Homework

This homework is based on Draca et al. (2011, AER) - **Panic on the Streets of London: Police, Crime, and the July 2005 Terror Attacks**. The paper studies the relationship between police and crime by exploiting increased security presence after the 2005 London terrorist attacks using a DID strategy. After the attacks, the London police implemented *Operation Theseus* for six weeks to increase police presence in central London. The authors collect data on police deployment and crime rate in 2004 and 2005 and analyze them at the borough level for each week. The time variation is before and after the terror attack. Moreover, in the post attack period, there is a six week policy period and post policy period. The cross sectional variation is central London (increased police presence; light blue boroughs in Fig 1) and outer London (less police presence; green boroughs in Fig 1). The authors find that crime fell significantly in central London relative to outer London during the six weeks of increased police presence. However, when police presence returned to their pre-attack levels six weeks later, the crime rate rapidly returned to its pre-attack level.

Figure 1: Map of London Boroughs

Notes: This map represents the 32 boroughs of London. The treatment boroughs are shown in light blue.

GENERAL INSTRUCTIONS:

- **Read the research paper carefully.** You should have a clear understanding of the research question, the contribution to the literature, the research design, potential threats to identification, the data used, and the key results of the paper.
- The exam will be **multiple-choice questions based on the paper** and will equally test your understanding of the paper, and of the Stata code used to reproduce key results of the paper.
- **You can carry a hard copy of the research paper to the exam**.
- The **Stata exercises in this homework can be discussed during the helpdesks** which will be conducted a week before the exam.

Stata Exercises

READ CAREFULLY

- You are provided with a
  - Dataset: **homework.dta**
  - *Partially written* do-file: **homework_partial.do**
- The goal of this homework is to reproduce key results of the paper by **filling the gaps in the code**. You should attempt it after reading the paper.
- Please read the questions carefully and also the notes provided below the Tables and Figures.

Part 0 - Data Exploration

The London Metropolitan Police Service is organized into 32 command units in its operations. The dataset that you have imported contains information on their operations over a two-year period. The following questions give you a rough idea of the scope of this dataset.

1. What are the different variables in the dataset? Identify the outcome variables and independent variables.
2. How many observations are there? Of each borough? Of each week?
3. Create a scatter plot of crime against police hours. Is this relationship what you expect? In the literature on crime, what is the typical concern about such a relationship?

Part I - Basic Difference-in-Difference (2004-2005)

In this exercise, we try to calculate the DD estimate of police deployment and crime using average outcomes before and after the July 2005 terror attacks in the treatment group boroughs as compared to all other boroughs. You should be able to generate the numbers provided in Table 1 (below).

1. *Preliminaries*:
   (a) Create an indicator for the treated boroughs.
   (b) Create an indicator for the policy period (which takes the value 1 for six weeks in 2005 when operation Theseus was implemented and 0 for these six weeks in 2004, which serves as the pre-period).
   (c) Create an interaction term of the indicator for treated boroughs and the indicator for the policy period.
2. For the rest of this question, let us focus on the policy period and pre-period defined in (1b). We also re-scale crime and police hours by the borough population.
   (a) Compute and store the average police hours and crime across the 4 groups (B=$\{0,1\} \times$ T=$\{0,1\}$); where B refers to borough and T is time.
   (b) Calculate the difference-in-difference estimate for police hours and crimes.

3. *Let's run a regression!*

    (a) Obtain the above DD estimates using a regression (*Note: The regression also gives you the standard errors!*).

Table 1: Basic DID

	Police Deployment per 1000 Pop.			Total Crime per 1000 Pop.		
	Pre-period	Post-period	Diff. (post-pre)	Pre-period	Post-period	Diff. (post-pre)
T=1	169.46	242.28	72.82	4.031	3.59	-0.441
T=0	82.77	84.94	2.17	1.99	1.974	-0.02
DD			70.65***			-0.43***
			(5.32)			(0.11)

Note: The corresponding table in the paper is Table 1. Post-period defined as the six weeks following Operation Theseus i.e. after 7/7/2005. Pre-period defined as the same six weeks in 2004 i.e. six weeks following 8/7/2004. Standard errors are in parentheses. The standard errors reported here don't match exactly with the paper.

Part II - Difference-in-Difference Regression Estimates (Main Results of the Paper)

In this exercise, we replicate the main reduced form results and structural estimates of the effect of police on crime from the paper. You should be able to generate the numbers provided in Table 2 (below).

1. *Preliminaries*:

    (a) Create an indicator for the treated boroughs.

    (b) Create an indicator for periods after operation Theseus is completed, and an indicator for period after the beginning of operation Theseus. What is the rationale for creating these separate indicators? *Make sure you understand their differences before moving on.*

    (c) Create seasonally differenced log variables. What reasons did the authors give for focusing on seasonal differences?

