

Causal Inference for Retention — Interview Brief (BGSU)

Scope

Estimate the causal effect of the Week 3 Learning Commons outreach on first-year retention and identify which student segments benefit the most. Context: Bowling Green State University (BGSU) Student Success Analytics. Cohort focus is first-year undergraduates. Primary KPI: next-term retention; secondary: term GPA, gateway pass rate, early-course engagement. Data sources: SIS, LMS, advising, Learning Commons outreach logs.

Business Questions

- What is the average treatment effect on retention (ATT) of the Week 3 outreach?
- Which subgroups (e.g., Pell-eligible, GPA 2.0–3.0) see the largest lift?
- What operational changes (timing, targeting) would increase impact next term?

Methodology (Plain)

- Define treatment precisely: outreach touch during Week 3 (email/SMS with booking link).
- Fix cohort and use only pre-Week 3 covariates (prior GPA/credits, major, Pell/first-gen, modality, pre-period LMS activity, prior outcomes).
- Primary design: Difference-in-Differences vs. prior first-year cohorts (parallel pre-trend checks, composition reweighting).
- Secondary design (if available): timing switchback (early vs late send windows) to tighten identification.
- Use propensity scores to improve balance across historical cohorts before DiD.
- Effect estimation: ATT with regression adjustment on matched/weighted data; cluster-robust CIs.
- Heterogeneity: Causal Forest / DR-Learner to estimate CATEs and propose policy targeting.
- Sensitivity: placebo outcomes, timing falsification, Rosenbaum bounds for hidden bias.

Tools

- SQL (cohort extraction, joins, time windows).
- Python: pandas, numpy, scikit-learn/lightgbm (propensity), statsmodels (DiD/GLM), econml or causalml (DR-Learner/causal forest), matplotlib for Love plots & pre-trends.
- Governance: versioned cohort definitions, data dictionary; privacy via FERPA-aligned de-identification.

Potential Results (Example framing)

- Overall ATT: +2.8 to +3.5 percentage points in next-term retention (95% CI reported).
- Largest uplift among Pell-eligible with prior GPA 2.3–3.0 and STEM gateway enrollment.
- Recommendation: keep universal outreach but front-load timing for high-uplift segments; run a 4-week switchback next term.

Interview Talking Points (60–90s)

- Problem → Approach → Result → Action structure.
- Stress pre-trend checks and balance over model AUC.
- Translate to operations: one metric (p90 pickup analog = retention), one change (timing/targeting), one experiment (switchback).

Risks & Mitigations

- Cohort differences → reweighting + covariate controls.
- Hidden confounding → sensitivity bounds + placebo checks.
- Leakage → strict pre-Week 3 covariate cutoff and audit.