Doves and Hawks – Notes

This session is designed to last about 50 minutes. The timings are approximate and will vary from group to group. You may find it easier to change the 'minutes elapsed' to the actual times of your presentation.

Required Knowledge:

- This lesson is based on the prisoner's dilemma. You can find out more about the prisoners dilemma here: https://en.wikipedia.org/wiki/Prisoner%27s_dilemma

Resources:

- PowerPoint
- Student workbook
- Split/steal cards
- Dove/Hawk cards
- Coins

Objectives of session:

- To understand and analyse a mathematical game.

Time	Activities/Questions/Points to make	Resources
0	Starter: One of the most recent uses of the prisoner's dilemma was in the TV show golden balls. It ended with a split or steal game. Two players had a prize fund. They individually chose to split (share) the money, or steal (to take the whole amount themselves). If both players split, they shared the money equally, if one splits, and one steals then stealing player wins all the money. If they both steal they end up with nothing. You can watch a clip here https://www.youtube.com/watch?v=cOH65fz-Dt8	PowerPoint. Hyperlink to the youtube clip.
5	Pose the question: Which is the best strategy to win? What would you do? Give each student a pair of split/steal cards. You could ask students to write split/steal on mini white boards if available. Ask the students to play the game with a partner 10 times. They can record the results in their workbook. (p2) Discuss conclusions with the class. What do you notice about how you both play? Ask the students to fill in the payoff matrix in their book. Make sure they are confident with how the payoff matrix works. Suggested conclusion: ▪ Both players are most likely to steal for exactly the same reasons. The players always choose (steal, steal) as their strategy. ▪ However, a strategy of (split, split) is better for both players. This is a conflict between *individual rationality* and *group rationality*: people often act only in their own self-interest, rather than for the group good.	Split/steal cards, or mini white boards. P2 of the student workbook.
20	We are now going to move on to look at how this works in nature, using the example of Doves and Hawks. There is a cartoon you may wish to show on the PowerPoint which is relevant to this topic. The next few slides on the PowerPoint describe the problem. (slides 15-18) Ask the students to fill in their payoff matrix in their workbook based on this game. A suggested solution is given on slide 20. Ask the students to play this game.	Dove/ Hawk cards. P3 of the workbook. Coins

	You can use the dove/hawk cards to allocate a role to each student, or you can allocate however you want. It is essential, however, that the students do not know the roles of others. Aim for a 50/50 split of doves and hawks. Students need to walk around. When they meet someone that person will either be a hawk or a dove. If they are the same then flip a coin to decide who wins the encounter. Walk off and meet someone else and repeat. They can write the results in their workbook.	
40	<u>Discussion.</u> Pose the question: If we want to maximise the number of points we have, is it better to be a hawk or a dove? To discuss this ask the students to think about the average points in different circumstances. 1. What would happen if we only had doves? In this case nobody ever gets hurts, there are just prolonged periods of posturing, where one dove eventually wins and one loses. In this case the winner gets 50 points, but is penalised -10 (for wasting time), so scores 40 points. The loser is penalised -10 for time wasting. On average we can expect an individual to win half of the contests and lose the other half, so the average number of points is 15 (average of 40 and -10). 2. What would happen if we had only doves but we introduce one hawk? In every fight they meet a dove and always win, so score 50 points, which is their average pay-off. The average score of the hawk is better than the dove's average score of 15, so now the hawk's genes spread rapidly, but now a hawk can no longer guarantee meeting a dove. 3. What would happen if we only had hawks? Then a hawk always meets a hawk. One of them is seriously hurt, scoring -100, the winner gets 50. So the average score is now -25. 4. What would happen if we had only hawks then introduce a dove? The dove always loses, but never gets hurt. The dove's average score is 0, which is better than the average score of the hawks, which is -25. So the doves' genes spread through the population. <u>Conclusions</u> Based on this discussion ask for the students conclusions. Suggested conclusion: If the population consists of all doves then the introduction of a hawk causes the population of doves to decrease. On the other hand, if the population consists of only hawks, then the introduction of a dove causes the population of hawks to decrease. This means at some point in the middle, where there is a mixture of hawks and doves, the number of hawks and doves remains the same. To put it another way, the average number of points earned by the doves and hawks is the same.	PowerPoint slides
50	<u>Plenary.</u> Ask the students to discuss the solution to the prisoner's dilemma. Slide 29-31.	PowerPoint slides