Political science. Master level.
STV-4217B Rational Choice Models and International Conflict
Fall 2021.

Please answer all questions.

I (15%)

Explain *briefly* the meaning of the following game-theoretical concepts:

(a) Decision node
- A point in the game tree where a player must make a decision.

(b) Strategy
- A plan that prescribes an action for each of a given player's information sets in the game.

(c) Weakly dominated strategy
- A strategy that is strictly worse than another strategy in one contingency and not better in any contingency.

(d) Common knowledge
- A piece of information is common knowledge if both (all) players know it, know that all players know it, know that all players know that all players know it, and so on *ad infinitum*.

(e) Information set
- An information set conveys the information a player has about previous moves in the game when the player concerned must make a decision.

(f) Dynamic game
- A game where at least one player can observe and react to another player's action.

(g) Perfect information
- The history of the game is always common knowledge.

(h) Complete information
- The players' strategic types (strategy sets and preferences) are common knowledge.

(i) Subgame
- A subgame starts with a singleton, encompasses all subsequent decision nodes, and does not cut across any information set.

(j) Bayesian perfect equilibrium
- Two definitional criteria: 1. A set of strategies that are best responses to each other for every subgame, given the players' beliefs. 2 The players' beliefs are updated along the equilibrium path, using Bayes' rule (wherever possible).

II (15%)

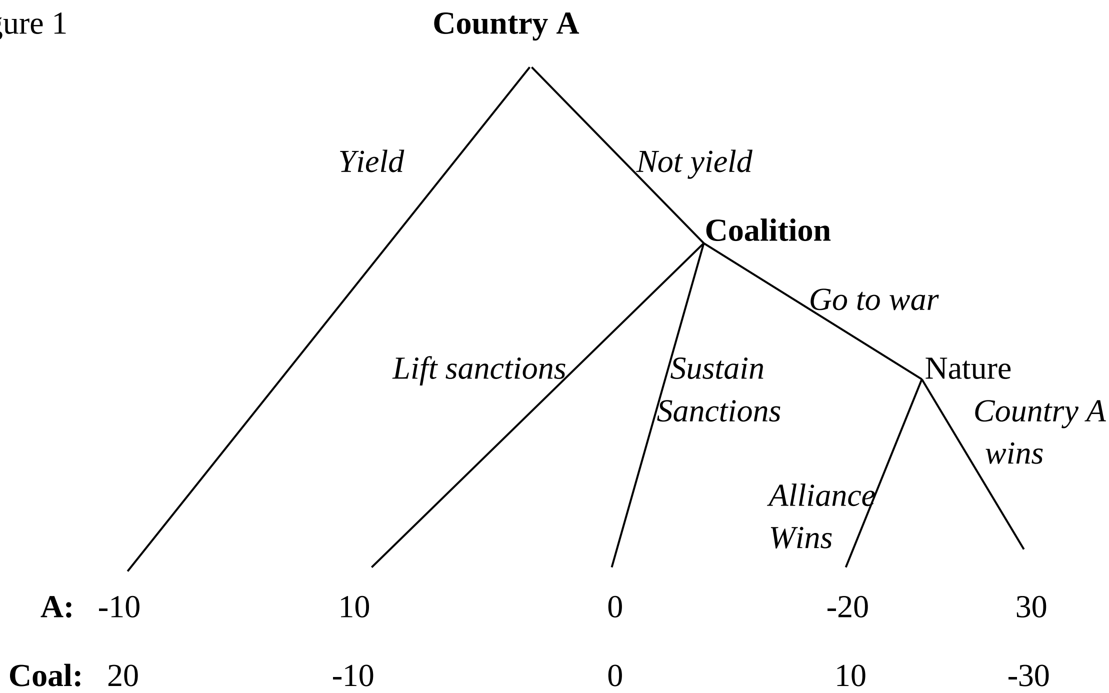
- Define Pareto optimality and suboptimality
  - An outcome is Pareto optimal if no other outcome exists such that at least one player is better off in this other outcome and no player is worse off.
- Is nuclear war Pareto optimal or suboptimal?

    - Nuclear war is severely suboptimal, because of all the damage and human suffering it causes. At least in principle, the resulting outcome could have been obtained through negotiations, thereby avoiding all this damage and suffering.
- Is successful nuclear deterrence Pareto optimal or suboptimal?
    - This question is somewhat tricky. If the same result could be obtained with less resources spent on (nuclear) weapons, then the outcome would be suboptimal. If not, it would be Pareto optimal.
- Are unsuccessful trade sanctions Pareto optimal or suboptimal?
    - Unsuccessful trade sanction are suboptimal, because trade sanctions hurt both sides (and unsuccessful sanctions do not make any difference to the outcome).
- Are successful trade sanctions Pareto optimal or suboptimal?
    - Even successful trade sanctions are suboptimal. Both sides would be better off if the target were to yield *without* sanctions being imposed.

