UCSC Evolutionary Game Theory Class

Winter 2015.

Midterm Exam

Instructions. Write your answer to each question on a separate piece of paper. Write your name at the top of each page. Points as marked. Generous partial credit for **brief** answers that display relevant knowledge but are incomplete.

1. Using single digit integers, e.g., $-1, 0, 1, 2$,

   a. write down a HD-type 2x2 fitness matrix with 0 entries on the main diagonal.[8 points]

   b. write down a Co-type 2x2 fitness matrix, again with 0 entries on the main diagonal.[8 points]

   c. write down a DS-type 2x2 fitness matrix, with (you guessed it!) 0 entries on the main diagonal. The top row should dominate the bottom row.[8 points]

2. Using your answers to the preceding question, write down a 3x3 fitness matrix whose three (2x2) edge games are HD, Co and DS.[10 points]

   a. Write down the three Delta functions in terms of the state variable $s = (s_1, s_2, s_3) = (x, y, 1 - x - y)$.[10 points]

   b. Is there an interior equilibrium? Find it or show that none exists. [10 points]

   c. Explain how you would determine the stability of the interior equilibrium if it exists and if you had plenty of time. [5 points]

   d. Explain how you would find all stable steady states under replicator dynamics for the present example if you had plenty of time.[5 points]

   e. For extra credit, find all stable steady states and their basins of attraction, if time does permit. [5 points max]

3. Beginning with the DS-type 2x2 matrix from Problem 1c above,

   a. add a single digit integer (e.g., -3) to both entries in one of the columns so that the new matrix defines a PD-subtype game.[8 points]

b. find a different single digit integer (and possibly a different column) so that adding it to both entries in one of the columns instead defines a LF-subtype game. [8 points]

c. Argue that monotone dynamics for all 3 games (the original one from 1c above plus the other two from a and b in the present problem) are identical, but the implications for population fitness are completely different. Hint: compare mean fitness functions. [5 points]

4. a. Describe a situation (biological, social or virtual) where the HD game might approximate the key strategic interaction.[5 points]

   b. Then explain exactly how the shares s_H and $s_D = 1 - s_H$ should enter the payoffs or fitnesses.In particular, do pairwise encounters actually occur at random? Or do individuals "play the field"? Or are there only local interactions? Can assortativity (or an adjustment matrix) play a role? Your answer should demonstrate your familiarity with these concepts.[10 points]