



Correlation of rural land value factors in Montana
by Robert Jordan Remer

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Agricultural Economics
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Abstract:

The market value of rural property is affected by many variable factors and conditions. The estimate of the market value of a property is used in many appraisal situations today including right of way acquisition by governmental agencies, mortgage loan appraisals, property sales and estate settlements. One of the chief problems confronted by an appraiser is the analysis or correlation of a number of market sales for trends.

In this study the use of the computer in assisting a field or reviewing appraiser to analyze market information is demonstrated in three ways. First, a general tabulation of the sales in a summary manner was made. Second, a productivity rating was computed for each sale in the group and the linear regression analysis statistics of sale price (dependent variable) and productivity (independent variable) computed to better evaluate this relationship. Third, multiple linear regression statistics were computed which would evaluate particular variables in a sale data group and provide information to predict other property values from these coefficients.

It is concluded that simple linear regression models may be used for the purpose of correlating a group of sales. In this model the productivity of the land is estimated and other variable factors which influence specific sales may be observed from the scatter diagram. The calculation of a composite productivity rating which considers many production factors such as soil, temperature, rainfall, elevation, etc., is the first step in this type of correlation where productivity is hypothesized to be an important influence in the price.

Multiple regression statistics are more meaningful in predicting property values because many variable factors are considered, however, this model was limited by sample size in this study. Sample size proves to be a limitation frequently for field appraisers because large numbers of comparable sales are not available in specific local areas. However, this model may be used in some cases to evaluate which variables were the most important for the group of sales as a whole. The use, advantages, and limitations of multiple regression statistics to forecast property values are demonstrated in this study.

Further study appears warranted to better define the relationships between the variables where they are nonlinear and to include other factors in a quantitative manner such as terms of sale. If the multiple regression model can be improved it may some day be possible to predict values for rural properties that would be within 5 percent or 10 percent of the true value for 95 percent of the cases.

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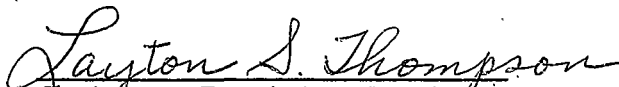
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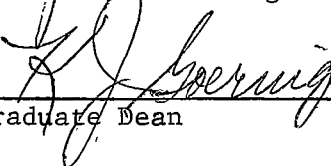
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The author assumes sole responsibility for any possible errors or omissions in this report.

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ABSTRACT

The market value of rural property is affected by many variable factors and conditions. The estimate of the market value of a property is used in many appraisal situations today including right of way acquisition by governmental agencies, mortgage loan appraisals, property sales and estate settlements. One of the chief problems confronted by an appraiser is the analysis or correlation of a number of market sales for trends.

In this study the use of the computer in assisting a field or reviewing appraiser to analyze market information is demonstrated in three ways. First, a general tabulation of the sales in a summary manner was made. Second, a productivity rating was computed for each sale in the group and the linear regression analysis statistics of sale price (dependent variable) and productivity (independent variable) computed to better evaluate this relationship. Third, multiple linear regression statistics were computed which would evaluate particular variables in a sale data group and provide information to predict other property values from these coefficients.

It is concluded that simple linear regression models may be used for the purpose of correlating a group of sales. In this model the productivity of the land is estimated and other variable factors which influence specific sales may be observed from the scatter diagram. The calculation of a composite productivity rating which considers many production factors such as soil, temperature, rainfall, elevation, etc., is the first step in this type of correlation where productivity is hypothesized to be an important influence in the price.

Multiple regression statistics are more meaningful in predicting property values because many variable factors are considered, however, this model was limited by sample size in this study. Sample size proves to be a limitation frequently for field appraisers because large numbers of comparable sales are not available in specific local areas. However, this model may be used in some cases to evaluate which variables were the most important for the group of sales as a whole. The use, advantages, and limitations of multiple regression statistics to forecast property values are demonstrated in this study.

Further study appears warranted to better define the relationships between the variables where they are nonlinear and to include other factors in a quantitative manner such as terms of sale. If the multiple regression model can be improved it may some day be possible to predict values for rural properties that would be within 5 percent or 10 percent of the true value for 95 percent of the cases.

