

Concepts: simulation studies, ADEMP, agent-based modeling

For this assignment, you should submit a pdf with a code appendix. There is a 12 page limit, excluding the code appendix.

1. **Agent-Based Modeling Paper** First, read the paper ‘Improving the impact of HIV pre-exposure prophylaxis implementation in small urban centers among men who have sex with men’ by Gantenberg et al. available on Canvas (hiv_prep_abm.pdf). This paper uses agent-based modeling to determine how to allocate PrEP most effectively. Then, respond to the questions below.

- (a) Write a 2-3 paragraph summary of the paper.
- (b) Why do you think agent-based modeling was used to address this question?
- (c) Give an overview of the model structure (what does an agent represent? how do agents interact?) and the measures/outcomes reported about the simulation study.
- (d) What were some of the limitations of the model and approach?

2. Simulating Bias and Uncertainty from Model Selection

The point of this question is to illustrate that reported regression coefficients and associated standard errors can be incorrect when ignoring the iterative nature of actual model building. This question illustrates this concept in a simple case.

Consider a simple linear regression model.

$$y_i = \beta_0 + \beta_1 x_i + \epsilon_i \quad \text{where} \quad \epsilon_i \sim N(0, 1)$$

Suppose you have m observations where $x = -1/\sqrt{m}$ for half of the observed observations and $x = 1/\sqrt{2m}$ for the other half. Your interest centers on estimating β_1 .

Consider the following estimation procedure. You fit the model and test $H_0 : \beta_1 = 0$ vs $H_1 : \beta_1 \neq 0$ at level of significance α . If the test fails to reject H_0 , set the estimator to 0. If the test rejects, set the estimator to the OLS estimator $\hat{\beta}$. Call this estimator $\hat{\beta}_1^\alpha$.

Evaluate the performance of $\hat{\beta}_1^\alpha$ for estimating β_1 by setting up a simulation study. Justify the design of your simulation study using the ADEMP framework seen in class. Further, interpret the results.