Backwards Design

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Practical Data Science

Group 8: Ayush (ag758), Divya (ds655), Jiayi (jz456), Jiechen (jl1254)

1 Topic

The problem we are addressing is the epidemic of opioid misuse and overdose in the United States. The situation has worsened due to doctors prescribing too many opioids, causing more people to become addicted and leading to increased deaths from overdoses. The stakeholders in this scenario could be government agencies, policymakers, healthcare organizations, and public health officials who are concerned with the impact of opioid abuse on individuals and communities. The goal is to evaluate the effectiveness of policy interventions designed to limit the over-prescription of opioids and to assess their impact on both opioid drug prescriptions and mortality from drug overdoses. Stricter regulations may reduce new addictions but could drive existing users to more dangerous substances. Examining prescription rates and overdose deaths provides a comprehensive assessment. The findings are crucial for informed policymaking and offer a template for evaluating policies in other domains, emphasizing the importance of considering unintended consequences.

2 Project Question

The specific questions we aim to address are as follows:

1. How do policies intended to regulate the prescription of opioid medications impact the quantity of opioids dispensed?
2. What is the impact of regulations on opioid drug prescriptions on the incidence of fatalities resulting from drug overdoses?

These two questions seek to establish a causal link between policy interventions and discernible outcomes in the domains of public health and drug regulation. By comprehending the consequences of these policies, stakeholders can make informed decisions regarding how to effectively combat opioid misuse.

3 Project Hypothesis

By conducting pre-post comparisons, it is anticipated that opioid prescription regulations will lead to a reduction in the volume of opioids prescribed in states implementing these regulations immediately after the policy is enacted. These regulations are specifically designed to address the issue of over-prescription.

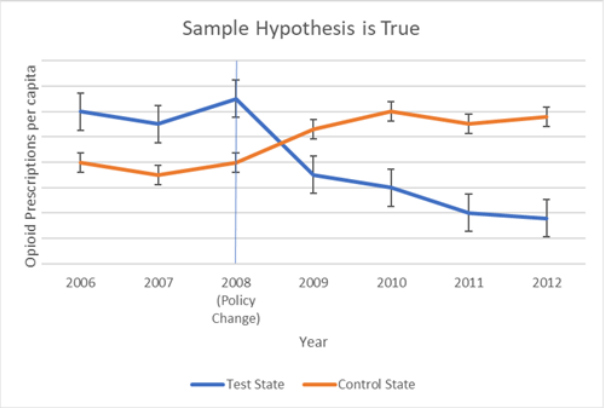
Through a difference-in-difference analysis, it becomes evident that states with opioid prescription regulations experience more significant changes when compared to the changes in overdose rates occurring in other states during the same period. This could be attributed to stricter controls on prescription practices, enhanced monitoring of opioid distribution, and increased awareness and education regarding the risks associated with opioid misuse.

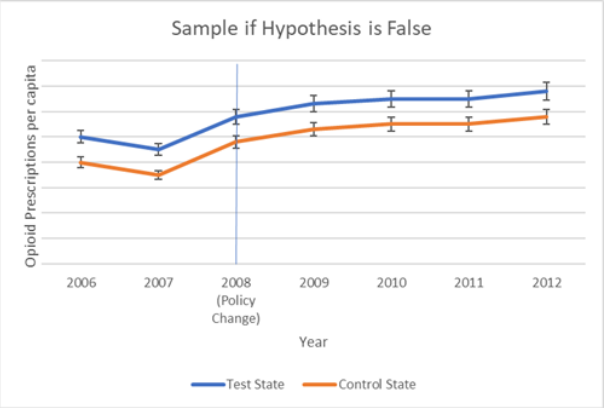
However, while a decrease in opioid prescriptions might be anticipated, the impact on drug overdose deaths is a more complex matter. It is hypothesized that opioid prescription regulations may have a mixed effect on drug overdose deaths. In the short term, there is a possibility that overdose deaths might increase, as individuals who are already addicted may turn to illegal and more perilous substances such as heroin or fentanyl.

Over the long term, however, if these policies prove effective in preventing new cases of addiction, we might anticipate a gradual decrease in overdose deaths. Therefore, with pre-post comparisons, overdose deaths might initially increase and subsequently decrease in states with the regulations implemented immediately after the policy. In the context of a difference-in-difference analysis, these states may exhibit more substantial changes in overdose deaths in comparison to the changes observed in other states over the same time frame.

