

Net Impact Analysis

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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.**

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.**

Controlling for Unobservable

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

Controlling for Observables Only

- Regression analysis $\rightarrow Y = g(X, P) \rightarrow$ strong assumption of correct functional form.
- Data matching: match comparison group up to program group in terms of personal characteristics \rightarrow weaker assumption
- Direct matching infeasible: too many empty cells; too much dimensionality.
- Propensity score matching \rightarrow program participation probability model \rightarrow just match the propensity scores.



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.**

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.**

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.**

Challenges in Net Impact Analysis

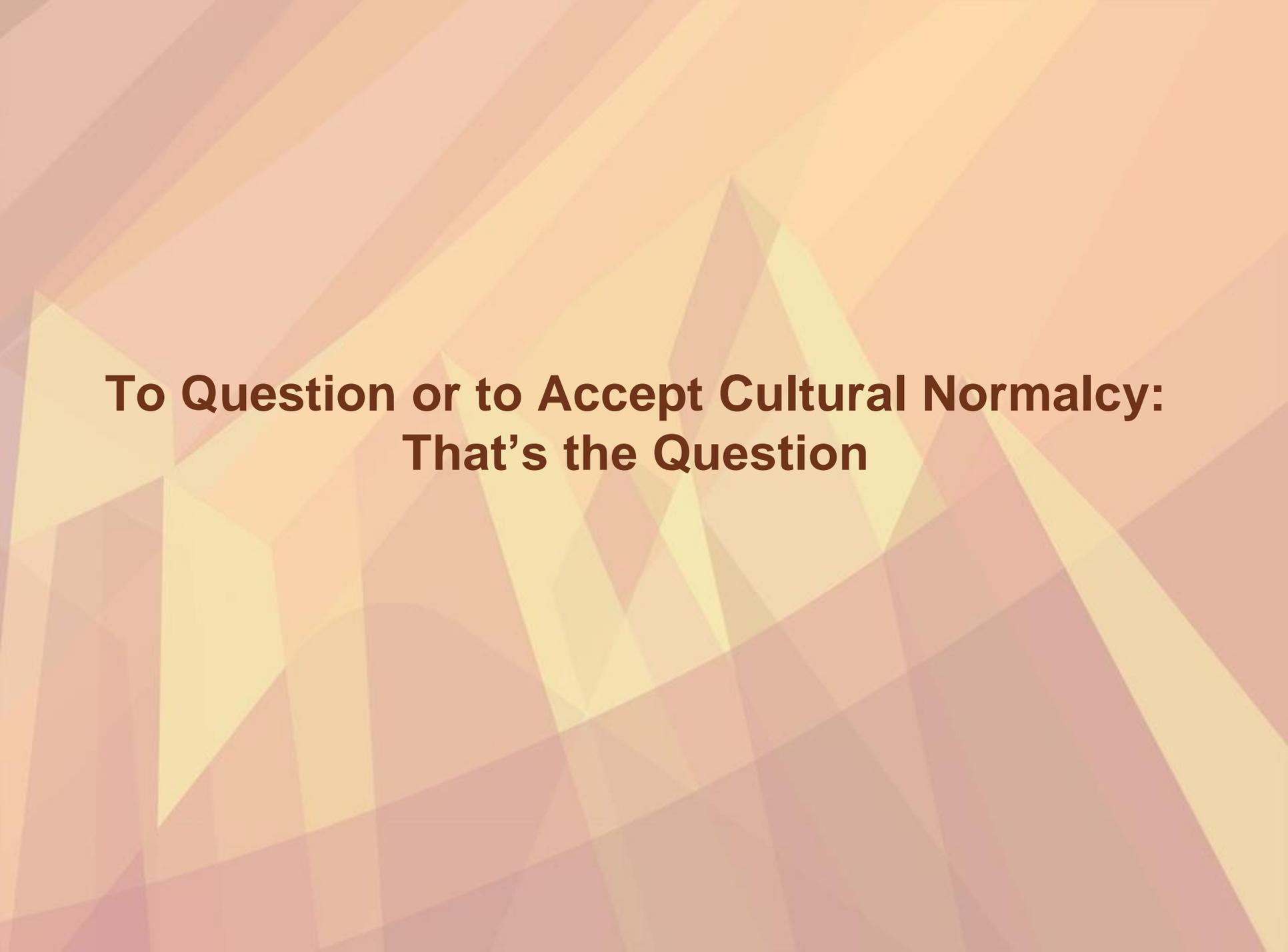
- Automating repetition for different programs and different groups of people: broad programs vs. narrow services; everyone vs. special groups.
- Not feasible to manually repeat the procedure for different data subsets.
- Must expand data to be one observation per person / analysis combination and then 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.

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.**

Statistical Distance Test

- Let X_1 be program group matching variables and X_2 be comparison group.
- Distance = $\sqrt{\text{sum}((X_1 - X_2)^2 / \text{pooled-variance})}$
- 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.



**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 = $1 / \text{Prob}(\text{response})$ corrects for nonresponse in surveys.
- Represent ideal world using
survey weight / $\text{Prob}(\text{participate})$ for program group and
survey weight / $\text{Prob}(\text{nonparticipant})$ for comparison.
- Ex-post: leave program group alone.
- Therefore, matched comparison = survey weight * $\text{Prob}(\text{participate}) / (1 - \text{Prob}(\text{nonparticipant}))$.

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.**

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.**

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.

Regression Towards the Mean Formula

- $Y = A + B \cdot X$ 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.

