# Foundations of Econometrics - Final Exam Pt. II

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You have 75 min to complete the exam and can achieve a maximum of 100 points + 5 bonus points. To receive partial credit show your work and give comments when appropriate. Keep your answers brief and solve easy questions first.

## 1 Random Experiments

(10 +5 points) An internet and mobile provider randomly contacts half of its phone customers (who are not yet using their internet services) with an offer to purchase a high-speed internet package. You would like to evaluate the effectiveness of such promotional activities on sales of internet packages.

 (a) (10 points) Explain briefly how you would calculate the average treatment effect. Suppose you had additional information on individual customers, e.g. age, gender, race, would you use such information?

 (b) (Bonus: 5 points) Could it be an issue if some phone customers live in the same household and share an internet connection? If yes, how could you address this in the randomization process?

## 2 Matching

(20 points) Answer the following questions about matching.

 (a) (13 points) State the formula of the propensity score estimator for the ATE. State one reason why it is suitable to use propensity score some cases rather than direct matching.

 (b) (7 points) Explain briefly how radius matching works.

## 3 Instrumental Variables

(25 points) You would like to study the effect of staying in school on crime rates of highschool-aged children.

 (a) (5 points) Describe in a few sentences why an instrument might be needed in this case.

(b) (10 points) You want to make use of an instrument, a law change that decreased the length of highschool by one year. Suppose you have data on two adjacent cohorts of children. For simplicity assume that all children begin studying in highschool at age 14 and that they cannot be retained (asked to repeat a grade) nor expelled. Hence, one cohort can stay in highschool until age 19 (cohort 0) and the other until age 18 (cohort 1). Some students might voluntarily drop out early. You further observe whether children of each cohort committed any crimes during ages 18-20.

Write down the formula for the IV estimator. What are $Y$, $D$ and $Z$ in this case?

(c) (10 points) You are given the following information:

The cumulative distribution of students' school leaving age for each cohort is given by:

| Leave School by Age/Cohort | 0 | 1 |
|---|---|---|
| 18 or earlier | 0.2 | 1.0 |
| 19 | 1.0 | 1.0 |

All children have left school by age 19 and it is apparent that cohort 1 is affected by the new law, with no children staying in school beyond age 18.

The crime rates for the two cohorts are given by:

| Cohort | 0 | 1 |
|---|---|---|
| Crime Rate | 0.02 | 0.05 |

Calculate the IV estimator. How general is the effect that you are estimating? Are there always-takers or never-takers?

# 4 Regression Discontinuity

(15 points) State the two conditions for $Y$ and $D$ around cut-off $z_0$ that are necessary for RD. Graphically illustrate the two conditions for a sharp design.

# 5 Difference-in-Difference

(10 points) You would like to assess the effect of Amazon's policy to offer same-day delivery on sales. There is data for locations A and B over time periods $T = \{0, 1\}$. Same-day delivery was only offered in location A in period 1. Assume you observe the following sales numbers in thousands of EUR:

| Period/Location | A | B |
|---|---|---|
| 0 | 100 | 150 |
| 1 | 200 | 200 |

Sketch the sales on the $Y - T$ plane for the two locations. Indicate the size of the treatment effect in your graph and also calculate it.

# 6   Applications From Class

(20 points) Write down the title of your presentation in class. Answer the questions below **for presentations other than your own**.

(a) (15 points) Briefly state the research question, data and findings for a presentations that used an instrumental variable approach.

(b) (5 points) State the $Z$ variable for a paper that uses Regression Discontinuity.