PROBLEM SET 4

Due on Monday, April 15, 2024

I - INSTRUCTIONS

To successfully complete this problem set, please follow these steps:

1. Download this Word document file into your computer and download the datasets into a data subfolder in your problem set-specific Stata Project or RStudio directory.

2. Insert your answers into this document and organize your code in a Stata or R script. You can also insert non-Word objects such as handwritten work or screenshots in your answers.

3. Once your document is complete, please save it as a PDF.

4. Please submit an electronic copy of the **PDF** and your **replicable Stata or R script** to the Canvas assignment page.

II - IDENTIFICATION

(1) Your information

Your Last Name: Boochever

Your First Name: Oscar

(2) Group Members (please list the classmates you worked with on this problem set):

N/A

(3) Compliance with Harvard Kennedy School Academic Code[1] (mark with an X below)

	Yes	**No**
I certify that my work in this problem set complies with the Harvard Kennedy School Academic Code	X	

[1] We abide by the Harvard Kennedy School Academic code for all aspects of the course. In terms of problem sets, unless explicitly written otherwise, the norms are the following: You are free (and encouraged) to discuss problem sets with your classmates. However, you must hand in your own unique written work and code in all cases. Any copy/paste of another's work is plagiarism. In other words, you can work with your classmate(s), sitting side-by-side and going through the problem set question-by-question, but you must each type your own answers and your own code. For more details, please see syllabus.

For this problem set, we will be examining the following paper:

> Stevenson, Betsey, and Justin Wolfers. 2006. "Bargaining in the Shadow of the Law: Divorce Laws and Family Distress," *Quarterly Journal of Economics*, 121 (1): 267-88.

Tips: For this problem set, you may find it more efficient to go back and forth between the conceptual and data analysis questions, as many questions are paired.

Instructions: Please keep your answers *concise*. Most sub-questions can be answered in 1-2 sentences. Bolding or italicizing keywords also help grading.

Conceptual Questions (35 points)

1. Read the paper.
    a. Clearly state the primary research question that the authors are trying to answer. (2 points)

    The primary research question addressed in the paper by Stevenson and Wolfers is how changes in divorce laws affect family well-being, specifically focusing on the impact of unilateral divorce laws on various outcomes related to family distress.

    b. In 2-3 sentences, explain the main finding of the paper using non-technical jargon, as if you were writing a brief policy memo. (2 points)

    The main finding of the paper suggests that implementing unilateral divorce laws, which allow one partner to end a marriage without the consent of the other, leads to a reduction in suicide rates among married women. This reduction is attributed to two channels: a decline in marital distress due to the availability of an exit option, and a decrease in the financial distress associated with divorce settlements.

    c. What are the two channels through which unilateral divorce laws may have reduced suicide rates among married women? (2 points)

    The two channels through which unilateral divorce laws may have reduced suicide rates among married women are:

    1. ***Decline in Marital Distress:*** *Unilateral divorce laws provide an exit option for individuals in unhappy marriages, reducing the level of stress and distress within the marital relationship.*
    2. ***Decrease in Financial Distress:*** *Unilateral divorce laws may alleviate financial concerns associated with divorce settlements, making the*

process of divorce less financially burdensome for individuals, particularly women.

2. The authors used a difference-in-differences (DID) design because they believed a comparison between state-years with and without unilateral divorce to be lacking. What are two possible confounders that would bias the results from a simple comparison and are hard to measure? Explain the mechanism of the omitted variable and use the omitted variable bias formula to argue whether it would lead to an understatement or overstatement of the true effect. (3 points)

Two possible confounders that would bias the results from a simple comparison of suicide rates between state-years with and without unilateral divorce laws are:

1. ***Divorce Rate**: States with higher divorce rates may be more likely to enact unilateral divorce laws, and the social and economic consequences of divorce could affect suicide rates.*

Suicide_Rate_i = a0 + a1Unilateral_Divorce_i + vi

Suicide_Rate_i = b0 + b1Unilateral_Divorce_i + b2Divorce_Rate_i + ei

Divorce_Rate_i = l + dUnilateral_Divorce_i =ni

***Bias**: a1 = b1 + b2*d*

Unilateral divorce laws decreases suicide rates so b1: negative

Divorce rate decreases suicide rates so b2: negative

Positive correlation between Unilateral_Divorce_i and Divorce_Rate_i so d: positive

*Since the effect of unilateral divorce implementation would be negative and the bias is negative, omitting divorce rate in the naïve regression would lead to an **overstatement** of the true effect unilateral divorce laws.*

