

Homework #7

Deadline: Friday, 26 October 2012, 18:00

Question 1 (10 marks)

Recall the distributed resource allocation framework discussed in class, where agents negotiate a sequence of individually rational deals. Without restrictions on the structure of deals, such sequences are known to always converge to an optimal allocation (here, an allocation that maximises utilitarian social welfare), but with structural restrictions this may not be so. The purpose of this exercise is to investigate what happens when all kinds of (individually rational) deals are allowed, except those that involve the complete set of agents within a single deal. From a result cited in class we know that convergence will not hold anymore in this case. The question is whether convergence can be maintained if we restrict the range of possible valuation functions. Check what happens if all agents have valuation functions that are (a) supermodular, (b) submodular, or (c) both super- and submodular.

Question 2 (10 marks)

Describe a discrete procedure for dividing a cake between four agents that guarantees that each agent believes they received at least $1/6$ of the cake and that uses only three cuts. (Additional marking queries as well as moving knives are not allowed.)

(Adapted from J. Robertson and W. Webb, *Cake-Cutting Algorithms*, A.K. Peters, 1998.)