Regression Discontinuity Designs in Quality Improvement

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GroupHealth

Agenda

- Introductions (5 min)
- Brief introduction to regression discontinuity (20 min)
- Group exercise 1 – evaluate some studies (45 min)
- Group exercise 2 – design your own RD study (45 min)
- Wrap-up (5 min)

Introduction

- Basic regression discontinuity (RD) design factors
- Comparison to interrupted time series (ITS) and randomized trials (RCT)
- Design considerations and threats to validity
- Use of multiple cutoffs for treatment (Tx) assignment
- RD design criteria – standards for evaluating the rigor of an RD study
- Examples

Basic Structure of RD

- Participants assigned to treatment or control based on the value of a continuous measure/variable/score
  - income, years of education, severity of illness
  - Cutoff selected at a meaningful value (average is most powerful)
- Participants assigned to treatment or control on the basis of being **DIFFERENT**; not the same!
  - Exchangeability on either side of the cutoff
  - Same functional form of relationship across all values of assignment variable
- Compare posttest scores/values of treatment outcome
- Assignment variable and outcome variable can be correlated or totally unrelated (i.e., instrument)

When to use and RD Design

- Assignment variable measures merit or need
  - E.g., underperforming sites/clinics or children most in need
- When random assignment is unethical
  - E.g., withholding treatment or restricting service availability
- Assignment to treatment is (or was) under the control of researcher or program staff;
- Assignment variable was the **ONLY** criterion for treatment assignment;

Selecting a Cutoff

- Professional opinion concerning need or performance
- Political opinion (ug!)
- Mean of the assignment variable distribution
- Pretest variable (may or may not be the same as posttest

- Do not use:
  - Extreme value of a distribution – modeling problems
  - Dichotomous variable – one value each side of cutoff
  - Poorly populated Likert scale
- Be aware of cutoffs where Tx is indicated (need)
  - Patients get treated for a reason.

Figure 7.2 Shadish et. al. (2002)

