Effects of Early Warning Emails on Student Performance

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Research Question

Does objective and motivating feedback through a warning email have a positive impact on student's performance

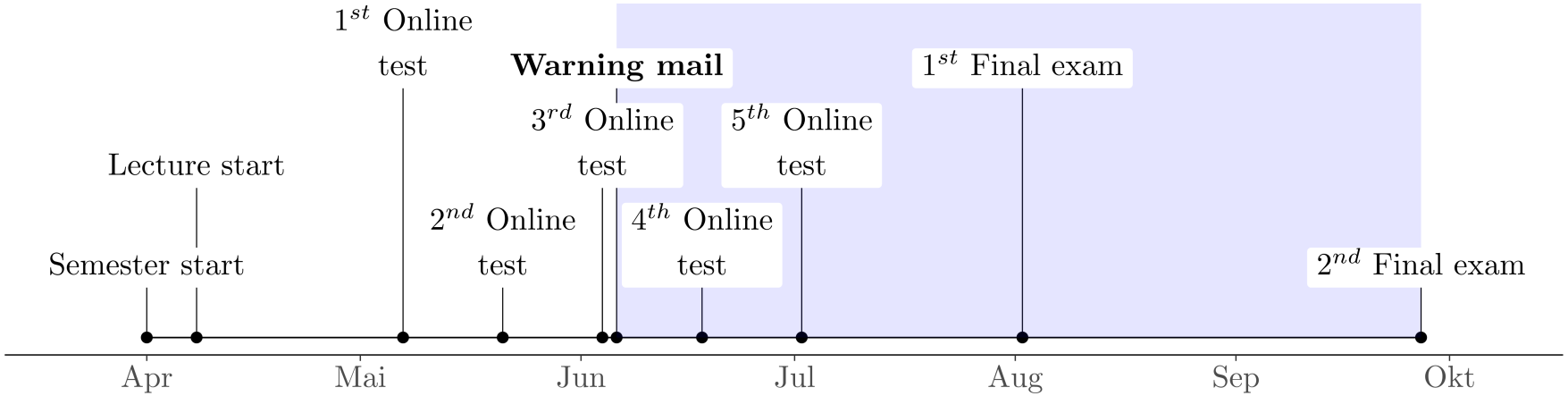
Course Description

- Analyzed Course: *Inferential Statistics* at the University of Duisburg-Essen
- Compulsory for business and economics
  - Weekly 2-hour lecture
  - Weekly 2-hour exercise
  - We also have other interventions
- **802** students at the beginning of the semester
  - **337** students took an exam at the end of the semester

Treatment Assignment

- A logit model was used to predict students' probability to pass the exam based on the first 3 online tests
  - The model was trained with the latest data obtained from the previous edition of the same course
- If predicted probability to pass ≤ 0.4 the student got a warning mail

Course Timeline Main Events



Timeline for the key events in the 2019 summer term course Inferential Statistics (treatment cohort)

- The shaded area indicates the period after treatment
- 57 days between the warning mail and 1^{st} exam
- 113 days between the warning email and 2^{nd} exam