2. ***Mental Health Programs:** Variation in the availability and effectiveness of mental health programs across states could also confound the relationship between unilateral divorce laws and suicide rates.*

Assuming mental health is more accessible in places with unilateral laws…

Suicide_Rate_i = a0 + a1 Unilateral_Divorce_i + vi

Suicide_Rate_i = b0 + b1Unilateral_Divorce_i + b2 MentalHealth_i + ei

MentalHealth_i = l + dUnilateral_Divorce_i =ni

***Bias**: a1 = b1 + b2*d*

Unilateral divorce laws decreases suicide rates so b1: negative

Mental health programs decrease suicide rates so b2: negative

Positive correlation between Unilateral_Divorce_i and MentalHealth_i so d: positive

*Since the effect of unilateral divorce implementation would be negative and the bias is negative, omitting divorce rate in the naïve regression would lead to an **overstatement** of the true effect unilateral divorce laws.*

3. The authors' main regression is:

$$Suicide\ rate_{s,t} = \sum_k \beta_k Unilateral^k_{s,t} + \sum_s \eta_s State_s + \sum_t \lambda_t Year_t + Controls_{s,t} + \varepsilon_{s,t}.$$

What kind of regression specification is this? Explain each term in the regression. How should we interpret the β_k coefficients? (3 points)

This is a two-way fixed effects estimator (TWFE) where the state represents state fixed effects (time invariant), year represents year fixed effects (state invariant), and additional controls are include. The Bk coefficients should be interpreted as the change in the suicide rate associated with a one-unit change in the presence of unilateral divorce laws, holding all other variables constant. Specifically, Bk represents the average treatment effect of unilateral divorce laws on overall suicide rates, controlling for both state-specific and year-specific factors as well as other covariates included in the regression.

4. What does the parallel trends assumption claim in this specific context? Why or why not do you think it is reasonable? Explain this in a way that someone not well-versed in statistics would understand. (2 points)

The parallel trends assumption suggests that, before the implementation of unilateral divorce laws, states that eventually adopt these laws and those that do not would have similar post-trends in suicide rates. The parallel trends assumption appears reasonable in this context. Before the implementation of unilateral divorce laws, states considering such reforms and those not considering them would likely have similar trends in suicide rates, because the decision to enact unilateral divorce laws is unlikely to be directly associated with trends in suicide rates prior to their implementation.

5. How would you estimate standard errors in this setting and why? (Note that the correct way to cluster is different from what the authors report). (2 points)

In this setting, I would estimate standard errors using cluster-robust standard errors, specifically clustering at the state level. Clustering at the state level accounts for potential correlation in outcomes within states over time, which is important in panel data settings where observations within the same state may be correlated.

6. The authors use the suicide rate for *all* women, not just those who have been married, "to avoid endogeneity problems posed by the possibility that marriage decisions may respond to divorce regime." Give one example of such an endogeneity problem. How would it bias the results? (2 points)

People may choose not to get married if they know that divorce requires both parties' consent. In this case, only using the suicide rate of those who have been married excludes those who would have been married but chose not to due to the legal setting. This would bias the results by skewing the observed suicide rates among married individuals, ignoring the effect of marriage decisions in the first place.

7. Comment on how the effect of unilateral divorce laws on *male* suicide differs from the effect on female suicide. Given the difference in baseline suicide rates for men and women, would you expect the elasticity of male suicide to be different from the elasticity of female suicide? (2 points)

The effect is smaller, or not discernible, for male suicide rates. Given that male suicide rates are 4x higher to begin with, I would expect a different and likely smaller elasticity of male suicide.

8. Give two ways that Figure I increases the credibility of the results presented in Table I. Would you change anything about how Figure I is presented? (3 points)

Figure I increases the credibility of Table I results by showing disaggregated results by age visually, with 1) a precise 0 for teens and little effect for elderly people, and 2) prime-age women comprising the bulk of the main effect. I might stack by "teen" "prime-age" and "elderly" rather than in rows, to make the effects immediately interpretable.

