

Statistical Power of Federal Environmental Justice Analyses: False negative errors and implications for American Indian populations

Ryan Emanuel¹, Louie Rivers¹, and Gary Blank¹

¹North Carolina State University Raleigh

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Abstract

Federal agencies in the US must evaluate the environmental justice implications of regulatory actions. Environmental justice analyses frequently use demographic tests to determine whether regulated projects will disproportionately impact vulnerable communities, including American Indian communities. Demographic tests typically yield negative results, which are often cited as evidence of no environmental justice implications. However, susceptibility of demographic tests to false negative errors is unknown. In these cases, false negative errors occur when a test cannot identify a vulnerable population concentrated disproportionately within a project study area. We developed a technique to evaluate the susceptibility of demographic tests to false negative errors. We used the technique to assess a test commonly used by regulators to permit fossil fuel pipelines. The Atlantic Coast Pipeline served as a case study. The demographic test did not identify disproportionately large American Indian populations under any realistic scenario, a false negative error rate of 100%. In our case study, the test did not detect a disproportionately large American Indian population until the study area contained a four times greater fraction of American Indians than the reference area. We extend the results to study the test's performance throughout the US. The test's inability to detect disproportionately large American Indian populations calls into question the validity of negative results and the general ability of the test to inform conclusions about environmental justice or sustainability. We recommend abandoning the test in favor of more rigorous methods.

Statistical Power of Federal Environmental Justice Analyses: False negative errors and implications for American Indian populations

Ryan E. Emanuel*, Louie Rivers III, Gary B. Blank

Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC *ryan_emanuel@ncsu.edu, @WaterPotential

NC STATE UNIVERSITY

Ecohydrology and

Watershed Science

@NC State



Summary

Federal agencies in the US must evaluate the environmental justice implications of regulatory actions.¹ Environmental justice analyses frequently use demographic tests to determine whether regulated projects will disproportionately impact vulnerable communities, including American Indian communities.

Demographic tests typically yield negative results, which are often cited as evidence of no environmental justice implications.² However, susceptibility of demographic tests to false negative errors is unknown. In these cases, false negative errors occur when a test cannot identify a vulnerable population concentrated disproportionately within a project study area.

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The test's inability to detect disproportionately large American Indian populations calls into question the validity of negative results and the general ability of the test to inform conclusions about environmental justice or sustainability. We recommend abandoning the test in favor of more rigorous methods.

Methods

We used a Monte Carlo simulation to generate 5 million random scenarios with study and reference populations drawn from American Indian population statistics reported by federal regulators for the Atlantic Coast Pipeline³ (Fig. 1).

We computed the actual disproportionality (D) for each scenario, defined as the minority fraction of the study population divided by the minority fraction of the reference population. We randomly inflated minority populations in study areas by 0–25 percentage points to determine the limit of detectability regulators' demographic test. False negative errors occurred where the regulators' demographic test failed to detect an actual disproportionality in the scenario, defined here as $D > 1.25$.

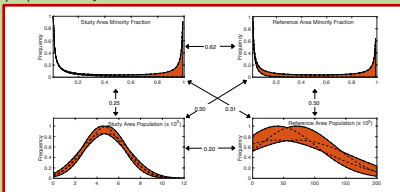
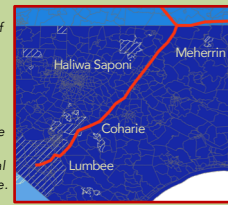


Fig. 1. Population statistics for study and reference areas associated with the Atlantic Coast Pipeline. Arrows are labeled with Spearman correlation coefficients.

Case Study

The Atlantic Coast Pipeline is designed to carry shale gas from West Virginia and Pennsylvania to Virginia and North Carolina. The route traverses present-day and ancestral territories of multiple tribes in North Carolina (Fig. 2). Approximately 30,000 American Indians live in the project's study area and make up a disproportionately large share of the population compared to reference populations.⁴ Federal regulators cited negative demographic test results in concluding that the project would have no environmental justice implications.

Fig. 2. Proposed route of the Atlantic Coast Pipeline (red) through eastern North Carolina. Present day American Indian areas are shown (hatching), and names are shown for tribes with present-day and ancestral territories along the route.



False Negative Error Results

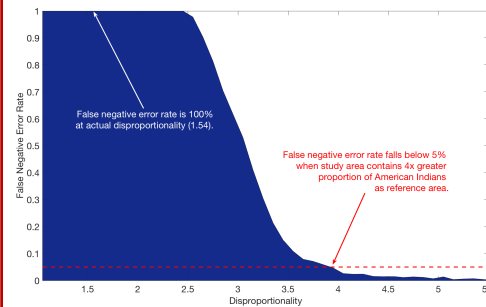


Fig. 3. False negative error rates as a function of disproportionality for scenarios with a reference population of 3% to 4% American Indian.

