THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by George Casper Haas for the degree of Master of Arts. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts.

John D Black
Chairman

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REPORT

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COMMITTEE ON EXAMINATION

This is to certify that we the undersigned, as a Committee of the Graduate School, have given George Casper Haas final oral examination for the degree of Master of Arts. We recommend that the degree of Master of Arts be conferred upon the candidate.

Minneapolis, Minnesota

March 20 1922

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A STATISTICAL ANALYSIS OF FARM SALES IN BLUE EARTH COUNTY, MINNESOTA, AS A BASIS FOR FARM LAND APPRAISAL

By

GEORGE CASPER HAAS

A Thesis submitted to the
Graduate School of the University of Minnesota
in partial fulfillment of the requirements for the degree of
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March, 1922

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Chapter I

INTRODUCTION

The purpose of this thesis is to present a statistical investigation of farm land sales in Blue Earth County, Minnesota, which has revealed certain relationships with such definiteness as to lead the writer to believe that they constitute a basis for a scientific appraisal system of farm lands.

By a ppraising farm lands is meant forecasting or predicting what they would sell for if sold on the basis of the present market. The values predicted are therefore actual market values, a nd not what any one, no matter how good his judgement, thinks they should be worth. These market values are facts resulting from the judgments of the land market composed of buyers and sellers of the general type of intelligence. It is these facts for which we seek and not any ideal value, notwithstanding how much more consistent with high intelligence the latter might seem to be.

By a scientific system, we mean one which is based on induction, experiment or observation;-- one in which the facts are weighed with precision and not by a more or less loose application of judgment guided only by general principles.

Practically all farm land appraisal systems in use today, at least all that the writer could find, are based on this latter principle. That a system with more scientific precision and accuracy is needed almost goes without saying. One need only look over a list of farm realty transfers and compare the sale prices with the full assessed values to note the discrepancies. If a tax is to be

based on the farm value and the value is erroneously determined, then surely the tax is not just to all.

Special assessments are based on the assumption of the relationship of the increased value of the adjoining real estate and value of the improvements. A scientific appraisal system should prove or disprove wholly or partly this assumption.

Accurate valuation has an important bearing on the question of loans, the security of which is based on the value of farm real estate. If values could be determined more accurately, more money could be loaned on the same farm than is consistant with safety at the present time. The mortgage bonds could perhaps be sold to the investing public at a lower rate if the public was confident the loans weresecured by farms scientifically and accurately appraised.

Bond houses could market improvement bonds, which are based on special assessments, to a better advantage when the relationship between the value of the improvement and the increased value of the adjacent or assessed property is known.

Public utility commissions are in need of scientific valuation systems in order that they may fix accurate and just railroad and other rates.

The successful operation of a farm realty and brokerage business is dependent on how accurately land values can be determined.

It is therefore evident that information along the lines of scientific land appraisal is very much needed at the present time and will help in the handling of many important economic and administrative problems.

Chapter II

THE LAND MARKET

In thinking of the land market we have the general commodity concept of market in mind; that is,-"the totality constituted by a group of competing sellers over against a group of competing buyers concerned in exchanging the same commodity".[1]

Probably the best method of presenting an analysis of a problem of this sort is by first projecting an ideal illustration based on hypothetical assumptions, drawing our conclusions therefrom and later making the necessary modifications so as to make our analysis fit the actual circumstances.

The assumptions of an ideal market are; first, that each man taking part in the exchange process is an ideal economic man. He is motivated only by economic forces, that is, getting the maximum of satisfactions for himself. Such motives as charity and sympathy are excluded from his make-up. His decisions are

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1 F. M. Taylor. Principles of Economics page 210 5th Ed. 1918.

2 "Economists understand by the term market, not any particular market place in which things are bought and sold, but the whole of any region in which buyers and sellers are in such free intercourse with one another that the prices of the same goods tend to equality easily and quickly".
Cournot. "Recherches sur les Principes Mathematiques de la Theorie des Richesses".

3 "Originally a market was a public place in a town where provisions and other objects were exposed for sale; but the word has been generalized so as to mean any body of persons who are in intimate business relations and carry on extensive transactions in any commodity. A great city may contain as many markets as there are important branches of trade, and these markets may or may not be localized. The central point of a market is the public exchange, mart or auction rooms, where the traders agree

to meet and transact business. In London the Stock Market, the Corn Market, the Coal Market, The Sugar Market, and many others are distinctly localized; in Manchester the Cotton Market, the Cotton Waste Market and others. But this distinction of locality is not necessary. The traders may be spread over a whole town, or region of country, and yet make a market, if they are, by means of fairs, meetings, published lists, the post office or otherwise, in close communication with each other".
Jevons "Theory of Political Economy. Ch IV.

made unerringly and his knowledge of market conditions is perfect. Secondly, we assume perfect marketing conditions existing between the buyers and sellers, which means essentially that every buyer is aware of every seller's particular offerings and every seller has similar knowledge of the bids of all the buyers. Finally, the economic man is supposed to continue to compete so long as there is a surplus of immediate economic advantage over the sacrifices made, but no longer.

To make sure that we understand the situation in the land market perfectly, let us take the conventional hypothetical illustration and explanation of the equation of supply and demand and see how it fits the present case.

D "Let us then turn to the ordinary dealings of modern life, and take an illustration from a corn market in a country town, and let us assume for the sake of simplicity that all the corn in the market is the same quality. The amount which each farmer or other seller offers for sale at any price is governed by his own need for money in hand, and by his calculation of the present and future conditions of the market with which he is connected. There are some prices which no seller would accept, some which no one would refuse. There are other intermediate prices which would be accepted for larger or smaller amounts by many or all of the sellers. Every one will try to guess the state of the market and to govern his actions accordingly. Let us suppose that in fact there are not more than 600 quarters, the holders of which are willing to accept as low a price as 35 s.; but that holders of another hundred would be tempted

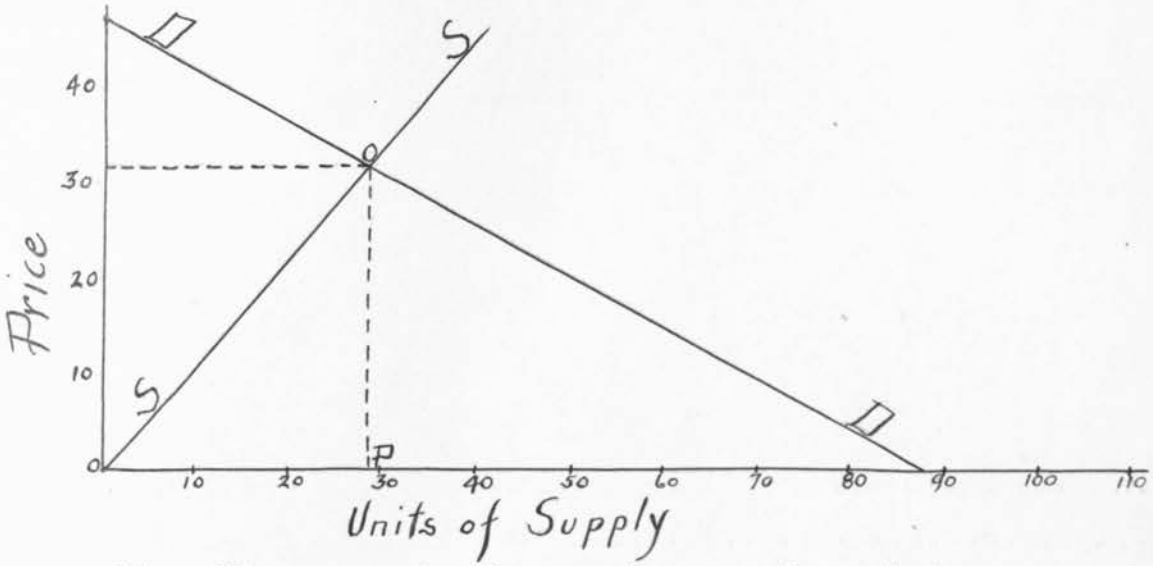
by 36s.; and holders of yet another hundred by 37s.. Let us suppose also that a price of 37s. would tempt buyers for only 600 quarters; while another hundred could be sold at 35s.. These facts may be put out in the table thus:---

At the price	Holders would be willing to sell	Buyers would be willing to buy
37s	1000 quarters	600 quarters
36s	700 quarters	700 quarters
35s	600 quarters	900 quarters

Of course some of those who are really willing to take 36s. rather than leave the market without selling, will not show at once that they are ready to accept that price. And in like manner buyers will fence, and pretent to be less eager than they really are. So the price may be tossed hither and thither like a shuttlecock, as one side or the other gets the better in the "higgling and bargaining" of the market. But unless they are unequally matched; unless, for instance, one side is very simple or unfortunate in failing to gauge the strength of the other side, the price is likely to be never very far from 36s.; and it is nearly sure to be pretty close to 36s. at the close of the market.

The price of 36s. has thus some claim to be called the true equilibrium price; because if it were fixed on at the beginning, and adhered to throughout, it would exactly equal demand and supply (i. e. the amount which buyers were willing to purchase at that price would just be equal to that for which sellers were willing to take at that price." Marshall "Principles of Economics" 6th Ed. pg 332.

In the following diagram DD, note that as the price goes down, more is taken off the market.



Line SS represents the supply,--as the price goes up, more is offered.

O--represents the point where the supply and demand equal each other.

OP is the selling price, which when read on the price scale, is about 32.

In this ideal market, the difference between the price of the marginal buyer and the marginal seller due to the large number of buyers and sellers is assumed to be infinitesimally small, so that bargaining necessary to determine exactly where the price will fall is reduced to a minimum.

Keeping in mind this ideal market which our analysis postulates, the same thing sells in the same market at the same price at the same time. Interpretated in the diagram, all units of the stock which are sold, sell at about 32.

How does our land market compare with this hypothetical illustration? Are similar or practically identical farms selling at the same time in the same market for the same prices? In practice we know that all sellers are not able to put their offerings before all the purchasers and also that every buyer does not have a chance to provide every seller with an opportunity to sell to him; but the general tendency on the part of both the buyers and sellers is to investigate the market rather thoroughly, the buyers seeking for the best bargain, and the sellers seeking for the purchaser offering the highest price. Those who do not deal cautiously and with discretion are known in the land market as "suckers" and the sale resulting is known as a "sucker sale". The price made in such cases of course is not a market price. The mere use of the term indicates that such sales are not common. It may be said, therefore, that the land market tends to operate so as to have the same grade of land sell in the same market at the same time at like prices; but that the adjustment is never perfect and there is always some variation in the market price of the same grade of land. But such variation as there may be is of much importance in the operation of a system which aims to predict the market price of land, and the reader's attention will be called to their real significance later on in the treatise.

This lack of perfect competition in the land market is due to many causes. The land market is not organized. There are not any extensive and efficient means of gaining information and disseminating it among buyers and sellers. There may be comparatively few buyers and sellers competing at any one sale. Conditions are

not always favorable for allowing men to act rationally on information received. Also many buyers and sellers are frequently influenced by non-economic motives, such as home ties, caprice, passion, and prejudice. Professional land salesmen have more than average knowledge concerning the land market and usually have the advantage when it comes to bargaining and of course succeed in making many sales of the same grade of land at different prices. The extent to which the same grade of land does not sell for the same price depends upon the presence or absence of any or all of these condtions.