CHAPTER I

RURAL APPRAISAL TODAY

The idea that the value of real estate is based on the benefits that may be received from its ownership or use is a fundamental concept. The benefits which may be received from the ownership or use of real estate include income, homesite, occupation, recreation or prestige. These benefits of real estate will vary with time, location, and the very nature of a particular tract. Legal claims to the benefits of real estate may be termed property or property rights. 1/ The appraisal of a tract of real estate then becomes a matter of estimating the value of the benefits which are anticipated to accrue in the future.

Rural property usually is thought to be property outside of a city or urban area. An agricultural property is one which is located in a rural area with a highest and best use of agricultural production. The usual boundary separating urban and agricultural property is a transitional zone. A transitional property may have a non-agricultural highest and best use as a whole, yet that part of the property which is tillable or grazing land may remain in agricultural production. Rural homesites, recreational areas, and commercial sites with excess land along highways may be examples of this type of transitional real estate. A transitional property may have a highest and best use as an agricultural producing unit

1/ The word property is most often used to mean that which one owns such as goods or tract of land. Property may also be the right of possession, enjoyment, or disposal of something tangible.

but have a higher price due to the potential for future urban development. A careful study of the sales and market trends in an area should indicate whether the highest and best uses of a rural property is for agricultural production only or as a transitional property.

An appraisal of rural property may be made for such purposes as fair market value, insurance value, loan value or tax value. The number of appraisals for market value has greatly increased in recent years. The increase in numbers of market value appraisals has been largely due to the appraisals made for governmental takings. Right-of-way acquisition for interstate and other highway takings require market value appraisals. Likewise, right-of-way is necessary for dams, flood control, power lines and other public projects. In many cases a market value appraisal is made separately for the land owner at his request in addition to the one made by the governmental agency. In most instances, appraisals made for loan purposes are market value appraisals or some proportion of market value. Market value may relate directly or indirectly in an insurance appraisal on improvements. For the various purposes for which an appraisal is made, market value overall is the most important consideration.

During the past 40 to 50 years, rural appraisers have considered and used the three basic approaches to value in varying degrees. These approaches to value are the income approach, cost approach and market data approach. The income approach utilizes a net income estimate for the property which is capitalized into an indication of value. The cost approach sums the value of the vacant land and the depreciated value of

the improvements. The market data approach is one of overall comparisons between the subject property which is being appraised and the comparable sales.

Appraisal situations may warrant the use of one or all three approaches to value. In particular cases one or two of the approaches may be limited in use or inappropriate. In many agricultural situations the cost approach is not found to be appropriate for the reason that the reproduction cost of the buildings less depreciation may not reflect the true contribution value of the buildings to the property as a whole. The income approach frequently is limited or difficult to apply because of the problems involved in interpreting a proper capitalization rate. These limitations to the cost and income approaches leave the market data approach most widely used either as the sole approach or in conjunction with the two other approaches. If more than one approach to value is used, a correlation is made to arrive at a final estimate of value for the property. The information which is necessary for the use of any one of the three approaches to value must come primarily from the market. The appraiser's job is to study the market. A study of the market means a study of comparable sales in the area and other pertinent economic data including population, income, and development trends. The analysis of comparable sales is the key to discovering how people have acted with respect to particular types of property in the past. A good understanding of comparable sales may well become a basis for predicting or estimating how the subject property would be considered if put up for sale. It is a

basic truth that fair market values are determined only in the market and this market must be studied carefully by the appraiser.

One of the first problems that arises in the use of the market data approach in making overall comparisons of sales with the subject property is the finding and selecting of the most comparable sales. Sale properties will not be exactly like the subject and may differ in many respects. A subject property which has been sold in recent years may also have been changed by improvements or deterioration. Even if the subject was sold recently a careful analysis is necessary to determine if the sale was a fair market transaction. Sale properties may be studied for apparent trends and special differences that may reflect information for the particular subject.

Although properties and conditions of sales vary, the market is often found to have some degree of uniformity. A study of the market involves many transactions but such factors in our economy as the principles of substitution and competition force a uniformity in the actions taken. For this reason it is important to study variables common to all the sales. Correlation becomes important in interpreting the differences between the sales.

