). The bean weevil had H about 0:15, while its parasitoid had H about 0:14: These values lie well within the range expected for a 1/f process. The estimates of H obtained for Utida's populations are, however, quite low. Could these time-series be governed by a white noise process ? To address this question, we used a property of the so-called fractional Brownian motion, generated after performing integration (successive addition) on the time-series generated by uncorrelated Gaussian processes. The integration of a Gaussian

uncorrelated signal (with H about 0) produces a random fractal with H about 0:5 (Sprott & Rowlands 1995): We have integrated Utida's data and have found that the Hurst exponents of the two integrated signals are H about 1, leading us to conclude that Utida's time-series are extremely unlikely to be Gaussian uncorrelated processes.

There is an important relationship between the value of the Hurst exponent of a time-series and its fractal dimension, D (Feder 1988; Peitgen et al. 1993): D = 2 - H. A straight line with H = 1 has a fractal dimension equal to 1. White noise with H = 0 has a fractal dimension of 2, as expected for a process that is space filling. On the other hand, all the Hurst exponents found for the populations above signal that their fractal dimensions are non-integers, as is expected for a dynamical behaviour that has properties of self-similarity.

The foregoing results provide strong evidence that populations free from the influences of environmental forcing can produce fluctuations characterized by well-defined scaling laws. These findings relate to a recent debate regarding the importance of the dominance of high and low frequencies in the power spectra of ecological time-series (Steele 1985; Pimm & Redfearn 1988; Halley 1996; Caswell & Cohen 1995; Cohen 1995; Sugihara 1995, 1996; White et al. 1996a,b; Kaitala & Ranta 1996; Ripa & Lundberg 1996; Sumi et al. 1997; Petchey et al. 1997). Clearly, our results support the generally accepted fact that many natural population fluctuations show `reddened' spectra, with low frequencies dominant. Traditionally, the dominance of low frequencies in ecological systems has been attributed to external environmental forcing (Steele 1985; Pimm & Redfern 1988; Halley 1996; Sugihara 1996). In contrast, however, we have shown that red noise may arise in laboratory systems, generated by internal population processes in the absence of environmental noise.

What intrinsic ecological mechanisms could be generating these patterns ? It has been shown that simple single-species models exhibiting chaos as a result of strong density dependence may give rise to red noise (Blarer & Doebeli 1996; White et al. 1996b). Whether the demographic parameters required for this are sufficiently realistic as to be expected in nature is a moot point. We propose what we believe to be a more generic mechanism.

We suggest that these dynamics may simply arise naturally from the interaction between (demographic) stochasticity and density dependence. .... ***The ubiquity of 1/f dynamics is one of the major puzzles in contemporary physical science.*** It is well known that many diverse phenomena generate 1/f noise, and many theories been advanced to attempt an identification processes responsible."