

Causal Inference Project:

Impact of Scholarships on Student Success

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1. Motivation

Retention and Completion: A Core Challenge for Universities

- **High dropout rates** are a persistent issue in higher education, especially during the first years of study.
- **Timely graduation** is crucial for both students (career entry) and universities (funding, reputation)
- ⇒ **Financial constraints** are a major barrier to academic success — especially for socio-economically disadvantaged students.



Scholarships as a Tool to Improve Student Retention and Graduation

- **Scholarship programs** are widely used as an intervention, but:
 - Their **causal effect** on student outcomes is difficult to measure
 - Many studies show correlations, but few rigorously identify causality.
- This study uses a **causal machine learning framework (DML)** to estimate the **true effect of scholarships**, adjusting for observed confounders.
- Findings can inform **policy decisions** on financial aid allocation and **targeting of support** for at-risk students.

2. PICO & Research Question

Population, Intervention, Comparison, Outcome

- P - Undergraduate students at a Portuguese university (N = 4,424), with data on demographics, socio-economic background, and prior academic performance.
- I - Receiving a scholarship during university studies.
- C - Students without scholarships, adjusted for observed confounders (grades, family background, gender, etc.).
- O - Two binary outcomes observed 3 years after enrollment:
 1. Dropout vs. Enrolled/Graduated
 2. Graduated vs. Dropout/Enrolled

Research Question

RQ1

Does receiving a scholarship **reduce** the likelihood of **dropping out** within 3 years?

RQ2

Does receiving a scholarship **increase** the likelihood of **graduating** within 3 years?

3. Data Overview and Exploratory Analysis

Source

- UCI Machine Learning Repository – Predict Students Dropout and Academic Success

Scope

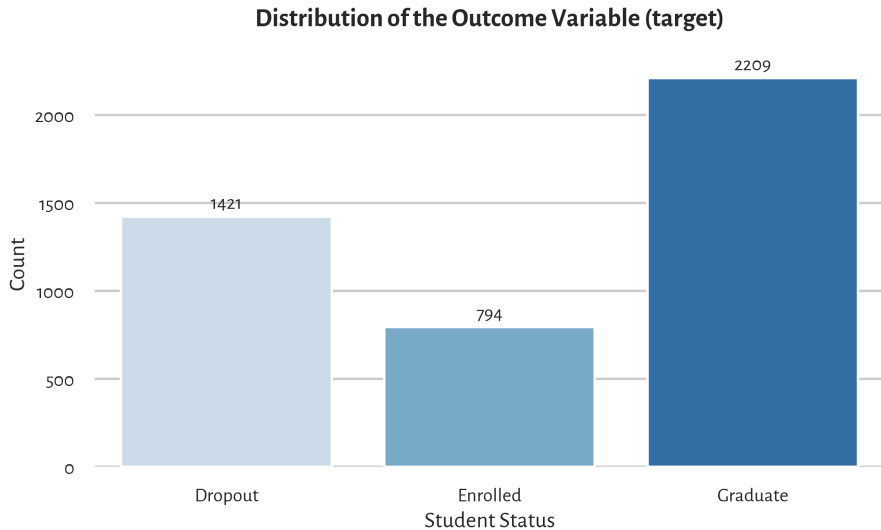
- Administrative records from a Portuguese university → 4,424 undergraduate students across various degree programs

Observation Period

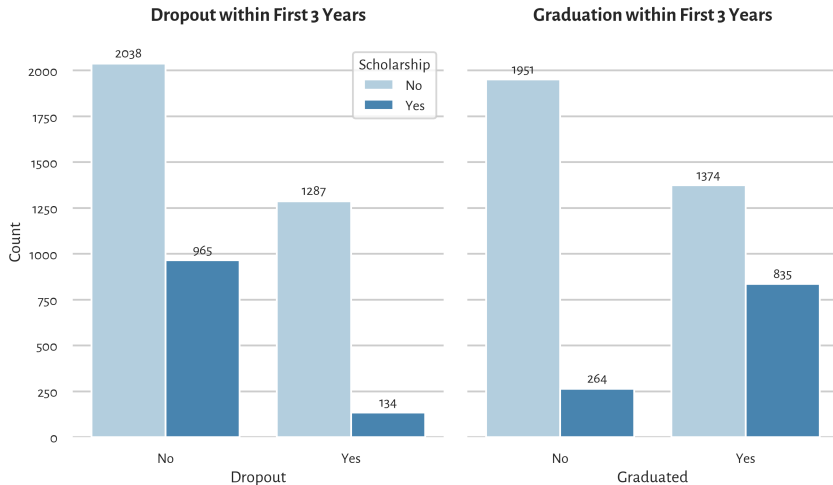
- Students tracked for 3 years after enrollment.

