LAND VALUE ESTIMATES FROM THE IOWA LAND VALUE SURVEY

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Each year since 1942, the Iowa Agriculture and Home Economics Experiment Station has conducted the Iowa Land Value Survey. The survey consists of questionnaires sent to more than 800 licensed real estate brokers across the state of Iowa. The questionnaire, as shown in Figure 1, requests the brokers to provide estimates of values as of Nov. 1, for high-, medium-, and low-grade farmland in their area. That information has been processed and analyzed each year to provide a summary description of the farmland market in Iowa. In recent years, however, several changes have been made in the construction of land value estimates and the way they are reported. As a result, there are no continuous series available from the Iowa Land Value Survey that are consistent in terms of methodology and reporting. The purpose of this report is to describe the current methods and procedures under which land value estimates are made from the Iowa Land Value Survey and to present a consistent historical series of Iowa land values for the years 1950 to 1979.
Preliminary Estimation Procedure

Land value estimates are made at the state, district, and county levels. Approximately 500 questionnaires are returned each year yielding, on the average, about five questionnaires for each of Iowa's 99 counties. Initially, four preliminary averages are calculated for each county. The first three averages consist of high-, medium-, and low-grade land values, and the fourth represents a weighted average over all grades of land.

For each county, the high-, medium-, and low-grade values are simple averages calculated by adding up the values for each grade of land and dividing by the number of observations for each land grade.

In 1976, for example, four questionnaires were returned for Story County with the following land value estimates: high-grade land, $2500, 2500, 1900, 2200; medium-grade land, $1450, 1800, 1000, 1400; low-grade land, $1200, 900, 675, 800. By averaging these figures to the nearest dollar, the 1976 preliminary estimates for high-, medium-, and low-grade land for Story County were $2275, $1413, and $894, respectively.
The fourth average is a weighted average and is calculated in a manner that accounts for the effect of each grade of land on land values. The grade of land is an important determinant of land value and in a county with a preponderance of a particular grade of land, a simple average of land values may not be representative of the true county value. For example, to calculate the land value of a county that has 75 percent high-grade land, 20 percent medium-grade land, and 5 percent low-grade land, a simple average of the three land grade estimates would underestimate the true value of land in that county.

To reduce this kind of bias, percentage weights representing the prevalence of each type of land have been introduced into the analysis to more accurately reflect the influence that grade of land has on value. Thus, the fourth average is a weighted average over all three grades of land. The weights used in these calculations were derived from the responses to a special question included on the 1976 survey (See Figure 1, question number 2), which asked the brokers to estimate the percentage of high-, medium-, and low-grade land in their area. In 1976, the four questionnaires returned for
Story County showed the following results: high-grade land, 50, 60, 70, 50 percent; medium-grade land, 25, 25, 20, 30 percent; low-grade land, 25, 15, 10, 20 percent. By taking a simple average of these percentages for each grade of land, it was estimated that Story County contains 57.5 percent high-grade land, 25 percent medium-grade land, and 17.5 percent low-grade land. These percentages are the grade-of-land weights for Story County, and in a like manner, were constructed for every other county in Iowa.

The weights are then used to calculate the weighted average value over all three grades of land. This is accomplished by multiplying the weight for each grade of land by its representative average land value (as previously described) and then adding the resulting figures. For example, in 1976, the weighted average land value for Story County was \((0.575)(\$2275) + (0.25)(\$1413) + (0.175)(\$894) = \$1818\). It is assumed that, for each county, these percentages of grade-of-land weights remain constant from year to year. Thus, in this historical survey of Iowa land values, the same set of weights is used for each year's calculation of Iowa land values.
The four preliminary county averages are not those reported in the survey results at the county level. The four preliminary averages do, however, provide the basis for all subsequent calculations including the state and district values and the final county estimates reported in the survey results.

State Land Value Estimation Procedures

On the basis of preliminary county values, four statewide averages are calculated. These consist of the state average for high-, medium-, and low-grade land and the state average for all grades of land. For each grade of land, the state average is found by dividing the sum of all preliminary county averages for each grade of land by 99, the number of counties in Iowa. The first three state averages can be expressed by the equation:

\[ \text{State Average } j = \frac{\sum_{i=1}^{99} \text{County Value } ij}{99} \]

where the subscript \( j \) refers to the grade of land, the \( i \)th county value for each grade of land is the preliminary average as just described. The state average over all grades of land is calculated by taking the simple average of the 99 weighted county averages.
In equation form, this is represented by:

\[
(2) \quad \text{State Average Weighted Over All Grades of Land} = \frac{\sum_{i=1}^{99} \text{Weighted County Averages}}{99}
\]

The four statewide averages thus consist of the three estimates for high-, medium-, and low-grade land and a state average weighted over all grades of land. These state averages are reported in the survey results each year.