III (35%)

Country A is an autocracy facing a rebellion. The rebels are strong enough to cause serious civil unrest, yet unable to topple country A's dictator without external support. A coalition of other countries have imposed economic sanctions on country A, threatening to sustain them until country A's leadership surrenders the power to the rebels. Country A must then choose between yielding and not yielding to the sanctions. If it yields, the (successful) sanctions are lifted, and the game ends. If it does not yield, the coalition must either (1) sustain the sanctions and go to limited war (impose a no-fly zone and bomb selected targets in country A to protect and support the rebels), (2) sustain the sanctions without going to war, or (3) give in and lift the (unsuccessful) sanctions. If the coalition goes to war, the coalition wins with probability q and country A wins with probability 1-q. The situation is depicted in figure 1.

Figure 1



Key: A = country A, All = alliance

(a) Find the game's subgame-perfect equilibrium for different values of q.
There are three subgame-perfect equilibria in the game, depending on the size of q:
- If q<1/5, then Country A yields, anticipating that the coalition would otherwise go to war (and A does not want to risk a war, given that the probability of winning is so small).
- If 1/5 < q < 1/4, then Country A does not yield, and the Coalition goes to war (both sides find their probability of winning acceptable). Nature decides which side wins the war.
- If q > 1/4, then Country A does not yield, and the Coalition sustains the sanctions (without going to war).

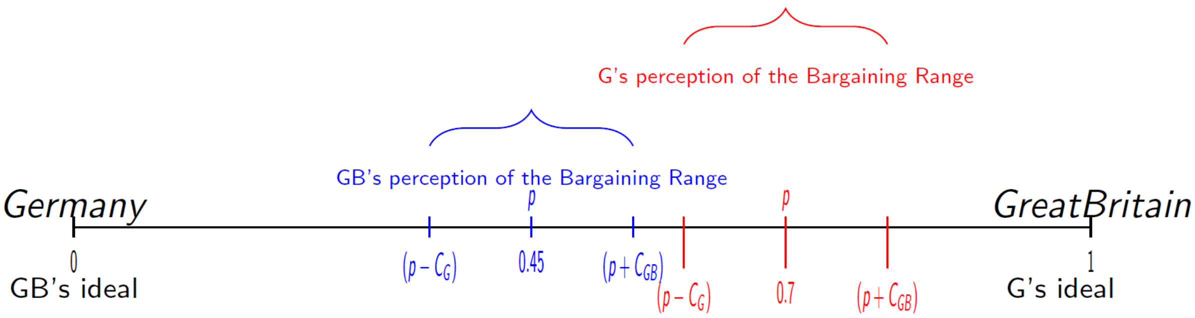
(b) Under what conditions (if any) will the outcome be that country A yields?
- Country A yields if q < 1/5.

(c) Under what conditions (if any) will the outcome be that country A does not yield, while the Alliance sustains the sanctions?
- This outcome occurs if q > 1/4.

(d) Under what conditions (if any) will the outcome be that country A does not yield, while the Alliance lifts the sanctions?
- This outcome is not a subgame-perfect equilibrium outcome for any values of q. To lift the sanctions if A does not yield is a weakly dominated strategy for the Coalition.

(e) Under what conditions (if any) will the parties end up waging a war?
- They end up waging a war if 1/5 < q < 1/4.

IV (35%)



1. Explain why war is possible, given the nature of this geometric model. Discuss the role of beliefs and information.

War is possible because there is no bargaining space. As portrayed in the Figure below, both Great Britain and Germany believe that they will win a war. The costs of war for both parties are such that there is no overlap in each country's perception of the bargaining range.

For this to occur there must be a problem of incomplete information. Both countries believe that they could win a war. Germany perceives that it would win 70% of the time. Great Britain believes that Germany has a 45% chance of winning (or that Britain has a 65% chance).

As portrayed in this figure, the costs of war are not uncertain. Only the chances of winning (p) is uncertain.

2. Using the geometric model above, show how increasing the costs of war could reduce the prospects for war.

In words, if the costs of war were greater, then ($p + C_{GB}$) would shift to the right and ($p - C_G$) would shift to the left. The greater the costs of war the greater the shift. These shifts would enlarge the perceived bargaining ranges for both countries. The larger the costs of war, the greater the degree of overlap between the two bargaining ranges. So, despite incomplete information and very different beliefs about who would win, the chances of war are reduced due to the overlapping bargaining ranges. The more the costs of war increase, the greater the size of the mutual bargaining range. A large bargaining range will decrease the chances of war.

I do not believe anyone could do this, but Figure 2 below shows how expanding the costs of war, leads to larger bargaining ranges. The two countries believe that there are different chances of winning and therefore they believe in different bargaining ranges. But because the perceptions of the bargaining ranges overlap, there exists a common bargaining range.

Figure 1.

