About the exam

The exam has three sections with a total of 9 questions and 100 points:

Section A — Concepts (5 questions, 30 points)
Section B — Evaluating studies (3 questions, 45 points)
Section C — Design task (1 question, 25 points)

Answer all questions.

All studies, programs, and data described in this exam are fictional and constructed for the exam.

1 A1

A newspaper reports that pupils who attended a voluntary summer school score higher on a test the following fall than pupils who did not attend, and concludes that the summer school raises test scores. Answer using the potential outcomes framework.

(i) Define the causal effect of the summer school as a comparison of potential outcomes. (2 p)

(ii) Explain why this comparison cannot be computed directly (i.e., the "fundamental problem of causal inference"). (2 p)

(iii) The newspaper compares two groups of pupils instead. Explain why the difference between those groups need not equal the causal effect in (i). Name the bias, and give one concrete example of how it could arise here. (2 p)

Answer all three parts in the box below, and label them (i), (ii), and (iii). Changes are saved automatically.

Maximum marks: 6

2 **A2**

Suppose instead that places in the summer school were allocated by lottery among the pupils who applied.

(i) Explain why randomization solves the problem with the newspaper's comparison. (3 p)

(ii) Discuss briefly whether a lottery would be feasible in this setting, and what problems it could raise. (2 p)

Answer both parts in the box below, and label them (i) and (ii). Changes are saved automatically.

Maximum marks: 5

3 # A3

Figure 1 shows a causal diagram (DAG) for the effect of attending the summer school (T) on achievement (Y), measured by the test the following fall. Arrows represent direct causal effects.

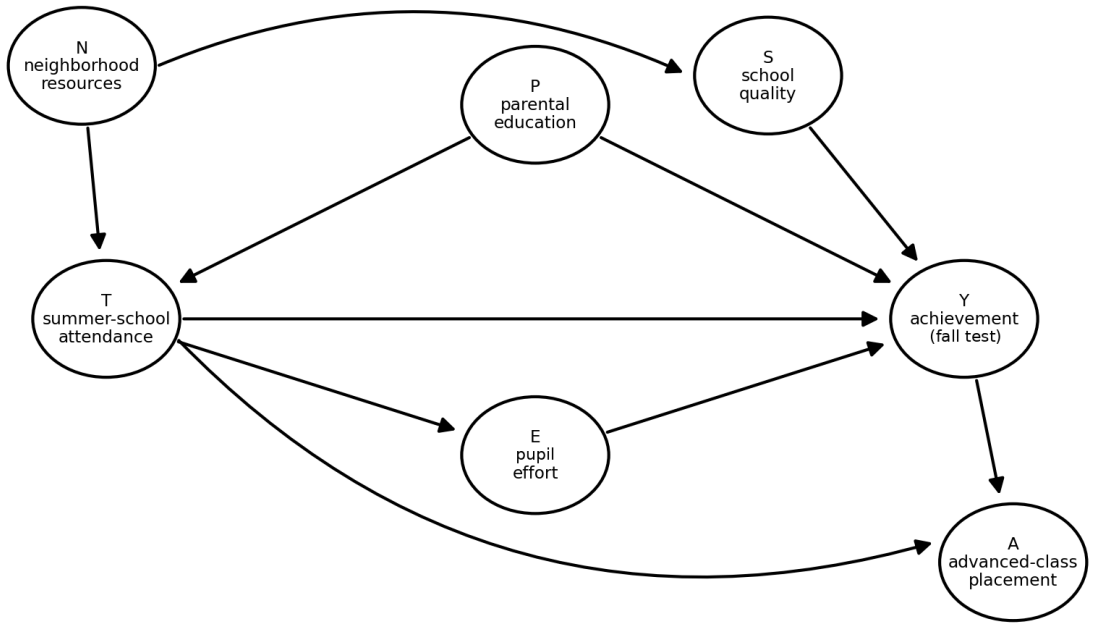


Figure 1: Causal diagram for question A3.

(i) A researcher wants to estimate the total causal effect of T on Y by controlling for covariates. List the open backdoor paths from T to Y, and give a set of variables that closes them all. (4 p)

(ii) Are there any variables in the diagram the researcher should not control for? If so, explain why. (3 p)

(iii) Suppose parental education (P) is not observed in the data. What does this imply for identification of the effect by controlling for covariates? Which family of strategies from this course addresses this situation, and what do they have in common? (2 p)

Answer all three parts in the box below, and label them (i), (ii), and (iii). Changes are saved automatically.

Maximum marks: 9

4 # A4

Controlling for observed covariates in a regression relies on an assumption that is often called "selection on observables". State what this assumption says, and explain why it is often hard to defend in practice. (5 p)

Write your answer in the box below. Changes are saved automatically.

Maximum marks: 5

5 # A5

The summer school is offered every year. A researcher has yearly data on test scores for the same pupils over several years, and some pupils attend the summer school in some years but not in others. The researcher estimates the effect of the summer school in a model with pupil fixed effects. Explain what the fixed effects remove here, and name two important limitations of this strategy. (5 p)

Write your answer in the box below. Changes are saved automatically.