**District Land Value Estimation Procedure**

Averages are calculated for the nine crop reporting districts in Iowa: Northwest, North Central, Northeast, West Central, Central, East Central, Southwest, South Central, and Southeast (Figure 2). As with the state averages, for each district, there are four averages that correspond to high-, medium-, and low-grade land and a district average over all grades. This district average, corresponding to each grade of land, is the simple average of the respective land grade estimates over all the counties included within the district. For example, the Northwest district average
for high-grade land is calculated by taking the simple average of
the high-grade land values for the counties included in the
Northwest district: Buena Vista, Cherokee, Clay, Dickinson, Emmet,
Lyon, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, and Sioux.
These same counties are included in the district average for
medium-grade land and low-grade land, and this same procedure is
used for each of the nine crop reporting districts. The district
average is expressed as:

\[(3) \text{ District Average Land Value } jk = \frac{\sum_{i=1}^{n} \text{ County Value } ijk}{n}\]

Subscript \(j\) reflects the grade of land, \(k\) represents the district
under consideration, and \(n\) represents the number of counties in
district \(k\). This will differ among districts. The district average
over all grades of land is determined by taking the simple average
of the weighted county land values included in that district:

\[(4) \text{ District Average Over } k = \text{ All Grades of Land } = \frac{\sum_{i=1}^{n} \text{ Weighted County Average } i}{n}\]

The calculation of the district averages is completely analogous.
to the calculation of the state averages. Thus, for each district, there are four averages which correspond to high-, medium-, and low-grade land and a weighted value over all grades of land.

**County Land Value Estimation Procedure**

The determination of county values is more complex than the calculation of district and state values. One of the problems that necessitates a more involved treatment of county values is that of sample size. A return of approximately 500 questionnaires each year provides each county with a sample size of only five or six questionnaires. With these few observations, the variance of county averages is too large to ensure accuracy of county averages and consistency in the reporting of county values. Because the Iowa Land Value Survey by itself does not provide enough data to calculate consistent estimates of county land values, the method used to determine the county values combines data from the Iowa Land Value Survey with data reported in the federal agricultural census, conducted every 5 years. The information provided from the two data sets is linked together to determine estimates of county values. Also, no estimates are made for high-, medium-, and low-grade land at the county level. The only county average reported is one weighted over all grades of land.
The calculation of weighted county values occurs in two steps. In the first step, an unadjusted county value is calculated, and in the second step, the value is then adjusted to account for border effects of neighboring districts.

Unadjusted County Land Values

The determination of the unadjusted county land values involves the use of data from the Iowa Land Value Survey and the federal census reports. Federal agricultural census data on land values are reported every 5 years and are based on responses obtained directly from farm operators. All farm operators were asked to estimate per-acre farmland values in 1950 and before. Since 1950, however, only a 20-percent sample of farm operators has been asked to participate in the survey. County farmland values provided by the federal census are used in the Iowa Land Value Survey in the estimation procedure for annual county values.

From the federal census data, a ratio called a census relative is calculated. The census relative is the ratio of federal census county value to federal census district value, i.e., \( \frac{\text{federal census county value}}{\text{federal census district value}} \), and this ratio defines the relationship between the county value and the value of the district in which it is situated. To determine the unadjusted
county land value, the census relative ratio is then multiplied by
the weighted average land value of the district in which the county
is situated. This weighted district land value is calculated from
the data provided by the Iowa Land Value Survey. The calculation of
the unadjusted county value may be expressed as:

\[
(5) \quad \text{Unadjusted County Land} = (\text{Census Value}) \times (\text{Weighted Survey Relative}) \times \text{Dist. Average}.
\]

By substitution, this equation may be rewritten and annotated below
as follows:

\[
(6) \quad (\text{Unadjust. Co.} = (\text{Fed. Census Co. Value}) \times (\text{Fed. Census Dist. Value}) \times (\text{Weighted Survey District Average})
\]

Based on Fed.
Census & the
Iowa Land
Value Survey

Based on data provided by the Federal Census

Based on data provided by the Iowa Land Value Survey

It should be evident from equation (6) that the Iowa Land Value
Survey provides the base value (i.e., the weighted survey district
average) for determining the unadjusted county value, and the
federal census survey determines the relationship (i.e., the
census relative) between the unadjusted county value and its
district value. By dividing both sides of equation (6) by the
weighted survey district average, an equality between two ratios is demonstrated:

\[
\text{(7) } \frac{\text{Unadjust. Co. Land Value}}{\text{Weighted Survey District Average}} = \frac{\text{Fed. Census Co. Value}}{\text{Fed. Census Dist. Value}}
\]

From equation 7 it is clear that the relationship between the county and district values as determined in the Iowa Land Value Survey will be identical with the relationship between the federal census county and census district values. Thus, the two surveys are linked together to provide more reliable estimates of county values.

