

6. Imagine that a zealous prosecutor (P) has accused a defendant (D) of committing a crime. Suppose that the trial involves evidence production by both parties and that by producing evidence, a litigant increases the probability of winning the trial. Specifically, suppose that the probability that the defendant wins is given by $e_D/(e_D + e_P)$, where e_D is the expenditure on evidence production by the defendant and e_P is the expenditure on evidence production by the prosecutor. Assume that e_D and e_P are greater than or equal to 0. The defendant must pay 8 if he is found guilty, whereas he pays 0 if he is found innocent. The prosecutor receives 8 if she wins and 0 if she loses the case.

(a) Represent this game in normal form.

| Prosecutor | | Wins | Loses | |
|------------|------------|-------|-------|--|
| Defendant | Guilty | -8, 8 | -8, 0 | |
| | Not Guilty | 0, 8 | 0, 0 | |

~~THIS DOESN'T HAPPEN~~

$$u_P(e_P, e_D) = 8e_P / (e_P + e_D) - e_P$$

$$u_D(e_P, e_D) = 8e_D / (e_P + e_D) - e_D$$

(b) Write the first-order condition and derive the best-response function for each player.

$$du = 8/(e_P + e_D) - 8e_P/(e_P + e_D)^2 - 1 = 0$$

$$8/(P+D) - 8P/(P+D)^2 = 1$$

$$8(P+D) - 8P = (P+D)^2 \quad \text{or} \quad 8D = (P+D)^2$$

$$P = \sqrt{8D} - D$$

$$D = \sqrt{8P} - P$$

(c) Find the Nash equilibrium of this game. What is the probability that the defendant wins in equilibrium.

$$P = \sqrt{8P} - P = 0 = 2$$

$$\text{Probability} = 1/2$$

(d) Is this outcome efficient? Why?

No