A point should be made about correlation in the appraisal process. Correlation begins in the studying of the appraisal problem, market

conditions, and comparable sales and continues throughout the appraisal study and report. 2/

A very useful and important technique in correlating comparable sales is the discovery and use of meaningful units of measurement common to all of the sales. A study of sales in a particular agricultural area may reveal that buyers and sellers think in terms of dollars per acre. In some other area the common unit may be dollars per animal unit. As the size of the farm or acreage decreases, buyers and sellers may react to the site as a whole including land and buildings together. What are the principle factors responsible for the price fluctuations or differences within the group? Any appraiser, of course, is quick to recognize that there are many factors which may be causing variations in price right down to the very impulses of the buyer and seller at the time of the sale. Measurable factors such as land quality, buildings, location, financing and size may be contributing to price differences between the sales. In many cases it is a difficult if not impossible task to determine how much particular attributes contributed to a particular sale price with all other things being equal. An analysis of how much particular attributes contributed to the sale prices involves multiple correlation analysis.

2/. American Institute of Real Estate Appraisers, The Appraisal of Real Estate, American Institute of Real Estate Appraisers, 36 South Wabash Avenue, Chicago 3, Ill., 1961, p. 196.

The most important factors affecting rural sales will vary as to type and importance for any specific area or time. The importance assigned to various factors by different appraisers who are interpreting the same market often varies. This situation can easily lead to disparity between individual appraisers.

Some modern computing techniques may assist an appraiser who is making a market study. The actual techniques or mathematical processes may not be new, but computers have speeded up the processes. One example of computer use is in the computation of a mathematical estimating equation which is based on several independent variable factors. Another example of computer use is in the cataloging of comparable sales for ready access and recall for a particular area. The computer may also be used to great advantage in preparing tabulation summary reports.

The problem facing real estate appraisers boils down to one of putting more logic and evidence into the appraisal. ^{3/} It is important to be able to support an estimate of value for a client by more than statements of general opinion or vast experience. More considerations must be taken into account in modern appraisals due to the growing complexities of our society. The problem of putting more logic and evidence into an appraisal is not an easy one. One thing an appraiser often would like to know is how much weight to give particular attributes of a property. To attempt

^{3/} William G. Murray, M.A.I., "Challenge Facing Real Estate Appraisers Today", The Journal of American Society of Farm Managers and Rural Appraisers, April 1961, p. 55.

to assign contribution amounts for various factors requires a careful measurement of many details.

The problem of putting more evidence into an appraisal may be dealt with by a better selection of the comparable sales which are used in making over all comparisons and correlations. A better selection of comparable sales may reduce the disparity between appraisers where two or more independent appraisals are made for one property. A better selection of comparable sales may be possible if the sale properties are carefully correlated amongst themselves by some common unit of measurement.

The problems of rural appraisal are many and varied. Some of these problems are the same ones that were present in the early days of the profession of farm appraisal. However, some progress has been made to put rural appraisal on a more scientific basis. The use of three approaches to value, where appropriate, offers a basic plan to get the appraiser started on the way to an estimate of value. In more recent years emphasis has been placed on the analysis of data. Mathematical techniques to analyze market data and predict a value for a subject property have received more attention in recent years due to a desire for finding better ways of estimating a value for a property and because of the availability of high-speed computers. The future of professional rural appraisal depends on the ability of appraisers to be able to make accurate analysis of the market.

CHAPTER II

TOWARD A SCIENTIFIC APPROACH TO APPRAISAL

The many problems which confront appraisers today indicate a need for better data analysis and methods of appraisal. A few specific problems which confront appraisers were noted in the previous chapter. A problem that often exists is that one or two of the three approaches to value may not be appropriate for use. Clients today are asking for more examples of data from the market to support estimates of value. In many instances a great disparity may exist between two appraisers on a particular appraisal. In the past 10 years there has been a growing need for the best, most accurate appraisals in right-of-way work of various governmental agencies. Better processing equipment in the form of computers offers a great advantage in tackling these problems by making detailed, scientific data studies more feasible. However, high speed processing alone won't solve these problems. There is a need for better, more complete, scientific data analysis techniques for rural appraisal.

Most of the work in recent years which has been characterized as "scientific appraisal" has involved an increased use of mathematics with emphasis on price prediction through multiple regression analysis. However, very few multiple regression equations have shown spectacular predicting qualities. Modern computers have made it possible to make studies with a large number of variables with the hope that a better system of price prediction can be developed. However, market variation is always a problem for an appraiser. A good multiple regression estimating equation depends wholly upon the market area and the ability of

the appraiser to discover the variables to be included. It is hoped that by further study of market situations and variables, better estimating equations may be developed.