Further elaboration needs to be made regarding the details of the county estimation procedure. The following procedures were introduced to capture the influence of land grade on values.

**Walker Districts.** First, the weighted survey district average as used in equations (5) through (7) refers to the weighted average of districts having homogeneous corn suitability ratings. These districts, as shown in Figure 3, are not the same as the familiar crop reporting districts. Developed by Larry A. Walker, these districts were designed to include areas of similar soil type, and their boundaries encompass homogeneous land market areas. The districts were constructed on the basis of homogeneous corn

suitability ratings, which reflect the integrated effects of slope, erosion, drainage, soil depth, parent material, biosequence, soil type, and weather on yields of row crops at specific levels of management. As the basis for the unadjusted county land values, these districts of homogeneous corn suitability ratings are used in place of the crop reporting districts because they produce estimates of unadjusted county land values likely to be more homogeneous than those based on crop reporting districts. Because land value is based in part on income, which in turn is a function of yields, districts made up of homogeneous soil types will tend to include counties that have homogeneous land values. The crop reporting districts, on the other hand, include heterogeneous soil types, and as a result, may exhibit a greater variance of county values. Thus, the adjusted county land values calculated by multiplying the census relative by the weighted Walker district average should show less variance across counties than if they were calculated on the basis of the crop reporting districts.

The Census Relative. Census relatives also are calculated on the basis of the Walker districts. Because the Walker districts exhibit more homogeneous soil types, census relatives based on those districts will likely have a value closer to unity than if they were
calculated on the basis of the crop reporting districts. Thus, calculating census relatives on the basis of the Walker districts helps to ensure that the resulting county land values are more homogeneous within a given land market.

For an example of the calculation of a census relative, consider Scott County. Scott County along with Cedar, Clinton, Jones, Linn, and Muscatine counties is located in the East Central Walker district. To find the census relative for Scott County, the federal census district value for the East Central Walker district must first be calculated. This is simply the arithmetic mean of all the federal census county values within that Walker district.

Finding the census relative for Scott County simply involves the construction of a ratio between the Scott County federal census value and the East Central Walker district census value. The census relatives for all other counties are calculated similarly.

Another aspect of the census relative that must be clarified is that the ratio used in the computations is a moving average of 5 census years—the most recent year and the previous 4 years. It is assumed that the census relative will remain roughly constant over census years. This means that the county land values change proportionately to the land values of the Walker district in which
the county is situated. Thus, the use of the census relative ensures that the county estimates derived in the survey have a relationship to their district values similar to the relationship that the census county values have to the census district values.

The following census years were included in the calculation of the census relatives that were used to estimate the 1950-1979 series of county values: 1920, 1925, 1930, 1935, 1940, 1945, 1950, 1954, 1959, 1964, 1969, and 1974.

In summary, the unadjusted county values are determined on the basis of two data sources—the federal agricultural census and the Iowa Land Value Survey. A weighted Walker district average, calculated from the Iowa Land Value Survey, is multiplied by a census relative based on the federal census, and the resulting product represents an unadjusted estimate of county land value.

**Adjusted County Land Values**

In the second step of the estimation procedure, the unadjusted county land values are adjusted for border effects of neighboring districts. The need for this adjustment becomes clear in considering the neighborhood effects that one district has on the counties bordering it in another district. Because land markets may not be coincident with Walker districts and because land quality
may change gradually over distance rather than abruptly at district boundaries, an adjustment for this kind of neighborhood effect must be made. To facilitate the explanation of the adjustment, the term "home county" will refer to the county under consideration, and "border county" refers to any county abutting the home county but situated in a Walker district other than the home county's Walker district.