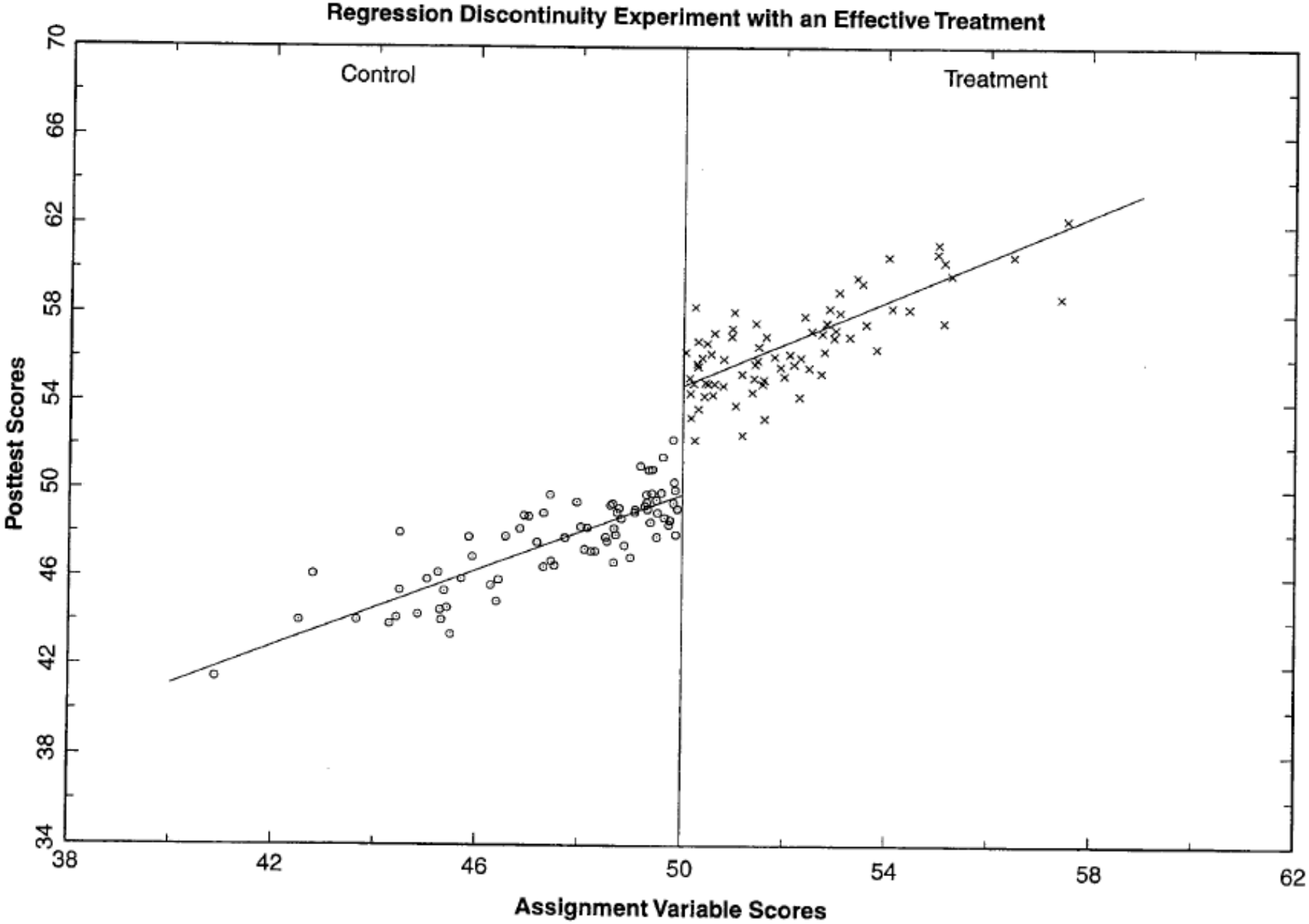
