Foster Mosden
MKT 680 - Home Assignment 1
Prof. Ibragimov

1. **Report mean and standard deviation for Profit 60 Days before/after treatment date**
    a. Average Profit 60 days before the treatment date: 77.33159666666667
    b. St. Dev of Profit 60 days before the treatment date: 229.00680235958325
    c. Average Profit 60 days after the treatment date: 119.34988583333335
    d. St. Dev. of Profit 60 days after the treatment date: 337.11882000569
2. **Before and After**
    a. The treatment effect of mailing a catalog is approximately $53.17.
    b. If we assume the results are statistically significant, we would launch a full-scale campaign based on these results. If we consider the cost of treatment ($20 per mailer), we still make a substantial profit of $33.17 based on the treatment effect.
    c. The expected gain of the marketing campaign if launched on the remaining population is approximately $504,219.47. This gain represents the difference in total profit between sending a catalog and not sending one to the entire customer base. Based on these results, it is recommended to launch a full-scale marketing campaign as the observed effect is statistically significant, and there is a substantial expected gain in profit. (note: as per the professors comment before class, I did not incorporate the $20 cost per mailer into this number explicitly. Either way, we know there is positive profit based on this analysis).
3. **Randomization Check**
    a. For checking the categorical variable "State," we can use the chi-square test to determine if there is a statistically significant difference in the distribution of states between treatment groups. The p-value obtained from the chi-square test is approximately 6.35e-17, indicating a significant difference in the distribution of states between treatment groups.
    b. To assess the "Profit 60 days before the treatment date," I used a two-sample t-test. The p-value obtained from the t-test is approximately 0.275, suggesting no statistically significant difference in profit between treatment groups 60 days before the treatment date.
    c. Based on the statistical tests conducted, the State variable shows a significant difference between treatment groups, while the Profit 60 days before the treatment date does not. Since both variables were assessed and only one showed statistically significant differences, further investigation may be necessary before proceeding to experiment evaluation. Ultimately, the decision depends on the full context of the experiment and its intentions.
4. **Average Treatment Effect**
    a. The Average Treatment Effect (ATE) of sending a catalog is approximately $17.74.
    b. The standard error of the ATE is approximately 6.15, and the t-statistic is approximately 2.88. The p-value for the ATE is approximately 0.0039, which is smaller than the significance level of 0.05 ($p < 0.05$). Therefore, the results are statistically significant.
    c. Based on the ATE and statistical significance, launching a full-scale marketing campaign is recommended.

d. The expected gain of the marketing campaign if launched on the remaining population is approximately $36,309,185.22.
e. Comparing the ATE obtained from this analysis (17.74) with the treatment effect from the "Before and After" analysis (53.17), we can see that the ATE is smaller. This indicates that the "Before and After" analysis may have overestimated the treatment effect, possibly due to confounding variables or biases in the analysis method, specifically only analyzing the treatment group while ignoring control customers. It's important to consider both analyses and their results when making decisions about launching this marketing campaign.

5. Difference-in-Difference

a. The difference-in-difference (DiD) estimator is calculated to be approximately 22.31.
b. The results are statistically significant at the 5% level, with a p-value of approximately 0.00029 and a standard error of approximately 6.15.
c. Yes, you should launch a full-scale marketing campaign based on the DiD analysis since the results are statistically significant at the 5% level.
d. The expected gain of the marketing campaign based on the DiD, if launched on the remaining population, is approximately $6692773.50.
e. Comparing the DiD estimator (22.31) with the Average Treatment Effect (ATE) from question 4 (17.74), we can see that the DiD estimator is slightly larger. This suggests that the DiD method accounts for any underlying changes in the control group over time, providing a more accurate estimate of the treatment effect compared to the ATE method.

6. Basic Targeting

a. The Average Treatment Effect (ATE) varies by state:
    i. For Virginia (VA): ATE is approximately $0.96.
    ii. For Ohio (OH): ATE is approximately $18.17.
    iii. For Georgia (GA): ATE is approximately $31.16.
b. Based on the ATE results for each state, launching a full-scale marketing campaign is recommended in all states due to the positive ATE. However, if we consider the cost of mailing a pamphlet, GA is the only state that makes sense.
c. The estimated number of customers from Georgia (GA) in the remaining population of 300,000 customers is approximately 108,125. This estimation is based on the proportion of customers from GA in the sample data. I used a similar approach to find the number of customers in the population from each state, and used that to calculate the expected gain for each state individually.
    i. For Virginia: $85,709.62
    ii. For Ohio: $1,863,333.09
    iii. For Georgia: $3,369,290.78

7. Compare Results

a. Comparing the results from questions 2, 4, 5, and 6, we see a consistent trend of positive treatment effects across different analysis methods and subgroups. While the "Before and After" analysis yielded the highest treatment effect estimate, subsequent analyses using ATE, DiD, and state-specific ATEs provided

more nuanced insights, considering changes over time and variations across states. Considering the statistically significant treatment effects and expected gains, I recommend launching a full-scale marketing campaign targeting all states (but if you consider the $20 cost, only in GA). The analysis suggests a substantial positive impact of the campaign, ensuring a more informed and effective marketing strategy.