

Measurement Phase

- (1) For level $i \in \{\text{US, state, county, tract, block group, block}\}$
 - (a) Determine the privacy-loss budget for the level i ;
 - (b) Take differentially private noisy measurements $\widetilde{\mathbf{M}}_\gamma$ for all nodes in level i .

Estimation Phase

- (1) For the US root node γ_0 estimate the contingency table vector \mathbf{x}_{γ_0} by
 - (a) Estimating a non-negative solution $\tilde{\mathbf{x}}_{\gamma_0}$ from the set of differentially private noisy measurements $\widetilde{\mathbf{M}}_{\gamma_0}$, invariants, and edit constraints at the US level;
 - (b) Estimating a non-negative integer solution $\hat{\mathbf{x}}_{\gamma_0}$ from $\tilde{\mathbf{x}}_{\gamma_0}$ by controlled rounding.
- (2) For level $i \in \{\text{state, county, tract, block group, block}\}$, let P_i represent the set of distinct parents among all nodes at level i . For each parent node $\gamma \in P_i$, estimate the joint contingency table vector $\mathbf{x}_{\text{children}(\gamma)}$ by
 - (a) Estimating a non-negative solution $\tilde{\mathbf{x}}_{\text{children}(\gamma)}$ from the set of differentially private noisy measurements $\widetilde{\mathbf{M}}_{\text{children}(\gamma)}$, invariants, edit constraints, and aggregate constraints enforcing that the children sum to $\hat{\mathbf{x}}_\gamma$;
 - (b) Estimating a non-negative integer solution $\hat{\mathbf{x}}_{\text{children}(\gamma)}$ from $\tilde{\mathbf{x}}_{\text{children}(\gamma)}$ by controlled rounding.