9. The authors present DID estimates of the effect of unilateral divorce laws on domestic violence in Table II. The first row presents the results from a simple DID and the next three rows sequentially add controls to address concerns about bias.

   a. Identify and interpret the treatment effect estimated by the main DID estimate in column 1 of Table II. (2 points)

The implementation of unilateral divorce laws is associated with a 4.3% decrease in violence rates in treatment states compared to control states.

   b. What is one potential source of bias in the DID that would be eliminated by the addition of state-level time-varying controls? (1 point)

Omitted variable bias related to changes in socioeconomic conditions within states over time. By including variables such as the maximum level of AFDC for a family of four, the proportion of the population on welfare, the ratio of female to male employment rates, the state unemployment rate, and log personal income per capita, the model can account for changes in these factors that may influence both the implementation of unilateral divorce laws and the outcome of interest (domestic violence rates).

   c. What is one potential source bias in the DID that remains even after adding all the controls listed in Table II (state fixed effects, individual controls, and state-level time-varying controls)? (1 point)

Unobserved time-varying factors that affect both the implementation of unilateral divorce laws and domestic violence rates. These unobserved factors could include changes in social norms, cultural attitudes towards divorce and marriage, or other policy changes not captured by the included controls.

10. The authors present estimates of the effect of unilateral divorce laws on intimate homicide in Table III. What is the regression specification they run in columns 1 and 2 (Hint: Read the note to Table III)? Note that this is a staggered treatment design. Describe how this estimator relates to a simple DID estimator. (2 points)

In columns 1 and 2 of Table III, the authors run regressions to estimate the effect of unilateral divorce laws on intimate homicide rates (without and with controls, respectively). This is a staggered treatment design, where different states implemented unilateral divorce laws at different times. The estimator used in this context is similar to a simple DID estimator, where the difference in outcomes over time for states that implemented unilateral divorce laws is compared to those that did not. However, unlike a typical DID estimator, which compares pre- and post-treatment periods for treated and control groups, this estimator compares states with and without unilateral divorce laws at different points in time, allowing for variation in treatment timing across states.

11. Figure II plots an event study of the effect of unilateral divorce laws on intimate homicide.

    a. What concerns does this figure raise? (1 point)

    There is concern that the decline in homicide predated the law change.

    b. How does the triple-difference (reported in column 4 of Table III) address some of these concerns? (1 point)

    The triple-difference estimator reported in column 4 of Table III addresses some of these concerns by accounting for changes in homicide rates among non-intimate partners as a control group. By comparing the difference in changes in homicide rates between intimate and non-intimate partners before

and after the implementation of unilateral divorce laws across states, this estimator can help isolate the specific effect of unilateral divorce laws on intimate homicide rates, controlling for broader trends in homicide rates.

c. Write down a regression equation to estimate the triple-difference results in Table III and indicate the coefficient of interest. (2 points)

$Y\_ist = \beta 0 + \beta 1\text{Unilateral} + \beta 2\text{Intimate} + \beta 3\text{Post} + \beta 4\text{Unilateral}\times\text{Intimate} + \beta 5\text{Unilateral}\times\text{Post} + \beta 6\text{Intimate}\times\text{Post} + \beta 7\text{Unilateral}\times\text{Intimate}\times\text{Post} + \epsilon ist$

$\beta 7$ is the coefficient of interest, capturing the triple-difference effect of unilateral divorce laws on intimate homicide rates, controlling for state and year fixed effects as well.

12. What is a specific example of a potential threat to a) internal validity and b) external validity in this study? (2 points)

A) Unobserved confounding factors, such as a cultural shift towards greater acceptance of divorce occurring simultaneously with the implementation of unilateral divorce laws. If this cultural change influences suicide or homicide rates, it could confound the estimated effect of unilateral divorce laws on these outcomes.

B) External validity might be compromised by the study's specific context, as findings may not generalize to countries with different legal systems, cultural norms, or socioeconomic conditions.

Data Analysis Questions (37 points + 1 extra point)

For this problem set, you can rely on a two-part demo: constructing variables for DID, and estimating DID coefficients with the two-way fixed effects estimator. That said, the techniques involved (e.g. fixed effects) are not new. A data appendix below describes the dataset and the key variables.

In this section, we will estimate the effect of unilateral divorce laws on female suicide. In the problem set link, we have provided a lightly cleaned version of their main analysis files: `stevenson_wolfers_210.dta`. The data we are using is available from Justin Wolfers' website.

The data for this problem set is a state-by-year panel. Observations are uniquely identified by state, year, and sex. The data has the following key variables:

- `st` and `year` are the state and year variables.
- `sex` indicates whether the outcome is observed for males or females. It is coded as 1 for males and 2 for females.
- `divyear` is the year of unilateral divorce reform. It is coded as 1950 if the state always had unilateral divorce laws and 2000 if unilateral divorce reform was never passed.
- `unilateral` indicates whether unilateral divorce is legal.
- `suiciderate_jag` is the suicide rate.

