Net Impact Analysis

By Matthew Landals

Introduction to Net Impact Analysis

What is Net Impact Analysis

- **Measuring the effect of a program on participants.**
- **Separating treatment effects from personal characteristics.**
- **Evaluate program by measuring what happens after – gross program outcome.**
- **Subtract what would have happened had those same people not participated.**

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Gold Standard

- Randomized experiments: gold star in statistics.
- But not always feasible.
- And not always ethical.
- Balance research with costs and social goals.
- Usually stuck with observational studies.
- Net impact analysis procedures overcome criticisms of nonexperimental studies.

Nonexperimental Net Impact Analysis

- Use data other than treatment or outcome to correct the selection bias.

- All nonexperimental methodologies make assumptions.

- Use the methodology that makes the weakest assumptions.

- Two types: those that control for unobservable personal characteristics and those that don't.

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Controlling for Unobservable

- **Instrumental variable analysis.**
- **Regression discontinuity design.**
- **Difference in difference.**
- **Panel data methods.**
- **Interrupted time series analysis.**

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Controlling for Observables Only

- **Regression analysis → Y = g(X, P) → strong assumption of correct functional form.**

- **Data matching: match comparison group up to program group in terms of personal characteristics → weaker assumption**

- **Direct matching infeasible: too many empty cells; too much dimensionality.**

- **Propensity score matching → program participation probability model → just match the propensity scores.**

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How Does Our Team Approach Net Impact

Work Outcome Reporting Program

- Alberta government programs are designed to help the unemployed and underemployed.
- Want to see if programs work to get clients employment or further training.
- Classroom training programs need evaluating.
- Comparison group are participants who took a one day or shorter workshop.
- Variables: personal characteristics; preprogram education level; preprogram employment; program participation; and post-program employment, training, and main source of income.

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Limitations of WORP

- No instrumental variable.
- No discontinuity in preprogram status vs. program participation.
- Little longitudinal follow-up. It's a cross-sectional dataset.
- Preprogram performance and post-program performance not the same measuring instrument.
- Can't control for unobservable personal characteristics.
- Stick to controlling for observables but can assume that unobservable personal characteristics are strongly correlated with observables.
- Strength of WORP: a vast number of personal characteristic variables to control for.

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Choose Propensity Score Matching

- **Regression assumption of correct functional form is too strong.**

- **Propensity score matching makes weaker assumption: everything that confounds program participation with post-program performance is either observed or strongly correlated with what's observed.**

- **Perfectly realistic assumption because the number of observed personal characteristics is overwhelming.**

Steps in Propensity Score Matching

- Transform raw data to a form suitable for net impact analysis.
- Logistic regression of program participation vs. personal characteristics and preprogram performance.
- Perform common support test.
- Use propensity scores to match comparison group to program group.
- Subtract matched comparison group from gross program outcome.
- Test net impacts for statistical significance.
- Optional: statistical distance between program group and matched comparison.

Steps in Data Transformation

- **Transform categorical variables into indicator variables: 1 for true and 0 for false.**

- **Compile different sources of the same numeric variable into one variable: i.e. different ways of reporting earnings into one variable.**

- **Create indicator variable for program participation and arbitrary coding variable to separate the different analyses.**

- **Filter out observations that aren't part of program group or comparison group.**

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Challenges in Net Impact Analysis

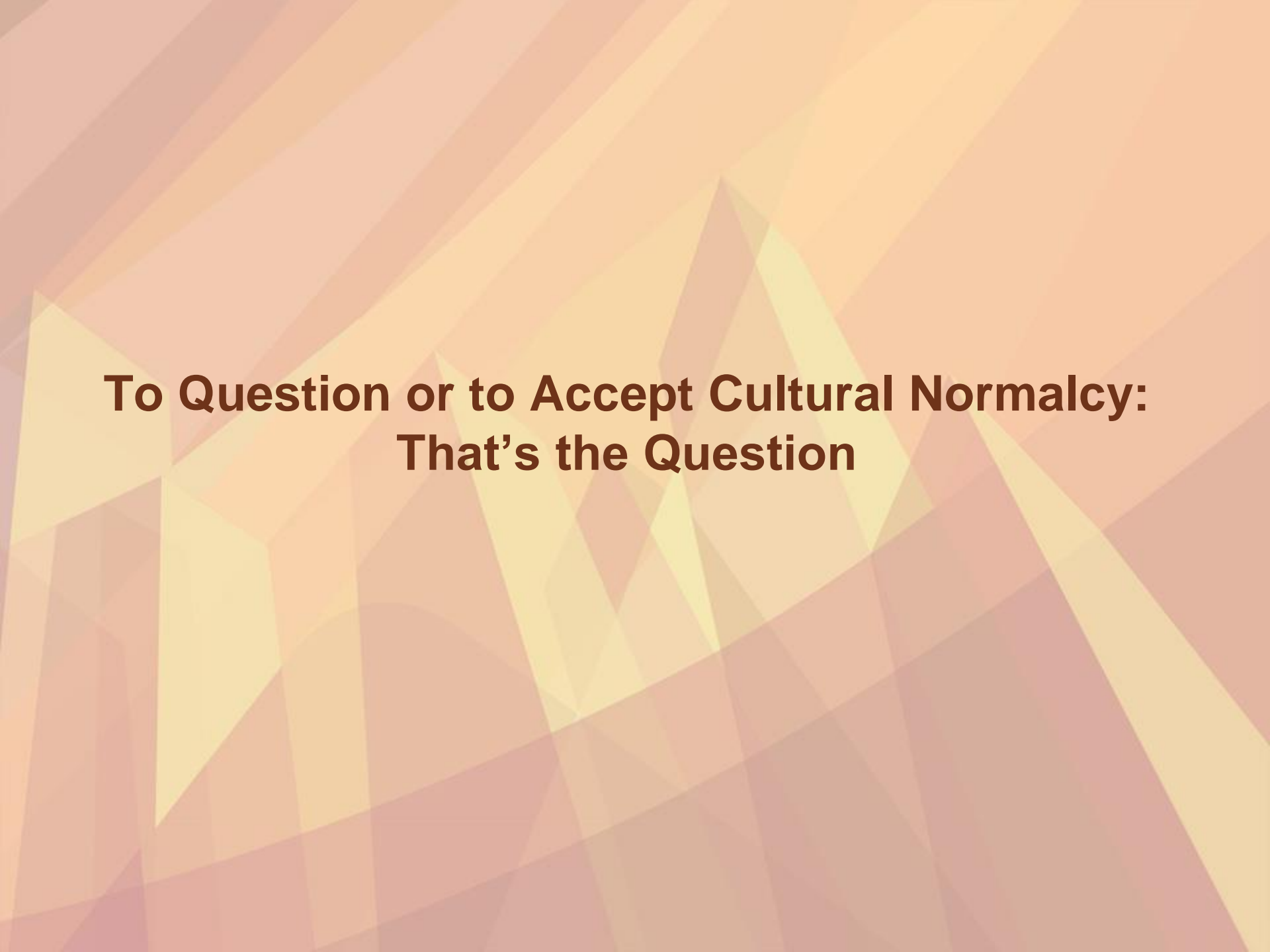- **Automating repetition for different programs and different groups of people: broad programs vs. narrow services; everyone vs. special groups.**

