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Farmland Assessment Through Multiple Regression Analysis

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Abstract: *Farmland owners and agricultural producers often require accurate measures of the market value of agricultural parcels. However, there are a number of complicating factors that make estimation difficult. We demonstrate how multiple regression analysis may be used to estimate the market values while controlling for property differences and minimizing human error. We provide an example that uses a set of 545 farmland sales in Minnesota from 2009. Further, we demonstrate how the analysis can be easily replicated by Extension educators for regional farmland price estimation.*

Introduction

Farmland accounts for over 80% of total farm assets and serves as the principal source of collateral for farm loans. As a result, accurate measures of farmland values are important to producers and non-operating farmland owners. Extension agents and farm real estate appraisers are often asked to estimate the market value of individual farmland parcels, yet it is recognized that market values may be difficult to estimate due to the fact that prices are determined by a number of factors that stem from both farm and non-farm influences. One popular method is to infer market values based on a handful of recent comparable sales, or "comps." However, it is often difficult to identify appropriate comps in regions with few farmland sales, and the estimation may be subject to human error or improper judgment.

Faced with similar problems, real estate professionals are increasingly relying on quantitative methods to estimate property values. The models rely on a larger number of previous sales to estimate the general trend in property values and adjust the estimates given the specific attributes of the property under examination. Multiple regression models have gained prominence based on their ability to:

- Control for quality differences between transacted properties,
- Use data from all recent sales, as opposed to 3 or 4 comparable properties,
- Provide a dollar value for each characteristic, free of value judgments or human error, and
- Estimate market values through standard statistical software, such as Microsoft Excel.

Once a proper dataset is constructed, the analysis can be conducted quickly and efficiently, and the dataset can be adjusted when new transaction information is obtained.

Multiple regression has been widely adopted by real estate industry professionals for mass appraisal, but it is also used extensively by economic researchers to construct real estate price indexes and identify the value of non-priced environmental amenities. An example from the

Extension literature includes Guiling, Doye, and Brorsen (2008), who estimate the influence of farm and non-farm attributes on the sales price of agricultural lands in Oklahoma. Similar multiple regression methods have been used to estimate the likelihood of farmland conversion in New York State (King, 2001).

An Example Using Real-World Data

The following example demonstrates how one can estimate market values of farmland through multiple regression analysis. The techniques can be replicated by Extension agents who possess a sufficiently large set of farmland transactions and access to statistical software. Our application uses data obtained from the Minnesota Land Economics Web-database maintained by the University of Minnesota Extension Service. The data represent one example of publicly available transaction data accessible at no cost. The dataset includes 545 farmland sales from 2009, and each record includes the sales per acre price of each parcel, as well as measures of its total acreage, percent tillable land, and soil productivity. Additional county-level variables were added using data published by the Economic Research Service and freely available on its website, including natural amenities, population density, and median family income. The additional variables were added to control for potentially important non-farm factors. The data are summarized in Table 1.

Table 1.
Variable Names and Descriptive Statistics

Variable	Description	Units	Mean	Std. Dev.	Min	Max
PRICEPA	Per-Acre Price	$ [a]	3,706.50	1,378.70	503.00	13,256.00
PRODUCT	Soil Productivity	0 – 100 [a]	67.61	12.63	22.00	96.00
SIZE	Parcel Size	Ac [a]	109.76	86.15	20.00	1,070.00
PTILL	Tillable Acreage	% [a]	87.77	16.15	5.00	100.00
AMENITY	Natural Amenity	1 – 7 [b]	2.03	0.51	1.00	3.00
POPDENSE	Persons/sq. mile	# [b]	33.80	24.12	8.49	113.88
INCOME	Median family income	$ [b]	47,393.46	6,749.64	39,113	71,728
[a] Transaction level, [b] County level						

Multiple regression analysis estimates the value of farmland parcels, **Y**, while controlling for the other relevant variables, **X**. Multiple regression analysis is available through a number of standard statistical packages. In our illustration, we use the "Regression" function as part of the "Data Analysis" tools in Microsoft Excel. Once the user specifies the **Y** and **X** input ranges, the software provides a summary output that includes summary regression statistics (goodness-of-fit measures), estimated coefficients, standard errors, and measures of statistical significance (t-Statistic and P-value). Table 2 includes the relevant portion of the output. The estimated coefficients provide a measure of the influence of each variable on the sales price in terms of both magnitude and direction. For example, the coefficient for PTILL suggests that each percent of tillable land per parcel increases farmland values at a rate of $14.36 per acre. The reported R^2 suggests that the explanatory variables explain 34% of the observed variation in farmland values, comparable to the results reported by Guiling, Doye, and Brorsen (2008) for Oklahoma agricultural land values.

Table 2.
Regression Estimates

Variable	Coefficient	Standard Error	P-value
Intercept	– 2,025.09	496.09	0.00
PRODUCT	44.00	4.36	0.00
SIZE	– 1.08	0.57	0.06
PTILL	14.36	3.28	0.00
AMENITY	224.67	97.77	0.02
POPDENSE	8.57	2.10	0.00
INCOME	0.02	0.01	0.02
R^2	0.34		

Thus, the market value of other Minnesota farmlands can be estimated by inserting the proper information into the equation:

Estimated price = –2,025.09 + 44.00*(PRODUCT) – 1.08*(SIZE) + 14.36*(PTILL) + 224.67*(AMENITY) + 8.57*(POPDENSE) + 0.02*(INCOME)

For example, the estimated market value of one transaction in Becker County, MN is:

$1,310.81 =–2,025.09 + 44.00*(22) – 1.08*(38) + 14.36*(65.79) + 224.67*(2) + 8.57*(22.89) + 0.02*(44,596)

Conclusions

Extension agents are often asked to provide accurate measures of farmland values. Multiple regression analysis, a tool common to many residential real estate appraisers, provides a simple quantitative approach for estimating market values. The technique only requires information on a sufficient number of transactions and access to standard statistical software. Our illustration demonstrates the necessary tools required for similar analysis.

Disclaimer

The views expressed are those of the authors and should not be attributed to ERS or USDA.

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