Variables

Outcome Variable	Treatment Variable	Covariates (Pre Treatment)
<p>Student status after 3 years:</p> <ul style="list-style-type: none">– Dropout– Still enrolled– Graduated <p>→ <i>Re-coded into two binary variables for RQ1 & RQ2</i></p>	<p>Received scholarship or not</p> <p><i>(Binary variable)</i></p>	<ul style="list-style-type: none">– Academic performance before university– Family background– Economic context– Demographics

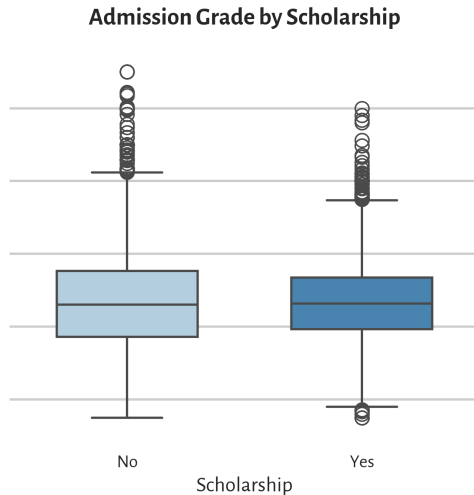
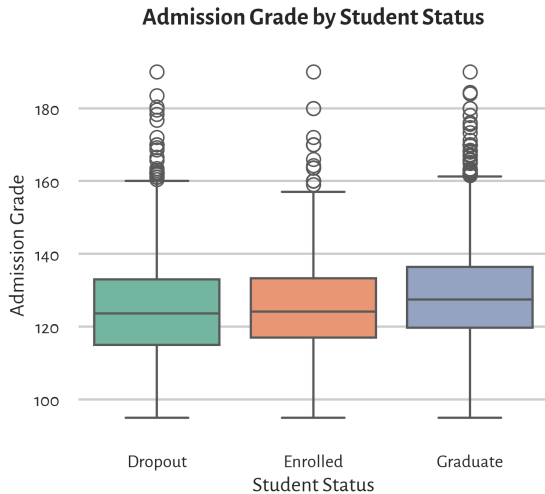


Treatment vs Outcome Variable

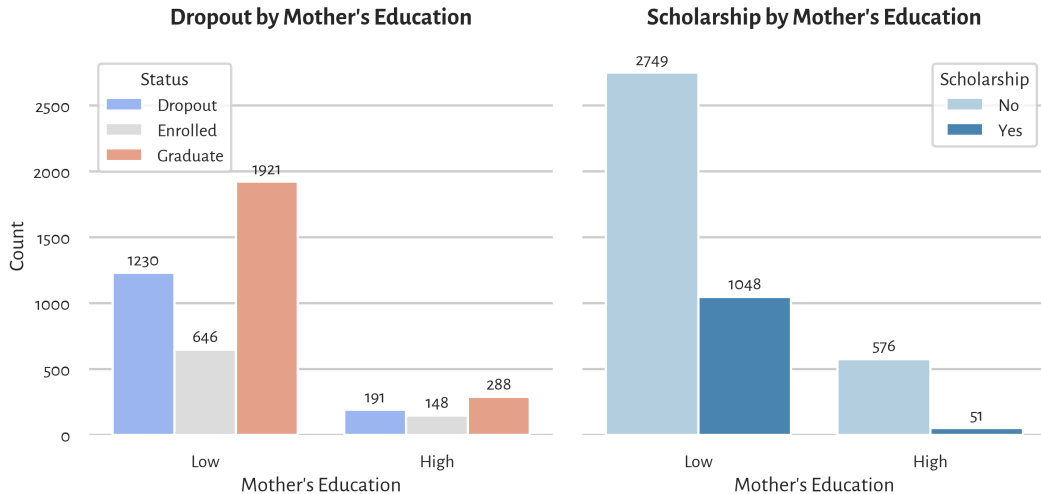


Dropout (Graduation) probability decreases (increases) by 68.50% (83.86%) for scholarship holders.

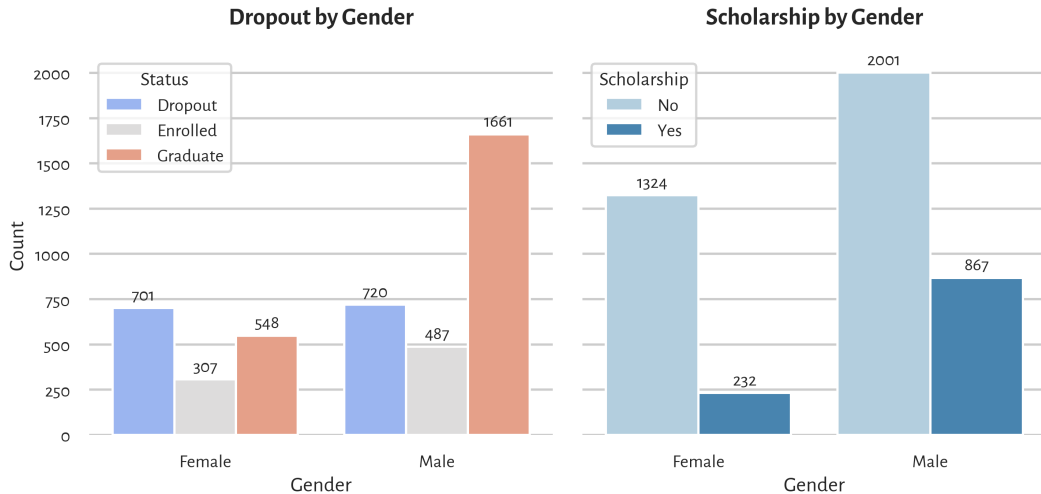
Covariates: Academic Preparation



Covariates: Family Background



Covariates: Gender



4. Causal Graph and Covariate Selection

5. Causal Effect Estimation Using Double Post Lasso

6. Causal Effect Estimation Using Double Machine Learning

X. Conclusion
