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Spatial Attribution in Nonpoint Source Pollution Policy

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Spatial Attribution in Nonpoint Source Pollution Policy

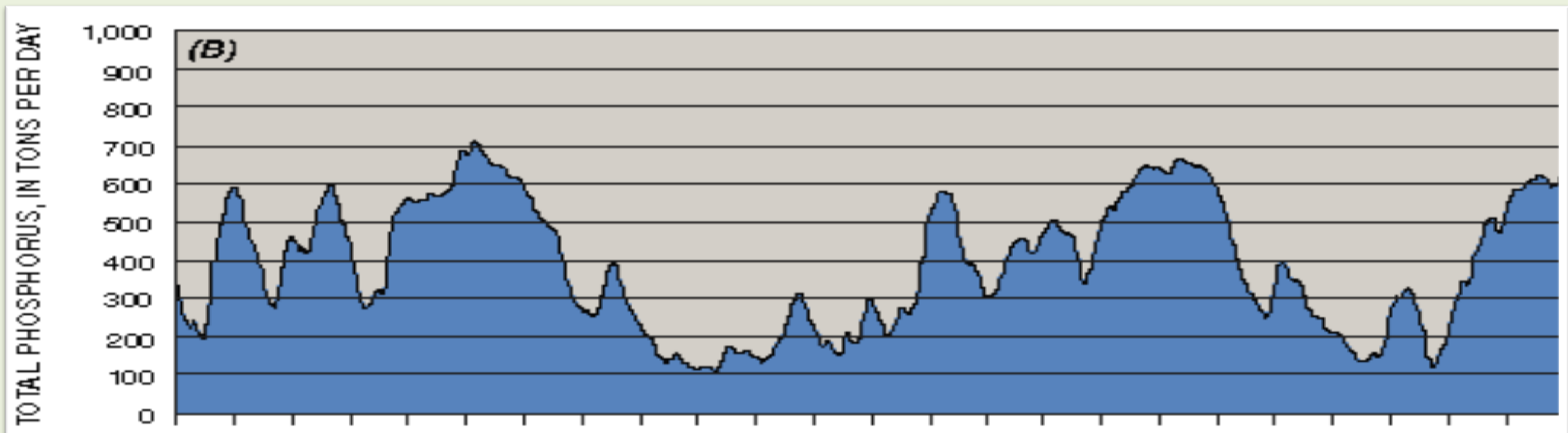
Jacob R Fooks, *University of Delaware*



AAEA & WAEA Joint Annual Meeting
San Francisco, CA, July, 2015

Overview

We have LOTS of very high frequency time series data on nutrient concentration.
The bulk of nutrients come in characteristic fluxes following large rain events.



Can we somehow use the shapes of these, along with what we know about transport dynamics to identify sources? We can use data mining to estimate individual production from ambient data, with spatially heterogeneous error.

Research Questions:

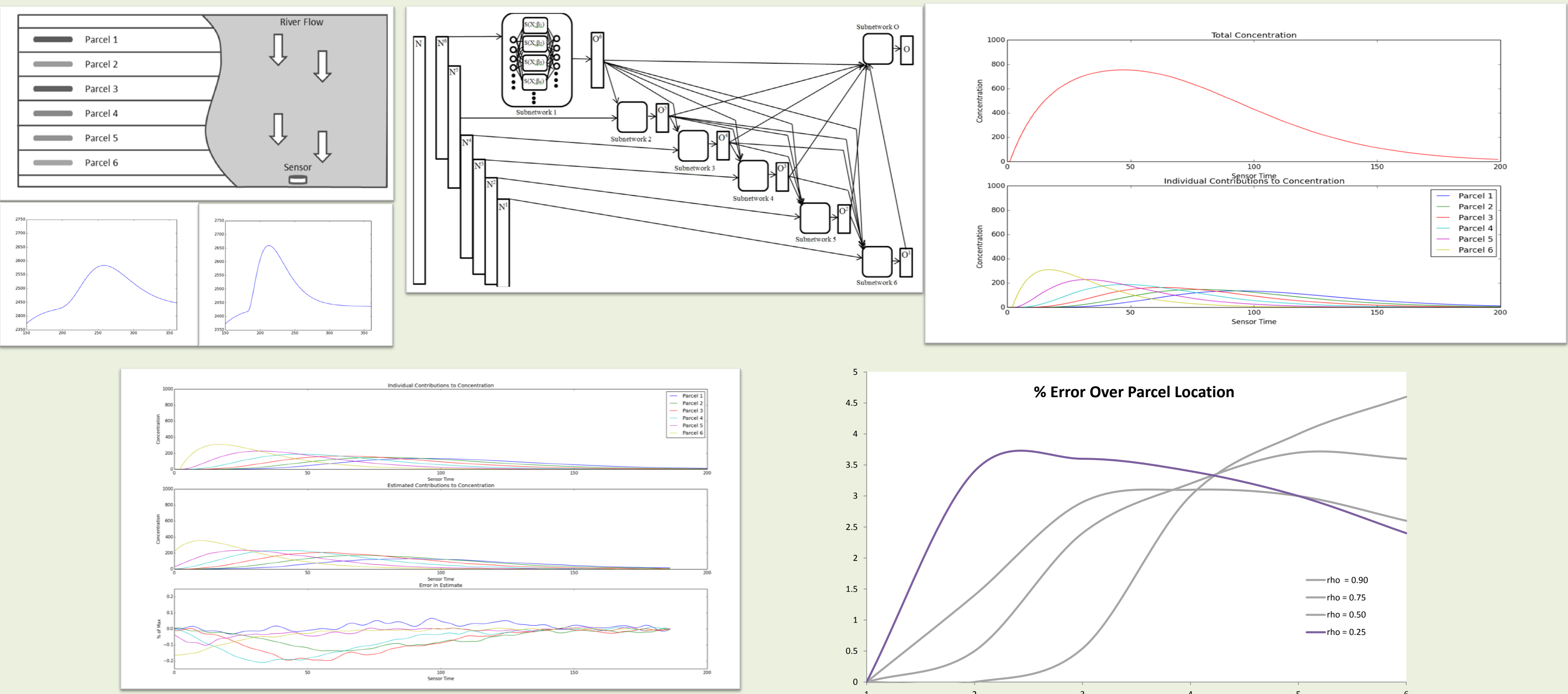
How does quality of information available to regulator or landowner affect outcomes?

- 4 Policy Treatments: No Policy, Ambient Tax, Estimated Tax, Exact Tax
- 3 Information Treatments: Ambient Information, Estimated Information, Exact Information

What are people's values for "updated" information treatments?

Attribution Approach

Structural Artificial Neural Network using a data generated from a synthetic watershed.
Applied in a CPR style Lab Experiment.