4 Model Results

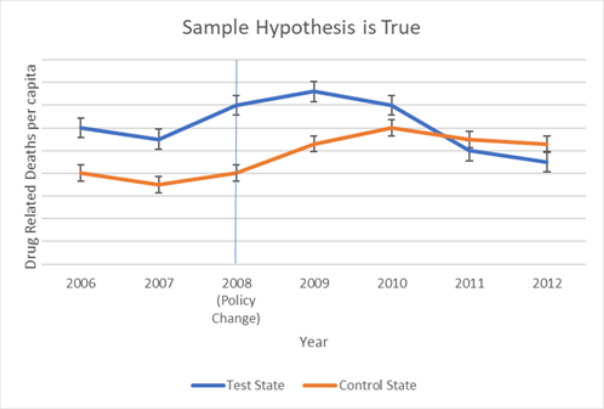
Hypothesis 1. Policies intended to regulate the prescription of opioid medications cause a reduction in the amount of opioids dispensed in the test state

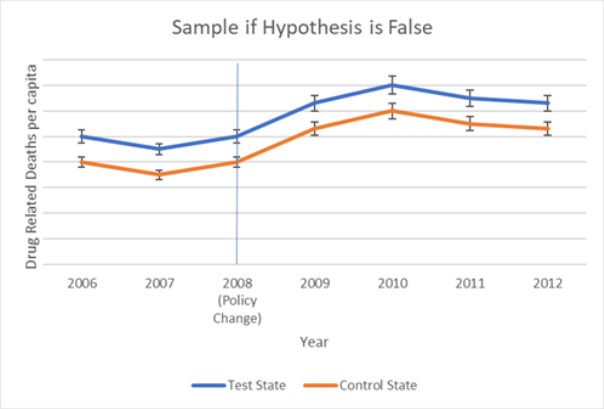




If our hypothesis holds, we anticipate a decline in the opioid prescriptions in our test state in comparison to the control state, as compared to previous years. Conversely, should our hypothesis prove false, the policy is unlikely to influence the observed trends, and the patterns in both states should remain relatively consistent.

Hypothesis 2. Policies intended to regulate the prescription of opioid medications cause a sudden increase in deaths and then there is a gradual decline in deaths.





If our hypothesis holds, we start anticipating a sudden increase in the following years in the opioid prescriptions for our test state in comparison to the control state since opioid addicts will look out for other drugs that could be harmful resulting in deaths. Then, we started observing a gradual decline in deaths in our test state compared to our control state. Conversely, should our

hypothesis prove false, the policy is unlikely to influence the observed trends, and the patterns in both states should remain relatively consistent.

5 Final Variables Required

To address the two questions we aim to explore, we will utilize a single comprehensive dataset. This dataset includes the following variables: state, county, year, the annual quantity of drugs prescribed per capita, and the percentage of deaths attributed to drug-related causes within the population. To ensure a fair and accurate comparison, we have chosen to calculate dosages and death percentages on a per capita basis, assessing them relative to the county's population. This approach normalizes the data, ensuring that dosage and death figures are proportionate and equally comparable across all counties.

Each observation within the dataset pertains to a specific county within a given state and a particular year.

For the states of interest, we have data for Florida spanning from 2006 to 2019, which aligns with the policy's effective date in February 2010. This results in a dataset covering 14 years across 67 counties, totaling approximately 938 rows. In the case of Texas, we possess data spanning from 2006 to 2019, corresponding to the policy's effective date on January 4, 2007. This yields a dataset covering 14 years across 254 counties, resulting in approximately 3,556 rows. As for Washington, we have data spanning from 2006 to 2019, which aligns with the policy's effective date in January 2012. This dataset encompasses 14 years across 39 counties, totaling approximately 546 rows. Additionally, we will identify control states that closely resemble the states of interest and obtain the corresponding data for them.

6 Data Sources

We will utilize the following data sources for our analysis: the opioid dataset for drug prescriptions on a state-by-state basis, the deaths dataset for state-wise deaths, and county population data for the states of interest across each year.

The opioid prescription dataset contains detailed information, including reporter details, addresses, dosage strengths, buyer addresses, and more. From this dataset, we will extract the number of drugs prescribed by year, state, and county. The year will be determined based on the observation date of the shipment. The number of drugs will be calculated by summing the total active weight of the drug in the transaction, measured in grams.

From the deaths dataset, we will obtain the number of drug-related deaths by year, state, and county. The dataset's unit of observation is based on the year, county, and total number of deaths.

Additionally, we will collect population data by year, state, and county from the population dataset, which is sourced from *the United States Census Bureau*. This inclusion is crucial due to significant variations in population sizes among different counties. It allows us to calculate two key variables: the quantity of drugs prescribed per capita and the percentage of deaths attributed to drug-related causes within the population. This enables us to make equitable comparisons across all counties.

To create the final dataset for our analysis, we will merge these three datasets based on the year, state, and county.

7 Division of Labor

Major Task	Minor Task	Primary Owner	Secondary Owner
Merge Dataset	Cleaning for Dosage	Jiayi	Divya
	Cleaning for Deaths	Jiechen	Ayush
	Cleaning for Population	Divya	Jiayi
	Merge Dataset	Divya	Ayush
	Quality Check	Jiayi	Jiechen
Analysis	Question 1	Ayush	Jiayi
	Question 2	Jiechen	Divya
Final Report	Writing	Ayush	Divya
	Formatting	Jiayi	Jiechen