Maximum marks: 5

6 # B1 — The app lottery (15 points)

A city buys a limited number of licenses for an adaptive mathematics app for grade 6. Families with a pupil in grade 6 can apply for a license, and the licenses are allocated by lottery among the families that apply. Families that win receive a license code. At the end of the school year, 62% of the pupils in families that won have used the app, and 8% of the pupils in families that applied but did not win have used it anyway, for example through an older sibling's code or a license bought privately. All pupils in families that applied take the same mathematics test at the end of the school year. A consultant proposes to evaluate the app by comparing the test scores of pupils who used the app with the test scores of pupils who did not.

(i) Explain why the consultant's comparison does not identify the causal effect of the app. (3 p)

(ii) Explain how the lottery can instead be used as an instrument for app use. State the assumptions this requires and, for each, say whether it is plausible in this setting and why. For the assumptions that can be checked with data, say how you would check them. (7 p)

(iii) The IV estimate applies to a particular group of pupils. Define that group in this setting. Explain why the IV estimate can differ from the average effect of the app for all pupils in the city, and why this matters if the city is considering buying licenses for all pupils. (5 p)

Answer all three parts in the box below, and label them (i), (ii), and (iii). Changes are saved automatically.

Maximum marks: 10

7 B2 — The reading threshold (15 points)

All pupils in grade 2 take a national reading screening test, which is scored by the pupils' own teachers. Pupils who score below a fixed threshold are assigned to a reading-support course. Pupils who score at or above the threshold are not. A researcher studies the effect of the course on the national reading test in grade 5, using pupils who scored close to the threshold. Figure 2 shows the average grade-5 test result by grade-2 screening score, measured as the distance to the threshold. Each dot is the average within a one-point score bin, and the lines are fitted separately on each side of the threshold.

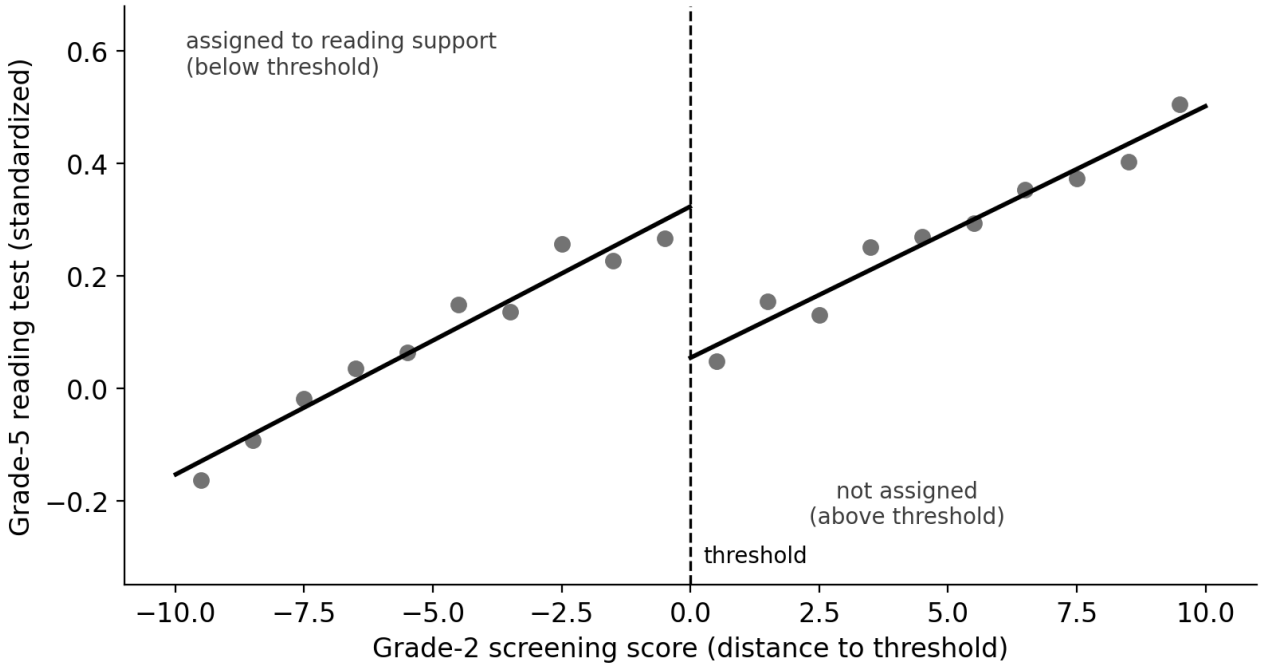


Figure 2: Grade-5 reading test by grade-2 screening score (fictional data), question B2.

(i) Which study design is this? Using Figure 2: what is the estimated effect of the reading-support course (sign and rough size)? Which feature of the figure carries the causal claim? (5 p)

(ii) Discuss the two threats to this design that you consider most important in this setting. For at least one of them, name a concrete check you would run to find out whether the threat is a problem. (6 p)

(iii) A policymaker concludes: "The course raises reading skills, so it should be offered to all pupils." Evaluate this conclusion, given the design of the study. (4 p)

Answer all three parts in the box below, and label them (i), (ii), and (iii). Changes are saved automatically.

