# A Statistical Evaluation of the Influence of Highways on Rural Land Values In the United States 

JAMES W. LONGLEY and BEATRICE T. GOLEY, Bureau of Public Roads

This paper discusses statıstical techniques appled to previous attempts to evaluate the impact of highway improvement on rural land values. Basic to the analysis are the data collected by the U.S. Department of Agriculture for the Bureau of Public Roads on land values by type of road (hard-surfaced, gravel, and dirt) by type of farming area. Various statistical devices have been used to analyze and standardize the data from some 5, 000 rural land sales with a view to determining the existing differentials between values of farm real estate by type of road (a) as to price per acre, and (b) as to price per farm and distance from nearest trading center. The paper also explores other relationships of the influence of various types of rural highways on land values.

An attempt is made to find general principles concerning land values from this national study that will have import for localized highway impact on land values.

- MANY LAND VALUE STUDIES have been made in connection with highway economic impact research. In fact, some 60 studies of land value trends in urban areas associated with highway improvements have been published. These have been summarized in a Congressional report (1, pp. 5-25).

In addition to these analyses of urban land values, researchers have been interested in rural land values associated with various factors (such as improvements, distance, and type of road) since the early 1920's (2, Table 13, p. 35). In the absence of sales data, some of the studies have through the years been based on opinions of the farmers or realtors as to the influence of land value as a result of upgrading the road surface adjacent to the properties in question. Earlier studies were relatıvely limited in number of sales and geographic scope of the samples taken.

A number of recent studies have attempted to compensate for such deficiencies. For instance, the U.S. Department of Agriculture sample surveys of March 1958 and March 1959 prepared in cooperation with the U.S. Bureau of Public Roads and a number of State-sponsored studies, discussed in this paper, are examples in point.

The main object of this paper is to apply some experimental techniques to unpublished data from the March 1958 land value survey made by the U.S. Department of Agriculture. In addition, an evaluation is made of the research endeavors by State highway departments and various university research teams, cooperating with the Bureau of Public Roads, as well as the scope of the methodology used, drawing general inferences on the adequacy of these techniques.

## SUMMARY OF OTHER STUDIES

## General Studies

Most urban land value studies have used the technique of weighted average price per unit of land in period I, compared with weighted average price per unit of land in period
II. One of the chief difficulties of this type of comparison is that the land sold in period II is usually farther out from the central business district than land sold in period I so that there is no common denominator by which the price changes between the two periods can be measured. Although this method may reveal what the average price per unit within a given area was in each of the two periods, it may not precisely measure the impact of highway improvement on land values.

Comparison of price changes between two periods is an index number problem wherein the weights (quantities of land) are fixed and the prices are permitted to vary. Knowledge of current land prices is important for planning activities, but such measures do not give the most precise indication of the impact of highway improvement on values of land that is not being offered for sale. Inasmuch as frequency distributions of land values usually include extreme items that would seriously distort the average price, the concept of median value, a price at which 50 percent of the land is sold, rather than the mean was used.

Most of the land value studies conducted in urban areas covered a rather complete survey of all sales transactions within given periods of time. But rural land value studies are particularly handicapped in that farm real estate turnover is rather slow, thus making current market values for particular areas difficult to determine. Some of these earlier rural land value studies in which correlation and other systematic statistical techniques have been used are described.

## Early Study by Mordecai Ezekiel

Among the studies conducted in the 1920's concerning the value of roads to farms was one by Ezekiel (3) of 422 farms in Chester County, Pennsylvania (2, Table 13, p. 35). Factors used to explain value per acre in this study were dwelling value, dairy buildings value, other buildings value, crop index, percent of area tillable, percent of area level, type of road, and distance to town. The value of improvements per acre accounted for 43.6 percent of total variance; type of road accounted for only 0.5 percent; and distance to town accounted for 2.1 percent. The percent of total variance explained by Ezekel's multiple correlation analysis was 59.7 , which would give a multiple coefficient of approximately 0.7725 . Of primary interest to many researchers is that distance or factor of location accounts for only 2 percent of total variance. Because the influence of type of road was so small, it would appear that value of improvements accounts for most of the difference in property value by type of road.

## Washington State Study of Three Counties

In a study covering three counties in Washungton State (Snohomish, Chelan, and Douglas Counties), Garrison (4) found that in one county (Snohomish County) distance traveled on paved roads to terminus of shopping center accounted for only 0.5 percent of total variance of value, whereas distance traveled to terminus of shopping center via non-paved roads accounted for only 1.7 percent of total variance. These findings are in accord with those of Ezekiel.

In the Douglas County area, where data by type of road surface for all three types of road surfaces were available in the survey (dirt, gravel, and hard-surfaced roads) Garrison found no difference between value of farm properties located as between dirt and gravel roads (4, footnote p. 33).

## University of Minnesota Study

The approach used in the University of Minnesota study (5) represented an attempt to estimate the market value of a whole area of farm real estate from only a few sales. The problems encountered were that sales were too thinly scattered to make estimates of property values for samll areas; that properties sold were dissimilar which impaired their representativeness; and that assessed valuations placed on land and buildings were widely varying fractions of market values. It was decided in this study, however, that, even though assessments may be at considerable variance with market
values, the proportionate breakdown of assessed values of buildings and land might be accurate. It was assumed that the more improvements a parcel had, the more valuable the property would be. Thus, the price per acre of land actually sold was plotted on the ratio of the assessed value of buildings to land. To test this hypothesis of the 337 sales in four counties, 84, or about 25 percent, were used in the scattergram. Estimated market values for the other 75 percent were computed with a maximum error of about 7 percent.

From a technical point of view, this particular approach to determining land values evidently proved successful because sales and assessments exhibited a low degree of association; i.e., little or no correlation. Yet, when sales were correlated with the ratios of buldings to land, the measure of positive association was high. It could be asserted that this was so because the assessors had accurately apportioned the relative values of buildings and land, even though the total values so obtained fluctuated sometimes widely from the actual market prices.

## Kentucky Study

The methodology of the Louisville-Watterson Expressway study (6) was to select several variables that would have a priori the most significant effect on land values, test them by partial correlation and use two or three of the most significant variables. Four variables were tested for the Shelby Mill Road farm land area: (a) the absence or presence of the facility; (b) the size of the parcel sold; (c) the value of the improvements on the properties sold; and (d) the distance from the facility. The correlation between adjusted land prices and distance from the point of access to the facility was -0.15 , or 2.2 percent of total variance. The correlation between land values and distance from the facility with improvements held constant was +0.20 or 4 percent with only 18 recorded sales. For the number of sales involved, this result is not significant from zero. The value of improvements was also considered not statistically significant, which varies from the findings of Ezekiel.

The correlation between the adjusted sales prices of land and the absence or presence of highway facility was +0.85 . The partial correlation between adjusted land value and the presence or absence of facility with size of tract held invariant was +0.88 . The correlation between adjusted land values, absence or presence of highway facility, and size of tract was +0.90 . Thus, absence or presence of facility with size of tract eliminated accounted for 77 percent of the total variance of value.

Distance to the highway facility from the point of access accounted for only a little over 2 percent of the total variance of value of property included in the sample. Land value increases in the "after" period over the "before" period are attributable largely to changes in land use brought on by the major highway improvement and not by distance.

## Two Michigan Studies

Two Michigan studies (7) sought to test the hypothesis that agricultural land values decrease as distance from hard-surfaced road increases. Data were grouped by year of sale into categories based on $0.5-\mathrm{mi}$ distances from a hard-surfaced road up to the last category consisting of land located at distances of 3.5 miles and over from a hardsurfaced road.

Data from Ingham County covering 574 sales for the years 1947-48, 1951-52, and 1956-57, and from Shiwassee County covering 918 sales for the years 1942-43, 194748, 1951-52, and 1956-57 were subjected to analysis of variance. A conclusion of this study was that land values tested were not affected by distance from a hard-surfaced road.

Although distances of 3.5 mi or less constitute virtually yeararound accessibility which would limit the findings of the study to only two counties, such findings by sampling techniques are not inconsistent with those of the Kentucky study derived through correlation technıques. So far, at least, there is some statistical evidence that the variable of distance is not a major influence in explaining the value of farm real estate.

## Ellis County Study

The Ellis County, Texas, study (8) is a report of the relationships between farm land values and quality of road services based on the sales of 214 farms sold during the years 1955-58. This study differs from the others mentioned in that it attempts to study land values by type of road, by distance to nearest town, by value of buildings on land, and by productivity index.