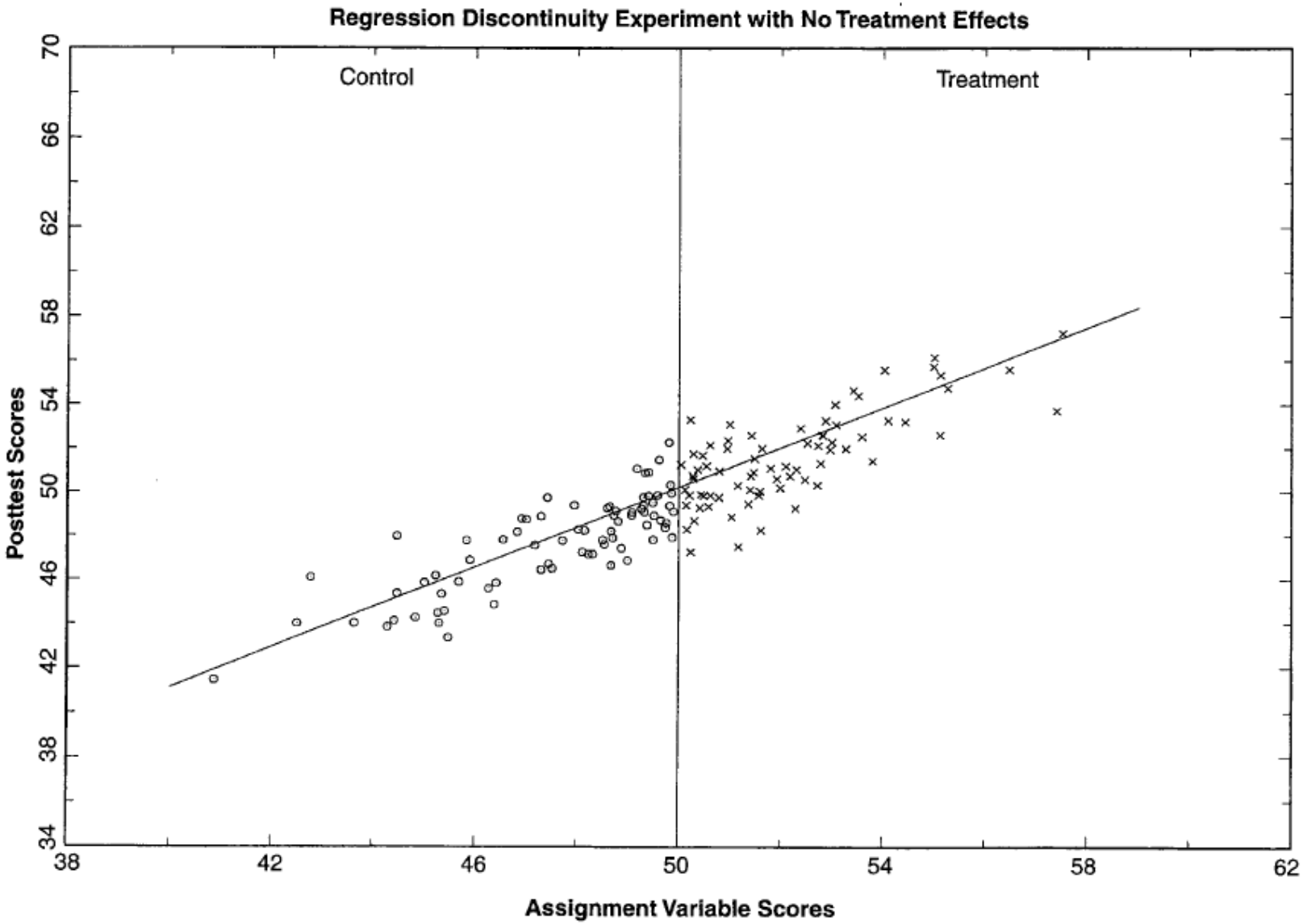