2. *Reduced Form Results*:

    (a) Estimate equations (1) and (2) for police deployment (hours per 1000 population) and total crimes (per 1000 population) using OLS. Also (i) include week fixed effects, (ii) weight your regression with borough population, and (iii) cluster standard errors at the borough level in your regression specification.

$$\Delta_{52} Y_{bt} = \alpha_1 + \beta_1 POST_t + \delta_1 (T_b \times POST_t) + \Delta_{52}\epsilon_{1bt} \tag{1}$$

$$\Delta_{52} Y_{bt} = \alpha_1 + \beta_1 POST_t^1 + \delta_1 (T_b \times POST_t^1) + \beta_2 POST_t^2 + \delta_2 (T_b \times POST_t^2) + \Delta_{52}\epsilon_{1bt} \tag{2}$$

Note: In equation 2, we split the post-attack period into two parts: $POST^1$ which are the 6 weeks of operation Theseus and $POST^2$ which are the weeks after operation Theseus.

3. *Structural Results*: We estimate equation 3 (see below) using 2SLS.

   (a) What motivates the use of a 2SLS regression here? Given the use of both DID and 2SLS, what are the assumptions needed for identification?

   (b) *First Stage*: Run the first stage regression using $T_b \times POST_t^1$ and $T_b \times POST_t^2$ as the excluded instruments for the change in police deployment.

   (c) Using the F statistic of your excluded instruments, check if these instruments are weak.

   (d) Estimate equation (3) using 2SLS. Also (i) include week fixed effects, (ii) weight your regression with borough population, and (iii) cluster standard errors at the borough level in your regression specification.

$$\Delta_{52} Crime_{bt} = \alpha_1 + \delta_1 \Delta_{52} Police_{bt} + \beta_1 POST_t^1 + \beta_2 POST_t^2 + \Delta_{52} \epsilon_{1bt} \tag{3}$$

Table 2: DID Regression Estimates, Police Deployment and Total Crime 2004-05

	(1)	(2)	(3)	(4)	(5)	(6)
	Police Deployment per 1000 Pop.		Total Crime per 1000 Pop.		Total Crime per 1000 Pop.	
Panel A: Reduced Form						
treat × full	0.0810***		-0.0519**			
	(0.010)		(0.021)			
treat × policy		0.3407***		-0.1114***		
		(0.028)		(0.027)		
treat × post		-0.0010		-0.0331		
		(0.011)		(0.027)		
Panel B: Structural Form					OLS	IV
Δln(police hours)					-0.0333	-0.3260***
					(0.053)	(0.089)
N	1,664	1,664	1,664	1,664	1,664	1,664

Note: The corresponding table in the paper is Table 2. All specifications include week fixed effects. Standard errors clustered by borough in parentheses. Regressions weighted by borough population. “Full” post-period for baseline models in column 1 and 3 of panel A defined as all weeks after 7/7/2005 until 31/12/2005 attack inclusive. treat × full is then defined as interaction of treatment group with a dummy variable for the full post-period. treat × policy is defined as interaction of treatment group with a deployment “policy” dummy for weeks 1–6 following the July 7, 2005, attack. treat × post is defined as treatment group interaction for all weeks subsequent to the main Operation Theseus deployment. Treatment group defined as boroughs of Westminster, Camden, Islington, Tower Hamlets, and Kensington-Chelsea. *** p<0.01, ** p<0.05, * p<0.1

Part III - Treatment Effects by Crime Type

In this exercise, we investigate treatment effects across different crime types such as theft, violence, robbery, and criminal damage. You should be able to generate the numbers provided in Table 3 (below).

1. Using equation (2) estimate the treatment effect across different crime types. Also (i) include week fixed effects, (ii) weight your regression with borough population, and (iii) cluster standard errors at the borough level in your regression specification.

Table 3: Treatment Effect by Crime Type

	(1) Theft	(2) Violence	(3) Robbery	(4) Crim. Damage
treat × policy	-0.1394***	-0.1244***	-0.1309	-0.0473
	(0.044)	(0.043)	(0.119)	(0.052)
treat × post	-0.0167	-0.0536	-0.0887	-0.0182
	(0.039)	(0.032)	(0.098)	(0.043)
N	1,664	1,664	1,664	1,664

Note: The corresponding table in the paper is Table 3. All specifications include week fixed effects. Standard errors clustered by borough in parentheses. Regressions weighted by borough population. treat × policy is defined as interaction of treatment group with a deployment "policy" dummy for weeks 1–6 following the July 7, 2005, attack. treat × post is defined as treatment group interaction for all weeks subsequent to the main Operation Theseus deployment. Treatment group defined as boroughs of Westminster, Camden, Islington, Tower Hamlets, and Kensington-Chelsea. *** p<0.01, ** p<0.05, * p<0.1

Part IV - Week-by-Week "Placebo" Policy Effects

In this exercise, we test for hypothetical or "placebo" policy effects in every week. Specifically, you will estimate reduced form models outlined in equation (2), defining a single week treatment group interaction term for each of the 52 weeks in our data. You will run 52 regressions, each featuring a different week $\times T_b$ interaction, and plot the estimated coefficient and confidence intervals. This exercise is therefore able to test whether the six-week operation Theseus effect is merely a product of time-series volatility or variation that is equally likely to occur in other sub-periods. You should be able generate Figure 2 (below).

