6CCS3AIN & 7CCSMAIN, 2018, Tutorial 05 (Version 1.0)

1. For each of the interaction scenarios below:

   (i) Determine which strategies are dominated (and explain why)

   (ii) Use the idea of deleting strongly dominated strategies to simplify the scenario where appropriate.

   (iii) Identify any Nash equilibria.

   (iv) Identify the Pareto optimal outcomes.

   (v) Identify the outcome that maximises social welfare.

(a)

i \ j	L	R
U	3 3	4 2
D	1 1	2 4

(b)

i \ j	L	R
U	-1 -1	2 1
D	1 2	-1 -1

(c)

i \ j	L	R
U	3 3	1 1
D	4 2	2 4

2. In the lecture we talked about the Prisoner's Dilemma. Another well studied game is the Stag Hunt. Here is the story which describes what it captures:

   > A group of hunters goes stag hunting. If they all stay focussed on the stag, they will catch it and all have a lot of food. If some of them head off to catch rabbits, the stag will escape. In this case the rabbit hunters will have some small amount of food and the (remaining) stag hunters will go hungry. What should each hunter do?

   As a two player game (two hunters, each of which can choose between Rabbit and Stag) this is:

i \ j	R	S
R	2 2	1 3
S	3 1	4 4

   Note that S is often interpreted as "cooperate" in the Prisoner's dilemma sense, and R as "defect". In that sense, mutual cooperation (both hunters choose S) is the best outcome.

   What are the Nash equilibria and Pareto optimal outcomes?

   How do the outomes of this game compare with those of the Prisoner's dilemma?

3. Another canonical 2 player game is "chicken", probably best explained in *Rebel without a Cause*:

   https://www.youtube.com/watch?v=u7hZ9jKrwvo

   Chicken has a payoff matrix like:

		j S	J
i	S	1 1	2 4
	J	4 2	3 3

where J denotes "jump" (cooperate in Prisoner's dilemma notation) and S denotes "stay in car" (defect in Prisoner's dilemma notation).

What are the Nash equilibria and Pareto optimal outcomes?

How do the outomes of this game compare with those of the Prisoner's dilemma?

4. For the optional computational part of the tutorial.

   On KEATS you can find the file `intro.py`. This is illustrates the cabailities of the Python package called `Nashpy`:

   `https://nashpy.readthedocs.io/en/stable/index.html`

   `Nashpy` provides tools for handling two player games. You can install it using:

   pip install nashpy

   Anaconda includes `pip`, which is a package manager for Python, as well as its own package maanger `conda` so if you have Anaconda installed[1] installation is easy. Otherwise, I'm afraid that you are on your own.

   With `Numpy` installed, you can run `intro.py` with:

   python intro.py

   from the command line. As set up, this loads up *Rock, paper, scissors*, *Matching pennies*, and *Prisoner's dilemma* and shows what `Nashpy` can do, extracting player utiities under specific strategies and searching for Nash equilibria.

   Now try using `Nashpy` to check your answers to part (iii) of Q1 (a)–(e). Note that where there are mixed strategy Nash equilibria, `Nashpy` will find those also.

5. Since `Nashpy` makes it possble to search through the outcomes of the games, you should be able to write code that:

   (a) Identifies dominated strategies.

   (b) Identified Pareto optimal outcomes

   (c) Identifies outcomes that maximise social welfare.

   Use your code to check your answers to parts (i), (iv) and (v) of Q1 (a)–(e).

6. Write code that uses `Nashpy` to search for pure strategy Nash equilibria.

[1] If you don't have Anaconda installed, you can install that from `https://www.anaconda.com/download`. If you are planning to do much with Python, Anaconda is pretty handy to have since it makes it easy to install new packages.