13. We will begin by estimating a simple 2x2 difference-in-differences regression.

    a. The year in which the greatest number of states passed unilateral divorce laws was 1973. Using data on states that passed unilateral divorce laws in 1973 and those that never passed unilateral divorce laws, run a simple 2x2 DID regression to estimate the effect of unilateral divorce laws on ln(suiciderate_jag) for women, clustering standard errors at the state level. Report the estimated DID effect and the standard error below. (4 points)

term	estimate	std.error	statistic	p.value
<chr>	<dbl>	<dbl>	<dbl>	<dbl>
(Intercept)	-9.82	0.0435	-226.	0
is_postTRUE	-0.154	0.0601	-2.55	0.0107
treated_group	-0.0647	0.0528	-1.23	0.221
treat	0.163	0.0856	1.90	0.0573

b. Interpret the point estimate. Explain which treatment/control groups are being compared and how the effect is estimated so that someone without statistical training could understand. (3 points)

The point estimate of 0.163 suggests that the implementation of unilateral divorce laws in 1973 is associated with an increase in the natural logarithm of suicide rates for women. Specifically, this means that, on average, the suicide rate for women in states that adopted unilateral divorce laws in 1973 increased relative to states that did not adopt such laws.

In this analysis:

- *The treatment group consists of women in states that passed unilateral divorce laws in 1973.*
- *The control group consists of women in states that never passed unilateral divorce laws.*

The effect is estimated by comparing changes in the suicide rate for women over time between the treatment and control groups before and after the implementation of unilateral divorce laws.

c. Are the results significant? Can you rule out substantively meaningful effect sizes? (1 point)

The results are statistically significant at the 10% level.

14. Now we will assess whether the parallel trends assumption is reasonable in this setting by estimating an event study, pooling data from all the states.

a. Consider the following event study regression specification:

$$Y_{st} = \sum_{j \neq -1} \beta_j \mathbf{1}(t - divyear_s = j) + \gamma_s + \delta_t + \epsilon_{st},$$

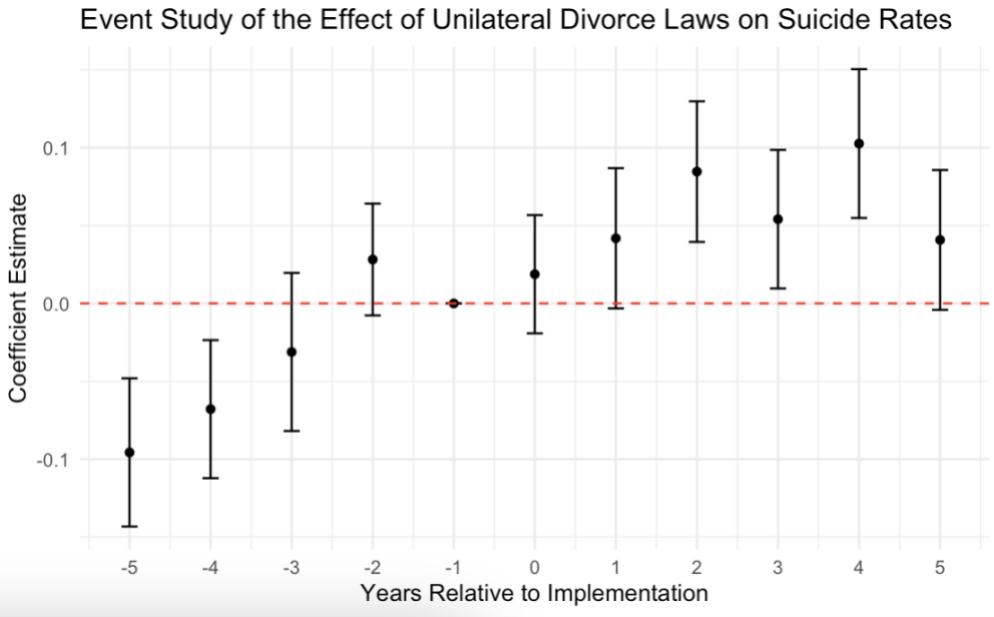
Interpret the coefficients. (2 points)

```
Call:
   felm(formula = log(suiciderate_jag) ~ year_rel1973 + unilateral |      st | 0 | st, data = event_study)

Residuals:
     Min       1Q   Median       3Q      Max
-1.33339 -0.57259  0.01569  0.58768  0.98312

Coefficients:
               Estimate Cluster s.e. t value Pr(>|t|)
year_rel1973-5 -0.09567      0.02428  -3.940 0.000253 ***
year_rel1973-4 -0.06787      0.02261  -3.002 0.004184 **
year_rel1973-3 -0.03117      0.02589  -1.204 0.234347
year_rel1973-2  0.02820      0.01831   1.540 0.129958
year_rel19730   0.01876      0.01938   0.968 0.337512
year_rel19731   0.04183      0.02298   1.821 0.074670 .
year_rel19732   0.08465      0.02303   3.675 0.000580 ***
year_rel19733   0.05409      0.02269   2.384 0.020979 *
year_rel19734   0.10265      0.02438   4.211 0.000106 ***
year_rel19735   0.04080      0.02290   1.781 0.080945 .
unilateral     -0.02781      0.02266  -1.228 0.225381
```