The principal findings and conclusions from the study ( 8 , pp. 5-6) are as follows:

1. Farms located on dirt roads sold for an average of $\$ 96.71$ per acre. Land prices on gravel roads averaged $\$ 138.37$ per acre, 43.1 percent higher than on dirt roads.
2. On farm-to-market roads, land prices averaged $\$ 150.36$ per acre, 55.5 percent more than on dirt roads. The average price of land on other State highways was $\$ 168.44$ per acre, 74.2 percent more than prices of farms on dirt roads.
3. Seemingly, the prices of land located on dirt and gravel roads were not greatly affected by distance from pavement. With other important variables held constant, the most reliable estimates of the effects of distance were (a) land one mile from pavement on a dirt road would be discounted in price by $\$ 22.61$ per acre, (b) a second mile of dirt road would result in an additional discount of $\$ 1.70$ per acre, (c) one mıle of gravel would reduce land prices by $\$ 14.08$ per acre, and (d) a second mile of gravel would decrease land prices by an additional $\$ 1.06$ per acre.
4. Distance from towns of various sizes had very little relationship with land prices. The productivity index of cropland weighted by the percentage of cropland had a very high correlation with land prices.
5. The only very strong relationship between quality of road service and land use was in regard to the value of farm buldings. Land on dirt roads had $\$ 5.24$ per acre of buildings value; land on all other road types had bulldings with a value of more than five times this amount.
6. Only three ( 14 percent) buyers of land located on dirt roads resided on the land purchased in 1959, indicating that such locations had little value as dwelling sites.

In addition to providing information on average price per acre by type of road, by distance both from a paved road and from town, the study considered the possibility of multiple regression techniques in attempts to 1 solate road service effects on land values. Some 30 variables were tested through a process of elimination until only three basic variables were retained to explain price per acre. These were productivity index, distance to nearest large town, and distance to nearest small town by type of road.

Because land economists, economic geographers, and highway engineers have paid considerable attention to distance as a factor in determining land values, it might be worthwhile to note the coefficients of correlation derived in the Adkins study. The coefficient of correlation between price per acre and distance on dirt road was -0.26 or 6.8 percent of total variance, and distance on gravel road in relation to price per acre was -0.14 or 2.0 percent. The correlation between price per acre and distance to nearest small town and large town was -0.09 or 0.8 percent, and -0.15 or 2.3 percent. Thus, in no instance does distance explain more than 6.8 percent of the total variance of price per acre. The influence of distance on price per acre with other factors eliminated probably would be even less.

So far, three separate studies, covering some 1, 724 sales, have concurred in the opinion that distance, however measured, contributes little toward explanation of property values. Although a coefficient of correlation of 0.20 is significant at the 5 percent level with 100 degrees of freedom, it still remains that 96 percent of the total variance of value has to be explained by other variables than that of distance. This does not mean, however, that distance should be eliminated from consideration, because the influence of distance, like that of time, may be useful as a common denominator between pairs of variates.

Although statistical findings sometimes differ from what is expected, the Ellis County study has provided some interesting bases for further conjectures. Adkins
provided detailed machine tabulations of the data used in this study. The data were rearranged by distance in miles from the nearest trading center in order to make the tabulations comparable with those made by the U.S. Department of Agriculture study of March 1958 and March 1959 (9), with the hope that the more detailed data available from the Ellis County study would throw some light on the U.S. Department of Agriculture study covering the enture United States. Retabulations of the data by type of road covering the Ellis County study are given in Table 1. The U.S. Department of Agriculture information is analyzed later.

TABLE 1
SUMMARY OF SALES OF FARM REAL ESTATE ON HARD-SURFACED, GRAVEL AND DIRT ROADS, ELLIS COUNTY, TEXAS'

| Dlstance |  |  | Size |  | Sales (\$) |  |  | per Acre |  |  | c per Farm |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| from Nearest Town (mi) | Acres | $\begin{aligned} & \text { Number } \\ & \text { of } \\ & \text { Sales } \end{aligned}$ |  | Includimg Improvement 6 | Excluding Improvements | Improvements | Including Improvements | Excluding Improvements | Improvements | Including Improvements | Excluding Improvements | Improve ments |
| (a) On Hard-Surfaced Roads |  |  |  |  |  |  |  |  |  |  |  |  |
| 0-2 | 871 | 11 | 79 | 142,618 | 94,032 | 48,586 | 164 | 108 | 56 | 12,965 | 8,548 | 4,417 |
| $2-4$ | 2,713 | 31 | 88 | 435, 158 | 339,574 | 85, 584 | 160 | 125 | 35 | 14,037 | 10,954 | 3,083 |
| 4-6 | 1,461 | 15 | 97 | 213,588 | 170, 933 | 42,655 | 146 | 117 | 29 | 14,239 | 11,396 | 2,844 |
| 6-8 | 1,266 | 11 | 115 | 198,433 | 152, 720 | 45,713 | 157 | 121 | 30 | 18,039 | 13, 884 | 4,156 |
| 8-10 | 781 | 6 | 130 | 105, 727 | 85, 285 | 20,442 | 135 | 109 | 26 | 17,621 | 14,214 | 3,407 |
| 10-12 | 613 | 6 | 102 | 00, 007 | 78, 070 | 11,937 | 147 | 127 | 19 | 15,001 | 13, 012 | 1,890 |
| Total Average | 7,705 | 80 | 96 | 1,185,531 | 920, 814 | 264,917 | 154 | 119 | 34 | 14,810 | 11,508 | 3,311 |
| (b) On Gravel Roads |  |  |  |  |  |  |  |  |  |  |  |  |
| 0-2 | 1,866 | 16 | 117 | 275,903 | 226,400 | 49,503 | 148 | 121 | 27 | 17,244 | 14, 150 | 3, 094 |
| 2-4 | 2,231 | 24 | 93 | 258, 821 | 205, 156 | 53,665 | 116 | 92 | 24 | 10,784 | 8,548 | 2, 236 |
| 4-6 | 3,267 | 26 | 126 | 490, 140 | 391, 242 | 98,898 | 150 | 120 | 30 | 18,852 | 15, 048 | 3, 804 |
| 6-8 | 2,029 | 18 | 113 | 230, 593 | 180,320 | 50, 273 | 114 | 89 | 25 | 12,811 | 10, 018 | 2,793 |
| 8-10 | 549 | 6 | 92 | 82, 136 | 63,406 | 18,730 | 150 | 115 | 34 | 13,880 | 10,568 | 3,122 |
| 10-12 | 178 | 2 | 89 | 19176 | 15738 | 3,440 | 108 |  | 19 | 9,588 | 7,868 | 1,720 |
| 12-14 | 178 | 2 | 89 | 19, 176 | 15,736 | 3,440 | 108 | 88 | 19 | 9,588 | 7,868 | 1,720 |
| Total <br> Average | 10,120 | 82 | 110 | 1,356,769 | 1,082, 260 | 274,509 | 134 | 107 | 27 | 14,747 | 11,764 | 2,984 |


| 0-2 | 405 | 6 | 68 | 57,594 | 49,530 | 8, 064 | 142 | 122 | 20 | 9,590 | 8,255 | 1,344 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2-4 | 1,776 | 16 | 111 | 167,517 | 156,411 | 11,106 | 94 | 88 | 6 | 10,470 | 9,776 | 694 |
| 4-6 | 849 | 13 | 65 | 84, 662 | 83,656 | 1,006 | 100 | 99 | 1 | 6,512 | 6,435 | 77 |
| 8-8 | 293 | 3 | 98 | 26,690 | 24,684 | 2,006 | 91 | 84 | 7 | B,897 | 8,228 | 609 |
| 8-10 | 645 | 4 | 161 | 38,767 | 38,687 | 100 | 60 | 60 | - | 9,692 | 9,667 | 25 |
| 10-12 | - | - | - | - | - | - | - | - | - | - | - |  |
| 12-14 | - | - | - | - | - | - | - | - | - | - | - |  |
| Total Average | 3,968 | 42 | 94 | 375, 230 | 352,948 | 22,282 | 95 | 89 | 6 | 0,934 | 8,404 | 531 |

${ }^{2}$ Adapted from unpublished worksheete (B)

The Ellis County study separated the value of the land from that of improvements. In Section (a) of Table 1, summary of sales of farm real estate on hard-surfaced roads, Ellis County, Texas, some interesting patterns begin to emerge.

Although number of sales and number of acres sold decrease with distance from the nearest town, price per acre excluding improvements is relatively constant, price per acre 2 to 4 mi out being $\$ 125$ and 10 to 12 mi out being $\$ 127$. But price per acre including improvements shows a definite downward trend with respect to distance. Thus, it would appear that the closer the property to town, the more expensive the improvements. For instance, property located within 2 to 4 mi from the nearest town averaged $\$ 35$ per acre in improvements as compared with $\$ 19$ for property located 10 to 12 mi from town. Section (a) of Table 1 also reveals that as distance from town increases, the average size of tract also increases, so that there is an inverse relationship between average price per acre including improvements and average size of tract.

The reported data revealed that, out of the 80 sales on hard-surfaced roads, 19 parcels had no improvements. Of the 19 parcels having no improvements, 14 were located within 5 mi from town. Section (b) of Table 1 shows that value of improvements per parcel sold averaged $\$ 2,984$, as compared with $\$ 3,311$ for hard-surfaced roads.