Literature on Warning Systems in Education

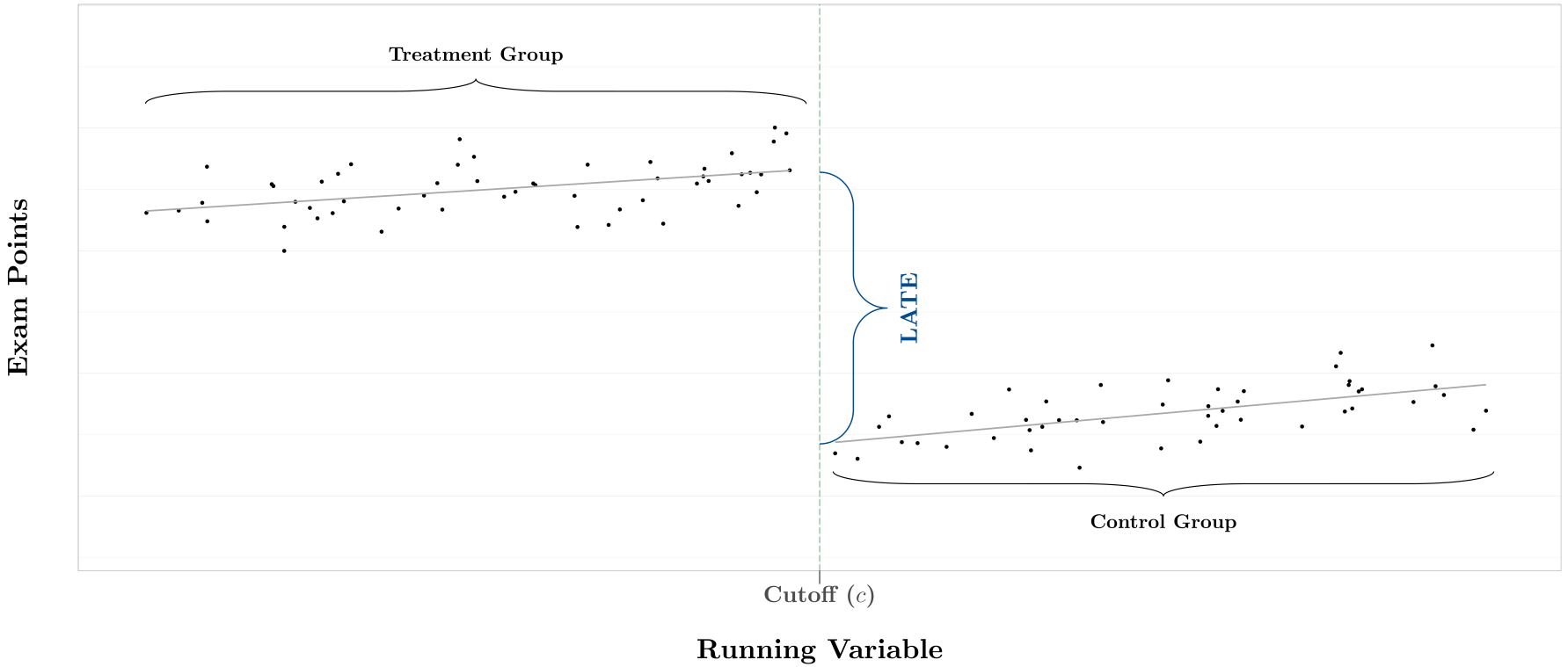
- Arnold and Pistilli (2012) investigated the effect of the signal light system at Purdue University and found a positive effect on student grades
- Bañeres, Rodríguez, Guerrero-Roldán, and Karadeniz (2020) implemented an early warning system but did not analyze the effect on students' performance
- Şahin and Yurdugül (2019) invented an *Intelligent Intervention System* where students get feedback for each assessment
  - Students emphasized the usefulness of the system
- Mac Iver, Stein, Davis, Balfanz, and Fox (2019) could not find an effect from their early warning system in the ninth grade
- Edmunds and Tancock (2002) analyzed the effects of incentives on third and four-graders' reading motivation and did not find an effect

- The literature on the effects of warning system is inconclusive
- Many studies analyzed the system with questionnaires

