Association for Information Systems
AIS Electronic Library (AISeL)

AMCIS 1997 Proceedings

Americas Conference on Information Systems (AMCIS)

8-15-1997

Farm Appraiser: A Neural Network for Agricultural Appraisal

Ojoung Kwon
University of Illinois at Springfield, kwon@uis.edu

Edward J. Kirby
kirby@uis.edu

Farm Appraiser: A Neural Network for Agricultural Appraisal

Ojoung Kwon,
Department of MIS, University of Illinois at Springfield
Edward J. Kirby, Kirby Farms
kwon@uis.edu and kirby@uis.edu

Abstract

This paper describes the research and development of a neural network, Farm Appraiser, that could conceivably reduce the amount of time required for an agricultural appraisal and could also significantly reduce the cost. Neural networks have been successfully applied to urban residential appraisal. However, very little if any application of this technique has been applied to the agricultural market. For this research, Farm Appraiser was trained and tested with 155 real farmland sales data in Mason County, Illinois. The current neural network predicted the price of farmland averaging 90% of actual selling price which is quite impressive prediction for this type of application. Given the speed of the appraisal (matter of seconds) and ease of use, this system could significantly expedite the appraisal process and considerably reduce the cost.

Introduction

Typically agricultural appraisals are completed using the traditional methodology of correlating values derived by using a market and an income approach. These methodologies are an industry standard but they require a considerable amount of time and effort.

Neural networks have been successfully applied to urban residential appraisal. However, very little if any application of this technique has been applied to the agricultural market. Neural networks have potential adaptability for agricultural appraisal analysis. The objective of this paper is to describe the research and development of a neural network, Farm Appraiser, that could conceivably reduce the amount of time required for an agricultural appraisal and could also significantly reduce the cost.

Current Farmland Appraisal Methodology

In farmland appraisal, two or three approaches are typically used to correlate a final appraised value. These include the market approach, income approach, and cost approach. [4] It is somewhat common for a appraiser to employ a market and an income approach in an appraisal analysis. It is also very common to put significant emphasis on the market approach since actual sales are those that reflect the current market conditions.

Given the amount of time and costs involved for ascertaining an appraised price for agricultural properties some institutions are considering alternative methods of valuation, such as regression analysis. According to Do and Grudnitski [2], multiple regression alleviates some of the shortcomings of traditional appraisals, but often its assessments results in significant appraisal errors. Further, several methodological problems are associated with the use of multiple regression for appraisals, including function form misspecification, non-linearity, and heteroskedasticity. [9] [10] [11] [12] [13]

Farmland Appraisal: Neural Network Approach

Neural networks have been successfully applied to the residential housing market and to the commercial real estate market. [1] [2] Agricultural real estate is a special subset of the overall real estate market. However, very little if any application of this technique has been applied to the agricultural market. This may be due to the lack of readily available data and a lack of expertise in the area of this emerging technology.

In the past few years neural network models have been applied in a variety of disciplines. These models learn by interacting with their environment in a process that can be described as a recursive statistical

estimation. [2] These models are data driven and learn by the reasoning process of induction. They have also been demonstrated to be particularly well suited for problems involving complex, incomplete, noisy or non-linear data. Such data is characteristic of that used in the market approach for farmland appraisal. [6] [7] [8]

Methodology

Data Acquisition:

The acquisition of data is a very important first step in the design and implementation of a neural network. A database was constructed for this project containing information regarding 155 actual sales of commercial agricultural properties located in Mason County, Illinois, from January of 1990 to October of 1996. Although the characteristics of these properties are quite variable they represent a reasonable number of learning facts for a neural network. [2, p. 41]

Typically in conventional farmland appraisal methodology a relatively small number of comparable sales properties are compared to a subject property. A neural network approach using a significantly larger number of comparable sales properties can add more objectivity to the analysis and can offer a more statistically correct appraisal. [3, p. 101]

Mathematical Representation of the Neural Network:

A mathematical representation for this project is Pi = f(Xij) where Pi is the selling price per acre of an agricultural property i and Xij represents a set of explanatory variables with j being the explanatory variable for property i.

Training and Testing:

The neural network was created by Brainmaker 3.1 from California Scientific Software. The chosen learning algorithm was back-propagation. Ten percent of the input data was used for testing. The initial number of hidden neurons (17) was determined based on the formula (# input neurons + # output neurons)/2 = # hidden neurons. [5, p.2-12] The final model contained 34 input neurons, 21 hidden neurons, and one output neuron.

The final model was created by preprocessing the output data as a square root function. After adding noise when the training error reached 0.18 the error levels were sequentially decreased until the network converged at a 0.15 level with 93 percent of the test data falling in the acceptable range.