Although 76 percent of the parcels sold along hard-surfaced roads included improvements, 65 percent of the parcels sold on gravel roads included improvements. If only those parcels are counted that have improvements, the average value of improvement per parcel on gravel roads was $\$ 4,289$ as compared with $\$ 4,343$ on hard-surfaced roads, a difference of $\$ 54$ per parcel.

The distribution of data in Section (c) of Table 1 is as regular as could be expected, considering that there were only 42 recorded sales. Of this number, only 16 , or 38 percent, of the parcels sold had improvements. The average dollar amount of improvements on parcels that had improvements was $\$ 1,393$ per parcel - less than onehalf the dollar amounts found on the other two types of roads. Also, 86 percent of total estimated improvements on dirt roads were located less than 4 mi from town.

Finally, Ellis County reported that the price per acre for land only on hard-surfaced roads was 34.3 percent greater than on dirt roads, and the price per acre for land only on gravel roads was 20.2 percent higher than on dirt roads.

The unpublished data in Adkins' study with respect to farms abutting hard-surfaced roads provide a statistical distribution similar to that found in the U.S. Department of Agriculture national sample, discussed next, although the results differ for farms located on dirt and gravel roads.

## U.S. Department of Agriculture Survey

In March 1958, and again in March 1959, the U.S. Department of Agriculture (9) conducted two sample surveys for the Bureau of Public Roads in an attempt to develop a comprehensive framework of principles and concepts covering the economic impact of highway improvement on the rural sector of the economy, particularly with respect to land use and land value based on actual sales of farm real estate. Most of the recorded sales transpired within a six-month period preceding the data of the surveys. The March 1958 survey included 5,623 sales and the March 1959 survey, 5,813 sales, making a total of 11,436 recorded sales. These sales were analyzed to determine average sales prices of properties served by dirt, gravel, and hard-surfaced roads, by type of farming area (Fig. 1). (This differs from information collected by the 1954 Census of Agriculture, in that prime consideration was given in the U.S. Department of Agriculture study to differences in land value by type of road surface. Also, the type of farming area seems to vary by classification from that of the Census of Agriculture.)

Although no definite estimates appear, the report states that more of the properties on hard roads were found to have buildings than those on lower quality roads, and that


Figure 1. Types of farmang areas, generallzed by crop-reporting districts.
the buildings were of somewhat better than average quality. "Properties nearest trading centers were also more likely to be located on hard roads. These two characteristics - improvements and location - account for some of the differences in sales prices of properties on dirt, gravel, and hard roads" (9, p. 1).

The U.S. Department of Agriculture has directed a survey to farm real estate dealers and other reporters for each March since 1926. A special section of this survey was designed for the March 1958 and March 1959 sample to obtain information on each sale reported as follows: (a) kind of road on which the property was located, (b) distance from the nearest trading center, (c) the reporters' estimates of the probable sales price if the property had been located on a better or poorer road, (d) the acreage involved, (e) the sales price of the parcel sold, and (f) the reporters' estimates of the quality of land and improvements.

The results of grouping sales by type of road indicate that the average price per acre of property located on hard-surfaced roads was 22.2 percent more than farms located on gravel roads, and that farms located on gravel roads sold for 86.2 percent more than farms located on dirt roads (9, p. 22). Of the total number of sales on gravel roads for the United States, the corn belt represented 29.8 percent. The dollar amount of sales and the acres sold on gravel roads for the corn belt was also a high percentage of the total gravel roads for the two samples combined. Tabulations from the worksheets on the March 1958 sample indicate that the corn belt represented 44.1 percent of the number of sales, 51.7 percent of the dollar amount of sales, and 24.5 percent of all the land sold on gravel roads out of the aggregate of 21 types of farming areas representing the United States. Moreover, of all the land sold in the corn belt, almost 64 percent was on gravel roads.

The average price per acre on hard-surfaced roads for the United States is \$132 as compared with $\$ 108$ on gravel roads as reported in the U.S. Department of Agriculture survey. It is possible that the real difference could be much greater than the spread indicated. For example, the weighted average price of farm real estate located on gravel roads in the corn belt was $\$ 193.17$ per acre as compared with $\$ 58.57$ for the remaining farm areas in the United States represented by the March 1958 sample. The weighted average price of properties located on hard-surfaced roads including the corn belt was $\$ 132.89$ per acre as compared with $\$ 113.87$ per acre excluding the corn belt.

The one solution to the problem appears to be to avoid comparisons between road types for the entire United States and instead make comparisons within each type of farming area. But the number of sales in many areas is not sufficiently large to make such comparisons.

> Actual sales prices of properties served by dafferent types of roads would provide a more objective measure of highway benefits than estimated sales prices if all other value-determining factors could be held constant. Multiple regression analysis is the most satisfactory procedure for measuring the net effects of different types of roads on sales prices, with other prıce variables held constant. However, few entirely satisfactory applications of this technique to land prices can be found in the literature of recent years. Major problems arise with respect to Identacication and measurement of the substantial number of factors that influence sales prices, particularly those of a qualitative and subjective nature ( $\mathbf{~ ( ~}$, p. 12).

As previously described, the Ellis County study sought to explain land values through use of an index of productivity. In this same manner, the U.S. Department of Agriculture report divided land into categories of "good," "average," and "poor" land by type of road. Although 46 percent of the sales of land on hard-surfaced roads was classified as "good" as compared with 35 percent on gravel roads, only 27 percent of the land on dirt roads was classified as "good." However, these estimates indicate that sales activity tends to be greater on good land, as compared with lands of lesser quality, along hard-surfaced roads, as compared with dirt or gravel.

This tendency for a higher proportion of farms on hard roads that were sold to have better land was most pronounced in the eastern part of the United States, where roads have a tendency to follow valleys in which land is likely to be more productive. "In areas where topography imposes few obstacles to highway construction, and land is more uniform as to quality, there seems to be little, if any, association between type of road and quality of land" (9, p. 15).

From the data collected by the agriculture survey and given in Table 2, there seems to be an inverse relationship between price per acre and distance from nearest trading center. For distances under two miles from nearest trading center on good land, price per acre on hard-surfaced roads was about 11 percent higher than on gravel roads and 55.9 percent higher than on dirt roads. The differential of gravel over dirt was 40.4 percent. The differentials were lower on "average" land and higher on "poor" land for distances less than two miles from the nearest trading center.

The U.S. Department of Agriculture study also prepared an experımental regression analysis to measure more precisely the net effects of the factors determined by crossclassification to be associated with land prices in the Indiana portion of the eastern corn belt for the year 1958. It was stated that this area was selected because of the adequate number of sales (172) avallable and because the area was relatively homogeneous with respect to land quality ( 9, p. 19). In general, the regression equations covered such variables as type of road, miles to trading center, land quality, acres per sale, miles to hard roads, and building quality. It was found that the most statistically significant variables were quality of land and size of tract, the latter being due to the dominance of buildings in the total of small tracts, coupled with the probability of land of lower acreage quality in larger tracts. The variable of distance was not considered statistically significant at the 95 percent confidence level, either from the nearest trading center or from a hard-surfaced road.

TABLE 2
AVERAGE SALE PRICE OF FARM PROPERTY ON DIRT, GRAVEL AND HARD-SURFACED ROADS, BY QUALITY OF LAND AND DISTANCE TO NEAREST TRADING CENTER, WESTERN CORN BELT, 1958-59 ${ }^{1}$

| Land Quality | Miles to Trading Center | Sale Price of Property (\$) |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{gathered} \text { On } \\ \text { Dirt Road } \end{gathered}$ | On Gravel Road | On Hard-Surfaced Road |
| Good land: | 1-2 | 188 | 264 | 293 |
|  | 3-4 | 157 | 247 | 247 |
|  | 5-6 | 157 | 230 | 249 |
|  | 7-8 | 132 | 254 | 193 |
|  | 9-10 | $-{ }^{2}$ | 214 | -- ${ }^{2}$ |
| Average land: | 1-2 | 116 | 162 | 176 |
|  | 3-4 | 76 | 165 | 179 |
|  | 5-6 | 103 | 171 | 161 |
|  | 7-8 | 118 | 132 | 164 |
|  | 9-10 | 74 | 153 | -- ${ }^{2}$ |
| Poor land: | 1-2 | 65 | 98 | 132 |
|  | 3-4 | 70 | 112 | -- ${ }^{2}$ |
|  | 5-6 | 62 | 100 | -- ${ }^{2}$ |
|  | 7-8 | -- ${ }^{2}$ | 89 | -- ${ }^{2}$ |
|  | 9-10 | $-{ }^{2}$ | 92 | -- ${ }^{2}$ |

## TECHNIQUES APPLIED TO BASIC DATA OF U.S. DEPARTMENT OF AGRICULTURE MARCH 1958 SAMPLE OF RURAL LAND VALUES IN THE UNITED STATES

In the preparation of Part VI of the "Final Report of the Highway Cost Allocation Study" (1), worksheets were obtained from the U.S. Department of Agriculture for the March $\overline{1958}$ sales data on farm real estate.

