Game Theory

Activity Instructions

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B all of the students together in the same space. A brief ir t is best to get the students started on the first activity as q e main discussion and learning about game theory takes p e activity.

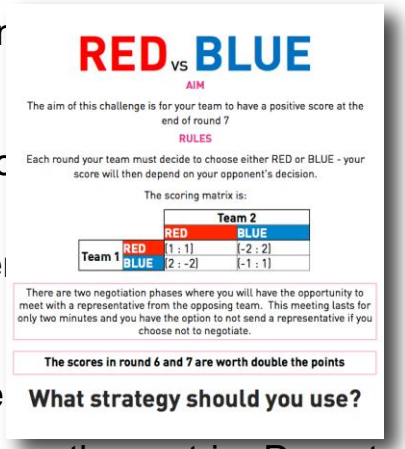
Introduce the 'lesson' as two exciting activities looking at game theory; that they will need to work together and sometimes compete; but most of all they will need to think carefully about the decisions they are taking and why.

Activity 1 (duration: 60-90mins)

Without explaining the activity further, split the group into two halves. One half should depart to another area/room. Once there, divide each of the groups into teams. Each team needs to play partnered with a team in the other room. Usually 4 or 5 teams in each room will work well, as exemplified in the table below.

Team		Team
1	*Plays*	6
2	*Plays*	7
3	*Plays*	8
4	*Plays*	9
5	*Plays*	10

Give each team at least one instruction sheet (pictured). Tear
read through and discuss what they think they have to do. It is
quite quickly into playing the game as it really comes to life onc


RED vs BLUE

AIM

The aim of this challenge is for your team to have a positive score at the end of round 7

RULES

Each round your team must decide to choose either RED or BLUE - your score will then depend on your opponent's decision.

The scoring matrix is:

		Team 2 RED	Team 2 BLUE
Team 1	RED	[1 : 1]	[-2 : 2]
	BLUE	[2 : -2]	[-1 : 1]

There are two negotiation phases where you will have the opportunity to meet with a representative from the opposing team. This meeting lasts for only two minutes and you have the option to not send a representative if you choose not to negotiate.

The scores in round 6 and 7 are worth double the points

What strategy should you use?

They should not be given any advice beyond explaining to the
to achieve their objective. Their entire goal of the next 45
achieve a positive score, doing whatever it takes within the
achieve this. You can also explain the scoring, which is as per the matrix. Do not highlight that the game is co-operative (as in both teams can win), as you want to see if they can realise this themselves.

Game procedure:

1. Hand out instructions sheets and explaining scoring to teams in both rooms. Explain they are playing for points ‘against’ a team in the other room.
2. Explain that there are 7 rounds but the last 2 rounds count for double points. Explain also that a team representative can meet the other team after rounds 2 and 5.
3. For each round, note the scoring on the interactive score sheet at the front of the room.
4. After rounds 2 and 5 ask teams whether they would like to meet the other team, and if both teams do want to meet then 1 person from each meets for a maximum of two minutes at a neutral location.

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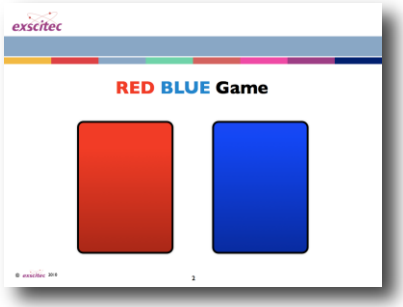
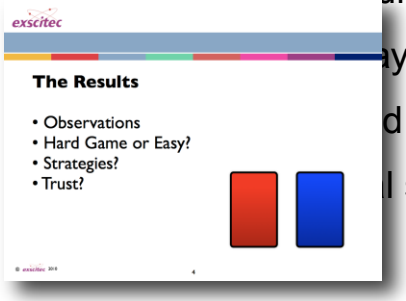


Just have this slide up when you introduce the game

This is a copy of the interactive score sheet, which appears as a separate file on the CD.

After the game has finished, bring the group back together. There may be a lot of noise and discussion as the students use the time to talk to the opposing groups about the activity. If this is getting too lively, it can be a good idea to point out that the game is now over (if groups are unhappy with having been lied to or let down!) or that there is so much good discussion that you want to let the whole group hear it.

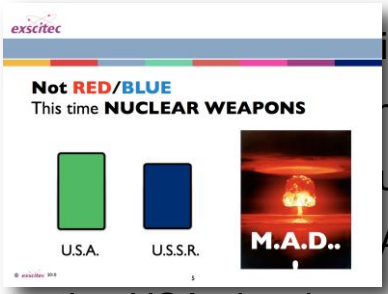
Once the group is ready, ask for comments from each team about their strategy: what worked, what didn't and why. Ask the group whether the game was easy or



y easy, reflect on how many groups actually achieved their

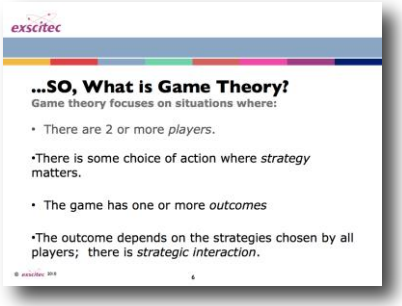
d perhaps be very few). Ask them what factors made the

l separation, competitiveness, etc).