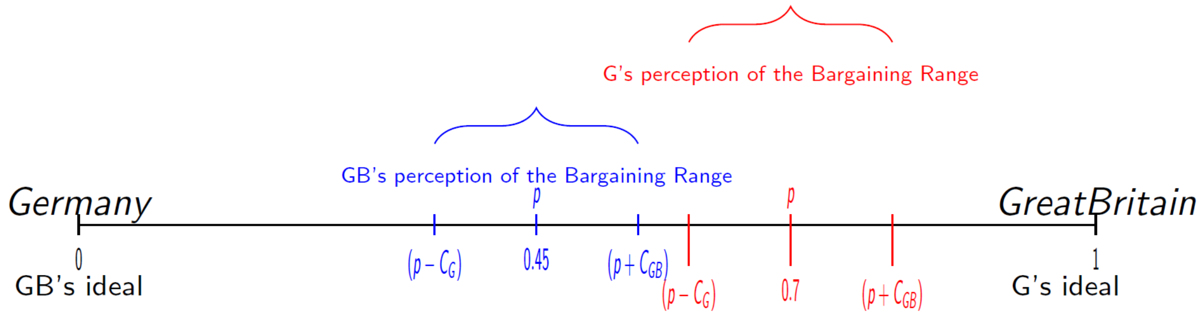
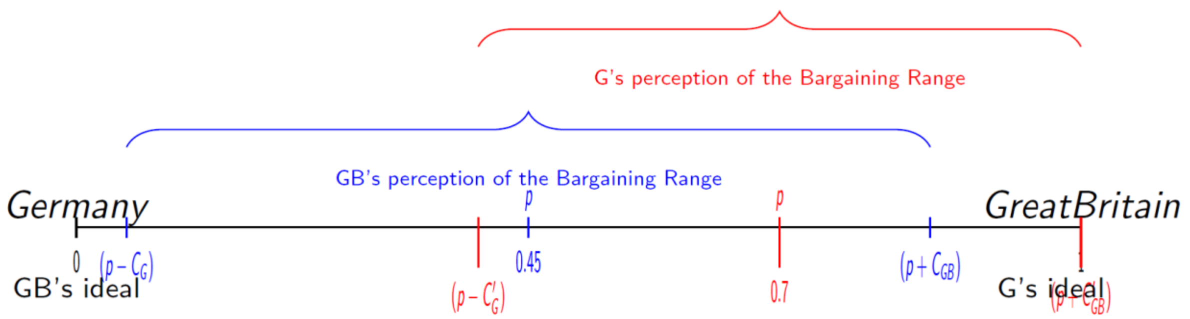
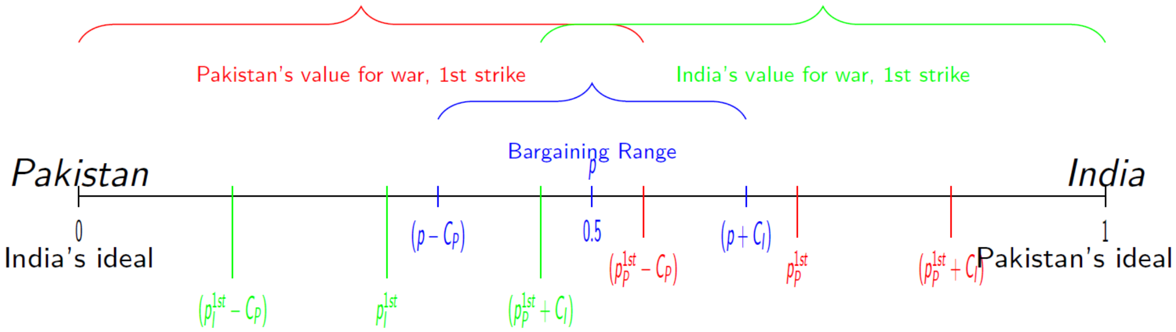


Figure 2.



3. Draw your own geometric model, show how a first-strike advantage makes war possible. Discuss how preemptive war can be a coordination problem.



This figure shows both countries with first-strike advantage. The bargaining range disappears. (One could also draw the model such that there is no bargaining range when only one country has a first-strike advantage).

When the combined states' (or a single state's) first-strike advantages are greater than the costs of war, the bargaining range is empty and no self-enforcing peaceful outcomes exist. When $p_f - c_P > p_s + c_I$ or $p_f - p_s > c_P + c_I$, the bargaining range is empty and no self-enforcing peaceful outcomes exist.

- Nonetheless, bargains do exist. Both sides would prefer peace rather than going to war: since both states cannot enjoy the advantage of going first, mutually advantageous agreements are always available in principle.
- The problem is that these bargains are not enforceable: the parties cannot credibly commit to the bargain when first-strike advantages exist.
- Still, bargains exist that both sides would prefer to war: since both states cannot enjoy the advantage of going first, agreements that both sides prefer to fighting are always available in principle.

If both states possess a first-strike advantage, the face a coordination problem. This can be shown in a matrix form game:

		Player B	
		Attack	Defend
Player A	Attack	0.3, 0.3	0.4, 0.2
	Defend	0.2, 0.4	0.5, 0.5

These pay-offs are derived as follows: If neither attack, the payoff is 0.5. The cost of war (when there is an attack) is 0.2. The payoff for first-strike advantage is 0.6. If both attack, they both get 0.5-0.2=0.3. If they attack first, they get 0.6-0.2=0.4. If they are attacked, they get 0.2.

{Defend; Defend} is an equilibrium. {Attack; Attack} is also an equilibrium. If one side believes the other will attack, they should attack. The worst outcome is to defend when the other attacks. This is a coordination problem.