The major contribution of this paper is the application of multiple correlation and index number techniques to the analysis of unpublished detail furnished to the U.S. Bureau of Public Roads by the U.S. Department of Agriculture. It would have been preferable to subject both samples to detailed analyses, but inasmuch as the 1958 data were already in an advanced stage of analysis when the March 1959 tabulation was completed, and because the distribution of the two samples was very similar, the detailed analysis of sales from the 1958 survey was considered to be adequate for this problem.

Most of the urban studies of land values have been concerned with comparing property values before a major highway improvement with property values after a major highway improvement, in many instances by type of land use (i.e., industrial, commercial, residential, or vacant) usually on a time-period basis. The U.S. Department of Agriculture survey is concerned with agricultural use and property values by type of roads, irrespective of the time when a road changed from dirt to gravel or to a hard-surfaced road. Therefore, an attempt to discover how much property values are increased as a result of highway or road improvement in agricultural areas is somewhat frustrated by the U.S. Department of Agriculture finding that a large percent of sales of land along hard roads is sales of land classified as "good" land. This partially answers whether land is more valuable because of improved roads or whether improved roads have a tendency to be located in more productive areas. Unfortunately, there is no definite quantitative answer to this problem at the present time.

The reworking of the data collected by the U.S. Department of Agriculture on land values by type of road surfacing posed the immediate problem of dealing statistically with distributions of various degrees of sample coverage - on hard-surfaced, gravel, and dirt roads. In addition, it was necessary to overcome two obstacles in the nature of the information collected. For instance, there were a number of extreme items in the sample. This problem is particularly acute when attempting to compare price per acre by distance as between types of roads. To overcome the problem of extreme items, the concept of the median was used, a price that would cover 50 percent of the number of acres sold or 50 percent of the number of sales.

The second difficulty relates to deficiencies in data. Not all of the farming areas sampled were of adequate size for each type of road to permit useful comparisons by type of local farming area. To overcome the sparseness of the data and to obtain an over-all picture of land values, simple, partial, and multiple correlation techniques were used relating aggregate sales value, distance, number of acres sold, and number of sales by type of road. From the derived estimates, average price per acre, average size of tract, and average price per farm were obtained.

Correlation procedures also indicated what variables available are most important in determining land values for each type of road so that the influence of type of road surface on rural land values could be isolated from other factors in the sample survey, and price differentials relating to type of road surface be obtained. The approach here recognizes the influence of some of the extreme items isolated and derives comparative prices through an index number method. Consistency is proven between the correlation and index-approaches.

## Median Values by Type of Road by Distance of Farm Real Estate from Nearest Trading Centers

Quartiles computed for the number of sales by distance are given in Table 3. This summary table indicates that 58 percent of the number of sales on hard-surfaced roads, 50 percent of the number of sales on gravel roads, and 38 percent of the number of sales on dirt roads (making an average of 51 percent for all roads), lie within 4 mi of

TABLE 3A

## NUMBER AND PERCENT OF SALES BY DISTANCE <br> (EXTREME ITEMS INCLUDED) ${ }^{1}$

| $\begin{aligned} & \begin{array}{c} \text { Distance }^{2} \\ (\mathrm{~m} 1) \end{array} \\ & \hline \end{aligned}$ | Code | Hard-Surfaced |  | Gravel |  | Dirt |  | Total |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | No. | \% | No. | $\%$ | No. | $\%$ | No. | \% |
| 1-2 | 1 | 644 | 31.0 | 503 | 20.3 | 172 | 16.1 | 1, 319 | 23.4 |
| $3-4$ | 2 | 566 | 27.3 | 738 | 29.7 | 234 | 21.9 | 1,538 | 27.3 |
| 5-6 | 3 | 388 | 18.8 | 575 | 23.1 | 213 | 20.0 | 1,176 | 20.9 |
| 7-8 | 4 | 191 | 9.2 | 299 | 12.0 | 132 | 12.4 | - 622 | 11.1 |
| 9-10 | 5 | 108 | 5.2 | 172 | 6.9 | 104 | 9.8 | 384 | 6.8 |
| 11-15 | 6 | 103 | 5.3 | 133 | 5.3 | 135 | 12.6 | 371 | 6.7 |
| 16-20 | 7 | 40 | 1.9 | 41 | 1.6 | 41 | 3.8 | 122 | 2.2 |
| 21-30 | 8 | 17 | 0.8 | 20 | 0.8 | 21 | 2.0 | 58 | 1.0 |
| 31 and over | 9 | 10 | 0.5 | 8 | 0.3 | 15 | 1.4 | 33 | 0.6 . |
| Total |  | 2,067 | 100.0 | 2,489 | 100.0 | 1,067 | 100.0 | 5,623 | 100.0 |

${ }^{1}$ Adapted from tabulations compled from March 1958 survey for (10).
${ }^{2}$ From nearest trading center.
TABLE 3B
PERCENT OF SALES BY DISTANCE

| Percent Sales | Distance from Nearest Trading Center (mı) |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Hard-Surfaced | Gravel | Dirt | Total |
|  | 1.6 | 2.3 | 2.8 | 2.1 |
| 50 | 3.4 | 4.0 | 5.2 | 3.9 |
| 75 | 5.8 | 6.3 | 8.9 | 6.6 |

the nearest trading center, and only 3.2 percent of the number of sales on hard-surfaced roads, 2.7 percent on gravel roads, and 7.2 percent on dirt roads (for a 3.8 percent national average) occurred beyond 15 ml from the nearest trading center.

Similar estimates of the percentage distribution of the number of acres sold by miles are given in Table 4. Though only 3.8 percent of all sales occurred beyond 15 $\mathrm{m}_{1}$ from the nearest trading center, 24.0 percent of all acres sold lay beyond 15 mi from the nearest trading center. Although the percentage number of sales definitely decrease with distance for all three types of roads, this generalization is not so pronounced in the percentage number of acres sold. What this means, therefore, is that there should be a direct correspondence between distance and size of tract beyond 15 mi from the nearest trading center, inasmuch as the number of acres sold divided by the number of sales gives average size of tract.

To point up the relationship between price, quantity and the number of sales, frequency distributions by type of road were prepared (a) between price per acre, distance, and number of acres sold (Tables 5 and 6 ) and (b) between size of tract, distance, and number of sales (Table 7). From these tables, average price per acre, median price per acre by distance, and type of road for the total United States, for the United States excluding the corn belt, excluding average size of tracts over 500 acres, and also excluding corn belt and average size of tracts over 500 acres (Tables 8,9 , and 10) were derived. In addition, separate computations were made for sales of parcels by type of road whose average size of tract was over 500 acres. Takıng large tracts into account separately was necessary, in that the number of sales were few and wherever they occurred the price per acre invariably was sufficiently low to distort the price per acre by distance between the three types of roads. For sales of tracts averaging over 500 acres, price per acre of property sold ongravel roads

TABLE 4
ACRES SOLD BY TYPE OF ROAD BY DISTANCE ${ }^{1}$

| Distance $(\mathrm{mi})^{8}$ | Code | Hard-Surfaced | Gravel |  | Dirt |  | Total |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Acres ¢ | Acres | \% | Acres | ¢ | Acres | 4 |

(a) By Distance

| 1-2 | 1 | 113,953 | 20.0 | 80, 025 | 11.7 | 29,095 | 7.6 | 223,073 | 136 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3-4 | 2 | 111,627 | 19.6 | 139, 198 | 20.4 | 40,178 | 10 | 291,003 | 79 |
| 5-6 | 3 | 69, 543 | 122 | 126,985 | 186 | 51,827 | 136 | 248,355 | 152 |
| 7-8 | 4 | 64, 700 | 113 | 59,186 | 87 | 35, 265 | 9.2 | 159, 151 | 9.7 |
| 9-10 | 5 | 57, 001 | 10.0 | 44,220 | 6.5 | 31, 173 | 8.2 | 132,394 | 8.1 |
| 11-15 | 6 | 50,950 | 89 | 73,334 | 10.8 | 63, 195 | 16.6 | 187,479 | 11.5 |
| 16-20 | 7 | 26,290 | 4.6 | 72, 523 | 106 | 32,532 | 8.5 | 131,345 | 80 |
| 21-30 | 8 | 42,021 | 74 | 14,252 | 2.1 | 29,095 | 76 | 85, 368 | 52 |
| 31 and over | 9 | 34,825 | 6.1 | 72,314 | 106 | 69,118 | 18.1 | 176,257 | 10.8 |
| Total |  | 570,910 | 100.1 | 682, 037 | 100.0 | 381,478 | 99 | 1,634,425 | 00 |