Maximum marks: 15

8 # B3 — The extended school day (15 points)

Some years ago, a number of municipalities introduced an extended school day in primary school (treatment municipalities). Pupils stay one extra hour per day, and the hour is used for teacher-led homework support. The other municipalities kept the ordinary school day (control municipalities). All treatment municipalities introduced the extended day in the same school year. A researcher compares standardized test scores in treatment and control municipalities before and after the introduction. Figure 3 shows the estimated difference between treatment and control municipalities by year relative to the introduction, with 95% confidence intervals. The year before the introduction (−1) is the reference year.

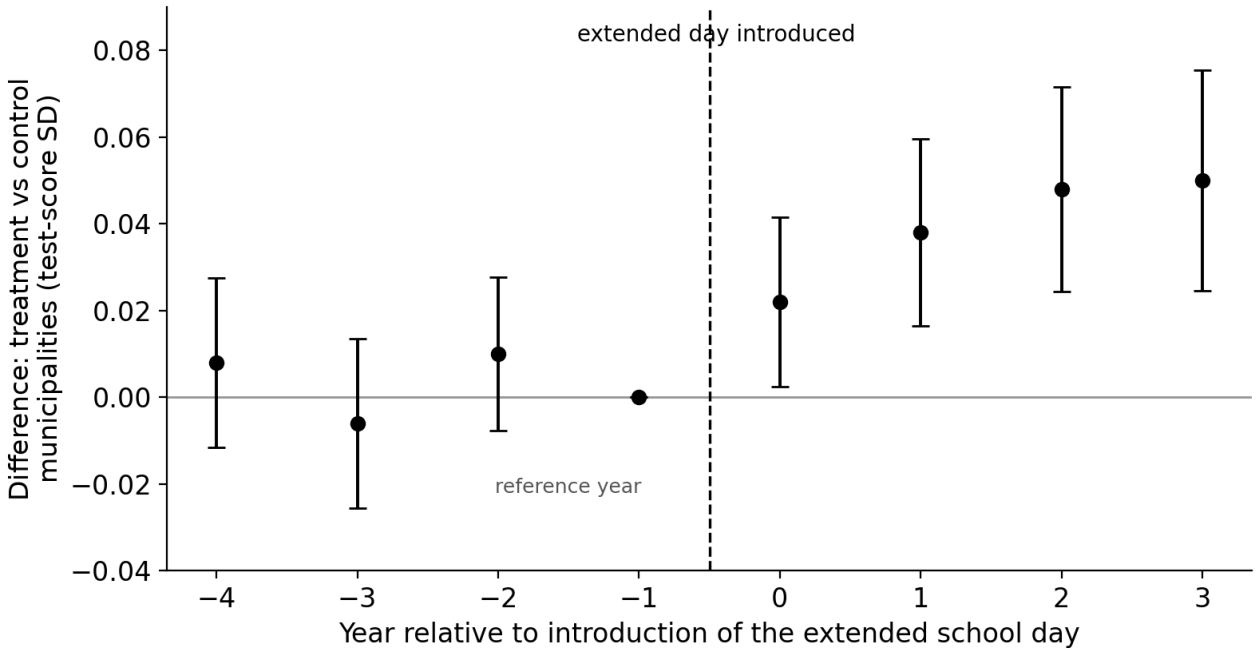


Figure 3: Event-study estimates around the introduction of the extended school day, question B3. Note that this is fictional data about a fictional reform.

(i) State the main assumption under which this design identifies the effect of the extended school day. (5 p)

(ii) Using Figure 3: what do the estimates for the years before the introduction tell you, and how do you interpret the pattern after the introduction? (5 p)

(iii) The municipalities chose themselves whether to introduce the extended school day. Explain why this does not by itself violate the assumption in (i), and give one concrete example of a situation in which it would. (5 p)

Answer all three parts in the box below, and label them (i), (ii), and (iii). Changes are saved automatically.

Maximum marks: 10

9 C — Design task (25 points)

The Ministry of Education has decided to introduce a free daily lunch in lower-secondary schools (free school meals) from fall 2027. Free school meals start in every municipality where the share of children from low-income families, measured in the 2025 register statistics, lies at or above a fixed cutoff. Municipalities below the cutoff do not get free school meals. The plan is fixed and has not yet started.

The ministry has hired you to design the evaluation. You will have national register data on attendance and test scores for all pupils, and a yearly pupil survey on concentration and well-being that is run in the same way in all municipalities. Both are available for every year since 2020.

(i) Propose the evaluation design you consider most credible. Explain how your design identifies the causal effect of free school meals, which assumptions it relies on in this setting, which municipalities or pupils the estimated effect applies to, and what the most important threats to your design are. (12 p)

(ii) The plan makes more than one design possible. Present one alternative to your main proposal and explain why you ranked it second: what are its advantages and disadvantages compared with your main design? (7 p)

(iii) Small adjustments to the plan are still possible. Give two concrete changes that would make the evaluation more informative, and justify each briefly. (6 p)

Answer all three parts in the box below, and label them (i), (ii), and (iii). Changes are saved automatically.

Maximum marks: 25