Figure 7.1 Shadish et. al. (2002)



Medicaid Eligibility Example – 7.4

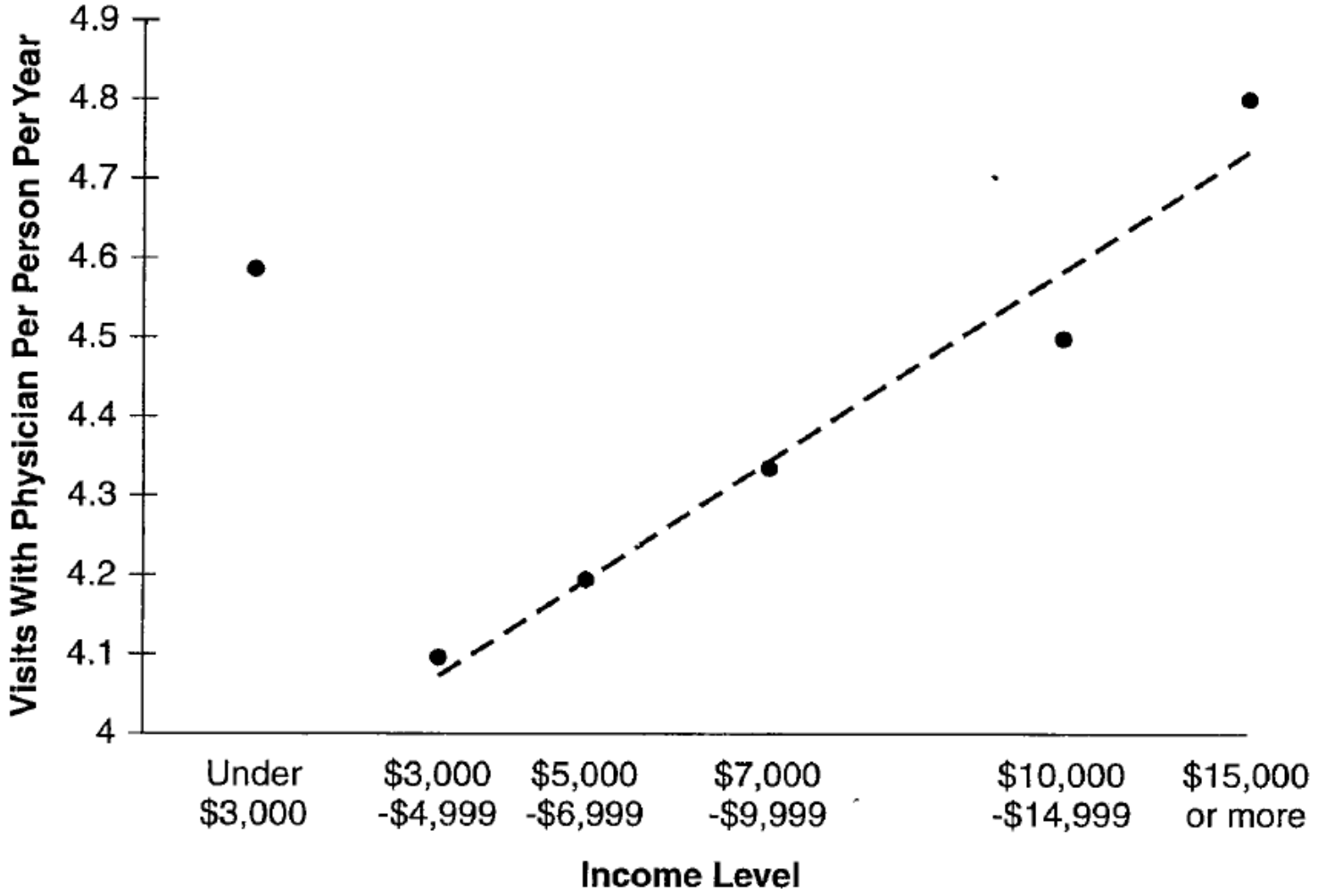


FIGURE 7.4 Quantified multiple control group posttest-only analysis of the effects of Medicaid. (After Lohr, 1972; Wilder, 1972).

Compare RD to ITS

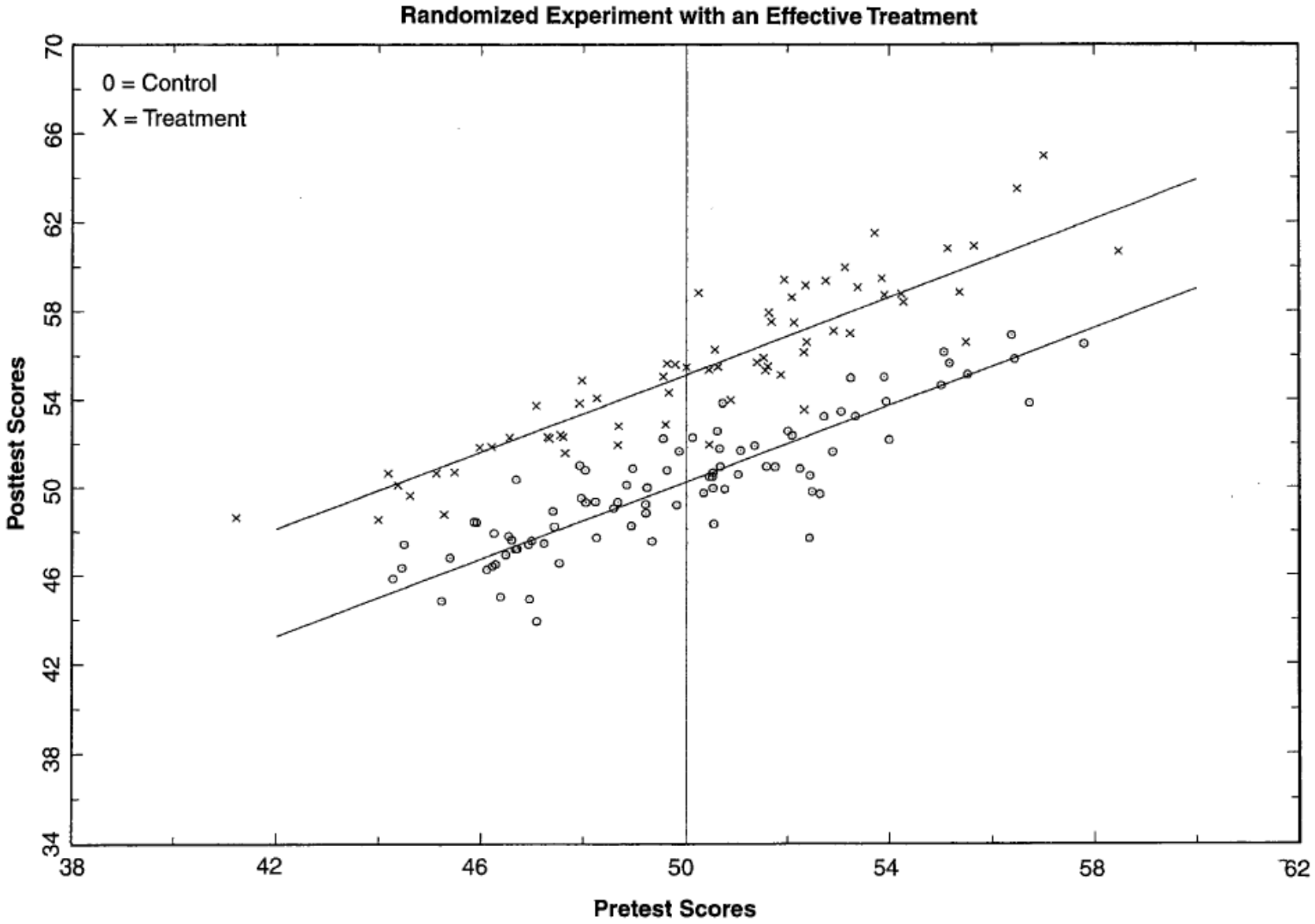
ITS	RD
• Time	• Continuous variable
• Population level data	• Individual level data
• Compare level (intercept) and trend (slope)	• Compare level (intercept) and trend (slope)
• Must rule-out competing interventions	• Must rule-out competing interventions
• Easy to do retrospectively	• Hard to do retrospectively
• Sensitive to competing interventions	• Robust to competing interventions
• Sensitive to changes in population composition	• Robust to population composition