(b) By Distance Excluding Corn Belt

| 1-2 | 1 | 90,903 | 18.1 | 46,870 | 9.4 | 25,116 | 72 | 162,889 | 12.0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3-4 | 2 | 89,890 | 17.9 | 79,941 | 16.0 | 31,387 | 90 | 201,218 | 149 |
| 5-6 | 3 | 55,638 | 11.1 | 81,414 | 163 | 43, 129 | 123 | 180, 181 | 133 |
| 7-8 | 4 | 59,355 | 118 | 38,311 | 7.7 | 31,545 | 9.0 | 129,211 | 9.5 |
| 9-10 | 5 | 55,433 | 110 | 32,636 | 6.5 | 28, 013 | 80 | 116,082 | 8.6 |
| 11-15 | 6 | 49, 299 | 98 | 64,612 | 12.9 | 60, 155 | 172 | 174,066 | 12.9 |
| 16-20 | 7 | 25,897 | 51 | 69,960 | 140 | 32,532 | 9.3 | 128, 389 | 9.5 |
| 21-30 | 8 | 42, 021 | 8.3 | 14, 252 | 28 | 29, 095 | 8.3 | 85, 368 | 63 |
| 31 and over | 9 | 34,825 | 6.9 | 72,314 | 14.5 | 69,118 | 197 | 176, 257 | 13 |
| Total |  | 503,261 | 100.0 | 500, 310 | 100.1 | 350,090 | 100.0 | 1,353,661 | 00.0 |


| (c) By Distance Excluding Tracts over 500 Acres |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1-2 | 1 | 95,565 | 29.0 | 80,025 | 18.1 | 29,095 | 171 | 204,685 | 217 |
| 3-4 | 2 | 91,390 | 27.8 | 139, 198 | 31.4 | 39,478 | 23.1 | 270, 066 | 28.6 |
| 5-6 | 3 | 69,543 | 21.1 | 97, 832 | 22.1 | 34,456 | 20.2 | 201,831 | 214 |
| 7-8 | 4 | 28,305 | 86 | 59, 186 | 134 | 21,348 | 125 | 108, 839 | 11.5 |
| 9-10 | 5 | 16, 724 | 51 | 33,413 | 7.5 | 18, 225 | 107 | 68,362 | 73 |
| 11-15 | 6 | 21,558 | 6.6 | 20,806 | 4.7 | 23,222 | 13.6 | 65,586 | 7.0 |
| 16-20 | 7 | 3,970 | 12 | 9,526 | 2.1 | 3,127 | 18 | 16,623 | 18 |
| 21-30 | 8 | 1,283 | 0.4 | 2,932 | 07 | 960 | 0.6 | 5,175 | 0.5 |
| 31 and over | 9 | 695 | 0.2 | 164 | - | 630 | 0.4 | 1,489 | 02 |
| Total |  | 329,033 | 100.0 | 443, 082 | 1000 | 170,541 | 100.0 | 942,656 1 | 1000 |

(d) By Distance Excluding Corn Belt and Tracts over 500 Acres

| 1-2 | 1 | 72,515 | 27.7 | 46,870 | 179 | 25,116 | 180 | 144,501 | 21.8 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3-4 | 2 | 69,653 | 26.6 | 79,941 | 30.6 | 30,687 | 22.1 | 180, 281 | 27.2 |
| 5-6 | 3 | 55,638 | 21.3 | 52, 261 | 200 | 25, 758 | 18.5 | 133, 657 | 20.2 |
| 7-8 | 4 | 22,960 | 88 | 38,311 | 14.7 | 17,628 | 127 | 78, 899 | 119 |
| 9-10 | 5 | 15,156 | 58 | 21,829 | 8.4 | 15, 065 | 108 | 52, 050 | 79 |
| 11-15 | 6 | 19,907 | 76 | 12, 084 | 46 | 20, 182 | 145 | 52, 173 | 7.9 |
| 16-20 | 7 | 3,577 | 14 | 6,963 | 2.7 | 3,127 | 2.2 | 13,667 | 21 |
| 21-30 | 8 | 1,283 | 0.5 | 2,932 | 11 | 960 | 07 | 5, 175 | 08 |
| 31 and over | 9 | 695 | 0.3 | 164 | - | 630 | 05 | 1,489 | 02 |
| Total |  | 261,384 | 100.0 | 261,355 | 100.0 | 139, 153 | 1000 | 661,892 | 00.0 |

[^0]was about the same as that on dirt roads but price per acre on hard-surfaced roads was twice that on gravel or dirt roads.

Table 11 probably represents a better means of comparison between price per acre by type of road than would have been possible by use of averages, because the median is less influenced by extreme items and, therefore, is more stable. Further, it would seem particularly appropriate to use the median instead of the mean in attempting to delineate the differences in price per acre by type of road inasmuch as the frequency distributions appear to cluster to the left with respect to distance, price per acre, and size of tract. For those interested in modal values, these could readily be computed where appropriate from Tables 8, 9, and 10.

TABLE 5
PRICE PER ACRE BY DISTANCE BY NUMBER OF ACRES SOLD ${ }^{1,2}$

| Price per Acre (\$) | Acres Sold |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1-2 Mi | $3-4 \mathrm{Mi}$ | $5-6 \mathrm{Mi}$ | $7-8 \mathrm{Mi}$ | $9-10 \mathrm{Mi}$ | 11-15 Mi | 16-20 Mi | 21-30 Mi | Over 30 Mi | Total | $\begin{aligned} & \text { Corn } \\ & \text { Belt } \\ & \hline \end{aligned}$ | Total E Corn |
| (a) Dirt Roads |  |  |  |  |  |  |  |  |  |  |  |  |
| 0-25 | - ${ }^{-}$ | - | 400 |  | 60 | (3,040) 51, - |  |  |  |  |  |  |
| 25-50 | 3,855 | 1,225 | 19,891 | 6, 859 | 15,738 | $(3,040) 51,076$ | 16,642 | 10,460 16,880 | 67,528 630 | 92,448 132,796 | 3, 040 | 92,4 129,7 |
| 50-75 | 3,272 | 8,223 | (7, 589) $\begin{array}{r}6,331\end{array}$ | 8,122 | 8,733 | 1,291 | 9,070 | 1,755 | 960 | 47,757 | 3, 040 | 129,7 47,7 |
| $75-100$ $100-125$ | 9,523 | (7, 747) 11, 1028 | $(7,589) 13,277$ | 5,621 | $(2,760) 3,958$ | 9,455 | , | 1,755 | - | 53,562 | 10,349 | 47,7 43,2 |
| $100-125$ $125-150$ | (2,636) $\begin{array}{r}2,521\end{array}$ | $(7,747) 10,779$ | 6,680 | $(3,720) 4,918$ | 120 | 63 | - | - | - | 25,081 | 11, 467 | 43,2 13,6 |
| $125-150$ $150-175$ | $(2,636)$ 6,006 1,862 | 4,987 | 2,626 |  | 260 | 720 | 820 | - | - | 15, 419 | 2,636 | 12, |
| $150-175$ $175-200$ | 1,862 140 | 1,638 | - |  |  | - | - | - | - | 3,500 | 2,63 | 3,5 |
| 200-225 | 140 | - | - | - | 1, 784 | - | - | - | - | 1,924 | - | 1,9 |
| 225-250 | (1,343) | - | 1,414 | - | 120 | 152 | - | - | - | 120 1,566 | - |  |
| 250-275 | $(1,343)$ | 306 | (1, - | 1,545 |  | 152 | - | -- | - | 1,566 3,194 | 1,343 | 1,5 1,8 |
| $275-300$ $300-325$ | - | - | $(1,109)$ |  | - | - | - | - | - | 1,109 | 1,109 | , |
| 325-350 | 573 | - | 19 | - | - | - | - | 5 | - | 19 | 1,109 |  |
| 350-375 | - | - | - | 200 |  | - | - | - | - | 573 | - |  |
| 375-400 | - | - | - | 200 | - | - | - | - | - | 200 | - |  |
| 400-425 | - | (1, - - | - | - | (400) | - | - | - | - | 400 | ${ }_{400}{ }^{-}$ |  |
| 425-450 | - | $(1,044)$ | - | - | - | - | - | - | - | 400 1,044 | 400 1,044 |  |
| $450-475$ $475-500$ | - | - | - | - | - | - | - | - | - | 1,044 | 1,044 |  |
| Over 500 |  | 248 | $8{ }^{-}$ | - |  | - | - | - | - | - | - |  |
| Total | 29, 095 | 40, 178 | 51,827 | 35, 265 | 31, 173 | 63,195 |  | 29, 095 | - | $\frac{766}{381.478}$ |  |  |
| Corn belt | 3,979 | 8,791 | 8,698 | 3, 3,720 | 31,173 3,160 | 63,195 3,040 | 32,532 | 29, 095 | 69, 118 | 381, 478 | 31,388 |  |
| Total excl. Corn belt | 25,116 | 31,387 | 43,129 | 31,545 | 28, 013 | 60,155 | 32,532 | 29,095 | 69,118 |  |  |  |

