

Economic Research to Support Development of the Yolo County Natural Heritage Program

David Sunding

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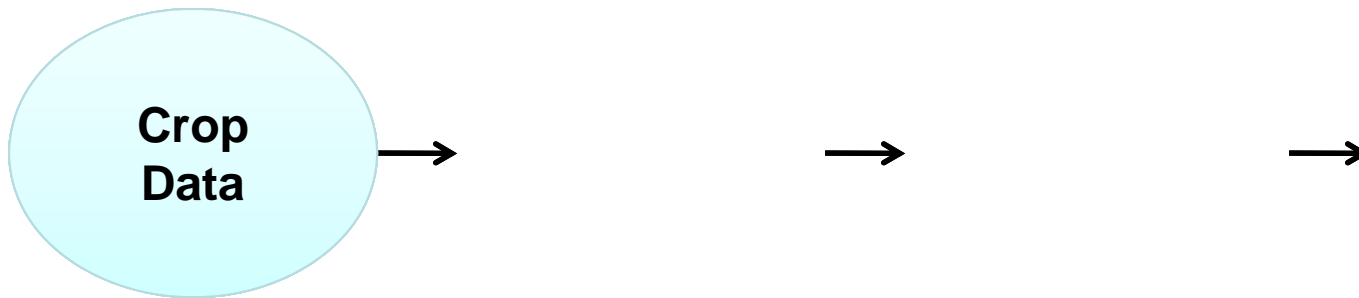
Economics of Land Use

- Allocation is an economic decision influenced by
 - Fixed effects
 - Time-varying effects
- Fixed effects result from environmental conditions, cost barriers to change and distance measures.
- Time-varying effects result from changes in crop prices, input prices, and weather conditions.

Objective of Empirical Model

- Develop a model for meaningful policy forecasts.
- Reflective of changing conditions in study area.
- Meld standard statistical theory with an empirical model whose properties were well understood in the literature.
- Result was to use a multinomial logit (MNL) to develop a Markov transition probabilities.

Stylized Analysis



Markov Process

- A stochastic process in which the probability of any particular future state, given knowledge of today's state, is unaffected by yesterday's state.
 - $\Pr\{X(t)=x|X(t-1),X(t-2),\dots\}=\Pr\{X(t)=x|X(t-1)\}$
- Let $P(j,i)$ denote the probability that state j is observed today, given state i was observed yesterday.
- $P(j,i)$ is called a transition probability, which is assumed to be time stationary.
 - For details, see, e.g., Karlin & Taylor, *An Introduction to Stochastic Modeling*.
- Can array transition probabilities.

Multinomial Logit (MNL)

- Probability model whose properties are well understood in the literature.
- Can be derived from optimizing behavior (given strong statistical assumptions).
- Given regressors X_i , the probability of observing outcome j is:

$$\Pr(y_i = j) = \frac{\exp(X_i\beta_j)}{1 + \sum_{j=1}^J \exp(X_i\beta_j)}$$

- Derivation of the likelihood function can be found in any standard econometrics textbook.
- Betas are estimated using maximum likelihood.

Melding Markov and MNL

- The MNL can be adapted to estimate the transition probabilities, $P(j,i)$.
 - Prior states are treated as predetermined today.
 - Include all possible prior states as regressors.
- Result is that the probability of observing state j today is conditional on having observed state i previously.
- Can use sampling variability from MNL to develop confidence intervals for forecasts.

Data Sources

- County Agriculture Commissioners (CAC): Field Border, various years
 - CAC crop reports
- Biologists generated 2007 land cover layer
- ESRI Street Map
- NRCS Soil Data
- PRISM Climate
- FEMA Floodplain

Empirical Specification

- Dependent variable is crop choice:
 - Deciduous, field, grain, pasture, rice, truck, or vineyard
- Explanatory variables include both fixed and time-varying measures.
- Fixed:
 - Distances (to roads, railroads, rivers, lakes, and cities), floodplain status, soil quality index
- Varying:
 - Precipitation, prices, and total acreage

Illustrative Calculation

Yellow Headed Blackbird

Class	Habitat Values	Acres of Crops in Habitat Zone	Habitat Units
	[a]	[b]	[c]= [a]*[b]
Deciduous	0	968	0
Field	0.13	3,904	508
Grain	0.5	3,086	1,543
Pasture	0.38	6,506	2,472
Rice	0.75	2,891	2,168
Truck	0	1,423	0
Vineyard	0	583	0
Total Habitat Units			6,691

