SMS Member Wins National Science AWARD

The National Science Award 2000 was awarded to Associate Professor Sun Yeneng of the Department of Mathematics, National University of Singapore for his outstanding contributions in the fields of mathematics and its applications.

The award was presented to Yeneng by Deputy Prime Minister Dr Tony Tan Keng Yam at the annual TechMonth Awards Presentation Dinner on 1 September 2000 at The Ritz Carlton.

Yeneng obtained his B.S. from University of Science and Technology of China in 1983, and his Ph.D. from University of Illinois at UrbanaChampaign, USA, in 1989. He joined NUS in October 1989 and won an NUS Outstanding University Research Award in 1998. He is currently the Director of the Computational Finance Programme in the Faculty of Science, NUS.

Yeneng has been a member of the Society for about ten years. He has been active in its activities, including serving on the Society's Committee in 1995 and the Singapore International Mathematical Olympiad Training Committee from 1990 to 1998.

His research achievements are succinctly reflected in the award citation which highlighted his "fundamental and significant contributions to the understanding of randomness and to its applications to economics, game theory and finance".

Randomness is the very stuff of life, looming large in our everyday experience. It is often said that the human and natural world is ruled by laws of chance. From the fluctuations of stock prices to the movement of molecules and elementary particles, randomness plays a central role. Although randomness is often viewed as a cause of disarray and misfortune, and may contribute to a sense of anxiety about the future, it is also our only shield against boring repetitiveness. Why do people talk so much about the weather, housing prices and human relationships? Because they are not completely predictable. Chance events furnish the element of surprise that makes languages, the arts, and human affairs in general sources of endless fascination.

Many important scientific results on randomness are stated in terms of the mathematical concepts of almost sure or weak convergence. In two papers published in *Advances in Mathematics,* Yeneng shows that problems involving almost sure or weak convergence in a general case are equivalent to their counterparts for the simplest case of the unit interval [0, 1]. This result reveals the nature of almost sure and weak convergence. Since stochastic processes can be regarded as random elements of spaces of functions, one can claim that the convergence of a sequence of stochastic processes is equivalent to the convergence of some sequence of random variables taking values in the unit interval [0, I]. This type of result was conjectured and sought after by prominent mathematicians without success many years ago.

The first version of the *law of large numbers* was obtained around 1700 by Jacques Bernoulli (1654-1705). It says that under the independence assumption, the average of a large number of random quantities converges to a non-random quantity. This means that if an insurance company has a large number of customers and the risks being insured are independent, then it can survive with certainty by charging the expected loss. That is, independent risks are insurable. Despite its great scientific importance and existence for almost three centuries, the law of large numbers was not studied from the converse point of view in terms of deriving independence as a necessary condition. Recently, Yeneng did show that the condition of independence is not only sufficient (as known before) but also necessary for the stability of sample functions in some sense. Thus we know not only that independent risks are insurable but also that *only the independent risks are insurable.*

The classical law of large numbers is an approximate result. Its exact version was postulated in a large amount of literature in economics. However, such an exact law of large numbers had already been shown to be essentially impossible in the classical framework by a worldleading probabilist, Joseph Doob (1910-), in 1937. From a mathematical point of view, this negative result of Doob is rather unsatisfactory. It is like the situation in which one cannot talk about the existence of an ideal unit circle but only about unit regular polygons with n sides for large n. However, using some new mathematical tools, Yeneng was able to prove several versions of the exact law of large numbers in a recent paper.

The general methodology developed by him also led to the discovery of completely new connections between many central concepts in the study of randomness. He has also applied these results to multi-person decision problems in economics and to the *identification of risks* in financial markets. His new mathematical framework lays the foundations for a rigorous approach to the formulation and analysis of problems in economics, game theory and finance.

Yeneng continues to apply his ideas to various problems, both theoretical and "concrete". We wish him more successes and discoveries in the years ahead.