In spite of these circumstances, however, for the purpose in hand we can assume that the same grade of land tends to sell at the same price. Then the problem of appraising land values consists of determining what factors the sellers and buyers consider in making their bidding and offering prices and what is the relation between these factors and the market price. The following chapter will discuss these factors and present a statement of the method employed in determining their relation to market price.

Chapter III

FACTORS TO BE CONSIDERED AND THE METHOD EMPLOYED IN DETERMINING THEIR RELATIONSHIP TO MARKET PRICE.

Land has value because it produces an income,(6) or materials, services and forces which satisfy human wants. The income from land may fall in any one or in all of the three following categories:(1) Material or physical income, the seasonal product of land in the form of farm produce, etc.,(2) Psychic income, which is exemplified in the pleasure a man derives from being an owner of his own home, by living in a favorable neighborhood, by being located in proximity of city or village where he can participate in the village social activities, attend church with ease, and associate with the townsmen,(3) Incomes which the owner of land expects to receive in the form of land value appreciation or increase in the land value. Future incomes and present incomes of like amount have different values placed upon them in the land market. Incomes are always valued in terms of their present worth or are discounted back to the present date. For example, $1000 of income due today and $1000 due a year from today will not be given equal values. The income due today will be valued at $1000, but the income due one year from today, discounted at 4 percent, will be worth $960.(7)(8)

(6) "The rate of interest acts as a link between income-value and capital-value, and by means of this link it is possible to derive from any given income-value its capital-value, i.e. "to capitalize" income.
Irving Fisher. The Nature of Capital and Income p 202.

(7) "We assume that the expected income is foreknown with certainty, and that the rate of interest (in the sense of an annual premium) is foreknown, and also that it is constant during successive years. With these provisos it is very simple to derive the capital-value of the income to be yielded by any

article of wealth or item of property; in other words, to derive the value of that wealth or property. That value is simply the present worth of the future income from the specified capital. This is true whether the income accrues continuously or discontinuously; whether it is uniform or fluctuating; whether the installments of income are few or infinite in number.

We begin by considering the simplest case, that, namely, in which the future income consists of a single item accruing at a definite instant of time. If, for instance, one holds a property right by virtue of which he will receive, at the end of one year, the sum of $104, the present value of this right, if the rate of interest is 4%, will be $100. If the property is the right to $1 one year hence, its present value is evidently 1/104th or $0.962, and if the sum to which the property entitled the owner is any other amount than $1, its present value is simply that amount divided by 1.04 or multiplied by .962. Thus the present value of $432 due in one year is $\frac{432}{1.04}$ or 432 x .962, which is $416.

If the future sum is due in two years, and the rate of interest is still 4%, it is evident that $1 today is the present value of $1.04 next year, which in turn (by compounding) will then be the present value of $1.04 x 1.04 i.e. $(1.04)^2$, or 1.082 at the end of the second year. The $1.082 is called the "amount" of $1 at the end of two years, and $1.04 is the "amount" of $1 in one year.

Similarly, in three years $(1.04)^3$ is the "amount" or sum worth $1 in present value; and so on for any number of years."

Irving Fisher. "The Nature of Capital and Income". p 202.

(8) "The simple mathematical method of finding this "sum" is to divide the annual value, that is, the net rent, by the rate which "reflects the prevailing premium on the present". If the net annual income derived from a piece of land is six dollars per acre, and the rate of discount is five per cent, the present capital value of the land would be one hundred and twenty dollars per acre. One hundred and twenty dollars is, then, the amount of money which, if lent at five percent, would yield an annual income of six dollars. This is usually spoken of as the capital value of land.

That this simple method of dividing the six dollar net rent by the prevailing rate of discount to find the capital value of a piece of land is equivalent to finding the sum of an infinite series of prospective net annual three dollar rents discounted at the same rate may be demonstrated as follows. The present value of A dollars due in T years if the interest be compounded at the rate R would be $\frac{A}{(1+R)T}$ since X dollars compounded at rate R would give X(1+R)T, and if X(1+R)T A then X= $\frac{A}{(1+R)T}$. If then the net income of a farm be A dollars a year its value would be expressed by the equation:

$$V = \frac{A}{1+R} + \frac{A}{(1+R)^2} \times \frac{A}{(1+R)^3} + \frac{A}{(1+R)^4} + \text{ad inf.}$$

This is an infinite "geometrical" progression with first term $\frac{A}{1+R}$ and ratio $\frac{1}{1+R}$. The limit of the sum of such a series is $\frac{\frac{A}{1+R}}{1-\frac{1}{1+R}}$ which reduces to $\frac{A}{R}$. We have then the formula for the value: $V=\frac{A}{R}$ which is the ordinary method of capitalizing rent."
H C Taylor. "Agricultural Economics" p 206.

Having decided that it is income which determines the price decisions, we must next analyze the problem of how the buyers and sellers of land approximate the income.

I believe it can safely be said that in no case does the buyer or seller have the exact income data before him. He may know with a fair degree of accuracy what the physical income or the land product is for one year or past years but he does not know it for the succeeding years, nor does he know exactly what to expect from increased value of the land. He may, however, have a fairly definite idea of what the psychic income is worth to him.

I believe the buyers and sellers analyze the income problem by means of comparison and analogy.(9) Assume they are prospective buyers of a farm: the question to be solved is what is its income or its discounted income, or in other words, its value. They compare this new farm with other farms of which they know the discounted income or value. All factors on the new farm which may influence income are compared with known cases where they can approximate their effect.

Thus each farm then is a combination of factors which affect income or value. Appraising farm lands, therefore, is a question of determining the weight, the importance and significance

(9) "The skillful employment of this substitutive process enables us to make measurements beyond the powers of our senses. No one can count the vibrations, for instance, of an organ pipe. But we can construct an instrument called the siren, so that, while producing a sound of any pitch, it shall register the number of vibrations constituting the sound. Adjusting the sound of the siren in unison with an organ-pipe, we measure indirectly the number of vibrations belonging to a sound of that pitch. To measure a sound of the same pitch is as good as to measure the sound itself."
W. S. Jevons Principles of Science p 10.

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of these factors on value. Having once obtained their significance or relationship in the form of numerical co-efficients, we can then go to a farm and measure each factor and apply the coefficient of relationship or its weight and predict the probable selling price of the farm.

In every territory the factors which influence value are somewhat different. In the section studied, the following factors were considered;--(1) the 1919 depreciated cost of buildings per acre, (2) land classification or the amounts of the different grades of lands, (3) productivity of the soil represented by relative crop yields, (4) distance to market, (5) type of road, (6) size of market town. These factors will be given a detailed explanation in a succeeding chapter.

The general methods used to determine the effect of the various factors mentioned on land value are known in statistical parlance as tabulation, partial and multiple correla tion.

The tabulation methods used are quite simple and their explanation will be reserved to the chapter on compilation where the presentation can be given most satisfactorily. Partial and multiple correlation, however, involve complicated statistical

analysis. Although it is not the province of this treatise to explain the theory[10] of multiple or partial correlation, some discussion of its use is needed at this point.

If in two series of variables, for example, in this case, cost of buildings per acre and value per acre, a high value of one tends to be associated with a high value of another, the variables are said to be correlated and the correlation is positive; while if a high value of one is associated with a low value of another the correlation is negative, as in the case of distance to market and value per acre. The best numerical measure of the amount of correlation is called Pearson's coefficient of correlation. The algebraic formula for this is: $r_{1,2} = \frac{\Sigma\Sigma\eta - N\bar{x}\bar{y}}{N\sigma_x\sigma_y}$

In a problem in which more than two factors are concerned, the simple or gross correlation may be an expression of an apparent relationship and what we must determine is the net relationship of one factor with another. The apparent correlation may be due to the fact that each of the two variables or factors is correlated with another or several variables. For example, assume in this case that distance to market and value per acre show a negative correlation. But as distance from town increases, the percentage of land of desirable grades decreases, or there is also a negative correlation between distance to market and the percentage of land of desirable grade. We also find value per acre and the percent of land of desirable grades are positively correlated. Thus the gross or apparent negative correlation of distance to market and value per acre is partly due to the fact that as the distance from market in-

(10) See bibliography on partial and multiple correlation.

creases, the percentage of land of desirable grade becomes smaller, this operating to make the farms further distant from market sell cheaper, not due to distance alone as the simple coefficient might lead one to believe.

In a problem of the type that land appraising presents, where we must consider simultaneously the relationship between several variables or factors, we calculate a coefficient of net or partial correlation. Thus if we are considering four variables, 1, 2, 3, and 4, the partial coefficient of correlation $r_{12.34}$ means the net relationship between variables 1 and 2 when the effect of factors 3 and 4 are held constant.

When three variables are considered the partial correlation $r_{12.3}$ may be calculated from the formula: (11)

$$r_{12.3} = \frac{r_{12} - r_{13} \cdot r_{23}}{\sqrt{1 - r^2_{13}} \sqrt{1 - r^2_{23}}}$$

By further expansion, the formula for five variables as used in this problem is:

$$r_{15.234} = \frac{r_{15.34} - r_{12.34} \cdot r_{25.34}}{\sqrt{1 - r^2_{12.34}} \sqrt{1 - r^2_{25.34}}}$$

From the coefficients of correlation, we can determine the coefficients of relationship expressed in absolute units, known as coefficients of regression: for example, $b_{15.234}$ ($\sigma_{\cdot}$ representing standard diviation.)

$$b_{15.234} = r_{15.234} \frac{\sigma_{1.5234}}{\sigma_{5.1234}}$$

The forecasting formula is readily arrived at when once the regression coefficients are known.

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(11) G. U. Yule Introduction to the Theory of Statistics.

$$X_1 = a + b_{12.345} X_2 + b_{13.245} X_3 + b_{14.235} X_4 + b_{15.234} X_5$$

X_1 represents value per acre in this case, and X_2 , X_3, X_4 , X_5 the other factors considered.

The probable error involved in predicting X, from the other factors is expressed in the formula:

$$\sigma_{1.2345} = \sigma_1 \left(1-r^2_{15}\right)\left(1-r^2_{14.5}\right)\left(1-r^2_{13.45}\right)\left(1-r^2_{12.345}\right)$$

Probable error = $\sigma_{1.2345} \times 0.674489$

The only object in presenting the above symbols a nd equation is so that a person may at least know what they represent when they are used later on in solving the land appraising problem. An explanation of how the equations are derived andhow the calculations are made involves a considerable portion of G.U.Yule's "An Introduction to the Theory of Statistics". Persons interested in the technique of the method are referred to this book or to G.U.Yule's "On the Theory of Correlation for Any Number of Variables Treated by a New System of Notation" Proc. Roy. Soc. Series A. Vol LXXIX 1907, p 182.

CHAPTER IV

DESCRIPTION OF BLUE EARTH COUNTY AND HOW THE DATA WERE SECURED.