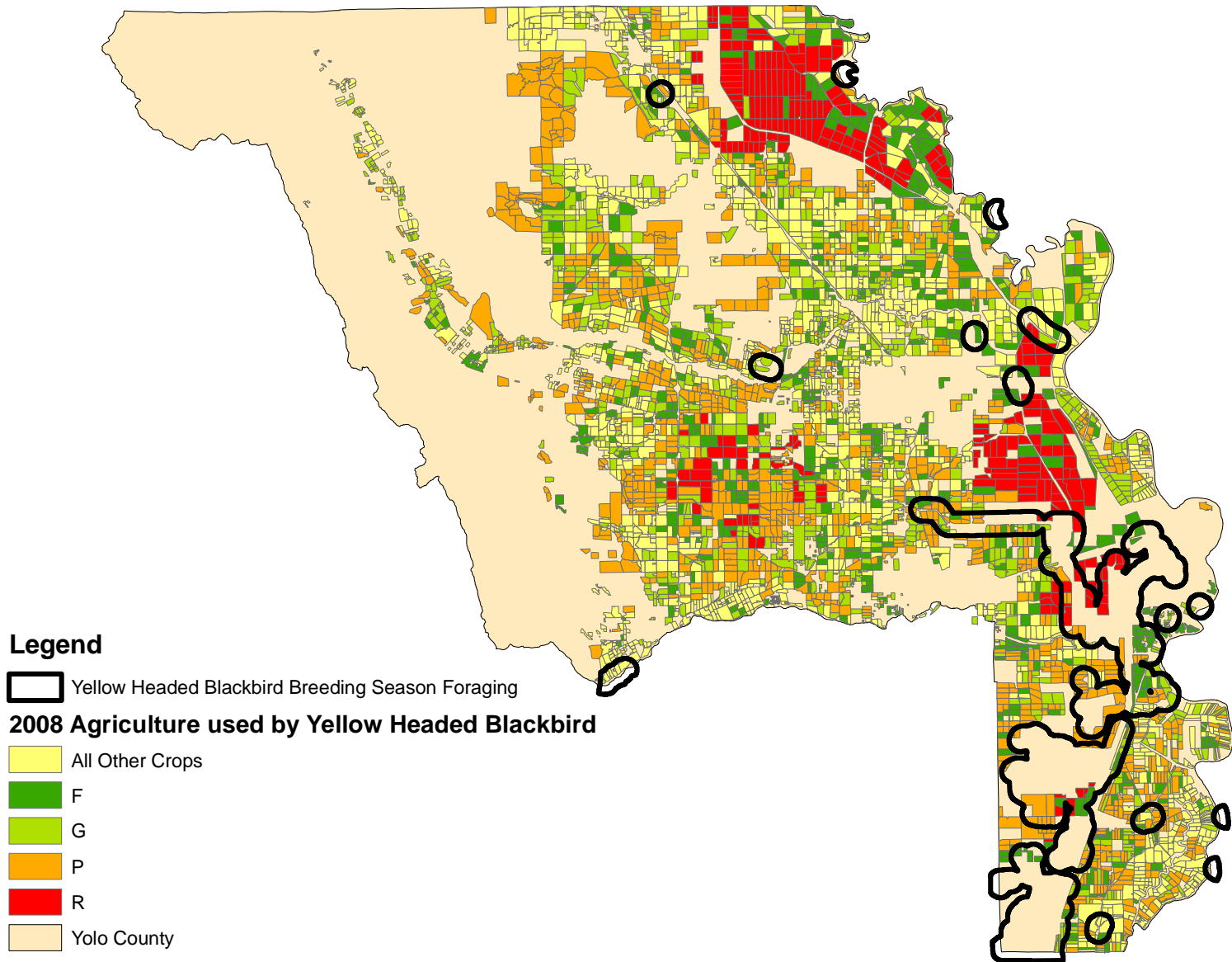
Notes:

[a] These are the habitat values for each crop type as given to us by the biologists

[b] Acres in habitat zone using 2008 field borders data

[c] Total habitat units of each crop type

Yellow Headed Blackbird Habitat



Measuring “Success”

- Model identifies most likely future land allocations, together with a distribution
- Success probabilities for next year depend in part on this years' land allocation
- Probability of future success is calculated over a five-year period using bootstrapping

Research in Progress

- Estimating final version of Markov model
- Calculating near-term “success” probabilities for species dependent on agricultural habitat
- Results to planning team within two weeks.