(b) Gravel Roads

|  |  | - | 891 |  |  |  | 62,997 | $(1,020) 3,080$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $25-50$ $50-75$ | 12,602 | 1 | 29,153 | 8,105 | 8,280 | 36,875 | 1,261 | $(1,020) 3,830$ 9,832 | 22,150 64 | 139,18 106,172 | 1,020 | 138,0 106,1 |
| 50-75 | 2, 672 | 31, 751 | 7,167 | 12,280 | 13, 622 | $(8,642) 30,149$ | 2,615 | 810 | - | 98,394 | 8,642 | 106,1 89,7 |
| 100-125 | 2,672 14,837 | 13, 823 | 19, 134 | 5,495 | 1, 701 | 850 | $(2,563) 5,490$ | 370 | 100 | 49,635 | 2, 563 | 47, 0 |
| 125-150 | 14,837 | 14,650 18,214 | 21,424 | 5,609 | 363 | 552 | - | 50 | - | 57,485 | - | 57,4 |
| 150-175 | 10, 701 | 1,268 | 1,185 | 6,648 $(16,639)$ | 8,630 $(10,919)$ | 848 3,042 | 160 | - | - | 36,279 | - ${ }^{-}$ | 36, 2 |
| 175-200 | $(25,872) 26,683$ | $(40,924)$ | $(35,398) 36,093$ |  | (10, 40 | 3,042 | - | - | - | 42,569 | 27,638 | 14,9 |
| 200-225 | (25,872) 26,683 | $(10,324)$ | (35, 398) 36,093 | - | 40 | - |  | 110 | - | 103,850 | 102, 194 | 1,6 |
| 225-250 | 4,121 | - | $(10,173) 11,293$ | $(4,236)$ | (665) | 500 |  | - | - |  | 15,074 |  |
| 250-275 | - | - | (10,173) 11,203 | $(4,236)$ | (665) | 500 | - | - | - | 20,815 | 15,074 | 5,7 |
| 275-300 | 372 | $(18,333)$ | - |  | - | - |  | - | - |  | 18,333 |  |
| 300-325 | (7, 283) 7, | - | - | - | - | - | - | - | - | 18, 705 | 18,333 |  |
| 325-350 | $(7,283) 7,373$ | - | - | - | - | 485 | - | - | - | 7,858 | 7,283 |  |
| $350-375$ $375-400$ | - | - | 645 | - | - | - | - | - | - | , 645 | 7, 283 |  |
| $375-400$ $400-425$ | - | 40 | - | 160 | - | - | - | - | - | 200 | - |  |
| 425-450 | - | - | - | - | - | - | - | - | - | - | - |  |
| 450-475 | - | - | - | - | - | - | - | - |  | - | - |  |
| 475-500 | - | - | - | - | - | - | - | - | - | - | - |  |
| Over 500 | 70 | 195 | - | 14 |  | $3 \bar{\square}$ | - | - | - | 312 | - |  |
| Total | 80, 025 | 139,198 | 126,985 | 59,186 | 44,220 | 73, 334 |  |  |  |  |  |  |
| Corn belt | 33, 155 | 59,257 | 45,571 | 20,875 | 11,584 | 8,722 | 2,563 | 14,252 1,020 | 72,314 | 682, 037 | 182, 747 |  |
| Total excl. Corn belt | 46,870 | 79,941 | 81, 414 | 38,311 | 32,636 | 64,612 | 2,563 69,960 | 1,020 13,232 | 72,314 | - | 182, 747 |  |

c) Hard-Surfaced Roads

| $0-25$ $25-50$ |  |  |  |  | 5, - | 27,800 | - | 29,536 | 25,750 | 83,086 | -- | 83,08 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $25-50$ $50-75$ | $(5,502) 18,388$ | - | - | 27,920 | 25,960 | 1,762 | 18,247 | - | 8,515 | 100, 792 | 5,502 | 83,08 95,29 |
| $50-75$ $75-100$ | 2,079 6,246 | 20,237 | 8,918 | 14, 180 | 14,437 | 347 | 4,733 | 5,970 | 8,515 | 50,664 | 5,502 | 95,29 50,66 |
| 100-125 | - 20,776 | 20,237 24,656 | 10,261 1,918 | 774 4,029 | 1,981 | 13, 165 | 1,430 | 6,277 | - | 60,371 | - | 60, 37 |
| 125-150 | 20,76 | 7,796 | 8,793 | $(2,440) \begin{array}{r}4,029 \\ 9,927\end{array}$ | 4,356 1,276 | 290 $(200)$ 661 | 116 | - | - | 56, 141 | - | 56,14 |
| 150-175 | 17,215 | 8,196 | 15,366 | $(2,440) 3,327$ | 5,601 | (200) 661 | (294) 1, 183 | 238 | - | 28,453 | 2,640 | 25, 81 |
| 175-200 | 9, 072 | 8,953 |  | 570 | 5,905 | $(1,451) 2,05$ | (294) 1, 183 | 238 | - | 47, 799 | 294 | 47,50 |
| 200-225 | $(12,079) 22,079$ | $(11,315) 14,406$ | $(7,260) 7,640$ | 570 | (540) 616 | $(1,451) 2,056$ | 364 | - | - | 21,920 | 1,451 | 20,46 |
| 225-250 | (12,073) 22,079 | (11,315) 302 | $(7,260) 7,640$ | 160 | (540) 616 | - | - | - | - | 44, 741 | 31, 194 | 13, 54 |
| 250-275 | 814 | 2, 502 | 1,419 | 3,297 |  | 4,869 | - | - | - | 462 | - |  |
| 275-300 | 818 | 5,275 | 1,410 | $(2,905)$ |  | 4,869 | - | - | - | 12,901 | - | 12,90 |
| 300-325 | - |  | 744 | (2,905) | (1, $02 \overline{8})$ |  |  | - | - | 8,998 | 2,905 | 6, 09 |
| 325-350 | - | - | $(6,645)$ | 855 | (1, 028 ) | - | (99) | - | - | 1,871 | 1,127 | 74 |
| 350-375 | 256 | $(10,422)$ |  | 85 | 130 | - | 118 | - | - | 7,618 | 6,645 | 97 |
| 375-400 | $(10,971)$ | (10, 422) |  | 83 | 130 | - | - | - | (560) | 11,451 | 10,422 | 1,02 |
| 400-425 | (10, | - |  | - | 711 | - | - | - | - | 19,521 | 10,971 | 8,55 |
| 425-450 | - | 8,650 | - | - | - | - | - | - | - | - | - |  |
| 450-475 | - | , |  | - | - | - | - | - |  | 8,650 | - | 8,65 |
| 475-500 | - | - | - | - | - | - | - | - |  | - | - |  |
| Over 500 | 5,239 | 232 | - | - |  |  | - | - | - | 5,471 | - |  |
| Total | 113,953 | 111,627 | 69,543 | 64,700 | 57, 001 |  |  |  |  | 570,910 | - |  |
| Corn belt | 28,552 | 21, 737 | 13,905 | 5,345 | 1,568 | 50,950 | 26,290 | 42, 021 | 34, 825 | 570, 910 | - |  |
| Total excl. |  |  |  | 5,345 | 1,568 | 1,651 | 393 | - | - | - | 73,151 |  |
| Corn belt | 85,401 | 89,890 | 55,638 | 59,355 | 55,433 | 49,299 | 25,897 | 42,021 | 34,825 | - |  | 497, 75 |

${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10).
${ }^{2}$ Figures in parenthesis are acres in Corn Belt.