Location. Blue Earth County, one of the second tier of counties from the northern line of Iowa, is situated in the central part of southern Minnesota.(12) Its northern boundary is indented by the great righta ngle bend of the Minnesota River which is the southernmost point of the stream. Mankato, located at the vertex of this angle, is about 150 miles west of Winona on the Mississippi River and nearly 90 miles southwest from Minneapolis and St. Paul. The length of the county from east to west is 30 miles, and its breadth from north to south varies from 21½ miles in the middle to 29 miles along the western boundary.

Land area and surface features. The land area of the county is approximately 749 square miles or 479,104 acres. About 22,000 acres more a re included in water systems. The percent of improved land in farms in 1920 was 90.3 percent.(13)

The surface features of the county varies from flat to hilly, but by far the larger part is flat to gently rolling. In general, the area is a flat gently rolling expanse with an imperceptible slope from east, south and west toward the central northern part of the county, which gives direction to the stream courses. The entire county lies within the drainage basin of the Minnesota River, a tributary of the Mississippi. Almost the whole area is drained by the Blue Earth River with its tributaries, the Maple,

(12) U.S.D.A. Soil Survey of Blue Earth County, Minnesota.
(13) 1920 Census, Agriculture of Minnesota.

and the Big and Little Cobb Rivers, which converge within a radius of 10 miles from the point of confluence of the Blue Earth with the Minnesota River.

The country in the neighborhood of streams, where erosion has been most active, is always more or less broken and rolling. Some of this is too rough for profitable cultivation. The land surface is interrupted here and there by glacial lakes varying in size from those too small to be represented on a map to bodies of 2 square miles in extent. The principal lakes in order of size are Jackson, Madison, Eagle and Loon. About five-sixths of the area was originally prairie. The streams and lakes were fringed with a narrow strip of timber.

Markets, etc. Mankato, the county seat, with a population of 12,469 in 1919,(14) is an important railroad and manufacturing center. The only other important towns are Lake Crystal, Vernon Center, Garden City, A mboy, Mapleton, Good Thunder, Madison Lake, and Eagle Lake, with populations ranging from 300 to 1200. The transportation and market facilities are good. Only a small proportion of the county is situated more than 10 miles from a shipping point. The Chicago, Great Western, the Chicago, St. Paul, Minneapolis and Omaha, the Chicago, Milwaukee and St. Paul, and the Chicago and Northwestern lines enter the county. There are grain elevators and cattle yards at convenient points along these lines throughout the county, and flour mills at various towns with outputs of 50 to 1,000 barrels a day. Thus, with moderate freight rates, secured through keen railroad competition, and with rapid service to Omaha, Minneapolis,

(14) 1920 Census.

St. Paul, Chicago, and other large cities, there is no trouble in finding outlets for any kind of produce. Telephones, rural free delivery of mail, and cooperative creameries are found in all sections. Churches and good comfortable schools are everywhere convenient. The roads are good in the summer and fall, but are apt to become badly cut up or even impassable in ma ny low places during the spring thaws.

Population. The population of the county in 1919 was 31,477 (15). This was made up of Americans, Germans, Swedes, Norwegians, and Welsh, named in order of relative numbers. There are many Welsh in the Lake Crystal neighborhood, while the section southwest of Vernon Center is largely settled by Germans. The population is cosmopolitan throughout the county,--it was not uncommon to hear several languages spoken in almost any small community.

As a rule, the farmers are a sturdy, hard working, broad-minded class, who on account of differences in nationality have not been drawn off into closed communities with set ideas and practices. Prosperity is nearly universal. Many of the farmers have acquired considerable wealth and now live in towns and rent their farms. Generally, the farm houses are neat and substantial, while barns, granaries, and other buildings are commodious and comfortable.

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(15) 1920 Census, Agriculture of Minnesota.

Agriculture.

Table I 1920 Census Blue Earth County Agricultural Statistics.

Number of farms	2,954
Percent of land area in farms	90.3
Percent of farm land improved	80.7
Average acreage per farm	149.1
Average improved acreage per farm	120.3
Percent of farms operated by owners	68.6
Percent of farms operated by tenants	30.8
Livestock	Total Number
Horses	17,476
Beef Cattle	19,365
Dairy Cattle	32,470
Sheep	7,319
Swine	61,318
Crop Acreage	Acres
Corn	70,325
Oats	42,265
Wheat	66,227
Barley	3,820
Rye	3,462
Hay and Forage	76,625

The system of agriculture practiced is general farming in connection with dairying and stock raising. Exclusive stock and dairy farms are few in number, but the increase in dairying has been rapid in recent years. Hog raising is proving quite profitable. Present indications are that this industry will continue to increase and probably in the near future will be one of the most important enterprises on every up-to-date farm. Sheep raising is a paying industry, especially on those farms adapted to grasses or infested with quack grass. The principal crops raised in order of acreage are hay, corn, wheat, oats, barley and rye.

Soils. While one frequently hears that one soil is more productive than another, very few of the soils of Blue Earth County are

reputed as being especially adapted to any one crop. Generally the organic matter content of the soil is so high that in favorable years fairly good yields of general farm crops can be secured even from the lightest types. Again, a very large proportion of the cultivable area embraces clays and heavy clay loams having such narrow textural differences that agricultural methods have been quite uniform and differences in crop adaptation have received but little attention. However, it is pretty generally understood that the heavier, better-drained types are better suited to wheat than are fine sands or fine sandy loams. Some recognize that rye does best on Marshall loam and the lighter phases of the Marshall silt loam.

It is generally concedeed that Fargo Clay loam, when well drained, is a most excellent corn soil, but that wheat and oats planted on this soil are inclined to go too much to straw. Most of those familiar with the Wabash fine sandy loam class it as a good oat, corn and potato soil.

Rotation is very effective on soils of this section. While systematic crop rotation has been neglected sadly, the productivity of many fields has been maintained fairly well simply through an occasional change of crops. Occasional pasturing of land has been invaluable in maintaining good soil conditions on many farms. The naturally high productive soils have given such good yields from year to year that the farmers have not until recently been brought to see the dangers of continuous cultivation to one crop.

In general, the soils of Blue Earth County are naturally very productive. They are as good as those of northern Illinois, where the same types are held at a much higher price per acre. They equal in fertility and ease of cultivation any soils of the prairie States. While the yields have in some cases been lowered by continuous wheat cultivation, and while noxious weeds have made their appearance, the inherent productiveness of the soil has not been materially affected.

HOW DATA WERE SECURED

Land Sales. The farms which were considered are those which have actually been sold during the four year period, 1916 to 1919, inclusive. The sale prices which were used are the considerations which were given when the transfer of deed was recorded. The sale data (16) were collected by the Minnesota State Tax Commission. All sales considerations which did not seem to the Tax Commission to be representative, as not being bona fide, were discarded. After the Tax Commission had thus revised the sales data, they were turned over to real estate men and bankers in each community, who also weeded out some which appeared fictitious to them.

As a result, the sale prices used in the study represent boni fide sales as nearly accurate as it is possible to obtain them*

The following is a specimen of the information on hand before visiting the farm.

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(16) Access to sales data files of the Minnesota State Tax Commission was given us through the courtesy of the Tax Commission.

* We also asked each farmer the purchase price of his farm as an additional check. In only two instances did the purchase price given by the farmer disagree with the sale price on record. The difference in these two cases was only about $200 on $20,000 sales.

Date of Sale: Mar. 1, 1919.

Seller: A. Churchill

Buyer: W. J. Rothrock

Legal description:--

S½ of N½ of SW¼

W½ of S½ of SW¼

Section 32 Twp 108 Ra nge 26 Acres 80

Consideration: $12,400

Assessed value land and buildings: $3,053
(Assessed value at 331/3 % of full value)

Assessor's estimate of full value of land: $8,160
" " " " " "bldgs: $1,000
" " " " " farm: $9,160

Each farm was then visited by the writer, or by Mr. E. W. Gaumnitz who helped with the field survey. The schedule used in the field survey follows, also an explanation of how it was used. (See schedule on next page.)

INSTRUCTIONS CONCERNING THE USE OF THE SCHEDULE.

1. Number each schedule with the number which appears on the county map and sales transfer card.

2. Check the "acres in purchase" against the seven classes of land listed, namely, woods not pastured, woods pastured, other non-tillable pasture, tillable pasture, wild hay land, other tillable land, and waste land.

3. The classification is so arranged that tillable land can be separated from all non-tillable land; also pasture land from crop land and woods. These totals can be worked out later.

4. Under "non-tillable pasture" indicate a check whether

LAND:

No. of farm_____

Acres in purchase			Name of owner
Woods not pastured			Date of purchase
Potentially tillable	xxxxxxx		Distance to market
Woods pastured			Name of market
Potentially tillable	xxxxxxx		Type of road
Other non-tillable pasture			Rods frontage
Rough Wet Stony			Topography
Tillable pasture			
Wild hay land( )			Soil types
Other tillable land			
Waste land( )			Remarks

BUILDINGS:

	Dimensions	When built	Reproduction value	Construction cost	Condition	Type of construction	Remarks
Dwelling							
Barn							
Hog barn							
Hen house							
Granary							
Corn crib							

LAND IMPROVEMENTS: (Only if unusual)

	Type	When made	Reproduction value	Construction cost	Condition	Remarks
Wells						
Fencing						
Tiling						

CROPS: Yields

	Corn	Silage	Oats	Barley	S.Wheat	W.Wheat	Rye	Potatoes	Wild hay	Tame hay
1920										
1919										
1918										
1917										
1916										

Livestock pastured year of purchase: Mature stock_____ Young stock_____

Remarks:

it is non-tillable because of roughness, wetness, or stones, If it is due to two or more reasons, indicate the number of acres due to each.

5. "Wild hay land" will include meadow too wet to be plowed, and in some cases, land too rough to be plowed. Indicate in the parenthesis following the reason the land is kept in wild hay.

6. Indicate in the parenthesis after "waste land" the nature of the waste land. The part of the waste land which is due to roads can be estimated from the "rods frontage" listed in the next column.

7. No place is provided in the schedule for listing the purchase price of the land. The reason for this is that the owner must not know that you havethis information. If he knew that you had obtained this information from the Tax Commission, he would be very greatly alarmed in many cases and would conclude that the purpose of your visit was to check up on the local assessor's work. You can not be too particular in this matter. Ordinarily a schedule should be such that the person interviewed could read it without being alarmed.

8. Fill in the name of owner and date of purchase before visiting the farm.

9. In a few cases you will find that the farm you visit has been sold since your last record of transfer. If you can get him to tell you the amount of the transfer, it will be worth while for you to take the record as of the latest date.

10. Under "rods frontage" count up the number of rods of road taken out of the farm. If the road passes thru the farm, the roads will need to be doubled, because in this case four square rods will be taken out for each rod of road in place of two square rods.

11. Under "soil types" indicate the soil type as described in the soil map of Blue Earth County. If a farm has more than one soil type, indicate the relative proportions of each..This will require that the farm be located rather definitely on the soil map. This can probably be done by matching the soil map against the plat book map. This work can be done mostly after you get home. I expect, however, that the soil map will need checking as to details.

