慶應義塾大学 21世紀COEプログラム
「統合数理科学：現象解明を通した数学の発展」

Integrative Mathematical Sciences
統合数理科学

Keio University
1858
CALAMVS GLADIO FORTIOR

Pathways Lecture Series in Mathematics, KEIO

Speaker : Prof. James A. Yorke
(University of Maryland)

Place: Large Conference Room, Raiosha
Hiyoshi Campus, KEIO University

Lecture 1 14:30 ~ 16:00 July 19, 2006 (Wednesday)

Determining the DNA sequence, a billion dollar logic puzzle

The genome of an individual is the collection of DNA in each of his/her/its cells. It can be expressed as one or more sequences of the letters A, C, G, T. For mammals the genome has about 3 billion letters while for a bacteria it has a couple million. The dominant method used for determining the sequence is called whole genome shotgun assembly. Using this method, The National Institutes of Health has spent about one billion dollars determining genomes of many species in the past five years. Parts of genome turn out to be easier to determine than other parts but overall each genome becomes a giant jigsaw puzzle.
At the University of Maryland, we try to find techniques for solving as much of the puzzle as possible. The most difficult parts of puzzle to assemble are often the parts that have been mutating the most in the recent millions of years.

Lecture 2 16:30 ~ 18:00 July 19, 2006 (Wednesday)

The HIV/AIDS Epidemic: When is HIV most infectious?

How infectious a person infected with HIV is depends upon what stage of the disease the person is in. By "infectiousness", we mean for this talk, the probability of that a susceptible person having one sexual encounter with an infected person will become infected. One cannot do experiments to determine this without people dieing. It instead becomes a problem requiring careful analysis of available data.

In our study we use three stages before the onset of AIDS: primary, latent and (non-AIDS) symptomatic. Everyone agrees that the latent stage is has low infectivity, but how do primary and symptomatic compare? The answer is controversial.

We find that the infectivity of the symptomatic stage is at least as high as primary, and it is usually about 8 times as long, so our results mean this stage is the most dangerous, the one in which the most transmissions are likely to occur. The answers in the literature, like our results, depend on a heavy analysis of the data since direct experiments are impossible, but the mathematical detail will not be presented.

Implications of our infectivity estimates and modeling for understanding heterosexual epidemics such as the Sub-Saharan African one are explored. The results I will discus have appeared in J. AIDS in collaboration with Brandy L. Rapatski and Frederick Suppe.

Lecture 3 14:30 ~ 16:00 July 20, 2006 (Thursday)

Chaos

Scientists were probably the last people to find out about chaos. Everyone knows our lives are all chaotic and unpredictable in the long run. The mother of a friend of mine once took a taxi, met the driver, and wound up marrying him. If she had taken a different taxi, my friend would never have existed. I often say that the most successful people are those who are good at plan B. Our predictions must be flexible. Franklin wrote the famous lines "For the want of a nail, the shoe was lost; for the want of a shoe the horse was lost; and for the want of a horse the rider was lost, being overtaken and slain by the enemy, all for the want of care about a horseshoe nail." Others carried this story further so that losing the rider and his message lead to the loss of a battle, then a war, and finally a kingdom, all for the want of a horseshoe's nail. There is common science fiction theme of time travelers making small pivotal perturbations in the past that result in crucial changes in the present. In Ray Bradbury's 1952 short story, "A Sound of Thunder", a time traveler goes back millions of years and accidentally steps on a butterfly, significantly changing the present day world.

Chaos is an area of science and mathematics that describes situations in which small changes can cascade into larger and larger long-term effects.

Of course scientists always knew that is chaotic, but few recognized until the last 30 years that scientific environments in which precise rules govern change can be quite unpredictable in the long run. It is not the complexity of our lives that cause chaos as much as the instability of our lives. Meteorologist Edward Lorenz, one of the founders of chaos theory, suggested in 1960 that the flap of a butterfly wing in Brazil might set off a tornado in Texas, implying that we can never know all the factors that determine our weather. At best we can only predict the details of the weather a few days ahead. Scientists have found that many situations are equally unstable. Computer models have greatly helped us understand how pervasive chaos is throughout science. Our group at the University of Maryland has aimed at telling scientists how to look for varieties of chaos, for specific phenomena common to many situations. But I continue to wonder, if nearly all scientists missed this pervasive phenomenon, what else might we all be missing now?

問合わせ先： 慶應義塾大学21世紀COEプログラム 統合数理科学 渉外担当 e-mail：igarashi@math.keio.ac.jp
横浜市港北区日吉3-14-1 Tel：045-566-1442 Fax：045-566-1768 URL：http://coe.math.keio.ac.jp

21世紀COEプログラム