There is a change in significance relative to the year -1. Specifically, while the coefficient for the year of implementation (year_rel19730) is not statistically significant at conventional levels (p-value = 0.10314), the coefficient for the years following the implementation (year_rel19731) become statistically significant. Also, there is no significant effect prior to -1, which is what we want. This change suggests a shift in the impact of unilateral divorce laws on suicide rates immediately after their implementation.

This observation indicates a notable shift in the effect of unilateral divorce laws on suicide rates, supporting the validity of the event study design in capturing the causal effect of unilateral divorce laws on suicide rates. The lack of a significant effect prior to the implementation year (-1) suggests that there was no anticipatory response or other trends affecting suicide rates before the enactment of unilateral divorce laws.

b. Plot the event study, being sure to include confidence bands as well as point estimates (Hint: Follow Andrew Goodman-Bacon's mini-guide here). (4 points)



c. Interpret the figure. Does it support the parallel trends assumption? How do the effects of the reform appear to unfold over time? (2 points)

It does support the parallel trends assumption, as the coefficients for three years prior to -1 are not statistically significant, and then there is a clear jump after implementation. However, the point estimates trending upward prior to the implementation is a bit concerning, despite the lack of statistical significance.

d. Read the abstract and introduction of Rambachan and Roth (2023), "A More Credible Approach to Parallel Trends." Explain the potential concerns with using the above event study regression estimates to assess the parallel trends assumptions. (3 points)

Bonus: Read the introduction of Sun and Abraham (2020) and explain the concern with event studies when there is staggered timing in treatment adoption. (1 extra point)

In the context of the event study regression estimates used in this scenario, the concern arises from the potential violation of parallel trends and the reliance on exact parallelism between pre- and post-treatment trends. Rambachan and Roth's approach offers a more credible and flexible alternative by allowing for

some deviation from strict parallelism, thereby providing more robust inference in the presence of potential violations of the parallel trends assumption.

15. Now estimate the pooled DID effect using a two-way fixed-effects regression specification.
    a. Report the coefficient and standard error clustered at the state level. How does the point estimate compare to the simple 2x2 estimate from question 13? How do the standard errors compare? (2 points)

```
> felm(log(suiciderate_jag) ~ unilateral | year + st | 0 | st, data = women) %>% tidy()
# A tibble: 1 x 5
  term       estimate std.error statistic p.value
  <chr>         <dbl>     <dbl>     <dbl>   <dbl>
1 unilateral  -0.0699    0.0482     -1.45   0.153
```

This point estimate is much lower, and not statistically significant.

    b. How should we think about the two-way fixed-effects estimate? What comparisons are being made? How many are there? Categorize these comparisons into four distinct groups. (4 points)

The two-way fixed effects estimate are comparing female suicide rates in states with and without unilateral divorce laws, before and after the implementation, controlling for state fixed effects and year fixed effects. There are many more comparison groups (staggering states and times), but in general, there are within-state within-year comparisons, between-state within-year comparisons, within-state between-year comparisons, and between-state between-year comparisons.

    c. Given the event study you estimated in question 14, what concerns might you have about some of these comparisons? Do you think the two-way fixed-effects estimate may be biased? If so, in what direction? (3 points)

Given the event study, I'm concerned about parallel trends and the seemingly preexisting upwards trend of suicide rates.