12. Under "remarks" mention any unusual circumstances, such as stony land, floods, poor drainage, run-down soil, etc.

13. Under "reproduction vale of buildings" get the best estimate you can of what it would have cost to have erected the buildings at the time the place was purchased. You can afford to spend considerable time talking with the farmer about this, because the accuracy of this estimate is very essential to the whole project. Check one farmer's estimates against another as you go along. Make sure that the farmer in his reasoning about the question considers all the factors entering into a correct estimate.

14. "Construction cost." Obtain the cost of original construction of the building whenever the farmer happens to know what it is.

15. "Condition." In general describe the condition of the building as "very good", "good", "fair", "poor" or "very poor."

Abbreviations can be used for these terms.

16. Under "remarks" enter any special circumstances connected with the construction of any of these buildings, such as sanitary barn equipment, etc.

17. "Land improvements." This information is asked for only for the sake of checking an interpretation. If the farm has the usual types of wells, fences, etc., nothing whatever needs to be entered.

18. Express the "yields" of the various crops in their usual units, i.e., corn in bushels per acre, silage in tons per acre, etc. Get data as to yields from any available source that you can locate. It will happen very frequently that the farmer who is on the place will not know very much about the yields made by his predecessor. If necessary, get the desired information from the nieghbors.

19. The classification, "tame hay", may mean red clover, alfalfa, timothy, or timothy and clover mixed. It might be well to indicate which is referred to by some form of abbreviation.

20. The livestock inquiry refers only to cattle and horses. If any considerable amount of land is used for pasturing sheep or hogs, a noteshould be made of this.

Preliminary to our going into the field, each farm to be visited was located on a detailed map of Blue Earth County to facilitate locating them. With this aid we did not experience any unexpected difficulty in this respect, but we were not entirely successful in getting all the information which appears on the schedule. The age of the buildings was not known in all cases but

we secured a very satisfactory estimate by combining our judgment with that of the farmers. After a few unsuccessful trials we did not attempt to secure the reproduction value, and in only comparatively few instances was the construction cost obtained* The information under the captions, "land improvements", and "livestock pastured on year of purchase" was secured, but has not been used in this study.

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* The method used in obtaining the building cost is explained in chapter five.

CHAPTER V

COMPILATION AND ANALYSIS OF THE DATA.

Value per acre. The 160 la nd sa les used in the study were ones consumated in four different years, 1916, 1917, 1918 and 1919; and because land values were constantly rising, it was first necessary t o reduce them to a comparable basis. This was accomplished by reducing the value per acre for each farm to the 1919 price level basis. To do this, it was first necessary to find the increase in general land prices in the county from 1916 to 1919; from 1917 to 1919 and from 1918 to 1919.

The difference in the average sales value per acre for each of the years respectively as compared to the 1919 average will give us the proper differential due to increase in land values, provided the sales included in figuring the average for each year are comparable, or that they represent sales of a similar distribution of grades of land. By this, we mean that the average sales value would not represent the increase due to rise in the general land value if the sales for one year were a ll high grade land and the next year the poorer grades were sold. In other words, if the average value of each years sales is to be significant the distribution of the sales with respect to the grades of land for each year must be similar.

The statistical measure used for this relative distribution is called the coefficient of variation, solved by the following formula: $V = 100 \frac{\sigma}{M}$ (17).

(17) Detailed discussion Karl Pearson "Chances of Death" G U Yule "Introduction to the Theory of Statistics".

Table 2. Showing yearly averages of sales, the index representing yearly increase in value, and the coefficient of variation for each year.

Year	Average value	Value Index	(18)(19)	Coef. of Var.
1919	$157.23	100.000		24.135
1918	$134.96	85.837		26.250
1917	$124.46	79.157		25.618
1916	$114.52	72.836		25.557

The coefficients of variations shown in the fourth column of the table are very uniform, thus furnishing us a basis for knowing that the distribution of sales in each of the four years was quite similar. Knowing this it is safe to assume that the average yearly value shown in the second column of the table represent the yearly increase in farm land values.

Using the year 1919 as a base, the third column of the table shows the index number of land value for each year. In order to reduce all the years to the 1919 land value basis, it is only necessary to divide the value per acre for farm by the land value index for the year in which the land was sold. For example, for a farm sold for $150 per acre in 1917, the index of land value for 1917 is .79157. Dividing $150 by .79157 gives $189.49 per acre, or the 1917 value put on the 1919 basis.

(18) Figures from Monthly Crop Reporter. U S D A Mar 1 919 p 33.

IOWA ALL PLOW LANDS

Year	Average Value	Index
1919	169	100.00
1918	154	91.12
1917	140	82.84
1916	135	79.88

(19) L C Gray U S D A Bulletin No 874
"Farm Land Values in Iowa" p 5
Increase in value 1918 to 1919, 22%.

Correction for State Macadam and Dirt Roads. The solution of the road differential for dirt and macadam roads was accomplished by means of cross-tabulation, the presentation and explanation of which is following. Lands on macadam roads were reduced to a dirt-road basis.

Table 3. Average Value per acre on State and Dirt Roads.

	Dirt Roads	State Roads
Average Value per acre	$147	$171
Total acres	10,393	4,873

Table 4. Cross Tabulation on Basis of State and Dirt Roads and Cost of Buildings per Acre.

Dirt Roads			State Roads		
Cost of Bldgs per acre	Value per acre	Acres	Cost of Bldgs per acre	Value per acre	Acres
0--12	$131	4949	0--12	$153	1492
12--24	$152	4037	12--24	$173	2164
24--36	$182	1058	24--36	$189	733
36--48			36--48	$164	176
48--60	$213	349	48--60	$194	277
60--72			60--72		
72--84			72--84	$349	30

Table 5. Cross Tabulation on Basis of State and Dirt Roads and Distance to Market (miles)

Dirt Roads			State Roads		
Distance to Market	Value per acre	Acres	Distance to Market	Value per acre	Acres
0--2.5	$160	2546	0--2.5	$180	1498
2.5--4.5	$155	4104	2.5--4.5	$173	2309
4.5--6.5	$133	2161	4.5--6.5	$203	210
6.5--8.5	$131	1352	6.5--8.5	$138	712
8.5--10.5	$127	155	8.5--10.5	$189	40
10.5--12.5	$ 78	75	10.5--12.5	$169	102

In Table No. 3, the simple tabulation shows a differential of $24. We shall investigate its degree of ostensibility in Tables No. 4 and No. 5 by cross tabulation. The assumption is that if $24 is a true constant difference between state and dirt roads, it should appear also in any cross tabulation of data, on the basis of other factors, provided the distribution or the acres included in each class interval is large enough to allow the effects of other influence factors to average out or compensate.

In the cross-tabulation represented by table No. 4, a constant difference of about $20 appears in the classes where the distribution is large. For example in the class interval "cost of buildings""0-$12"; dirt roads, $131, state road,$153; and also in the class $12-$24; dirt roads, $152, state roads, $173. In the other classes in this table the distribution or number of acres is too small to warrant any consideration in the way of furnishing evidence as to the genuineness of the differential.

Similarily in Table No. 5, the cross-tabulation on the distance to market basis, the differential of about $20 again occurs in the classes having the large distributions. For example, in class interval 0-2.5: dirt roads, $160, state roads $180: and class 2.5-4.5, dirt roads $155, state roads $173.

On the basis of these data an average weighted differential (20) was worked out and used as the correction for state roads.

(20)The average weighted differential was obtained from tables No4 and No. 5. The differential appearing in the two classes 0-12 and 12-24 in Table No.4 and the two classes 0-2.5 and 2.5-4.5 in Table No. 5 were used because these classes contained the largest acreage. The weights used in determining the average differential were the number of acres in each class. The computation is as follows:--

From Table No. 3.

4949A x $131		$648,392	
4037A x $152		$616,408	
8986A	8986	1,264,800	$140.75
1492A x $153		$229,105	
2164A x $173		$374,837	
3656A	3656	603,942	$165.19

$165.19
$140.75
$ 24.44 weighted difference Table No. 3.

From Tab le No. 4.

2500A x $160		$400,000	
4100A x $155		$635,500	
6600A	6600	1,035,500	$156.89
1500A x $180		$270,000	
2300A x $173		$397,900	
3800A (x)	3800	667,900	$175.76

$175.76
$156.89
18.87 weighted difference Table No. 4.

Difference weighted on total acres involved.

$24.44 x	12,642A	$308,970	
$18.87 x	10,400A	$196,248	
	23,042A	505,218	$21.92

$21.92 average w eighted differential or correction for state roads.

Statistical evidence, other than that which appeared in the cross-tabulation, that $21.92 represents a fairly true constant difference, will now be presented using the four classes which were not used in calculating the differential because the distribututions were small, These four classes will be grouped together which will increase the distribution or acres. If our reasoning has been correct, the difference in the one large or grouped class should tend to approach our accepted constant difference, $21.92.

Tab le No. 6 (from table no. 4) Value per Acre According to Distance to Market and Acres.

	Distance to Market.			
	4.5-6.5	6.5-8.5	8.5-10.5	10.5-12.5
Dirt Roads	$133	$132	$127	$79
--acres	2200	1250	155	75
State Roads	$204	$139	$189	$170
--acres	210	712	40	102
Difference	$71	$7	$62	$91

Table No. 7 Four Classes in Table No. 6 Grouped into One.

	Distance to Market.
	4.5 -- 12.5
Dirt roads	$130
--acres	3743
State roads	$156
--acres	1062
Difference	$26

The differences in the first case ranged from $7 to $91; when grouped together the difference reverted back to $26 as was expected. This difference perhaps should have been nearer $21.92, but even in this combination class the acreage on state roads is only 1062 a cres.

The farms on state and dirt roads were separated and correlated with distance to market. On this basis the following forecasting equations resulted:--

X = value per acre; Y = distance to market.

State Roads $X = 187.29 - 7.04Y$

Dirt Roads $X = 161.47 - 5.05Y$

On the basis of these equations, the predicted value per

acre for the following distances to market are:

Miles	State Road	Dirt Road	Difference
1.25	$178.49	$155.16	$23
3.75	$160.89	$142.53	$18
			$41
		Average Difference	$20.50

Here again note the appearance of the constant difference of about $20.

After the values per acre of the farms on state roads were corrected by the means of the difference $21.92, all the farms adjacent to "Class Two" (21) towns w ere sorted out. These farms were then classified on the basis of state and dirt roads.

Table 8. State and Dirt Roads Class 2 Towns.

	Value per Acre and Acres.
State Roads	$144.48
-- acres	58.42
Dirt Roads	$144.74
-- acres	24.33

In that the effect of roads has been corrected for or eliminated, a tabulation on this basis should not reveal any difference when the distribution is large. Note that the above shows a difference of only a few cents, which again confirms the assumed constant $21.92.

Correlation between distance to market a nd value per acre of the farms adjoining "Class Two" towns was made,,first of those on state roads and then of those on dirt roads: The coefficients were r = -.394 and r = -.24 respectively. All of the farms were

(21) Small towns of about 500 population.

then corrected for the state road by means of the correction $21.92 and the correlation between distance to market and value per acre was again calculated. The coefficient in this case was r=-.23 . This coefficient is only one point from the r=-.24 of the farms on dirt roads. This again supports the accuracy of the correction $21.92 in putting the farms on a dirt-road basis or eliminating the effect of the state road.

