A Path to the Arrow-Debreu Competitive Market Equilibrium

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Abstract : We present polynomial-time interior-point algorithms for solving the Fischer and Arrow-Debreu competitive market equilibrium problems with n players. The algorithm for solving the Fischer problem is a modified primal-dual path-following algorithm, and the one for solving the Arrow-Debreu problem is a primal-based algorithm. Both of them have the arithmetic computation complexity bound of $O(n^4\log(1/\epsilon))$ for computing an ϵ equilibrium solution. If the solutions are rational numbers and their bit-length bounded by L, then the complexity to generate an exact solution is $O(n^4L)$ which is in line with the best complexity bound for linear programming of the same dimension and size. We also present a continuous path leading to the set of the Arrow-Debreu equilibrium, similar to the central path developed for linear programming interior-point methods. This path is derived from the weighted logarithmic utility and barrier functions and the fixed point theorem. The defining equations are bilinear and possess some primal-dual structure for the application of Newton's path-following method.