

A Dynamical System Model for Analysing Economic Impacts of Water Competition upon A Water Company

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Having been introduced by Government in the Water Act 2003 (WA03), competition between water supply companies within England and Wales will take effect on 1 December 2005. Water companies will initially be able to compete for non-household customers, and for household customers later on. Aimed at improving its decision-making on adjustment of future policies, it is, therefore, highly desirable for a water company to develop a means to evaluate the possible economic impacts of the competition on its business.

This paper describes a real world software system, developed by CERCIA (the Centre of Excellence for Research in Computational Intelligence and Applications) at the University of Birmingham, which is currently in commercial use by one of the biggest water companies in England. The system is aimed to understand the impact of competition on water consumption and to evaluate the impact on the revenue of the company. Both goals are achieved based on a mathematical model of customer company switching under parallel forms of competition.

The mathematical model addresses the competition between an incumbent company and new-entrant companies (i.e. licensees). The model captures aspects of demonopolisation of markets and customers' company preferences, as well as cases where multiple forms of competition occur in parallel (e.g. wholesale or/and common carriage). The model works from the point of view of an incumbent company that is assumed to have a monopoly over a set of customers. Over time, the monopoly is gradually removed in stages due to government intervention, and customers become free to switch from the incumbent company to licensees (i.e. losing customers) or to switch back to a new licensee set up by the incumbent company (i.e. gaining customers). The model is able to approach various scenarios characterised with different parameters such as dual switching rates (i.e. a losing rate and a gaining rate), competition forms, and competing market sizes (i.e. fractions of all incumbent customers eligible for competition). These parameters are adjustable based on users' interests in terms of market situations. The ultimate outcomes of the model are predicted customer market shares changed quarterly over many years.

The mathematical model has been extended further by two advanced models. Firstly, a water competition scenario consumption model is capable of making predictions of overall water consumption, given average potential water consumption per customer

per year. Secondly, a water competition scenario revenue model is capable of generating predicted revenue by taking into account various tariffs of the incumbent company and all/part of new licensees, together with assumed possible tariffs imposed in wholesale or/and common carriage due to the competition. More importantly, the software system provides users with friendly GUIs (Graphic User Interface), enabling them to easily manipulate a variety of scenarios for all three models.

Although the model has been developed to meet the needs of a water company on analysis of economic impacts due to the competition, great potential exists for this model to be exploited in other similar industries, such as gas, electricity and telecommunication.

Biography

Dr Jin Li is currently a research fellow at CERCIA, whose work is focused on applying computational intelligence techniques to real-world problems. His previous research has also explored the use of evolutionary computation for applications in finance. In industry, Dr Li has several years of experience in building web based e-commerce systems. He has designed and developed a variety of management data mining tools for accounting, personnel and payroll systems. Dr Li has presented a number of his research papers in international conferences and delivered several public courses to industrial people on subjects of data mining and evolutionary computation.

Prof. Xin Yao leads [the Natural Computation Group](#) at the School of Computer Science, the University of Birmingham, UK). He is an IEEE Fellow, a distinguished lecturer (2003) of the IEEE Neural Network Society, and the Chair of IEEE Neural Network Society Technical Committee on Evolutionary Computation. He is the Editor-in-Chief of IEEE Transactions on Evolutionary Computation, an associate editor or an editorial board member of six other international journals, the editor of the World Scientific book series on "Advances in Natural Computation", and a guest editor of several journal special issues. He has been invited to present 26 keynote or plenary speeches at conferences worldwide and holds several honorary visiting professorships at universities in Australia and P. R.China. He has more than 150 research publications. His research interests include evolutionary computation, neural network ensembles, global optimisation, data mining, computational time complexity of evolutionary algorithms, complex adaptive systems, and real-world applications. Prof. Yao works closely with various industrial partners in Europe, including BTEExact, Marconi, HP Labs and Rolls Royce in the UK, Honda Research Institute (Europe) and DaimlerChrysler in Germany, Thales Research and Technology in the UK and Netherlands, etc. He is the Director of The Centre of Excellence for Research in Computational Intelligence and Applications (CERCIA) (www.cercia.com), which is set up to do knowledge transfer/sharing between the School's Natural Computation Group and industry.