Recognizing the problems and limitations of good multiple regression estimating equations, a different approach to the problem of making rural appraisals more scientific seems to be warranted. This approach is to find one variable which takes into account a number of factors and explains a major amount of the market variation in sales price. An overall productivity rating which considers land type, topography, climate, temperature, rainfall, growing season, etc., would be a logical variable to consider for rural properties. A graphical picture of the correlation between sales price and the productivity variable may be easily made for a number of sales. A plotting of the group of sales on a graph may allow observing the effect of other variables. Frequently some "special variable" doesn't affect more than a few of the sales in the group. The graph or scatter diagram may provide the beginning analysis of farm or ranch sale data. This analysis is the correlation of the sales amongst themselves. A graph with its correlation relationship may enable an appraiser to better select the most comparable sales from the entire group. In addition, such a graph might provide a better overall picture of the market to a client. Statistics may be used to evaluate some of the characteristics of the scatter diagram and trends.

The discovery of a variable or overall unit for rating farm productivity offers some other very important uses. An important advantage of

using an overall productivity rating is that the various parts of a property may be evaluated based on their contribution to the whole. Two examples of where contribution value of parts of a farm are important in farm mortgage loan appraisal and highway right-of-way appraisal. Frequently, in farm mortgage loan appraisal it is desired to know what value per acre should be allotted to a particular tract which is being released from the mortgage. In highway right-of-way appraisal it is often necessary to allocate a value to various classes of land which are taken or depreciated but where specific sales of particular types of land are not available or appropriate. In either farm mortgage loan appraisal or highway right-of-way appraisal it may be observed that a particular tract of land contributes more to the unit on a per acre basis than independent sales of that type land. The reverse situation may be observed in other instances.

The placing of emphasis on a simple linear model should not be thought of as making a multiple regression study useless. Multiple regression is more realistic in any predicting sense because it recognizes many factors. However, some of the advantages are often limited by sample size and market characteristics. In spite of these limitations it is still highly desirable to study a market with this technique. The predicting qualities of an estimating equation may be evaluated. In addition, some idea of the significance and rank of independent variables may be obtained.

Both the linear and multiple linear regression model are hypothesized to add meaningful information to an appraiser. The hypothesis to be tested then is that a statistically significant overall productivity variable may be found and used in the linear regression model. For the multiple regression model, it is hypothesized that a statistically significant model may be developed which explains market variation and that significant variables may be delineated.

CHAPTER III

MATHEMATICAL DATA STUDIES AND SURVEYS

Some early attempts to use mathematical techniques such as multiple regression analysis to study real estate market variables and estimate values date back to the 1920's. However, appraisal literature frequently has warned against the use of mathematical formulas for the purpose of estimating values. Instead, experience has long been heralded to be the mark of an expert along with professional society affiliation. Many people have tried to bring a greater degree of science to the art of appraisal through such techniques as multiple regression analysis, but until the development of modern computers in recent years, multiple regression analysis meant many hard tedious hours of calculations. Large models would be highly laborious to do by hand calculations.

A summary of some of the attempts at scientific appraisal through multiple regression analysis has been made by Edward F. Renshaw. ^{4/} In his discussion of the case for an econometric approach, he notes that although it may be hopeless to isolate all the factors which buyers take into consideration when purchasing a property, it is possible to establish a correlation between real estate values and a select sub-set of determining variables. ^{5/} It is not necessary to have the perfect model, only one which can predict real estate values with sufficient accuracy.

^{4/} Edward F. Renshaw, "Scientific Appraisal", National Tax Journal, Vol. XI, No. 4, December 1958.

^{5/} Ibid., p. 319.

It is possible to make a comparison of the variances in the appraisals made by this and other methods.

Several multiple regression studies that have been done in the past years are cited in the paragraphs that follow. The purpose for citing these examples of statistical analysis is to illustrate the types of problems encountered and some of the variables considered.

In 1922, G. C. Hass conducted a study in Minnesota for farms sold during the period 1916 - 1919. 6/ The factors included in this multiple regression study were depreciated cost of buildings per acre, land classification index, soil index, and distance to market. These four factors explained 65 percent of the sales price variation.

Another study during the same period of time was conducted by H. A. Wallace in 1925. 7/ Here four factors were correlated with census estimates of bare land values in 99 Iowa counties. The factors used were 10-year average corn yield per acre, percentage of land in corn and in small grain, and percentage of land not plowable. With these factors, 84 percent of the sales price variation was explained. Wallace points out that county differences exist due to such things as metropolitan influence where the multiple regression formula doesn't make any special allowances.

