

6 To Stand or Not to Stand, that is the Question (25 points)

In a scene at the end of *The Princess Bride* (same movie as the poison scene from lesson L01-1), the hero, Wesley, confronts the evil Prince Humperdinck. This interaction can be modeled as the following game. Wesley can either be strong or weak, as randomly picked by nature with equal probability. Wesley, knowing if he is strong or weak, can then choose to stand or continue lying on the bed. The prince observes this decision but does not know Wesley's type and chooses to fight or surrender. The prince can beat a weak Wesley (Wesley was "mostly" dead only a few hours earlier) and can really beat up a weak Wesley who stays in bed. If a weak Wesley stands and the prince fights, then the base payoffs are 1 for the prince and -1 for Wesley. If Wesley stays in bed, then the prince gets 2 and Wesley still gets -1. If Wesley is weak and the prince surrenders, regardless of whether Wesley has stood or not the base payoffs are 1 for Wesley and 0 for the prince. A strong Wesley, however, will destroy the prince and enjoy doing it should the prince try to fight. It is easier for Wesley to beat the Prince if he stands, though, so in that case he gets a payoff of 3 while the prince gets -2. If Wesley stays in bed and the Prince chooses to fight, the payoffs are 1 for Wesley and -1 for the prince. In the event that the prince chooses not to fight, Wesley gets 2 if he stands and 1 if he stays in bed while in either case the prince gets 0. The final complication to the payoffs is that if Wesley is weak, standing costs him some extra amount c , while it costs a strong Wesley nothing.

- a) (5 points) derive the extensive form of the game
 - b) (10 points) derive a pooling BNE where $q = 0.5$ represents the prince's initial belief that Wesley is weak. Be sure to include what are the prince's beliefs about Wesley's type if he observes Wesley in bed or observes him standing. Find the range of values for c that makes the belief valid.
 - c) (10 points) derive a separating BNE for this game as well as the range of c over which it is valid.
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