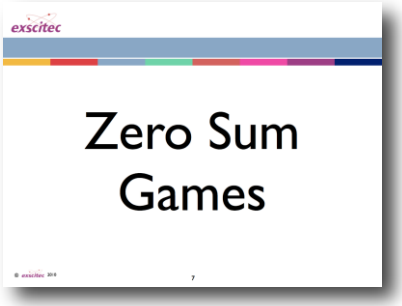


iscuss other situations which involve the same decisions as his example is about the nuclear arms race after World War uperpowers are trying to make sure that the other does not Ask for responses on what the USSR should do to respond to the USA development of Nuclear Weapons (i.e. get some themselves, and probably a few more to give them the upper hand). Then discuss how this leads the USA to acquire more, etc.

There are many other examples of this situation, which is the classic 'prisoners'

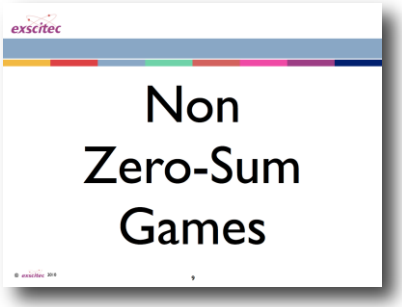


This slide gives a definition of game theory. Make the point that game theory is not really about 'games' although it can be. It covers situations in economics, industry, politics and almost every situation in life. You could mention John Nash here, and the fact that he won the Nobel Prize in the 1970s for his work in game theory



The next few slides explain the difference between zero-sum, and non zero-sum games. A zero sum game is one where one player's loss is another player's exact gain. I.e. the net change is always zero. The next slide

This is an example of a zero-sum game. If a cake is shared between two people (here red and blue) then if the blue person gets a bit more, then red will lose this equal amount. You can ask students to talk about what strategies they have used to make sure that two people



This is the other possibility, where one person's gain is not equal to another's loss. The red blue game is an example of this type of game since if both players play red, and then one switches to blue, he will gain 1 point whereas the other player will lose 2

So, the red blue game is in fact an example of a classic problem in game theory called the Prisoner's Dilemma. This slide facilitates an explanation of the problem and helps students understand why it is so hard to avoid both players choosing

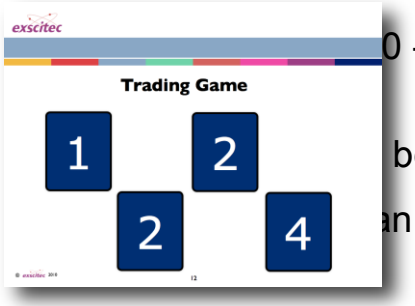
resent by telling a story:

ommitting a robbery and they were caught! They were both

y locked up separately?- to make sure they can't agree their

o look at what options Andy has, and what he should do in order to spend the least amount of time possible in prison. In other words, we are going to set morality aside and focus on the mathematically best strategy!

Andy speaks to his solicitor and decides that he has two options - he can stay silent or he can betray Bob. [Talk through the results of each choice for Bob staying silent or betraying him]. Now we will think about what Andy should do. If Bob stays silent what should he do? (Ans: betray Bob). If Bob betrays him, what should Andy do? (Ans: Betray Bob). So you can see that whatever Bob does, Andy is better to betray him, so overall this must be what Andy chooses to do. However, this is also true for Bob (you can talk through it again) so Bob also chooses to betray. This means that



0 - 40 mins)

be together, in the same room for this activity, however, it can n also work to separate students if you have the staff / space.

1. Split the group into teams of four (make some teams of five if need be)
2. Distribute cards 1,2,2,4 to each team (for teams of five players add an extra 2 card)
3. Explain there will be x number of rounds (as many as you like which is time dependent - each round takes approximately 10 minutes) and that the objective of the game overall is to make as much money as possible. Tell students to focus entirely on achieving the best outcome for themselves.
4. Each round lasts two minutes.
5. Each round students have £12 (i.e. an extra £12 per team each round). This

7. Deals are only possible between players where the total of the points that they hold is a majority of the points available

8. Ask students to record their individual results for each round on the score sheets.

In a group with four players there are points cards worth 1, 2, 2 and 4 this means there is a total of 9 points available. To make a deal, two or more players must combine their cards together so that they have more points than everyone else

le waiting until the last second, and you can discuss the y bidding strategy.

he varied nature of game theory and its amazing application across many areas of life. Reflect on things that the students have picked out during the challenges! Ask students to think about what has changed, if anything, about their opinion of mathematics and its applications.