

CUNY – Data Science

Game Theory and Social Choice

Homework 2 – Games

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- 1) **Referring to the Nash bargaining paper. Suppose two agents are bargaining to pick a point in the set  $\{(x, y) | (0 \leq x, y) \wedge (x+y \leq 2)\}$  Then the Nash bargain must lie on the line  $x + y = 2$ . why?**

Say A and B are true values of variables  $x$  and  $y$ . Since both  $x$  and  $y$  are positive and their sum is less than or equal to two, A and B both need to exist within the triangle (0,0) (0,2), and (2,0). The Nash bargain must lie on the line  $x + y = 2$ . Because if it does not lie on the line  $x + y = 2$ , the full benefit of the bargain is not being maximized, and either A or B still have the option to move up or to the right and increase their benefit. The outcome of the Nash bargain is the outcome with optimal gain so the Nash bargain must lie on the line  $x + y = 2$ .

**The Nash solution is  $x = y = 1$ . By symmetry, or by finding the maximum of  $x(2 - x)$ .**

**What happens if they are choosing a bargain instead from the set  $\{(x, y) | (0 \leq x, y) \wedge (x + 2y \leq 3)\}$ ?**

To optimize full benefit the Nash bargain must lie on the line  $x + y = 3$ . Since  $x$  and  $y$  are both positive numbers and  $x + 2y \leq 3$ , some possibilities for  $x$  and  $y$  are or  $x=0$  and  $y=1.5$   $x=1$  and  $y=1$ ,  $x=3$  and  $y=0$ . The optimal solution is  $x=3$  and  $y=0$  because the outcome of the bargaining will be the outcome that maximizes the product of the two gains.  $0+3=3$  and any other option is less than 3 since  $x$  and  $y$  are both positive numbers.

- 2) **Ann has preferences among the three flavors of ice cream, Chocolate (C), Vanilla (V) and Strawberry (S). Someone knowing Ann's preferences assigns utilities of 1,3,7. Someone else assigns utilities of 1,9,5 and someone else assigns utilities of 3, 11, 7. Which is the odd one out?**

1,3,7 is the odd one out because that utility which was assigned by the person who knows Ann's preferences gives Strawberry the highest ranking, while the other two utilities which were both assigned by two different individuals who do not know Ann's preferences give Vanilla the highest ranking. Additionally, 1,9,5 and 3,11,7 are simply two digits apart from each other. Add two to each value in 1,9,5 and the outcome is 3,11,7 so these rankings are the same in distance, while 1,3,7 is not.