STATISTICS POWERS AMERICAN AGRICULTURE

STATISTICAL SIGNIFICANCE

County crop statistics guide farm programs, crop insurance, disaster response, and agricultural planning. Yet estimates for counties with few sampled farms can vary widely—and they must still add up to official state totals, stay above known county minimums, and report an uncertainty computed under those same rules. Getting all of this right at once is where statistics makes the difference.

Why are county crop estimates challenging?

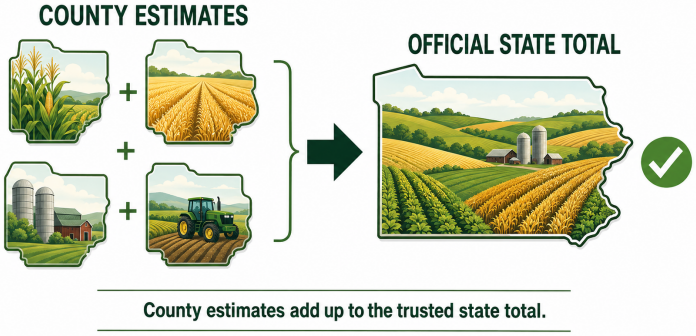
The crop yield of a county is used to calculate Agriculture Risk Coverage, including area-based crop insurance, as well as support for markets, storage, disaster response, and policy planning.

When only a small number of farms are surveyed, a direct estimate for a county can differ significantly, and its estimated sampling variance is also uncertain. At the same time, the estimates need to conform to two known facts:

- counties within a state must add to the official state total; and
- county estimates should not fall below their documented administrative minimum.

X Adjusting estimates to satisfy these known facts after the analysis produces estimates with miscalibrated uncertainty

✓ Building these constraints into the model allows the estimate and its uncertainty to be properly calibrated.



Counties are modeled jointly—so every estimate stays above its minimum while the set reproduces the official state total.

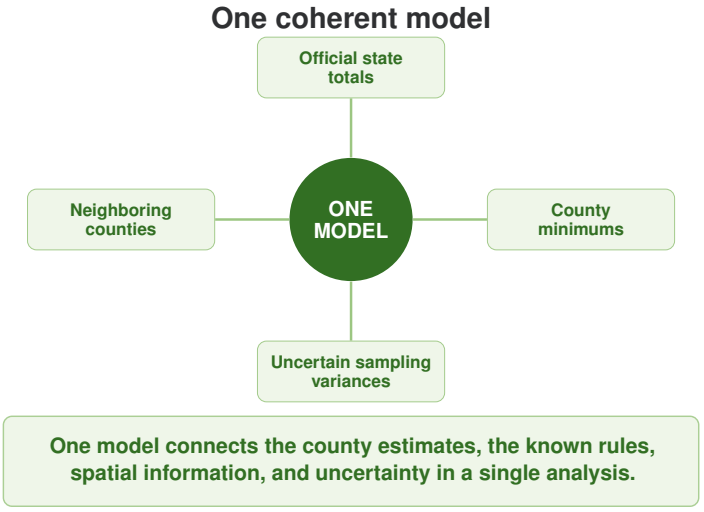
> "If you change your answer, you must also change how sure you are about it."

How statistics addresses this challenge?

Our model builds the state totals and county minimums directly into the analysis from the start—a method called Constrained Heteroscedastic Area Level Model (CHALM), and its spatial variant.

Hence, every *scenario* it generates (a plausible set of county estimates) already satisfies both requirements, so the reported uncertainty is computed for those same constrained estimates.

The spatial variant of the CHALM also lets nearby counties share information when local survey data are limited. Neighboring counties often have related soil, climate, and farming conditions, so this sharpens estimates without changing the required totals or minimums.



Statistics improves county crop information

♦ Evidence from corn data

Iowa simulation. The full constrained spatial model reduced average county estimation error by about **83%** compared with direct estimates. Most of the gain came from imposing the state-total and county-minimum requirements; spatial information added a further improvement.

Eight-state application. Every model-generated scenario matched all eight state totals and respected every county minimum. Against the nonspatial constrained model, SCHALM lowered the average uncertainty per county by **11.5%**, tightening it for **664 of 733 counties**.

♦ Why society benefits

Reliable local estimates support:

- ✓ **Farmers and rural communities** that depend on accurate crop information;
- ✓ **Crop-insurance and disaster-relief programs** that allocate support county by county;
- ✓ **USDA and policymakers** who need county figures that agree with official totals; and
- ✓ **Researchers** facing the same benchmarking problem in public health, population, and economic statistics.

Based on: "Benchmarking and Inequality Constraints for Bayesian Small Area Estimation with Joint Spatial Modeling of Means and Variances," T. S. Morrison, P. A. Parker, and S. H. Holan.

JSM2026 BOSTON, MA • AUGUST 1–6 ASA