AN UNDERHAND DEAL

After having briefly introduced Game Theory...

Knowing that a criminal group possesses disruption capabilities able to relevantly harm it, a nation recovering from a difficult conflict is considering to negotiate an unofficial deal with the group. Substantially, the nation promises to turn a blind eye towards some of the criminal group's activities, and in exchange the group will not act in ways that would hinder the nation's recover.
The idea behind this bargain is that both stakeholders would have interest in respecting it, for the sake of reliability and other reasons. But, in fact, there are not guarantees in that sense, at least *a priori*.

Let us consider all the set of possible choices: the nation can either cooperate, by actually prosecuting less the criminal group's activities, or defect, by continuing their repression of these activities and the group responsible for them. Concurrently, the criminal group can either cooperate, by stopping the harmful actions, or defect, by continuing them.
We suppose that the relative outcomes are as follows:

- Both the nations and the criminal group cooperate: this is a good outcome for both the stakeholders. The nation can claim to successfully proceed with the support operations, and the criminal group can pursue its interests by keeping a low profile, without having to take dangerous actions to defend its business.
- The nation cooperates, but the criminal group defects: this is a neutral outcome for the nation, since they right away renounce to prosecute the criminal group, but they can resume just after realizing the counterpart's defection. For the group, the outcome is neutral too: if on the short term they obtain something at cost zero, on the long term the defection prevents the possibility of negotiating similar bargains in the future.
- The criminal group cooperates, but the nation defects: this is a very bad outcome for the criminal group, since it renounces to an important part of its business, while obtaining basically nothing in exchange. For the nation, the outcome is neutral, for the same reasons as where the situation was reversed.
- Both the nation and the criminal group defect: this is a bad outcome for both the stakeholders, since they basically tried to fool the counterpart, but either part gave a try, and so they simply lost time in negotiating futilely.

This results in the table:

	C cooperates	C defects
N cooperates	3, 3	2, 2
N defects	2, 0	1, 1

Task 1: try to play in this situation. Which outcome will result by playing? (*use of Wooclap for data*

collection)

Introduction of Nash equilibria, then Task 1 is performed again, in order to detect possible differences in light of having introduced that theoretical tool.

Task 2: an investigative journalist comes into possession of documents that present evidence of the negotiation; if they are made public, the nation would have serious disadvantages in continuing the cooperation, since the public opinion would likely disapprove a bargain of that kind.
This causes changes in some outcomes: if both the nation and the criminal group cooperate, then the outcome for the nation is "bad" instead of "good", while if the nation cooperates but the criminal group defects, then the outcome for the nation is "very bad" instead of "neutral".
Construct the table relative to this modified setting, play with it, and comment the results (also in relation with the outcomes of the previous Task).

Task 3: is it possible to modify the outcomes in a way such that a different number of Nash equilibria, compared to those found in the previous items, is present?
Try to tune the payoffs, and give contextualized motivations for which it could happen, like we motivated the modifications in Task 2 with the investigation of the journalist.
You can help yourself with the following system of interactive components:

	C cooperates	C defects
N cooperates	$N =$ [ ] , $C =$ [ ]	$N =$ [ ] , $C =$ [ ]
N defects	$N =$ [ ] , $C =$ [ ]	$N =$ [ ] , $C =$ [ ]

Compute! Rese...

- N cooperates, C cooperates [ ] a Nash equilibrium and [ ] Pareto optimal.
- N cooperates, C defects [ ] a Nash equilibrium and [ ] Pareto optimal.

- N defects, C cooperates [ ] a Nash equilibrium and [ ] Pareto optimal.
- N defects, C defects [ ] a Nash equilibrium and [ ] Pareto optimal.

Task 4: does a mixed equilibrium exist in the table relative to the previous item? In the case, find and interpret it.

Task 5: explore mixed equilibria in such situations, by means of the following system of interactive components:

	C cooperates	C defects
N cooperates	$N =$ [ ] , $C =$ [ ]	$N =$ [ ] , $C =$ [ ]
N defects	$N =$ [ ] , $C =$ [ ]	$N =$ [ ] , $C =$ [ ]

Compute! Rese...

Let us suppose that C "cooperates" with probability p; then, N expects to obtain [ ] by "cooperating", [ ] by "defecting".

Player N would choose randomly if they are equal, that is, if the first degree equation [ ] is verified.

Its solution, that is the probability that C "cooperates" in a mixed strategy equilibrium, is [ ] .

Analogously, let us suppose that N "cooperates" with probability *q*; then, C expects to obtain

[ ] by "cooperating", [ ] by "defecting".

Player C would choose randomly if they are equal, that is, if the first degree equation

[ ] is verified.

Its solution, that is the probability that N "cooperates" in a mixed strategy equilibrium, is

[ ] .

SOLUTIONS

Task 1: the only Nash equilibrium is "N cooperates, C cooperates", with payoffs (3,3).

Task 2: the payoffs in the first row become respectively (1,3) and (0,2). As a result, the only Nash equilibrium changes in "N defects, C defects", with payoffs (1,1).

Task 3: yes, for example by averaging the two tables relative to the previous tasks. This can be motivated with uncertainty either in the possession of documents, or in disapproval from public opinion.

Task 4: With the averaged table, having (2,3) and (1,2) in its first row, there are mixed equilibria for C playing each strategy with probability 1/2, while for N there is complete indifference.