To determine the adjusted land value for any home county, a weighted average is constructed by using the unadjusted values of the home county and its border counties. A weight with a value of 2 is assigned to the home county's value, and a fractional weight ranging in value between zero and unity is assigned to each of the border counties. The fractional weight given a border county represents the distance of the common boundary (measured in miles) between the border county and the home county. If a home county has only one border county, then the fractional weight of the border county is equal to unity. If, however, the home county has two or more border counties, then the fractional weights given to each of the border counties will be less than unity, and the specific values will equal the ratio of the common distance between each border county to the total distance in common between the home county and all border counties.
For example, Sac County is located in the Northwest Walker district (Figure 3). Abutting Sac County are three border counties, Ida, Crawford, and Calhoun, each of which is situated in a Walker district other than the Northwest district. To obtain the weights for each of these border counties, the common distance between each border county and the home county is divided by the total distance between the home county and all the border counties. The total common distance between Sac County and the three border counties is 72 miles, and the common distances between Sac County and Ida, Crawford, and Calhoun counties are 29 miles, 14 miles, and 29 miles, respectively. Therefore, the weights for Ida, Crawford, and Calhoun counties are 29/72 = 0.403, 14/72 = 0.194, and 29/72 = 0.403, respectively. The sum of the fractional weights equals one. By representing the distance between the border county and the home county, the border county weights reflect the relative influence or neighborhood effect that a border county has on the home county.

As stated previously, the adjusted county land value is a weighted average. Specifically, it is the average of the values of the home county and the border counties where the home county value is weighted by a factor of two and the weights of the border counties, as just described, sum to unity. The weighted values of the home and border counties are summed and then divided by 3, the sum of the weights. To illustrate the adjustment, the adjust-
The equation for Sac County is:

\[ \left( \frac{(8) (\text{Adjusted Land Value for Sac County})}{(\text{Unadjusted Land Value for Sac County}) + (0.403 \text{ Land Value for Ida County})} \right) \]

0.194 (Unadjusted Land Value for Crawford County) + 0.403 (Unadjusted Land Value for Calhoun County) \[ \div 3 \]

Similar equations exist for each Iowa county subject to neighborhood effects. For those counties in a Walker district that don't have border counties situated in other Walker districts, there is no need for an adjustment equation, and the adjusted county land value is identical with the unadjusted county land value as calculated in step 1.

The determination of county land values involves three basic principles. First, the Iowa Land Value Survey is linked with the federal census to reduce the problem resulting from small sample size at the county level. Second, the weighted district averages and the census relatives are calculated on the basis of homogeneous soil districts to ensure that the resulting county estimates have minimum variance within a contiguous land market. Finally, neighborhood effects are reflected in the adjustment to guarantee a more consistent pattern of county land values across districts. The adjusted county land values as described in this section are the
ones reported in the yearly publication of the Iowa Land Value Survey.

On the basis of the methodology outlined in this report, state, district, and county land values in Iowa have been estimated for the years 1950 to 1979. In the tables that follow, a 30-year time series of Iowa land values is presented. All time series of land values presented in this report are consistent with the values reported in the annual Iowa Land Value Survey.
Figure 1: Sample of the Iowa Land Value Survey Questionnaire.
November 1, 1976

Gentlemen:

Your cooperation in supplying information for the land value survey last November was appreciated. The report received extensive news coverage, and you were sent a copy of the survey report. We would like to have your cooperation again this year. As always, your participation in this survey is voluntary and the data will be treated confidentially. Please fill in the answers to the questions and return the survey in the enclosed envelope. We will again send you a copy of the results. If you have any questions concerning the survey, please let us know.

Sincerely,

Duane G. Harris
Agricultural Economics

Farm Land Values in Your Territory as of November 1, 1976

1. Values for average-size farms in your territory are:

<table>
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<tr>
<th></th>
<th>One Year Ago*</th>
<th>Present</th>
</tr>
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<tbody>
<tr>
<td>High grade land</td>
<td>$ __________ per acre</td>
<td>$ __________ per acre</td>
</tr>
<tr>
<td>Medium grade land</td>
<td>$ __________ per acre</td>
<td>$ __________ per acre</td>
</tr>
<tr>
<td>Low grade land</td>
<td>$ __________ per acre</td>
<td>$ __________ per acre</td>
</tr>
</tbody>
</table>

2. The approximate percentage that each grade of land represents in the total acres of your territory is: high grade ________%; medium grade ________%; low grade ________%. (Note: percentages should total to 100).

3. Number of sales you have made in the last 12 months compared to the same period in 1975 is:
   More ____________ Same ____________ Less ____________ (check one)

4. In your opinion, what were the most important factors operating in the land market in your territory since November 1975?
   a. ___________________________________________________________________
   b. ___________________________________________________________________
   c. ___________________________________________________________________

*This was your report to us last year.
Figure 2: Map of Iowa: Crop Reporting Districts
Figure 3: Map of Iowa: Walker Districts