14.75: PROBLEM SET 5

Please include stata do-file code and output for all exercises.

(1) This problem is based on Miguel et al. (2004). Use `mss_repdata.dta` for the following exercise. First run the contents of `hint.txt`.
  (a) Replicate the regressions of columns (1), (3) and (5) of Table 2 in the paper. (Remember to cluster at the country level.) This is the first-stage. Interpret the key coefficient(s) of interest and explain why it is important in the paper's IV strategy.
  (b) Replicate both columns of Table 3 in the paper. (Remember to cluster at the country level.) This is the reduced form. What does this suggest about the 2sls estimates that you will likely be getting?
  (c) Replicate column (4) and column (6) of Table 4 in the paper. (Again remember to cluster.) Interpret your findings in words.

(2) This problem is inspired by the tragedy of Kitty Genovese. There are two individuals who witness a crime on the street and each has to decide whether or not to call the police. The payoffs are given by the following matrix where you can read them off as (Row, Column).

	Call Police	Not
Call Police	(0,0)	(0,1)
Not	(1,0)	(-10,-10)

Notice that there is an implicit cost in calling the police, though the worst outcome for each individual is for neither to call the police.
  (a) What is/are the pure strategy Nash equilibri(um/a)?
  (b) But coordinating this might be hard. There is also a symmetric mixed strategy equilibrium. Compute it. What is the probability that an individual calls the police? What is the probability that the cops are not called when the game is played under this mixed strategy equilibrium?
  (c) Now we are interested in what happens when there are $n > 2$ people. Imagine that there are n individuals and the payoffs of person i are given by

$$\begin{cases} 1 & \text{if at least one other calls the police and } i \text{ does not,} \\ 0 & \text{if } i \text{ calls the police,} \\ -10 & \text{if no one calls the police.} \end{cases}$$

  There are a number of asymmetric pure strategy Nash equilibria. But we focus on the symmetric mixed strategy equilibrium again. Compute the probability that a given individual calls the police. What is $p = p_n$? What is $\lim_{n\to\infty} p_n$?
  (d) Finally, we want to compute the probability that none of the n individuals call the police and the crime is committed. Call it Q_n.
  (e) What is Q_n?
    (i) How does Q_n change with n? Plot Q_n.
    (ii) What is $\lim_{n\to\infty} Q_n$?
  (f) How does this relate to the collective action discussion from class?

(3) We want to understand how heterogeneity interacts with collective action. In particular, there will be a type of public good. An agent prefers a public good that is in accordance with her preferences. Let d_i denote the distance between the individual's most preferred type of good (θ_i) and the actual good provided (θ). Her payoffs are

$$u_i = \log g \cdot (1 - d_i) + y - t = (1 - |\theta_i - \theta|) \log g + y - t$$

where y is income, t is lump-sum tax to finance the good and g is the amount used. Timing is as follows. First, voters vote on the size of the public good. In the second period the type of good is chosen by the median voter's ideal type (θ^m). As in class, normalize the population size so $t = g$.

(a) What is the chosen size of the public good for person i as a function of distance $\widehat{d}_i = |\theta_i - \theta^m|$ from the median voter's ideal type?

(b) What is the chosen size of the public good by the population? *(Hint: Let $\widehat{g}_i$ denote the amount of public good preferred by i when the type chosen is according to the second stage median voter's ideal type (θ^m). Also let $d^m(\theta)$ denote the median of the distribution of d_i's at a given θ. In the first stage, what $\widehat{g}_i$ is chosen?)*

(c) Imagine that $\theta \sim N(\mu, \sigma)$. Define the MAD, the *median absolute deviation*, of this distribution as

$$\mathrm{P}(\mathrm{MAD} \geq |\theta - \mu|) = \frac{1}{2}.$$

(For a normal the mean is the median.) Then one can solve and show

$$\mathrm{P}\left(\frac{\mathrm{MAD}}{\sigma} \geq Z\right) = \frac{1}{2}$$

where $Z := \frac{|\theta - \mu|}{\sigma}$ is a standard normal variable. This implies that $\sigma = \Phi^{-1}(3/4) \cdot \mathrm{MAD}$.[1]

(i) What is the level of public good chosen in equilibrium with this type distribution when $\sigma = 1$ and $\mu = 0$?

(ii) What if $\sigma = 1$ and $\mu = 1$?

(iii) What if $\sigma = 2$ and $\mu = 0$?

(iv) What if $\sigma = 1/2$ and $\mu = 0$?

(v) Reflect on c.(i)-c.(iv).

(4) Now we look at wars. There are two countries i and j. Let the wealth of i be greater than the wealth of j, $w_i > w_j$. Each can decide to start a war with the other and i wins with probability

$$p_i(w_i, w_j) = \frac{e^{w_i + \beta w_i w_j}}{e^{w_i + \beta w_i w_j} + e^{w_j}}, \ \beta \in \mathbb{R}.$$

Assume that if a country l wins, it gains an α-fraction of the other countries wealth, αw_{-l} and the other country keeps $(1 - \alpha) w_{-l}$. Both countries lose C. There are no side payments between countries.

(a) Probabilities.

(i) What is $p_j(w_i, w_j)$?

(ii) What is $\frac{\partial p_i}{\partial w_i}$ are $\frac{\partial p_i}{\partial w_j}$?

(iii) What are $\frac{\partial p_i}{\partial \beta}$ and $\frac{\partial p_j}{\partial \beta}$?

(b) Payoffs

(i) What is i's payoff if it wins the war? If it loses the war?

[1] Note that

$$\frac{1}{2} = \Phi\left(\frac{\mathrm{MAD}}{\sigma}\right) - \Phi\left(-\frac{\mathrm{MAD}}{\sigma}\right) \iff \frac{1}{2} = \Phi\left(\frac{\mathrm{MAD}}{\sigma}\right) - 1 + \Phi\left(\frac{\mathrm{MAD}}{\sigma}\right) \iff \frac{3}{4} = \Phi\left(\frac{\mathrm{MAD}}{\sigma}\right).$$

(ii) What are its expected payoffs from starting the war?
(iii) When will i start the war?

(c) Conditions.
(i) Assume $C > \max\{w_i, w_j\}$. What happens as $\alpha \to 0$ to i's willingness to go to war (for a fixed w_i and w_j)? Interpret this in words.
(ii) Assume $C < 2\min\{w_i, w_j\}$. What happens as $\alpha \to 1$ to i's willingness to go to war (for a fixed w_i and w_j)? Interpret this in words as well.
(iii) Assume that we are at parameter values that leave i indifferent to declaring war. Moreover, assume here that $\beta = 0$.
(A) What happens to i's willingness to declare war as β increases to $\beta' > 0$? Interpret this in words.
(B) What about when β decreases to $\beta' < 0$? Interpret this in words.

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