Table 1 contains the results of the test data in final form. We used 16 actual sales data for testing. Output column is the predicted output from the Farm Appraiser in square root value. Pattern column shows the actual sales of the property in square root value. Output**2 column indicates the predicted sales value per tillable acre while Pattern**2 column indicates the actual sales price per tillable acre of the property. On average, Farm Appraiser predicted about 95% of the actual sales price in square root value. When we converted the value to the real dollar amount, Farm Appraiser was still able to perform well with about 90% accuracy.

Conclusions and Future Directions

Today, a farmland appraisal may cost $500-$1000 or considerably more. These appraisals may take a significant amount of time (generally 2 weeks or more) while a client waits for the magic number. These appraisals are also subject to a potential lack of objectivity.

The Farm Appraiser is a neural network which is trained by relatively a large number of real sales data in the target market. For this research, it was trained and tested with 155 real farmland sales data in Mason County, Illinois. The current neural network predicted the price of farmland averaging 90% of actual selling price which is quite impressive prediction for this type of application. Given the speed of the appraisal (matter of seconds) and ease of use, this system could significantly expedite the appraisal process and considerably reduce the cost.

It should be pointed out that very little or no research and/or application has been evidenced in the area of applying neural networks to agricultural appraisal analysis. This project, if not the first of its kind, is probably one of the first for this type of application.

List of References

1. Lawrence, Jeannette, Introduction to Neural Networks, 6th ed., Nevada City: California Scientific Software Press, July, 1994.

1. Do, A. Quang and Gary Grudnitski, "A Neural Network Approach to Residential Property Appraisal," The Real Estate Appraiser, Vol. 58, December, 1992.

1. Bylinsky, Gene, "Computers That Learn," Fortune, Vol. 128, September 6, 1993.

1. Murray, William G., Farm Appraisal and Valuation, 5th ed., Ames: The Iowa State University Press, 1969.

1. Lawrence, Jeannette and Janell Fredrickson, The Brainmaker's Users Guide Reference Manual, 7th ed., Nevada City: California Scientific Software Press, August , 1993.

1. Using Neural Networks, Pittsburgh: NeuralWare, Inc. Technical Publications Group, 1995.

1. Turban, E., E. McClean, and J. Wetherbe, Information Technology for Management, Improving Quality and Productivity, John Wiley & Sons, Inc., 1996.

1. Turban, Efraim, Expert Systems and Applied Artificial Intelligence, McMillan Publishing Company, Inc., 1992.

1. Larsen, J.E. and M.L. Peterson, "Correcting for Errors in Statistical Appraisal Equations," The Real Estate Appraiser & Analyst, Fall 1988, pp. 45-49.

1. Mark, J., "Multiple Regression Analysis and Mass Assessment: A review of the Issues," The Appraisal Journal, January, 1988, pp.23-27.

1. Coleman, J.W. and Larsen, J.E., "Alternative Estimation Techniques for Linear Appraisal Models," The Real Estate Appraiser & Analyst, Winter 1989, pp. 526-532.

1. Murphy, L. T. III, "Determining Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal, October, 1989, pp.498-517.

1. Newsome, B.A. and J. Zeitz, "Adjusting Comparable Sales Using Multiple Regression Analysis-The Need for Segmentation," The Appraisal Journal, January, 1992, pp.129-135.

NOTE: Due to space limitations, a large number of tables for data preprocessing and all the details of the methodology used have been omitted. Please contact the authors for a full version of the paper.

Table 1. Test Results of Farm Appraiser.

Data #	Output	Pattern	% Error 1	Output**2	Pattern**2	Difference	% Error 2
1	26	26	2.6%	690	656	35	5.3%
2	37	34	6.8%	1333	1168	165	14.1%
3	29	32	7.9%	852	1004	153	15.2%
4	26	26	3.3%	695	652	43	6.7%
5	29	25	17.5%	844	612	233	38.1%
6	43	44	4.1%	1816	1973	158	8.0%
7	35	36	3.5%	1236	1326	91	6.8%
8	43	43	1.0%	1853	1816	37	2.0%
9	36	34	6.7%	1331	1170	161	13.8%
10	25	24	4.8%	628	572	56	9.8%
11	40	40	1.9%	1563	1625	63	3.9%
12	51	52	0.7%	2624	2661	37	1.4%
13	40	36	9.9%	1608	1332	276	20.7%
14	51	53	2.9%	2641	2802	162	5.8%
15	51	51	0.2%	2606	2594	12	0.5%
16	50	45	9.3%	2464	2062	402	19.5%
Average	38.3	37.6	**5.2%**	1548.9	1501.5	130.1	**10.7%**