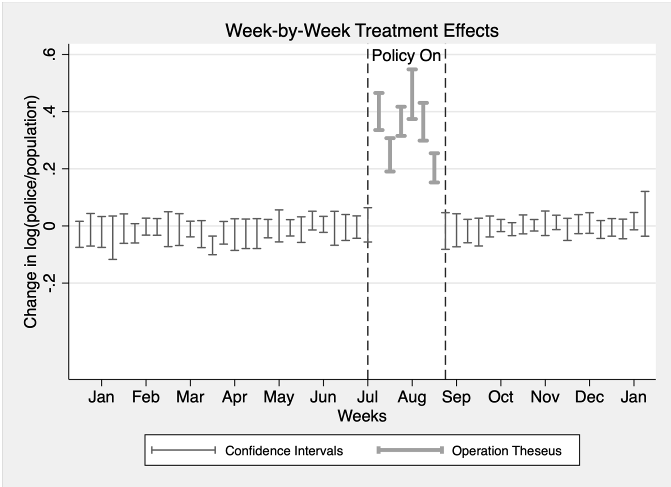
1. Plot the week-by-week treatment effect on police hours.

   Note: Most of the code for this exercise is already provided to you in Q4(a). You should be able to fill the gaps (in three lines) and then use the code to generate the figures for total crime and susceptible crime.

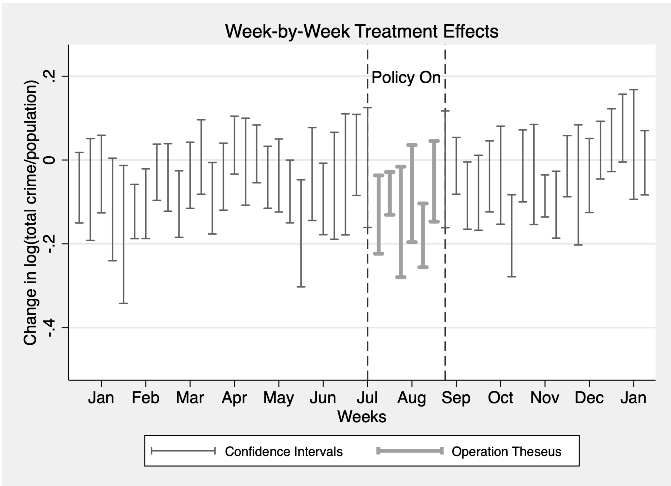
2. Plot the week-by-week treatment effect on total crime.

3. Plot the week-by-week treatment effect on susceptible crimes.

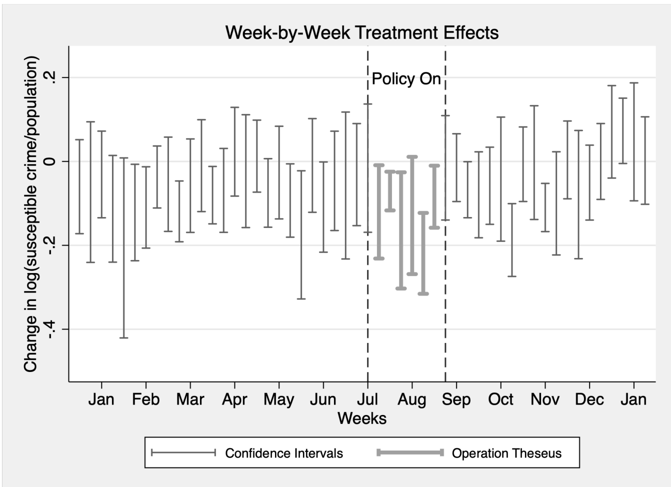
Figure 2: *Placebo* Policy Effects



((a)) Year-on-Year change in Police Hours



((b)) Year-on-Year change in Total Crime Rate



((c)) Year-on-Year change in Susceptible Crime Rate

Notes: The corresponding figure in the paper is Figure 3. The figure in Panel (b) is not in the paper and the figure in Panel (c) does not match exactly with the paper. These figures plots the coefficients and confidence intervals for week-by-week treatment*week interactions from January 2005 to January 2006. These are estimated following the reduced-form specifications in the main body of the paper. Standard errors clustered by borough.