Compare RD to a Randomized Trial

RD	RCT
• Cutoff assignment	• Random assignment
• Assignment is perfectly known and measure	• Assignment is perfectly known and measured
• Compare regressions	• Compare posttest means
• Exchangeability at cutoff	• Exchangeability

- In both designs, we know exactly how participants got into conditions and the processes contain no error for this purpose.
  - Assignment is error free; not necessarily measurement of the RD assignment variable.

Shadish et. al. - Figure 7.7



Threats to Validity

- Confounders MUST occur at exactly the same cutoff or time to in fact be confounders.
  - Because measuring Tx effect at the discontinuity
- Other “treatments” that use the same cutoff
  - E.g., other program that uses same assignment cutoff
- Contemporaneous QI initiatives or programs
- Heterogeneity of the “population”
- Time – changing mean, eligibility, possible Tx exposure
- Crossover, attrition
- Size of discontinuity (Tx effect) changes along the continuum of the assignment variable
- Change in exposure to Tx with increase in assignment var.

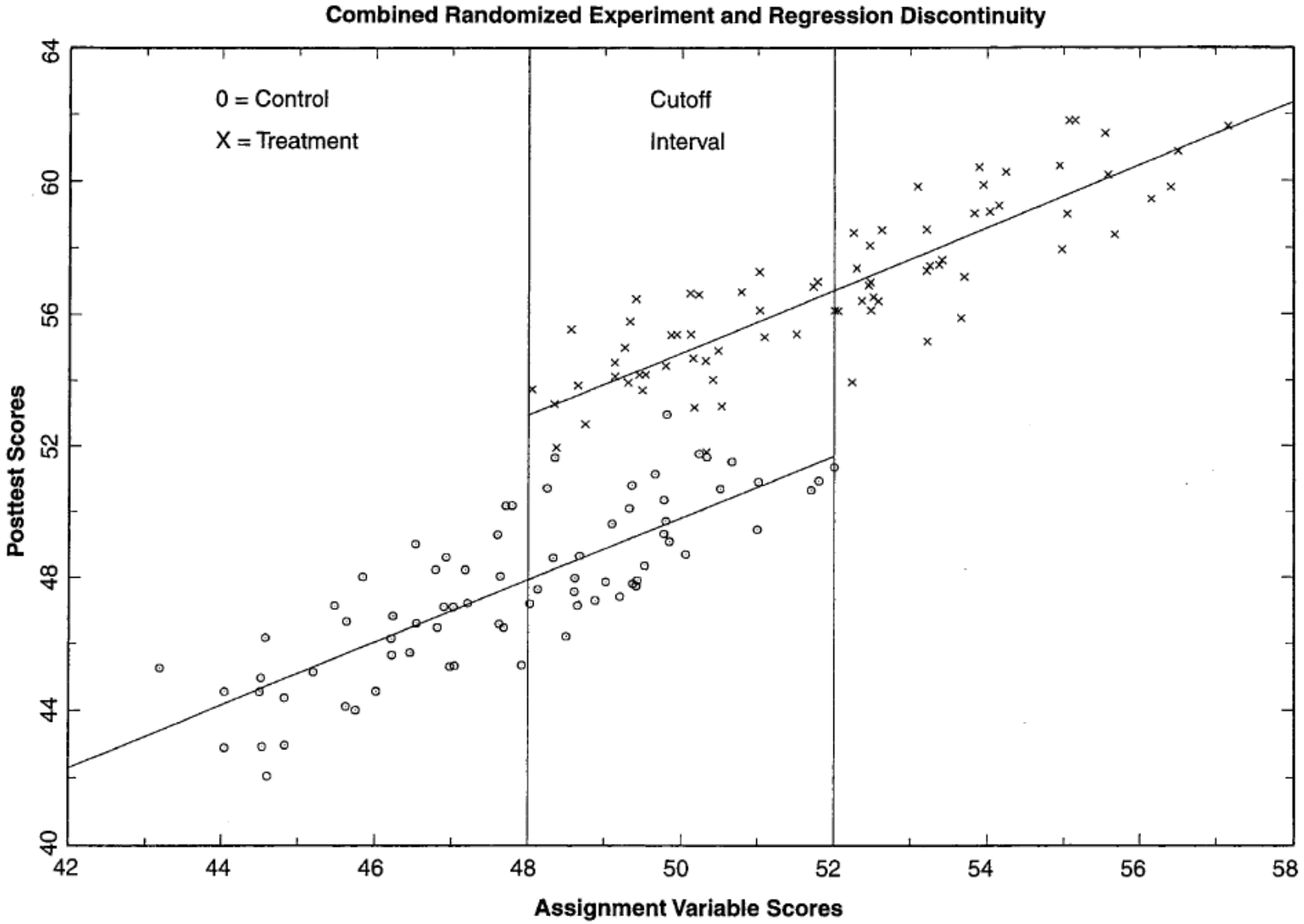
Threats to Validity cont'd

- Non-linearity
- Interaction – e.g., Tx more effective near the cutoff

- History
- Maturation
- Instrumentation
- Mortality (attrition)
- Ceiling and floor effects in measurement of Tx effect

Two Cutoffs with Three Groups

Shadish et. al. Figure 7.13 p239



RD Design Standards

Schochet, Cook et. al., 2010

1. Integrity of the assignment variable
   - Institutional integrity (manipulation of cutoff)
   - Statistical integrity (especially around cutoff)
2. Attrition
3. Continuity of the outcome assignment variable – smooth at the cutoff
   - Balance in baseline covariates
   - Absence of discontinuities away from cutoff
4. Functional form and bandwidth
   - Always include cutoff dummy, test higher-order models, local regression at cutoff, stratify by site, include graph

Group Exercise 1

- Divide into 4 groups of 6 people
- Read the methods section of the paper (randomly) assigned to your group
- Use what you know about threats to validity and RD evaluation standards to review the manuscripts
- Report back to the larger group on what you think

Group Exercise 2

- Design a RD evaluation of the national implementation of team care for reducing youth obesity rates.
  - Include any implementation considerations in your design
    (e.g., sequential roll-out by site?)
- How will you select a cutoff or cutoffs?
- Stratification?
- Sub-population analyses?
- Why not do an RCT? Could an ITS approach work?
- Threats to validity?