TABLE G
PRICE PER ACRE BY DISTANCE by NUMBER OF ACRES SOLD EXCLUDING SALES OVER 500 ACRES 1,2

| per Sold | 1-2 MI | 3-4 Mi | 5-6 Mi | 7-8 Mi | 9-10 Mi | 11-15 Mi | 16.20 Mi | 21-30 Mi | $\text { Over } 30$ MI | $\begin{gathered} \text { Total } \\ \text { Mi } \end{gathered}$ | Corn | Total Ex Corn Bel |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| (a) Dirt Roads |  |  |  |  |  |  |  |  |  |  |  |  |
| 25 | - | - | 400 | 300 | 60 | - | $\cdots$ | - | ${ }^{-}$ | 760 |  | 760 |
| 50 | 3,855 | 1,225 | 2,520 | 642 | 2,700 | (3, 040) 11, 103 | 847 | 960 | 830 | 24,572 | 3,040 | 21,532 |
| 75 | 3,272 | 7,523 | 6,331 | 8, 122 | 8,733 | 1,291 | 1,460 | - | - | 36, 732 |  | 36,732 |
| 100 | 9,523 | 11,728 | (7,589) 13, 277 | 5,621 | $(2,760) 3,958$ | 9,455 | - |  |  | 53,562 | 10,349 | 43, 213 |
| 125 | 2,521 | (7, 747) 10, 779 | 6,680 | $(3,720) 4,918$ | 120 | 83 |  | - |  | 25,081 | 11,467 | 13,614 |
| 150 | $(2,636) 8,006$ | 4,987 | 2,626 | - | 260 | 720 | 820 | - |  | 15,419 | 2,636 | 12,783 |
| 175 | 1,862 | 1,638 |  | - |  | - | - | - |  | 3,500 |  | 3,500 |
| 200 | 140 | - | - | - | 1,784 | - |  | , |  | 1.924 |  | 1,924 120 |
| 225 | - | - |  | - | 120 |  | - | - |  | 1,566 | - | 120 1,566 |
| 250 |  | - | 1,414 |  | - | 152 |  |  |  | 3,194 | 1,343 | 1,566 1,851 |
| 275 | $(1,343)$ | 300 |  | 1,545 | - | - | - | - | : | 1,109 | 1,109 | 1,851 |
| 300 |  | - | $(1,109)$ | - |  |  | - | - | - | 19 |  | 19 |
| 325 350 | - | - | 19 | - | - | - | - | - | - | 573 | - | 573 |
| 330 | 573 | - | - | 200 | - | - | - | - | - | 200 | - | 200 |
| 400 | - | - | - | - | - | - | - | - |  | - |  | - |
| 425 | - | - | - | - | (400) | - |  | - |  | 400 | 400 |  |
| 450 | - | (1,044) | - | - |  | - | - | - |  | 1,044 | 1,044 |  |
| 475 | - | - | $\cdot$ | - |  | - | - | $\square$ | - | - | - |  |
| 500 | - | 248 | 80 | - | - | 438 | - | - | - | 760 | - | 766 |
|  | - |  | - | - | -205 | 22 | , 27 | $\underline{0} 0$ |  | $\overline{170.541}$ | $\overline{31,388}$ | - |
| belt | 29,095 3,979 | 39,478 8,791 | 34,456 8,698 | 21,348 3,720 | 18,225 3,160 | 23,222 3,040 | 3,127 | 960 | 630 | 170,541. | 31,388 | - |
| excl n belt | 25,116 | 30,687 | 25,758 | 17,628 | 15,065 | 20, 182 | 3,127 | 960 | 630 | - | - | 139,153 |
| (b) Gravel Roads |  |  |  |  |  |  |  |  |  |  |  |  |
| 25 | $\cdot$ | - | 891 | - | - - |  | - | 2, 060 | $-$ | 2,95! | $\bullet$ | 2,851 |
| 50 | 12,602 | - ${ }^{-}$ |  | 8, 105 | 360 | (13, ${ }^{3,818}$ | 1,261 | 342 | 64 | 26,552 |  | 26, 552 |
| 75 |  | 31, 751 | 7,167 | 12, 280 | 13,622 | (8.642) 13.640 | 2,615 | 370 | $\stackrel{-}{-}$ | 81,075 | 8, 642 | 72,433 |
| 100 | 2,672 | 13, 823 | 19, 134 | 5,495 | 1,701 | 850 | $(2,563) 5,490$ | 370 | 100 | 49,635 | 2,563 | 47,072 |
| 125 | 14,837 | 14,650 | 21,424 | 5,609 | 363 | 552 | - | 50 | - | 57,485 | - | 57,485 |
| 150 | 594 | 18, 214 | 1,185 | 6,648 | 5,743 | 848 | 160 | - | - | 33,392 | - | 33,392 |
| 175 | 10,701 | 1,268 |  | $(16,639)$ | $(10,919)$ | (80) | - | - | - | 39,607 | 27,638 | 11,969 |
| 200 | $(25,872) 26,683$ | $(40,024)$ | $(35,398) 36,093$ |  | 40 | - | - | 110 | - | 103,850 | 102, 194 | 1,656 |
| 225 |  | - | $(10,173) 11,293$ | $(4,236)$ |  | 500 |  |  | - |  |  |  |
| 250 | 4,121 | - | $(10,173) 11,293$ | $(4,236)$ | (665) | 500 | - |  | - | 20,815 | 15,074 | 5, 741 |
| 275 300 | 372 | $(18,333)$ |  | - |  | - | - | - | - | 18,705 | 18, 333 | 372 |
| 325 |  | (1ヵ, |  | - |  | 5 | - |  | - |  |  |  |
| 350 | (7, 283) 7,373 | - | - | - |  | 485 | - | - | - | 7, 858 | 7,283 | 575 |
| 375 | - |  | 845 | - |  | - | - | - | - | 645 | - | 645 |
| 400 | - | 40 |  | 160 | - | - | - | - | - | 200 | - | 200 |
| 425 | - | - | - | - | - | - | - |  | - | - |  |  |
| 450 | - | - | - | - | - | - | - |  | - | - |  |  |
| 475 | - | - | - | $\square$ | - | - | - |  | - | - |  |  |
| 500 | 70 | 185 | - | 14 | - | 33 | - | - | - | 312 |  | 312 |
|  | 80, 025 | 139, 198 | 97, 832 | 59,186 | $\overline{33,413}$ | 20, 806 | 9,526 | 2, 032 | 164 | 443, 082 |  |  |
| belt | 33, 155 | 59, 257 | 45,571 | 20,875 | 11,584 | 8,722 | 2,563 |  |  |  | 181, 727 |  |
| $\begin{aligned} & \text { excl } \\ & \text { n belt } \end{aligned}$ | 46, 870 | 79,941 | 52,201 | 38,311 | 21,829 | 12,084 | 6,963 | 2,932 | 164 | - | - | 261, 355 |
| (c) Hard-Surfaced Roads |  |  |  |  |  |  |  |  |  |  |  |  |
|  | - | - |  | - | - | $\checkmark$ | - | 136 | - | 136 | - | 136 |
| 50 |  | - |  |  | 120 | 1,762 | 660 |  | 135 | 2,677 | - | 2,677 |
| 75 | 2,079 | - | 8,018 | 5,705 |  | 347 | ${ }^{\circ}$ |  | - | 17, 049 |  | 17,049 |
| 100 | 6,246 | - ${ }^{-}$ | 10,261 | 774 | 1,981 | 11,573 | 1,430 | 909 | - | 33,174 |  | 33,174 |
| 125 | 20, 776 | 24, 656 | 1,918 | 4,029 | 4,358 | 290 | 116 |  |  | 56,141 | ${ }^{-}$ | 56, 141 |
| 150 |  | 7, 796 | 8,793 | $(2,440) 9,927$ | 1,276 | (200) 661 |  | - |  | 28,453 | 2, 640 | 25, 813 |
| -175 | 17,215 | 8, 196 | 15,366 |  | 5,601 |  | (294) 1,183 | 38 |  | 47,799 | 294 | 47,505 |
| 200 | 9, 072 | 8,953 |  | 570 | 905 | (1,451) 2,056 | 364 | - |  | 21,920 | 1,451 | 20,469 |
| 225 | (12.070) 22,079 | (11,315) 14, 406 | $(7,260) 7,040$ | - | (540) 616 |  | - | - | - | 44, 741 | 31, 194 | 13,547 |
| 250 |  | ${ }_{302}$ |  | 160 | - |  | - | - |  | 462 | - | 482 |
| 275 | 814 | 2, 502 | 1,419 | 3,297 | - | 4,869 | - | - | - | 12,901 | ${ }^{-}$ | 12,901 |
| - 300 | 818 | 5,275 |  | $(2,005)$ |  |  | - | - | - | 8,998 | 2,905 | 8,093 |
| 325 |  |  | 744 | - | $(1,028)$ | ) | (99) | - | - | 1.871 | 1.127 | 744 |
| 350 | - |  | $(6,645)$ | 855 | - | - | 118 | - | - | 7.618 | 6,645 | 873 |
| - 375 | 256 | $(10,422)$ |  | 83 | 130 | - | - | - | 560 | 11,451 | 10,422 | 1,029 |
| 400 | $(10,971)$ |  | 7,839 | - | 711 | - | - | - | - | 19,521 | 10,971 | 8,550 |
| -425 |  |  | - |  | - | - | - | - | - | 8,650 | - | 8,650 |
| 450 |  | 8,650 | - | - | - | - | - | - | - | 8,650 |  |  |
| 475 -500 | - |  | - |  |  | - |  | - |  | - |  |  |
| 500 500 | 5,239 | 232 | - |  |  |  | - | - | - | 5,471 | - | 5,471 |
|  | 95,565 | 91,390 | $\overline{69,543}$ | 28,305 | 16, 724 | 2t,558 | 3,970 | 1,283 | 695 | 329, 033 | - |  |
| belt | 23,050 | 21, 737 | 13,905 | 5,345 | 1,568 | 1,651 | 393 |  | - | - | 67,640 |  |
| 1 excl | 72,515 | 69,653 | 55,638 | 22,000 | 15,156 | 19,907 | 3,577 | 1,283 | 695 | - | - | 261,384 |