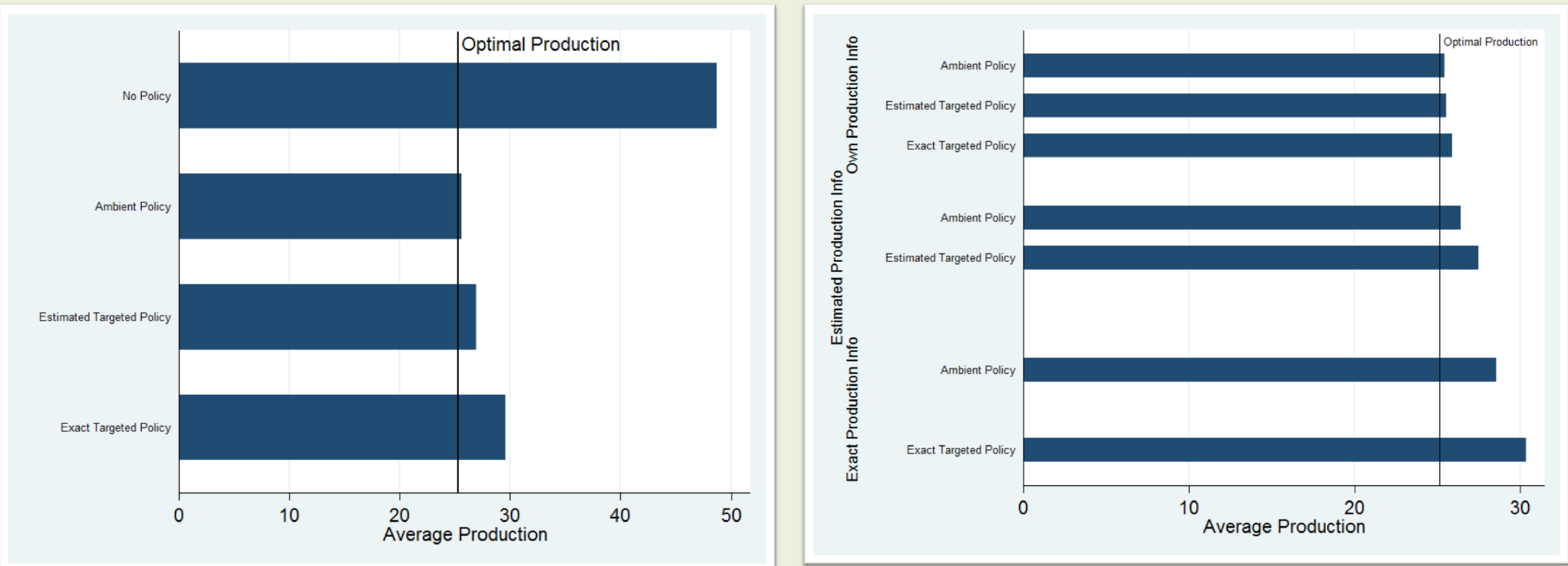
Design

| | |
|------------------|---|
| Subjects | 120 Subjects (96 Undergraduates, 24 Farmers) |
| Session Setup | 3 Rooms; 12 Subjects, 4 per room |
| Time Structure | 9 Enrollment Periods, 3-6 rounds each |
| Average Earnings | \$30 for Undergraduates, \$55 for Landowners |
| Time | 2.5 Hours |
| Format | Production based externality public good game |
| Payoff | $= \text{Income} - \text{Transfer}(\text{Damage})$ $= [35 - 0.0075 * (50 - \text{Production})^2] - [\text{fine}(\text{Total Production}^2)]$ $0 \leq \text{Production} \leq 50$ |

| | Ambient Info | Estimated Info | Exact Info | Ambient Policy $\text{fine}_{\text{Ambient}}(D_k) = \begin{cases} 0, & D_k < 120 \\ 0.37 * (D_k - 120), & D_k \geq 120 \end{cases}$ |
|-----------|--------------|----------------|------------|--|
| No Policy | A | B | C | Estimated Policy $\text{fine}_{\text{Estimated}}(D_k) = \begin{cases} 0, & \tilde{x}_{i,k} < 25 \text{ OR } D_k < 120 \\ 0.37 * (\tilde{x}_{i,k} - 25), & \tilde{x}_{i,k} \geq 25 \text{ AND } D_k \geq 120 \end{cases}$ |
| Ambient | D | E | F | Exact Fine $\text{fine}_{\text{Exact}}(D_k) = \begin{cases} 0, & x_{i,k} < 25 \text{ OR } D_k < 120 \\ 0.37 * (x_{i,k} - 25), & x_{i,k} \geq 25 \text{ AND } D_k \geq 120 \end{cases}$ |
| Estimated | G | H | - | |
| Exact | I | - | J | |

Treatments K & L: What are people's values for "updated" information treatments (Treatments H, I)?

Results



Treatment effects on production:

Exact Policy
-Amb. Info: 1.58***
-Exact Info: +1.44***

Estimated Policy
-Amb. Info: Not Sig
-Est Info: 1.28**

Prior Overproduction
-Exact Info: 3.15***
-Est Info: +1.63**
-Amb Info: +1.36*

| | Students Info Value | Farmer Info Value |
|-------------------------|---------------------|-------------------|
| Upper 95% Bound | 4.36 | 2.61 |
| Estimated Policy & Info | -0.14 | 0.37 |
| Lower 95% Bound | -6.10 | -2.43 |
| Upper 95% Bound | 4.74 | 5.22 |
| Exact Policy & Info | 2.01 | 3.00 |
| Lower 95% Bound | -2.08 | 1.01 |