The value per acre of all of the farms was then put on a dirt-road basis by correcting for the state-road influence.

Correction for influence of towns, due to size, market facilities, etc.: The towns in the area were put in two classes on the basis of population, market facilities, etc.

Class One includes Mankato, Lake Crystal and Janesville.

Class Two includes all small towns of about 500 population.

The correction for the influence of the Class One towns on land value was worked by cross-tabulation in a manner which is similar to the differential calculation for roads.

Table 9 Average Value per Acre by Class of Towns.

Towns	Class One	Class Two
Average value per acre:	$158.36	$143.98
---Acres	3720	8290
Difference	$14.37	

Before we can intelligently investigate by cross-classification the genuineness of $14.37 as being the true constant difference, the average value of the other factors present in each class of towns must be known. The following cross-classifications were made.

Table 10. Average Value of Factors in Each Class of Towns.

Tow ns	Class One	Class Two
Cost of buildings	$15.52	$12.71
Productivity index	99.7	95.0
Land classification	86.9	85.5
Distance to market	3.96	3.45

Table 11.

Class Two Towns Distance to Market 2.5-4.5		Class One Towns Distance to Market 2.5-4.5	
Cost of Bldgs $89-$100	$152.60	Cost of Bldgs.	$165.03
--Acres	903	--Acres	1299
Difference			$12.43

Table 12.

Class Two Towns Cost of Bldgs $12-$24		Class One Towns Cost of Bldgs $12-$24	
Productivity Index 76-90	$151.48	Productivity Index 76-90	$161.84
--Acres	701	--Acres	507
Difference			10.35
Productivity Index 90-104	$138.94	Productivity Index 90-104	$155.64
**Acres	1486	--Acres	817
Difference			15.69
Productivity Index 104-118	$154.52	Productivity Index 104-118	$166.52
**Acres	1076	ACRES	542
Difference			12.00

(22)

A weighted a verage difference was worked out for the three differences appearing in Table 12.

10.357 x 1208	$12,511.256	
15.697 x 2302	$36,134.494	
12.008 x 1618	$19,428.944	
5128	68,074.68	13.275 equals the weighted average difference

(22) Weight on acreage basis.

Table 13.

Class Two Towns		Class One Towns	
Dirt Road	$144.48	Dirt Road	$157.19
--Acres	5842	--Acres	2915
Difference			$12.70

The three differences appearing or resulting from the Tables 11,12 and 13 were then weighted (23) and the average weighted difference (24) used as the correction for the town classes.

The value per acre of all the farms was then corrected by means of the differential $12.82 and put on a "Class Two" town basis.

By using the three corrections for increase in land value, for type of road, and class of town, the value per acre of all the farms was put on this basis: Sold in 1919; adjacent to "Class Two" town; on dirt road.

Calculation of 1919 depreciated cost of buildings. The dimensions and type of structure of each building was obtained in the field. Knowing the dimensions, the cubic foot content of each farm structure was calculated. The cubic foot contents was then multiplied by a certain cost per cubic foot depending on the type and kind of structure. This cost was then depreciated down to the year 1919. The depreciation rate depended on the condition of repair the building was in and its age.

(23) By number of acres.

(24) Table 11.

$12.43 x	3563	$44,288.09
$13.275x	5128	$68,074.20
$12.707x	8757	$111,275.199
	17448	223,637.48 $12.817

Hence $12.82 equals the average weighted difference.

The following is a sample of the calculations for one farm.

Table 14. Sample Calculation of Building Cost.

Building	Cu. ft.	Cost per cu. ft.	Cost	Depreciation Rate	Depreciated Cost 1919.
Dwelling	11,520	14 ¢	$1612.80	38%	$ 999.94
Barn	16,456	5 ¢	822.80	51%	403.17
Hen House	3,500	5¢¢	175.00	80%	35.00
Machine shed	4,000	3½¢	140.00	80%	28.00
Milk house	1,260	5 ¢	63.00	51%	30.87
Granary	4,480	5 ¢	224.00	28%	161.28
Corn crib	7,500	3½¢	262.50	80%	52.50
Shed	2,160	5 ¢	108.00	28%	77.76
Total 1919 depreciated cost					$1788.52

In calculating the costs the following scales and tables were used:

Table 15. Building Cost per Cubic Foot. (25)

Type of Building	Cost per cu ft in 1919
Dwellings, frame, small box House, no cornice	9½¢
Dwellings, frame, shingle roof, small cornice, plain	12¢ to 14¢
Dwellings, brick, same class	16½¢to 19¢
Dwellings, frame, shingle roof, good cornice, sash weights, good house	16½¢to 19¢
Dwellings, brick, same class, good house	21½cto 24¢
Barns, frame, shingle, roof, not painted, plain finish	3½¢to 6¢
Barns, frame, shingle roof, painted, good foundation	6 ¢to 7¢
(26) Single Corn Crib	4¢
(26) Double Corn Crib	3½¢
(26) Machine Shed	3½¢

Tables were not used to determin e cost of silos, each one being considered individually, because of the lack of uniformity in construction. The estimates were based on the "New Building Estimator", Wm. Arthur--Silo Cost data p 535-55.

(25) "New Building Estimator", Wm Arthur p 311. Prices for 1902 were raised to 1919 level by U S Bureau of Labor price indices.

(26) Calculated by writer.

Table 16. Depreciation Tables for Frame Dwellings. (27)

Years	Percentage Depreciation according to Condition		
	Good	Fair	Bad
1	3%	4%	10%
2	6	7	17
3	8	10	23
4	10	12	27
5	13	15	31
6	15	17	34
7	17	19	37
8	18	21	40
9	20	23	42
10	22	25	45
11	23	26	47
12	25	28	49
13	26	30	51
14	28	31	53
15	29	32	55
16	30	34	57
17	31	35	58
18	32	36	60
19	33	37	61
20	34	38	63
21	34	39	65
22	35	40	66
23	36	41	68
24	37	42	69
25	37	43	71
26	38	44	72
27	39	45	74
28	39	46	75
29	40	47	79
30	41	48	80
31	41	48	80
32	42	49	82
33	42	50	83
34	43	51	85
35	43	52	86
36	44	53	88
37	45	53	90
38	45	54	91
39	46	55	93
40	46	56	95
41	47	57	
42	47	59	
43	48	59	
44	48	59	
45	49	60	
46	50	61	
47	50	61	
48	51	63	
49	51	64	
50	52	64	

(27) Used in the Cleveland Va luation "New Building Estimator", Wm. Arthur.

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Table 17. Depreciation Tab le for Brick Dwellings. (28)

Years	Depreciation
1	5%
2	7
3	9
4	11
5	13
10	18
15	23
20	28
25	33
30	39
35	45
40	50
50	60
60	70
70	80

Table 1 8. Depreciation Table for Barns, Granaries and Other Farm Buildings.

Yea rs	Depreciation rate according to Condition.		
	Good	Fair	Bad
1	10	12	14
2	12	15	17
3	14	18	20
4	16	21	23
5	18	23	26
6	20	26	29
7	22	29	32
8	24	32	35
9	26	35	38
10	28	38	41
11	30	41	44
12	32	43	47
13	35	47	53
14	38	51	59
15	41	55	65
16	43	59	71
17	46	63	77
18	49	67	83
19	52	71	
20	55	75	
21	58	79	
22	61	81	

See continuation on next page--

(28) The Bernard Depreciation Table "How to Asses Property in Cities and Rural Towns". H V Cowles and J H Leenhouts. Wis. Tax Com. 1914-p32.

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Continued--
Table 18. Depreciation Table for Barns, Granaries and other Farm Buildings.

Years	Depreciation rate according to Condition.		
	Good	Fair	Bad
23	64		
24	67		
25	70		
26	73		
27	76		
28	79		
29	82		
30			

Land Classification Index. On each farm there were various grades or classes of land and the percentage of the good and poor grades on each farm influenced the value per acre.

The percentage of each grade of land could be entered into the multiple correlation equation, but not without increasing the required calculations many fold. For this reason it was thought feasible to reduce all of the grades to a more or less common denominator and express their combined significance in one figure, which was called the land classification index.

The land classification index was calculated by weighting percentage of each class of land by a figure representing their approximated relative value significance.

The weights used were:

Table 19. Land Classification Index Computed.

	Grade of Land	Weight[29]
1.	Woods--not potentially tillable[30]	1/5
2.	Woods--potentially tillable	1/2
3.	Wild Hay land	3/4
4.	Tillable	1

(29) The weights were approximations resulting from judgments based on the observation of sales of the various grades, and

Tab le 18 cont-
Illustration:--

Grade	Percent	Weight
Grade 1	10	2
Grade 2	10	5
Grade 3	20	15
Grade 4	60	60
	Land Classification Index	82

(29) Cont.
on data found in Minnesota Bulletin No. 145. "The Cost of Producing Minnesota Farm Products."; Minnesota Bulletin No 19 "Cost of Milk Production"; Minnesota 1920 Census; and Crop Reporter, Dec. 1919.
The weight 3/4 Placed on wild hay land may seem a little large but on the average this was good low land which could be tiled. It was not tiled, however, because the farmers found that especially in dry seasons the wild hay crop would compensate for the short crop of tame hay.

(30) Includes other not potentially tillable land which can be pastured.

Productivity of Soil Index: The productivity index is a relative, figured out on the basis of crop yields in Blue Earth County. The average yield of all the crops grown in the county was calculated. The index for each farm was the average percent that the average crop yield of the farm was to the average crop yield of the county. In making the survey the yields for each crop on each farm were obtained for as many years as possible. In most instances, yields for at least three years were obtained.

Table 20. Illustration of Calculation of Productivity Index for One Farm.

Crops grown	Av Yield	County Av Yield	Percent of County Av Yield
Corn	65	48.23	134.7
Oats	55	41.26	133.2
Spring wheat	18	12.53	143.5
Clover and timothy	2	2.18	91.5
			503.19
	Productivity of soil index		125.80

Distance to Market: The distance to market figure was obtained by asking the farmer the question, how far is it to the town where you market most of your products.

The following five factors were then considered in multiple correlation:-

X_1 = Value per acre corrected, as previously explained.

X_2 = 1919 depreciated cost of buildings per acre.

X_3 = Land classification index

X_4 = Productivity of soil index

X_5 = Distance to market.

The forecasting equation which resulted is:-(31)

$$X_1 = 53.449 + 1.154\ X_2 + .787\ X_3 + .179\ X_4 - 3.70\ X_5$$

It is interesting to note some of the relationships as evidenced by the equation. An increase in a dollar's worth of buildings per acre increases the land value $1.15 per acre. An increase of one point in the land classification index results in a rise in the value per acre of $.78. In this area the productivity of soil index was the least significant factor studied. This index merely indicates soil productivity differences and most of the land variation is indicated in the land classification index. An increase of one point in this soil productivity index results in a $.17 increase in the value per acre. The most interesting and yet the most difficult relationship to study was that of distance to market and value per acre. Coupled with this relationship is the relative significance of the type of road and class of town. On a farm which is on a dirt road and adjoining a Class Two town, each

(31) See appendix for calculation.

mile from town decreases the land value per acre $3.70. On the average the state macadam roads increased the adjacent land value $21.92 per acre over the land adjacent to dirt roads. Class One towns influenced the value per acre $12.82 per acre more than Class Two towns.