6/ G. C. Hass, "Sale Prices as a Basis for Farm Land Appraisal", Minn. Agr. Exp. Sta. Tech. Bul. 9, 1922. This Bulletin is noted in William G. Murray's Farm Appraisal, Iowa State College Press, 3rd Ed., 1954, pp. 288-290.

7/ Henry A. Wallace, "Comparative Farm-Land Values in Iowa", Journal of Land and Public Utility Economics, II, No. 4, October 1926, pp. 385-392.

Adjustments would also need to be made to include buildings. He further points out that such formulas will obviously apply only where the type of farming is fairly uniform.

One limitation encountered in the Wallace Study was that value estimates were based on census figures which were largely estimates on the part of farm owners of their farm values.

In a study conducted by Mordecai Ezekiel, 1936, the multiple correlation of eight factors linearly accounted for 41 percent of the price variation. 8/ However, curvilinear correlation yielded a higher percentage of explained variation, 60 percent. Buildings accounted for 44 percent of the variation in farm value and were separated into three factors: dwellings, dairy buildings, and other buildings. Other factors included were crop index, percentage area tillable, percentage level land, type of road, and distance to town.

A strong case is made for the use of statistical methods for farm appraisal by Irving F. Davis, Jr. 9/ This case develops out of a need for reducing disparity between individual appraisers who appraise the

8/ William G. Murray notes a study by Mordecai Ezekiel entitled "Factors Affecting Farmers' Earnings in Southeastern Pennsylvania", U.S.D.A. Bulletin 1400, 1936, in his book Farm Appraisal, Iowa State College Press, 3rd Ed., 1954, pp. 288-290.

9/ Irving F. Davis, Jr., A Statistical Approach to Real Estate Value with Applications to Farm Appraisal, California Division of Real Estate, Sacramento, California, 1965.

same property. This study considered some 50 independent variable factors. Specific factors related to cotton farms, vineyards, ranches, citrus, dry grain farms and irrigated farms. Variables which were used included ones usually thought of such as size, date of sale, distance to town and some more obscure but potentially significant ones such as soil profile, growing season and distance to nearest road. Much could be said for the careful inclusion of many variables where the computer selects those which are most significant. However, one question that exists with any study of this nature is whether this many detailed variables are evaluated individually in the minds of buyers and sellers at the time of sale. This study well points out the advantages that could come if it were possible to predict sale prices that would be within 10 percent of true value in 95 percent of the cases.

Multiple regression analysis hasn't been restricted to rural property. Several multiple regression studies have been conducted dealing with city homesites. One study in recent years which involved residential sales in Washington, D. C., was made by William C. Pendleton. ^{10/} Here the selling price was estimated from such factors as log of size of house, driving time to central business district, log of size of lot, if brick, if basement, log of number of baths, if extras, median income level of

^{10/} William C. Pendleton, "Statistical Inference in Appraisal and Assessment Procedures", Appraisal Journal, January 1965, pp. 73-82.

area, age of house, stories, and detachment. A particular feature to be noted in this study is the weighting of particular factors by the use of logarithms. For example, it is hypothesized from costs, etc. that 100 additional square feet of house added to a house in the 900 square foot category makes more of a value difference than a 100 square feet difference in the 1,800 square feet category. The variables chosen in one model explained 86 percent of the variation and each variable except one was significant at the 95 percent level. Such a test for significance indicates that there is less than one chance in twenty that the universe from which these samples were drawn does not display a positive association between selling price and each of the independent variables.

A pilot study of residential property values has been undertaken by O. R. Colan. 11/ After a choice of independent variables was made and the multiple regression equation determined, a prediction of each sale was made by putting the sale into the equation and computing a predicted value. The results indicate that the estimates based on the multiple regression were within 5 percent, 68 percent of the time and within 10 percent, 95 percent of the time.

Not all regression studies have been multiple regression although this method recognizes the influence of many factors affecting price. A study was conducted by Gerald Drew where linear correlations were made

11/ O. R. Colan, Organization and Control of Right-of-Way Functions Through the Implementation of the Multiple Linear Regression Equation in Estimating Fair Market Value of Real Estate, The State Road Commission of West Virginia, 1966.