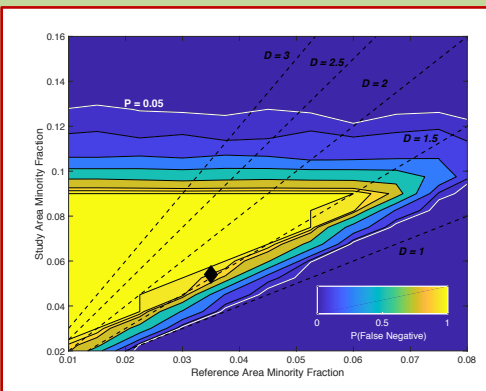


Fig. 4. False negative error rates for American Indian populations. Dashed lines show disproportionality. The Atlantic Coast Pipeline scenario (black diamond) falls on the edge of the region yielding only negative results.

American Indians make up 5.4% of the study area population and 3.5% of the reference area population for the Atlantic Coast Pipeline, a disproportionality of 1.54. Simulation results show:

- The demographic test failed to detect the disproportionality in all of the 961 matching scenarios, a false negative error rate of 100% (Fig. 3).
- The test has no ability to detect the disproportionately large American Indian population located along the Atlantic Coast Pipeline route.
- The false negative error rate fell to 5% once the proportion of American Indians living in the study area exceeded the proportion of American Indians living in the reference area by nearly four times.

The full set of 5 million scenarios shows that false negative error rates exceed 5% (Fig. 4, white contour) where:

- Study area populations have a proportional American Indian population exceeding that of the reference area by a user-determined threshold (defined here as a disproportionality of 1.1), and
- Fewer than 13% of people in the study area are American Indians.

The test only gives negative results (Fig. 4, yellow region) where:

- Fewer than 9% of people in the study area are American Indians, and
- The disproportionality is at least approximately 1.5.

Note: The upper bound of the 5% false negative contour is defined by the threshold of 10 percentage points used in regulators' demographic test. The distance between the white contour and yellow region is determined by the individual and joint distributions of population variables (Fig. 1).

National Implications

Regulators' demographic test would yield false negative results for American Indian populations in 30% to 50% of the US Census tracts within each state (Fig. 5). Disproportionately large American Indian populations may be overlooked by the test regardless of the state's overall American Indian population and number of tribal areas (Fig. 6).

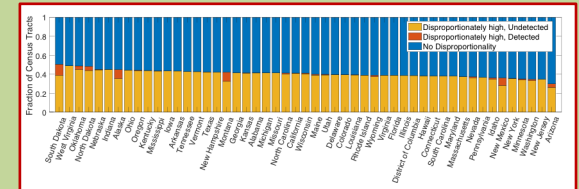


Fig. 5. Fraction of US Census tracts in each state with disproportionately large American Indian populations undetectable (yellow) and detectable (red) by federal regulators' test.

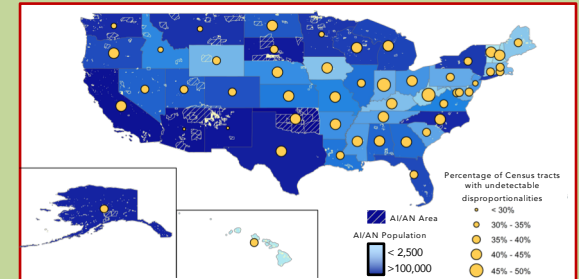


Fig. 6. American Indian and Alaska Native (AI/AN) population by state percentage of US Census tracts with disproportionately large AI/AN populations undetectable by regulators' test.

Recommendations

- Given the failure of regulators' demographic test to detect disproportionately large American Indian populations for the Atlantic Coast Pipeline and nationally, the test should be abandoned in favor of more rigorous methods.
- New methods should be developed in cooperation with demographers, other social scientists, and experts within communities affected by regulated projects.
- In the meantime, EPA's EJSCREEN tool should be modified to accommodate large-scale projects such as interstate pipelines.

References and Resources

- Executive Order Number 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994).
- L. Rose, N. A. Davila, K. A. Tzournis, D. J. Doenges, Environmental Justice Analysis: How Has It Been Implemented in Draft Environmental Impact Statements? Environmental Practice. 7, 235–245 (2005).
- US Federal Energy Regulatory Commission, "Atlantic Coast Pipeline and Supply Header Project Final Environmental Impact Statement" (2017).
- R. E. Emanuel, Flawed environmental justice analyses. Science. 357, 260–260 (2017).

For more information about environmental justice, indigenous rights, and the Atlantic Coast Pipeline see: NativeEnvironment.weebly.com, RobesonRises.com, go.ncsu.edu/cultural