Following are two illustrations of the use of the forecasting equation:

Farm No 14*

Farm sold in 1918 for $150 per acre, on state road, "Class One" town.

X_2 = 1919 depreciated cost of buildings per acre $36.24

X_3 = Land classifica tion index 87

X_4 = Productivity of soil index 96.6

X_5 = Distance to ma rket 9 miles

$X_1 = 53.449 + 1.154 X_2 + .787 X_3 + .179 X_4 - 3.70 X_5$

$53.449 + 41.82 + 68.469 + 17.29 - 33.30$

$147.73
21.92 state road correction
12.82 "class one" town
$182.47
x .8584 1918 land value index
$156.63 prediction; $150 actual value

Farm No 107

Farm sold in 1919 for $135 per acre; on dirt road, "Class Two" town.

X_2 = 1919 depreciated cost of buildings $12.47

X_3 = Land classification index 75.62

X_4 = Productivity of soil index 103.7

X_5 = Distance to Market 3 1/2 miles

solution of problem on next pg.

* Similar data on the balance of the 160 farms is in the appendix.

$X_1 = 53.499 + 1.154\ X_2 + .787\ X_3 + .179\ X_4 - 3.70\ X_5$

$53.499 + 14.39 + 59.51 + 18.56 - 12.95$

$137.96 prediction; $135 actual price.

Prediction by means of this equation involves a probable error of $17.46 per acre. The two illustrations are chance selections, number 14 showing a farm with three corrected items, and number 107, with no corrected items. The largest error in prediction will be found in the forecasted value of farms which contain other factors which have not yet been considered. For example, a farm may have site value such as lake frontage or perhaps resident-value due to being located in close proximity of Mankato or some other town. Corrections for these factors and some others will be ascertained in a further investigation of the problem. With this information at hand it is hoped that the error in prediction in these extreme cases may be greatly reduced. Another reason for error in some instances is due to the fact that we assume the land price level is the same through out the whole year. This is certain to cause error in predicting the sale price of a farm which sold at a time which is far remote from the month in which the mean value for the year occurs. It is simply a case of using the mean to represent the distribution of sales for one year. The exact error is dependent on the standard deviation of the distribution. Finally, part of the error is due to imperfect market adjustment resulting from the lack of organization in the land market and the bargaining differential. The same grade of land does not always sell for the same price at same time in the same market.

12-21-6M

CHAPTER VI.

CONCLUSION.

It has been shown that the formula furnishes a means by which the most probable land values in Blue Earth County can be ascertained. The equation may be of much value in other sections where conditions are quite different but this does not necessarily follow. Further investigation is needed in this phase of the problem.

The land equation is similar to other measures, in that to measure with accuracy, the conditions must remain the same or corrections must be made in the measure to take into account the change in conditions. A fifty-foot steel tape is only fifty feet when the temperature is a certain degree. When the temperature rises, allowance in measuring must be made for the expansion. Likewise, the land value measure worked out in Blue Earth County is only accurate in territories in which conditions are similar, but slight modifications may render the formula very useful in quite different regions.

The formula is of particular practical importance where scientific appraisal of land is required. The land tax which is based on a perdentage of the land value, could be adminstered with unerring equality, by use of the value equation. The present injustice and inequality in assessment which results in some land being overvalued and some undervalued, would be eliminated. The value of every farm would be determined with the same yardstick, the value equation.

Many tax problems are linked up with a scientific analysis of land value. Among these problems are many which have their justice based wholly or partly on the theory of "benefit received". Who receives the benefit is a question of land value analysis. Cases bearing upon this point are many, the construction of new roads, county ditches, irrigation and other reclamation projects, and special assessments.

People who participate in the land market, including farm real-estate men and all other buyers and sellers of land, are at present in need of a measure for the commodity in which they deal. The land value equation will serve the purpose.

The Federal Land Bank, other banks, mortgage companies, insurance companies and others who loan money on farm land are in need of a scientific measure of farm land values. If land values can be measured more accurately, it is possible that lenders can advance larger loans on land than heretofore, and at the same time not incur any more or as much risk. The buyers of farm mortgages, knowing that the valuation placed on the land represents a scientific valuation or its actual value and that it is a superior security basis, may be willing to accept lower net yields on their investment, and this will operate to lowering the interest rate to the farmers on long-time credit.

In new sections of the county, many problems connected with land credit, such as the effect of clearing an acre of land on land value, can be solved by means of a value equation.

The Interstate Commerce Commission and public utilities

commissions adjust rates to the valuation of the company's property. Scientific rate adjustment is dependent on having accurate value equations.

The land value equation which was solved and presented in this treatise is not the most refined piece of statistical work possible. It is only in its preliminary stages. More equations must be solved to fit the various needs, many of which I have already enumerated.

The real practical and scientific significance of the presentation is that it portrays a scientific solution of valuation problems by means of the accurate mathematico statistical logic*; that it puts land valuation on a genuine scientific basis by an accurate solution of an identity,(32) the land value equation.

(32) Science arises from the discovery of Identity amidst Diversity. The process may be described in different words, but our language must always imply the presence of one common and necessary element. In every act of inference or scientific method we are engaged about certain identity, sameness, similarity, likeness, resemblance, analogy, equivalence, or equality apparent between two objects. It is doubtful whether an entirely isolated phenomenon could present itself to cut notice, since there must always be some points of similarity between object and object. But in any case, an isolated phenomenon could be studied to no useful purpose. The whole value of science consists in the power which it confers upon us of applying to one object the knowledge acquired from like objects; and it is only so far, therefore, as we can discover and register resemblances, that we can turn our observations to account.
Nature is a spectacle continually exhibited to our senses, in which phenomena are mingled in combinations of endless variety and novelty. Wonder fixes the minds attention; memory stores up a record of each distinct impression; the powers of association bring forth the record when the like is felt again. By the higher faculties of judgment and reasoning the mind compares the new with the old, recognizes essential identity, even when disguised by diverse circumstances, and expects to find again what was before experienced. It must be the ground of all reasoning and inference that what is true of one thing

* Karl Pearson Chances of Death p 105

will be true of its equiva l ent, and that under careful ascertained conditions Nature repeats herself."
W J Jevons Principles of Science p 1

Expressing economic relationships which cannot be definitely measured, as identities or in the form of equations has received no little criticism from some people. They think of mathematical equations as being of no value except in expressing exactitudes. Their misconception is due to not understanding what the members of the equation represent. As in this instance the left hand member of the equation represents not the exact market value of land but the most probable market value.(33) It is on this principle of probable equality, the theory of approximations and probability that scientific land valuation must find its basis.

(33) In reality even apparent equality is rarely to be expected. More commonly experiments will give only probable equality, that is results will come so near to each other that the difference may be ascribed to unimportant disturbing causes. Physicists often assume quantities to be equal provided that they fall within the limits of probable error of the processes employed. We cannot expect observations to agree with theory more closely than they agree with each other, as Newton remarked of his investigations concerning Halley's Comet."
W S Jevons Principles of Science p 480.

12-21-6M

THE CALCULATION OF THE COEFFICIENTS OF CORRELATION, ETC.

Variables	Standard Deviations	Means
X_1 = Value per Acre	1 = 3.495763	M_1 = 142.4181
X_2 = Cost of Bldgs per acre	2 = 4.095649	M_2 = 15.45216
X_3 = Land Classification Index	3 = 4.397174	M_3 = 86.40367
X_4 = Productivity Index	4 = 3.977397	M_4 = 99.588368
X_5 = Distance to Market	5 = 2.2190138	M_5 = 3.978048

Zero Order Coefficients of Correlation.

1.	2.	3.	4.
2 +.507972			
3 +.449009	+.16654021		
4 +.2501448	+.2190054	+.2071274	
5 -.386969	-.1490111	-.2878383	-.0770776

Table I.

Means	Standard Deviations	Coefficient of Correlation.	$\sqrt{1-r^2}$
1 142.4181	:1 (3.495763) Class Intervals (34.957) units	12 + .507972	.86137
2 15.45216	:2 (4.095649) Class Intervals (12.286) units	13 + .449009	.89352
3 86.40367	:3 (4.397174) Class Intervals (13.191) units	14 + .2501448	.96820
4 99.588368	:4 (3.977394) Class Intervals (15.909) units	15 - .386969	.92209
5 3.978048	:5 (2.2190138) Class Intervals (2.219) units	23 + .16654021	.98603
		24 + .2190054	.97572
		25 - .1490111	.98883
		34 + .2071274	.97831
		35 - .2878383	.95768
		45 - .0770776	.99702

Table II.

Coef of Correlation (Zero Order)	Product term Numerator	Numerator and Denominator	Coef of Correlation First Order	$\sqrt{1-r^2}$
12 +.507972	+.057662	$+\frac{.450310}{.911790}$	r12.5 +.493874	.8694
15 −.386969	−.0756934	$-\frac{.3112756}{.8517484}$	r15.2 −.365454	.9308
25 −.1490111	−.195694	$+\frac{.0475583}{.7942606}$	r25.1 +.059877	.9982
12 +.507972	+.054783	$+\frac{.453189}{.944692}$	r12.4 +.479721	.8774
14 +.2501448	+.111248	$+\frac{.138896}{.840455}$	r14.2 +.165262	.9862
24 +.2190054	+.127066	$+\frac{.091939}{.833978}$	r24.1 +.110241	.9939
12 +.507972	+.074777	$+\frac{.433195}{.881037}$	r12.3 +.491687	.8707
13 +.449009	+.084597	$+\frac{.364412}{.849336}$	r13.2 +.429055	.9032
23 +.166540	+.228083	$-\frac{.061543}{.769651}$	r23.1 −.079962	.9968
13 +.449009	+.111384	$+\frac{.337625}{.883067}$	13.5 +.382332	.9239
15 −.386969	−.129241	$-\frac{.257728}{.855706}$	15.3 −.301187	.9535
35 −.287883	−.173752	$-\frac{.114086}{.823905}$	35.1 −.138469	.9903
13 +.449009	+.0518118	$+\frac{.397197}{.947199}$	13.4 +.419338	.9077
14 +.2501448	+.093002	$+\frac{.157142}{.874139}$	14.3 +.179767	.9836
34 +.2071274	+.112317	$+\frac{.094810}{.865106}$	34.1 +.109593	.9939
14 +.2501448	+.029826	$+\frac{.220318}{.919342}$	14.5 +.239647	.9708
15 −.386969	−.019280	$-\frac{.367689}{.965314}$	15.4 −.380900	.9245
45 −.0770776	−.096798	$+\frac{.019720}{.892767}$	45.1 +.022088	.9997

Tab le II continued.