➔ We try to measure the direct effect on students' performance

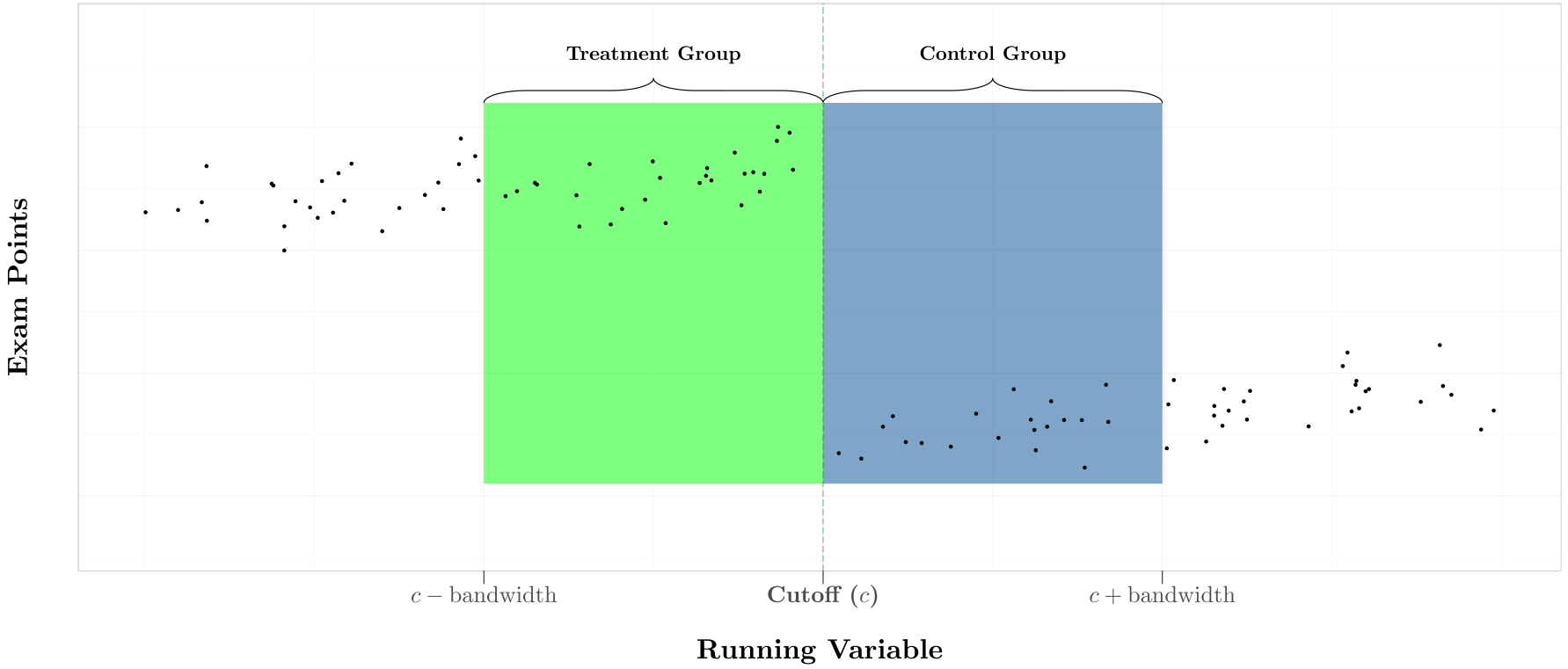
RDD Toy Example — I

Parametric Estimation



RDD Toy Example — II

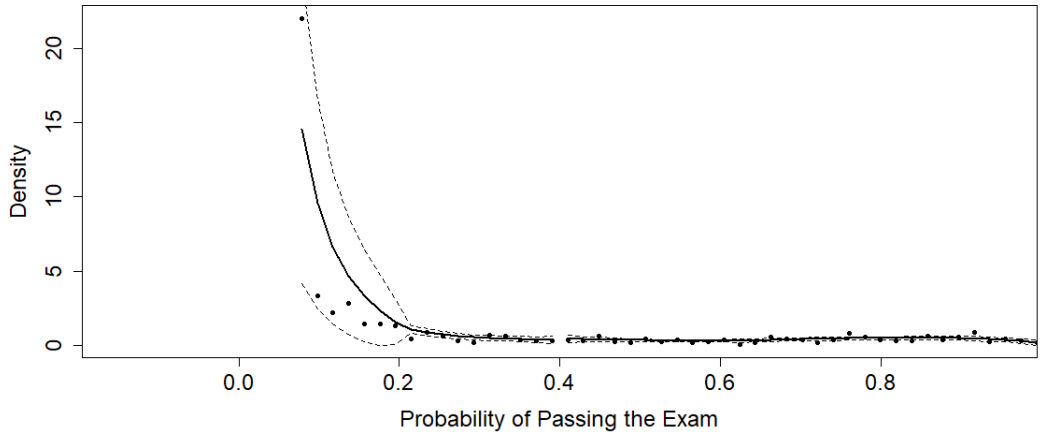
Non-parametric Estimation



- We used the data-driven approach by Imbens and Kalyanaraman (2009) to determine the bandwidth