- **Not feasible to manually repeat the procedure for different data subsets.**

- **Must expand data to be one observation per person / analysis combination and then automate.**

- **Net impact analysis is a nonstandard hard procedure: desire a procedural programming language but most SAS is nonprocedural. Hope this will change with PROC IML.**

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Controversies in Net Impact Analysis

- Experts recommend theory-based regression over stepwise regression: trying to minimize stepwise elimination but cannot avoid it entirely.

- Standard methodology is one to one propensity score matching but reweighting comparison group as a whole seems to give a better match.

- Possible and surely logical to evaluate match with statistical distance test but this is nonstandard.

- Ongoing battle between culturally normal thinking and revolutionarily logical thinking.

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Statistical Distance Test

- Let X_1 be program group matching variables and X_2 be comparison group.

- Distance = sqrt(sum((X_1 – X_2)^2 / pooled-variance))

- Distance >= 0 but smaller distances are always better.

- Surely illogical to believe match good when statistical distance says it's bad but standard practice is not to worry about it.

- Moreover, can use this test to compare alternative propensity score matching methodologies but not alternative program participation models.

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To Question or to Accept Cultural Normalcy: That's the Question

General Moral Dilemma

- Society rewards conformity and punishes nonconformity.
- But culturally normalcy is not always on the side of good.
- And bitter lessons have been learned from history.

Reasons to Disbelieve Standard Practice

- Culturally normal beliefs aren't always the truth.
- Time when people thought the earth was flat → science disproved that.
- Time when people thought the sun revolved around the earth → science disproved that.
- So culturally normal belief and capital T truth are two different things.
- People should be thinking evidence and logic, not standard practice and cultural normalcy.
- Might be next scientist born at right time for cultural change.

Revolutionary Idea Regarding Propensity Score Matching

- **View as nonresponse problem: want clients to respond to both treatment and control but only respond to one.**

- **Weight = 1 / Prob(response) corrects for nonresponse in surveys.**

- **Represent ideal world using**

   survey weight / Prob(participate) for program group and survey weight / Prob(nonparticipant) for comparison.

- **Ex-post: leave program group alone.**

- **Therefore, matched comparsion = survey weight * Prob(participate) / (1 – Prob(nonparticipant)).**

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Advantages of Revolutionary Idea

- So easy to SAS program that it takes essentially no time to generate matched comparison group.

- Usually gives better match than traditional one on one matching.

- Traditional one to one matching invites program vs. matched comparison dissimilarity through fact that no two people are exactly the same.

- Matching comparison group as a whole invites similarity by bypassing the hurdle of needing individual matches.

- Extrapolates the well-founded idea of using weights to correct for nonresponse.

Disadvantages of Revolutionary Idea

- Doesn't always give better statistical distance. Sometimes traditional one to one matching does better.

- Doesn't do common support testing. Traditional one to one flags lack of common support when it encounters too many program participants above the comparison group maximum.

- View that net impact problem is nonresponse problem is nonstarter when there is a lack of common support.

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So What do I do?

- Net impact analysis both ways: hardly more work than doing it one way.

- Compare statistical distances to see which works better.

- Present all results and let management decide what to report.

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Concluding Remarks

- **Thanks to presenters last time I attended. I hope to save a ton of time by using PROC IML and the procedural and object oriented side of SAS.**
- **Questions?**
- **Anything not clear?**
- **Anything you disagree with?**
- **Anything you are wondering about?**
- **Let's hear it.**

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Regression Towards the Mean Formula

- Y = A + B*X where 0 < B < 1
- Difference in difference assumes B = 1. Surely this isn't true.
- Gross impact analysis assumes B = 0.
- Truth is somewhere in between.