Coef of Correlation (Zero Order)	Product Term Numerator	Numerator and Denominator	Coef of Correlation First Order	$\sqrt{1-r^2}$
23 +.1665402	+.042891	$+\frac{.123649}{.946982}$	23.5 +.130571	.9914
25 -.1490111	-.047936	$-\frac{.101075}{.944301}$	25.3 -.107036	.9942
35 -.2878383	-.024816	$-\frac{.263022}{.975016}$	35.2 -.269761	.9629
23 +.1665402	+.045362	$+\frac{.121178}{.954556}$	23.4 +.126946	.9918
24 +.2190054	+.034495	$+\frac{.184510}{.964643}$	24.3 +.191272	.9815
34 +.2071274	+.036473	$+\frac{.170654}{.962089}$	34.2 +.177378	.9841
24 +.2190054	+.011485	$+\frac{.207520}{.985883}$	24.5 +.210491	.9776
25 -.1490111	-.016880	$-\frac{.132131}{.972812}$	25.4 -.135823	.9907
45 -.0770776	-.032634	$-\frac{.044443}{.964821}$	45.2 -.046063	.9989
34 +.2071274	+.022185	$+\frac{.184942}{.954826}$	34.5 +.193691	.9810
35 -.2878383	-.015964	$-\frac{.271874}{.975394}$	35.4 -.278732	.9603
45 -.0770776	-.059619	$-\frac{.017458}{.936907}$	45.3 -.018633	.9998

Table III.

Coef of Correlation of First Order	Product Term Numerator	Numerator and Denominator	Coef of Correlation Second Order	$\sqrt{1-r^2}$
12.3 +.491687	+.032237	$+\frac{.459450}{.947969}$	12.53 +.484667	.8747
15.3 -.301187	-.052628	$-\frac{.248559}{.865649}$	15.23 -.287136	
25.3 -.107036	-.148089	$+\frac{.041053}{.830212}$	25.13 +.049448	
12.5 +.493874	+.050443	$+\frac{.443431}{.949054}$	12.45 +.467234	.8841
14.5 +.239647	+.103956	$+\frac{.135691}{.849925}$	14.25 +.159650	
24.5 +.210491	+.118355	$+\frac{.092136}{.844013}$	24.15 +.109164	
12.4 +.479721	+.053222	$+\frac{.426499}{.900256}$	12.34 +.473753	.8807
13.4 +.419338	+.060898	$+\frac{.358440}{.870205}$	13.24 +.411902	
23.4 +.126946	+.201165	$-\frac{.074219}{.796415}$	23.14 -.09319	
13.4 +.419338	+.106169	$+\frac{.313169}{.887797}$	13.54 +.352748	.9356
15.4 -.380900	-.116882	$-\frac{.264018}{.871664}$	15.34 -.302889	.9531
35.4 -.278732	-.159725	$-\frac{.119007}{.839169}$	35.14 -.141815	
13.5 +.382332	+.046417	$+\frac{.335915}{.952354}$	13.45 +.352720	
14.5 +.239647	+.074054	$+\frac{.165593}{.906345}$	14.35 +.182704	.9832
34.5 +.193691	+.091624	$+\frac{.102067}{.896922}$	34.15 +.113796	
23.4 +.126946	+.037858	$+\frac{.089088}{.951369}$	23.54 +.093641	.9956
25.4 -.135823	-.035383	$-\frac{.100440}{.952425}$	25.34 -.105457	.9944
35.4 -.278732	-.017242	$-\frac{.261490}{.982576}$	35.54 -.266126	
23.5 +.130571	+.040770	$+\frac{.089801}{.959025}$	23.45 +.093637	
24.5 +.210491	+.0025290	$+\frac{.185201}{.972563}$	24.35 +.190425	.9817
34.5 +.193691	+.027484	$+\frac{.166207}{.969192}$	34.25 +.171490	

Table IV.

Coef of Correlation of Second Order	Product Term Numerator	Numerator and Denominator	Coef of Correlation Third Order	$\sqrt{1-r^2}$
12.35 +.484667	+.034791	$+\frac{.449876}{.965207}$	12.435 +.466092	.8847
14.35 +.182704	+.092292	$+\frac{.090412}{.858692}$	14.235 +.105290	.9944
24.35 +.190425	+.092292	$+\frac{.098133}{.860005}$	24.135 +.114107	
13.54 +.352748	+.043752	$+\frac{.308996}{.880209}$	13.254 +.351048	.9363
12.54 +.467234	+.033031	$+\frac{.434203}{.931483}$	12.354 +.466141	
23.54 +.093641	+.164815	$-\frac{.071174}{.827163}$	23.154 -.086045	
15.34 -.302889	-.049960	$-\frac{.252929}{.875768}$	15.234 -.288808	.9574
12.34 +.473753	+.031941	$+\frac{.441812}{.947762}$	12.534 +.466163	
25.34 -.105457	-.143494	$+\frac{.038037}{.839395}$	25.134 +.045314	

Standard Deviations.

$\sigma_{1.2345} = 34.957 \sqrt{1-r^2_{15}} \sqrt{1-r^2_{14.5}} \sqrt{1-r^2_{13.45}} \sqrt{1-r^2_{12.345}}$

$= 34.957\ (.92209)(.9708)(9356)(.8847)$

$= 34.957\ (.7409)$

$= 25.899\ (.674489)$ \$17.468 Probable error.

$\sigma_{2.1345} = 12.286 \sqrt{1-r^2_{25}} \sqrt{1-r^2_{24.5}} \sqrt{1-r^2_{23.45}} \sqrt{1-r^2_{12.345}}$

$= 12.286\ (.9888)(9776)(9956)(.8847)$

$= 12.286\ (.8513)$

$= 10.459$

$\sigma_{3.1245} = 13.191 \sqrt{1-r^2_{35}} \sqrt{1-r^2_{34.5}} \sqrt{1-r^2_{23.45}} \sqrt{1-r^2_{13.245}}$

$= 13.191\ (.95768)(.9956)(.9810)(.9363)$

$= 13.191\ (.87576)$

$= 11.552$

$\sigma_{4.1235} = 15.909 \sqrt{1-r^2_{45}} \sqrt{1-r^2_{34.5}} \sqrt{1-r^2_{24.35}} \sqrt{1-r^2_{14.235}}$

$= 15.909\ (.99702)(.9810)(.9817)(.9944)$

$= 15.909\ (.95479)$

$= 15.189$

$\sigma_{5.1234} = 2.219 \sqrt{1-r^2_{45}} \sqrt{1-r^2_{35.4}} \sqrt{1-r^2_{25.34}} \sqrt{1-r^2_{15.234}}$

$= 2.219\ (.99702)(.9603)(.9944)(9574)$

$= 2.219\ (.9114)$

$= 2.022$

Coefficients of Regression.

$$b_{12.345} = r_{12.345} \frac{\sigma 1.2345}{\sigma 2.1345}$$

$$= .4660 \frac{25.899}{10.459}$$

$$= .4660 \text{ ---------- } (2.4762)$$

$$= 1.1539$$

$$b_{13.245} = r_{13.245} \frac{\sigma 1.2345}{\sigma 3.1245}$$

$$= .3510 \frac{25.899}{11.552}$$

$$= .3510 \qquad (2.2419)$$

$$= .7869$$

$$b_{14.235} = r_{14.235} \frac{\sigma 1.2345}{\sigma 4.1245}$$

$$= .1052 \frac{25.899}{15.189}$$

$$= .1052 \qquad (1.7051)$$

$$= .17937$$

$$b_{15.234} = r_{15.234} \frac{\sigma 1.2345}{\sigma 5.1234}$$

$$= .2888 \frac{25.899}{2.022}$$

$$= .2888 \qquad (12.8086)$$

$$= 3.6991$$

Multiple Correlation Equation.

$X_1 = 1.1539x2 + .7869x3 + .17937x4 - 3.6991x5$

$X_1 = 142.418 + 1.1539(X_2 - 15.4521) + .7869(X_3 - 86.4036) + .17937 (X_4 - 99.5883) - 3.6991 (X_5 - 3.978)$

$X_1 = 142.418\ 1.1539X_2 - 17.8301 + .7869X_3 - 67.9909 + .17937X_4 - 17.86315 - 3.6991X_5 + 14.7150$

$X_1 = 53.449 + 1.1539X_2 + .7869X_3 + .17937X_4 - 3.699X_5$

Coefficient of Multiple Correlation.

$\sigma^2 1.2345 = \sigma_1^2 (1-R^2 1(2345))$

$(25.899)^2 = (34.957)^2(1-R^2)$

$670.758 = 1221.99 (1-R^2)$

$670.758 = 1221.99\ \ 1221.99R^2$

$1221.99R^2 = 1221.99 - 670.758$

$1221.99R^2 = 551.232$

$R^2 = \frac{551.232}{1221.99}$

$R^2 = .451093$

$R = .67163$

Standard deviation of original sales $38.219

Standard error of corrected sales $25.889

Then $\frac{25.889}{38.219} = .6776$

Therefore .7353 = R including corrections made for value per. road and size of town.

LAND VALUATION DATA FOR THE 160 FARMS, INCLUDING THE ORIGINAL PRICE, CORRECTIONS AND VALUE FACTORS.

Schedule Number	Original price per acre	Year of Sale	Reduced to 1919 basis	Corrected for roads	Corrected for towns	1919 depreciated cost of buildings per acre	Land classification Index	Productivity of soil Index	Distance to Market
1	$190.00	1919	$190.00	$168.08	$155.26	$22.36	97.50	125.80	3
2	185.00	1919	185.00	163.08	150.26	17.60	100.00	92.70	3
3	175.00	1919	175.00	153.08	140.26	24.04	94.28	124.80	3
4	185.00	1919	185.00	163.08	150.26	29.26	95.00	87.27	2
5	169.60	1919	169.60	147.68	134.86	34.08	56.78	87.73	11
6	125.00	1919	125.00	103.08	90.26	none	100.00	103.67	7
7	130.00	1919	130.00	108.08	95.26	12.25	72.50	93.80	3 ½
8	150.00	1919	150.00	128.08	115.26	none	80.00	101.00	7
9	300.00	1918	349.50	327.58	314.76	82.98	100.00	122.79	1
10	133.33	1918	155.33	133.41	120.59	43.47	100.00	100.00	1
11	137.50	1917	173.70	151.78	138.96	35.65	90.00	90.60	3
12	125.00	1917	157.91	135.99	123.17	39.35	91.69	129.96	8
13	156.00	1917	197.07	175.15	162.33	16.10	93.75	130.41	3
14	150.00	1918	189.49	167.57	154.75	36.24	87.00	96.60	9
15	160.00	1917	202.12	180.20	167.38	22.68	80.25	122.00	1 ½
16	80.00	1916	109.84	87.92	75.10	none	69.22	106.46	7
17	85.46	1916	117.33	95.41	82.59	10.07	80.81	125.00	6 ½
18	150.00	1919	150.00	128.08	115.26	none	97.50	109.00	½
19	125.00	1919	125.00	103.08	90.26	8.53	55.39	61.54	7
20	205.00	1919	205.00	183.08	170.26	26.40	88.87	128.76	1 ½
21	200.00	1919	200.00	178.08	165.26	35.52	85.22	122.00	3
22	60.00	1917	75.79	62.97	62.97	none	72.25	78.82	7 ½
23	105.00	1919	105.00		92.18	13.58	57.55	81.69	8
24	140.00	1916	192.21		179.39	none	91.25	139.64	3 ½
25	94.28	1918	109.84		97.02	none	52.91	92.11	11 ½
26	100.00	1916	137.29		124.47	13.23	95.62	103.60	5
27	111.32	1916	152.84		140.02	7.02	91.88	91.80	6 ½
28	146.34	1916	200.92		188.10	none	90.22	109.94	3
29	45.00	1917	56.84		44.02	none	35.00	73.00	9
30	120.73	1916	165.76		152.94	26.77	87.06	116.43	9
31	42.50	1916	58.35		45.53	11.86	77.50	100.26	8
32	37.50	1916	51.49		38.67	none	48.00	97.41	11 ½
33	101.26	1916	139.02		126.20	none	74.66	128.39	6
34	54.37	1916	74.65		61.83	15.28	60.00	82.04	6
35	65.00	1917	82.11		69.29	none	96.19	118.63	5
36	100.00	1917	126.33		113.51	8.68	78.03	91.86	7 ½