16. Use the bacondecomp command to decompose the two-way fixed-effects estimate into a weighted average of 2x2 DID effects and visualize the estimates against the weights.

a. Which kinds of comparisons get the most weight in the two-way fixed-effects estimate? (2 points)

b. Are the results of the decomposition consistent with any concerns you had about bias in the estimate? (1 point)

c. Use the results of the decomposition to estimate a pooled DID that omits 2x2 comparisons in which the post-reform period of early reform states serves as the control group for states that passed unilateral divorce laws later (the forbidden comparison). (2 points)

17. Run a regression specification that does not use the post-reform period of the early reform states as a control group for states that passed unilateral divorce laws later. To do so, create a separate dataset for each reform group (e.g., states that passed unilateral divorce laws in 1973) that excludes earlier reform groups and excludes the post-reform period for later reform groups. Stack these datasets into a single dataset and estimate a two-way-fixed-effects regression that interacts year fixed effects with dataset fixed effects. Report the coefficient and standard error below. Comment on how and why it differs from the regular two-way fixed effects regression. (4 points)

DIDs in Your Own Work (14 points)

18. Drawing from your own experience and interests, suggest a question that you might try to answer using a difference-in-differences model. As you think through what this would entail, explain the following aspects of your proposed analysis:

a. Propose a specific policy question. Explain why you think this is an interesting and important policy question. Provide evidence that there is ***not*** already a conclusive answer to this question. (2 points)

How does the implementation of mandatory minimum sentencing laws affect recidivism rates among nonviolent drug offenders?

This is an important policy question because mandatory minimum sentencing laws have been widely implemented across many jurisdictions as a means of deterring crime and ensuring consistency in sentencing. However, there is ongoing debate about their effectiveness, particularly in cases involving nonviolent drug offenses. Understanding the impact of these laws on recidivism rates is crucial for informing policy decisions and shaping criminal justice reform efforts. While there have been studies examining the effects of mandatory minimum sentencing laws, there is not yet a conclusive answer regarding their impact on recidivism rates, especially among nonviolent drug offenders.

b. Describe your treatment group. (1 point)

The treatment group consists of individuals convicted of nonviolent drug offenses in jurisdictions where mandatory minimum sentencing laws have been implemented.

c. Propose a comparison group and explain why you chose that group. In your answer, make sure to explain what the parallel trends assumption would mean for your analysis and whether you think that assumption will be satisfied. (2 points)

The comparison group comprises individuals convicted of similar nonviolent drug offenses in jurisdictions where mandatory minimum sentencing laws have not been implemented. The parallel trends assumption in this analysis would mean that, prior to the implementation of mandatory minimum sentencing laws, the trends in recidivism rates for both the treatment and comparison groups should be similar. It may be challenging to satisfy this assumption completely, as jurisdictions with different sentencing laws may have different underlying trends in recidivism rates. However, careful selection of comparison jurisdictions based on similarity in demographics, crime rates, and other relevant factors can help mitigate this concern.

d. Describe the fixed effects that you would use in your difference-in-differences specification. (1 point)

In the difference-in-differences specification, fixed effects would include both state-level and year-level fixed effects to account for time-invariant state characteristics and common time trends, respectively. State-level fixed effects capture unobserved heterogeneity across states that may affect recidivism rates, while year-level fixed effects control for common shocks or trends that may influence recidivism rates over time.

e. Describe how you would cluster your standard errors, if at all. (1 point)

Standard errors would be clustered at the state level to account for potential correlation in outcomes within the same state due to shared characteristics, policies, and enforcement practices.

f. Provide three examples of confounding issues that would be addressed by using the fixed effects that you include. (3 points)

1. *Differences in law enforcement practices and resources across states could influence arrest rates and subsequent recidivism rates, but state fixed effects help control for these differences.*
2. *Socioeconomic factors, such as access to education and employment opportunities, may vary across states and affect recidivism rates, but state fixed effects help mitigate this confounding by capturing time-invariant state-level characteristics.*
3. *Changes in federal drug rehabilitation programs or other interventions over time may affect recidivism rates, but year fixed effects help control for common time trends.*

g. Provide three examples of additional issues that might still bias your estimates despite using a difference-in-differences specification. How might you consider addressing those issues? (4 points)

1. *Differential effects of mandatory minimum sentencing laws on specific demographic groups (e.g., racial minorities) could bias estimates, but interaction terms between treatment status and demographic variables can be included to explore potential heterogeneity in treatment effects.*
2. *Noncompliance with sentencing laws or variations in enforcement practices across jurisdictions could affect the treatment assignment, but sensitivity analyses or instrumental variable approaches may help address these concerns.*

3. *Measurement error or misclassification of recidivism outcomes could bias estimates, but sensitivity analyses using alternative measures of recidivism or validation studies can help assess the robustness of results.*

Reminder: please include your replicable separately in your submission.