Model Assumptions

- The running variable W (predicted probability to pass the exam) must not have a jump around the cutoff in the density function

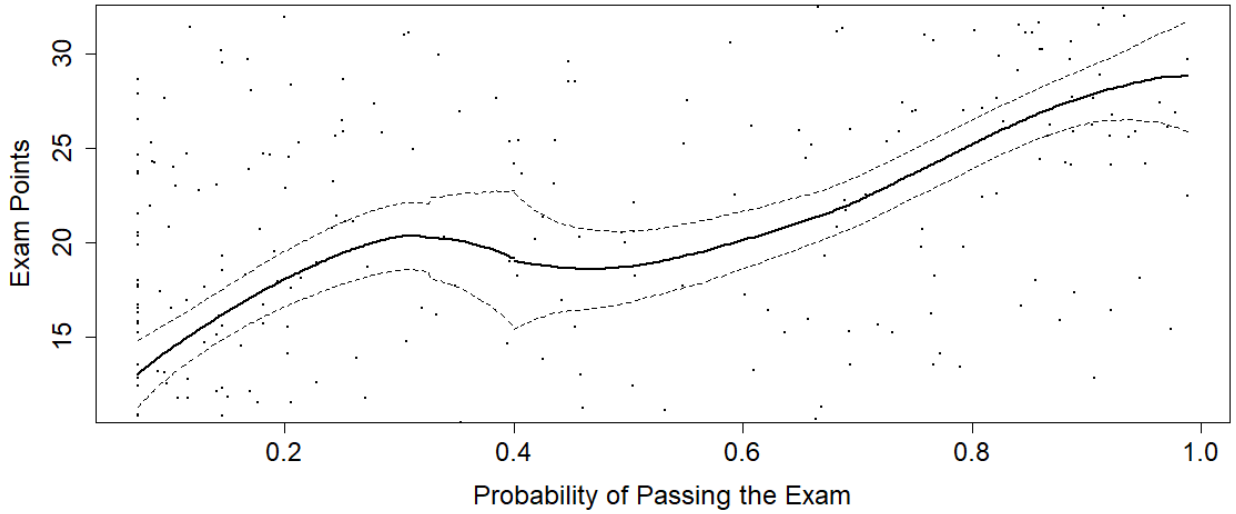


Graphical illustration of the McCrary sorting test

- There is no jump in the density around the cutoff point of 0.4
- p-value: 0.509
- The incentive to manipulate the treatment is quite low

- Also, standard IV estimation assumptions must hold

Empirical Results — I



Graphical illustration of the RDD model

Estimate

- LATE: 0.193
  - SE: 4.889
  - p-value: 0.968
- Bandwidth: 0.255
- N: 126

Empirical Results — II

- The LATE estimate is positive but not significant
  - An estimate of 0.193 means that students who received the warning email achieved 0.193 points more than comparable students who did not
  - Compared to the 60-point exam, the effect size seems limited
- Bandwidth of 0.255
  - Only students with a predicted probability 0.4 (cutoff) $\pm$ 0.255 (bandwidth), are included in the analysis
- This leads to the effective sample size of 126 students

Discussion – I

- Our RDD results do not provide evidence that the warning email has a significant effect on students' results (or behavior)
- The variance around the cutoff is relatively high, which compromises the detection of an effect
- Many individuals are not included in the final analysis for several reasons
  - Students dropping the course
  - Students far away from the cutoff are not providing much information

➔ Thus precise estimation of the treatment becomes more difficult

Discussion – II

- Students also get feedback through their online tests
- The warning may also lead weak students to postpone participation to a later semester
  - The cost in our program to postpone exams is quite low
- The objective feedback and motivation from one warning email is rather small

Further Research

- The effect on the dropout rate from such warning emails or systems requires further attention
- An automatic repeated feedback system could have a more significant impact on student's motivation
  - Detailed recurring feedback could also be used to guide students

We see the open and transparent communication of the student's performance to the students as a positive aspect of the system

References

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