continued

Schedule Number	Original price per acre	Year of Sale	Reduced to 1919 basis	Corrected for roads	Corrected for towns	1919 depreciated cost of buildings per acre	Land classification Index	Productivity of soil Index	Distance Market
37	$108.69	1918	$126.62		$113.80	$ 9.26	72.98	115.01	8
38	225.00	1918	262.12		249.30	49.53	79.50	75.57	1
39	130.00	1919	130.00		117.18	21.59	84.50	81.62	8
40	150.00	1919	150.00		137.18	9.38	83.12	134.90	3
41	112.50	1919	112.50		99.68	none	50.75	82.94	3
42	239.72	1919	239.72		226.90	22.06	89.03	124.40	1
43	125.00	1919	125.00		112.18	14.51	93.55	100.15	5
44	135.00	1919	135.00		122.18	5.60	78.62	92.18	5
45	150.00	1919	150.00		137.18	3.79	75.00	112.25	7
46	152.50	1919	152.50		139.68	17.21	77.42	100.31	7
47	125.00	1916	171.62	149.70	136.88	20.15	93.36	93.36	3
48	177.50	1919	177.50	155.88	142.76	22.87	100.00	99.82	2 1/2
49	175.00	1919	175.00	153.08	140.26	14.82	95.00	96.00	1 1/2
50	165.00	1916	226.54	204.62	191.80	13.40	95.36	112.20	5
51	140.57	1918	163.76	141.84	129.02	19.27	100.00	110.32	2 1/2
52	175.00	1919	175.00			13.94	68.00	89.11	4
53	97.00	1919	97.00		84.18	none	63.99	93.30	6
54	125.00	1919	125.00		112.18	18.62	74.50	90.18	8
55	165.00	1919	165.00		152.18	15.00	85.00	89.90	2
56	175.00	1919	175.00		162.18	32.84	98.62	98.65	6
57	155.00	1919	155.00		142.18	12.77	99.37	88.93	4
58	100.00	1919	100.00		87.18	3.37	58.32	99.97	7
59	165.00	1919	165.00		152.18	16.89	91.79	97.62	3
60	175.00	1919	175.00		162.18	26.71	92.27	104.90	2
61	150.00	1919	150.00		137.18	35.16	96.25	106.92	2 1/2
62	133.00	1919	133.00		120.18	10.09	68.94	109.07	6
63	71.42	1918	83.20		70.38	none	55.24	75.40	6
64	165.43	1918	192.73		179.91	30.49	95.25	100.00	1
65	130.00	1918	151.45		138.63	8.83	84.00	83.56	7
66	125.00	1917	157.91		145.09	11.46	100.00	104.75	8
67	150.00	1917	189.49		176.67	15.68	93.32	137.74	8
68	102.75	1917	129.80		116.98	20.64	88.25	106.37	3
69	78.94	1916	108.38		95.56	none	89.46	117.23	5 1/2
70	125.00	1916	171.62		158.80	10.57	78.00	95.56	4
71	165.00	1919	165.00		152.18	19.04	93.05	109.22	4
72	205.00	1919	205.00		192.18	24.01	100.00	101.66	3 1/2

continued

Schedule Number	Original price per acre	Year of Sale	Reduced to 1919 basis	Corrected for roads	Corrected for towns	1919 depreciated cost of buildings per acre	Land classification Index	Productivity of soil Index	Distance to Market
73	$ 98.33	1916	$135.00		$122.18	$ 5.38	$ 92.90	88.11	6
74	125.00	1916	171.61		158.79	12.80	82.50	108.00	5
75	125.00	1916	171.62		158.80	15.56	87.50	99.69	5 1/2
76	125.00	1919	125.00	$103.08		18.52	64.85	100.44	3
77	179.00	1919	179.00	157.08		23.22	85.20	97.40	2 1/2
78	160.70	1919	160.70	138.78		49.56	71.23	110.68	3
79	134.00	1919	134.00	112.08		12.47	100.00	102.70	4
80	152.50	1919	152.50	130.58		11.28	100.00	82.86	3
81.	133.33	1919	133.00	111.08		none	88.45	114.70	2
82	87.50	1919	87.50	65.58		none	75.00	86.80	1
83	135.00	1919	135.00	113.08		2.97	73.45	79.22	1/2
84	175.00	1919	175.00	153.08		11.82	81.25	60.29	2 1/2
85	210.00	1919	210.00	188.08		9.50	92.30	102.64	1
86	130.00	1919	130.00	108.08		none	62.00	97.39	5 1/2
87	175.00	1919	175.00	153.08		18.70	93.25	114.12	2 1/2
88	125.00	1918	145.62	123.70		5.30	93.00	107.88	2 1/2
89	132.00	1918	153.78	131.86		19.00	86.29	78.10	7
90	132.50	1918	154.36	132.44		none	88.00	80.58	2
91	100.00	1918	137.29	115.37		19.41	86.06	110.48	7
92	125.00	1918	145.62	123.70		none	100.00	99.00	1/2
93	155.45	1917	196.38	174.46		13.89	97.69	113.00	1/2
94	155.00	1917	195.81	173.89		none	100.00	135.66	0
95	174.70	1916	239.85	217.93		57.44	90.60	108.96	2 1/2
96	150.00	1917	189.49	167.57		31.06	74.88	69.82	2
97	190.00	1919	190.00	168.08		10.42	95.78	114.70	2 1/2
98	100.00	1919	100.00			16.90	93.00	77.86	8
99	125.00	1919	125.00			5.80	91.86	91.69	6
100	165.00	1919	165.00			11.29	82.27	95.00	7
101	138.00	1919	138.00			14.47	95.30	93.06	4 1/2
102	100.00	1919	100.00			none	100.00	102.96	3
103	126.36	1919	126.36			15.17	100.00	100.00	3 1/2
104	125.00	1919	125.00			9.13	76.70	81.58	1 1/2
105	205.00	1919	205.00			19.84	93.16	92.94	0
106	85.00	1919	85.00			19.08	57.50	87.97	3 1/2
107	135.00	1919	135.00			12.47	75.62	103.75	3 1/2
108	150.00	1919	150.00			21.72	88.11	104.81	3

Schedule Number	Original price per acre	Year of Sale	Reduced to 1919 basis	Corrected for roads	Corrected for towns	1919 depreciated cost of buildings per acre	Land classification Index	Productivity of soil Index	Distance to Market
109	$107.50	1916	$147.59			none	75.00	104.72	3
110	120.00	1919	120.00			none	90.00	109.35	4 1/2
111	120.00	1919	120.00			none	98.99	96.26	4 1/2
112	69.92	1919	69.92			4.63	61.26	63.24	2
113	254.62	1919	254.62			53.39	83.22	115.65	4
114	135.00	1919	135.00			19.86	88.12	102.55	4
115	178.00	1919	178.00			3.73	98.75	95.62	3 1/2
116	100.00	1919	100.00			none	96.25	76.16	3 1/2
117	165.00	1919	165.00			24.17	86.40	99.69	3
118	150.00	1919	150.00			21.61	90.00	107.44	2
119	110.00	1919	110.00			21.22	65.00	81.64	1 1/4
120	140.00	1919	140.00			26.21	74.00	62.20	3
121	100.00	1918	116.50			none	83.75	69.81	4
122	150.00	1918	174.75			56.20	100.00	102.94	4
123	85.00	1918	99.02			none	92.50	88.61	1 1/2
124	90.00	1918	104.85			none	67.00	63.31	8 1/2
125	133.82	1918	155.90			6.28	94.97	83.15	2 1/2
126.	135.00	1919	135.00			none	97.80	100.73	5
127	155.00	1919	155.00			15.77	90.42	106.76	4 1/2
128	155.00	1919	155.00			18.05	99.16	94.03	3 1/2
129	110.00	1919	110.00			none	100.00	114.04	4
130	92.94	1917	117.41			14.60	92.71	99.99	3
131	113.13	1917	142.91			none	92.50	112.87	4 1/2
132	105.00	1917	132.64			3.89	80.62	100.41	3
133	163.50	1918	190.47			34.70	100.00	102.19	4
134	152.00	1918	177.08			14.50	100.00	116.78	2
135	124.00	1918	144.50			23.29	64.00	113.69	2
136	125.00	1916	171.61			19.31	93.12	76.43	2
137	100.00	1916	137.29			none	97.00	107.66	5
138	150.00	1917	189.49			none	73.75	76.85	3/4
139	106.97	1917	135.13			none	96.50	61.88	4
140	80.74	1917	101.99			none	45.94	123.88	3
141	108.75	1917	137.38			17.47	92.29	98.00	3 1/2
142	100.00	1917	126.33			none	61.66	91.59	3
143	160.00	1917	202.12			45.21	96.87	104.91	3
144	125.00	1917	157.91			23.32	87.00	79.13	2

continued

Schedule Number	Original price per acre	Year of Sale	Reduced to 1919 basis	Corrected for roads	Corrected for towns	1919 depreciated cost of buildings per acre	Land classification Index	Productivity of soil Index	Distance to Market
145	$118.30	1919	$118.30			$ 21.97	63.37	111.70	1 1/2
146	100.00	1916	137.29			7.38	100.00	88.22	1 1/2
147	65.00	1916	89.24			5.26	90.62	102.57	6
148	125.00	1916	171.62			none	100.00	92.94	1/2
149	175.00	1919	175.00			none	73.20	87.97	3
150	143.75	1916	197.36			15.52	97.93	80.90	4
151	120.00	1916	164.75			none	97.50	77.82	5
152	130.00	1916	178.48			8.19	88.10	101.72	1 1/2
153	125.00	1916	171.61			none	86.25	109.00	1
154	135.00	1916	185.34			25.42	80.82	90.66	2
155	94.11	1916	129.21			10.28	78.04	85.29	7
156	93.75	1916	129.03			11.61	80.50	101.08	1 1/2
157	50.00	1916	68.65			none	75.00	77.23	2 1/2
158	93.75	1916	128.71			none	62.50	83.43	1 1/2
159	82.00	1916	112.58			none	87.00	79.86	3
160	105.26	1916	144.52			59.92	63.15	147.13	0

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