TABLE 7
SIZE OF TRACT BY DISTANCE BY NUMBER OF SALES ${ }^{i, 2}$

| Size of Tract (acres) | Number of Sales |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1-2 Mi | 3-4 Mi | 5-8 Mi | 7-8 Mi | 9-10 Mi | 11-15 Mi | 16-20 ML | 21-30 Mi | Over 30 | Total Mi | $\begin{aligned} & \text { Corn } \\ & \text { Belt } \end{aligned}$ | Trotal Excl Corn Belt |
| (a) Dirt Roads |  |  |  |  |  |  |  |  |  |  |  |  |
| 0-50 | - | 4 | 4 | - | - | 1 | - | - | - | 9 |  | 9 |
| 50-100 | 11 | 23 | - | 5 | 7 | 9 | - | - | - | 55 | - | ${ }^{9} 5$ |
| 100-150 | (33) 50 | (9) 75 | (8) 56 | 23 | 13 | 8 | 4 | - | - | 229 | 50 | 179 |
| 150-200 | 59 | (39) 95 | 42 | 17 | (16) 24 | 4 | 5 | - | - | 246 | 55 | 191 |
| 200-250 | 24 | 4 | (38) 80 | (18) 43 | 6 | 30 | 4 | - | - | 191 | 54 | 137 |
| 250-300 | - | 12 |  |  | 7 | 36 | - | - | - | 66 | - | 66 |
| 300-350 | 5 | 20 | - | 5 | 27 | (9) 9 | - | - | 2 | 68 | 9 | 59 |
| 350-400 | 14 | , | 5 | - | - |  | - | - | 2 | 10 | - | 19 |
| 400-450 | 9 | - | 5 | - | - | - | 2 | - | - | 16 | - | 16 |
| 450-500 | - | - | - | - | - | - | - | 2 | - | 16 | - | 16 2 |
| Over 500 | - | 1 | 31 | 18 | 20 | 38 | 26 | 19 | 13 | $\begin{array}{r}2 \\ 186 \\ \hline\end{array}$ | - | 168 |
| Total | 172 | 234 | 223 | 122 | 104 | 135 | 41 | 21 | 15 | 1,067 | - |  |
| Corn belt | 33 | 48 | 44 | 18 | 16 | 9 | - | - | - | 1,007 | 168 | - |
| Total excl corn belt | 139 | 186 | 179 | 104 | 88 | 126 | 41 | 21 | 15 | - | 108 | 898 |

(b) Gravel Roads

| 0-50 | 1 | 7 | - | 2 | 1 | 1 | - | 1 |  | 13 |  | 13 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 50-100 | (57) 34 | 4 | 8 | 6 | 11 | (1) 5 | 6 | - | 2 | 76 | 1 | 75 |
| 100-150 | (57) 149 | 118 | (75) 196 | (120) 94 | (5) 10 | 11 | - | 1 | - | 579 | 137 | 442 |
| 150-200 | (172) 215 | (373) 446 | (196) 264 | (126) 167 | (52) 26 | 5 | 3 | , | - | 1,127 | 867 | 260 |
| 200-250 | 24 | 17 | 3 | (129) 29 | (52) 92 | 19 | - | - | - | -184 | 52 | 132 |
| 250-300 | 1 | 61 | 16 |  | - | (33) 36 | 2 | - | - | 116 | 33 | 83 |
| 300-350 | - | 8 | 40 | - | 1 | - | - | 2 | - | 51 | 3 | 51 |
| 350-400 | 0 | 71 | - | 17 | 17 | - | 3 | 2 | - | +114 | - | 51 |
| 400-450 | 30 | 1 | - | 20 | 17 | 4 | (6) 10 | - | - | 114 64 | $\overline{6}$ | 114 |
| 450-500 | - | 6 | 10 | 7 | - | 1 | (\%) | - | - | 64 24 | 6 | 58 24 |
| Over 500 | - | - | 38 | 7 | 17 | 48 | 17 | (1) 13 | 6 | $\begin{array}{r}24 \\ 139 \\ \hline\end{array}$ | 1 | $\begin{array}{r}24 \\ 138 \\ \hline\end{array}$ |
| Total | 460 | 738 | 575 | 342 | 175 | 130 | 41 | 18 | 8 | 2,487 | $\square$ | - |
| Corn belt Total excl | 229 | 373 | 271 | 126 | 57 | 34 | 6 | 1 | - | 2,487 | 1,097 | - |
| corn belt | 231 | 365 | 304 | 216 | 118 | 96 | 35 | 17 | 8 | - | - | 1,390 |


| (c) Hard-Surfaced Roads |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0-50 | 11 | 9 | - | - | 2 | 2 | - | - | - | 24 |  | 24 |
| 50-100 | 28 | 5 | 7 | 10 | 4 | (3) 6 | 1 | 5 | - | 66 | 3 | 24 63 |
| 100-150 | (173) 480 | (76) 278 | (54) 181 | (22) 87 | (5) 18 | 27 | 5 | 3 | 1 | 1,080 | 330 | 750 |
| 150-200 | - | (69) 155 | (43) 96 | (13) 38 | 12 | 15 | 1 | - | $\underline{-}$ | , 317 | 125 | 192 |
| 200-250 | 56 | 42 | 45 | 10 | (5) 53 | (6) 7 | 4 | - | - | 217 | 11 | 206 |
| 250-300 | 24 | 22 | 32 | 11 | - | 10 | (1) 6 | - | 2 | 107 | 1 | 100 |
| 300-350 | - | - | 3 | - | - | 16 | 2 | - | - | 21 | - | 21 |
| 350-400 | - | - | 10 | - | - | 13 | - | - | - | 23 | - | 23 |
| $400-450$ $450-500$ | 29 | 30 | 14 | 8 | - | - | - | - | - | 81 | - | 81 |
| 450-500 |  | - | . | - | - | - | - | - | - | - | - | 1 |
| Over 500 | (5) 16 | 25 | - | 27 | 19 | 7 | 23 | 8 | 6 | 131 | 5 | 126 |
| Total | 644 | 566 | 388 | 191 | 108 | 103 | 42 | 16 | 9 | 2, 067 | - | - |
| Corn belt | 178 | 145 | 97 | 35 | 10 | 9 | 1 | 16 | - | 2,007 | 475 | - |
| Total excl corn belt | 466 | 421 | 291 | 156 | 98 | 94 | 41 | 16 | 9 | - | 45 | 1,592 |

${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10)
${ }^{1}$ Figures in parentheses are acres in Corn Belt
From Table 11, it is clear that the influence of the corn belt on the over-all price differential in this sample between types of road is considerable. For the aggregate of the March 1958 survey sample, median price per acre of rural properties located on hard-surfaced roads exceeds that on gravel roads by 30 percent. But, where the corn belt is excluded, price per acre on hard-surfaced roads exceeds that on gravel roads by 63 percent. Although gravel roads exceed dirt roads by 68 percent when the corn belt is included, price per acre of farm property on gravel roads exceeds dirt roads by only 24 percent when the corn belt is excluded from the computations. These findings are somewhat in line with those relating to tracts that average over 500 acres.

Thus, computations were made of price per acre excluding sales of tracts the averages of which were over 500 acres. In this series, the relative prices of farm real estate located on different types of roads become more stable and consistent. Price per acre of farm real estate located on hard-surfaced roads over price per acre of farm real estate located on gravel roads for the United States as of the March 1958 sample excluding large tracts of land was 28 percent as compared with 30 percent including large tracts (Table 11 and Fig. 2). But, when the corn belt is omitted, the result increases to 60 percent hard-surfaced roads over gravel roads, and farm

TABLE 8
price per acre and size of tract by miles from nearest trading center, dirt roads

| Price or Size | Miles from Nearest Trading Center |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-15 | 16-20 | 21-30 | Over 30 | Avg |
| Average price per acre (\$) Average slze of tract (acres) | 109 195 | 110 168 | 80 241 | 68 282 | $\begin{array}{r} 66 \\ 301 \end{array}$ | $\begin{array}{r} 50 \\ 491 \end{array}$ | $\begin{array}{r} 42 \\ 794 \end{array}$ | $\begin{array}{r} 30 \\ 1,385 \end{array}$ | $\begin{array}{r} 11 \\ 4,609 \end{array}$ | $\begin{array}{r} 60 \\ 361 \end{array}$ |
| Median price per acre (\$) Median size of tract (acres) | 94 171 | 98 158 | 72 206 | 59 210 | 50 264 | $\begin{array}{r} 40 \\ 272 \end{array}$ | $\begin{array}{r} 40 \\ 537 \end{array}$ | $\begin{array}{r} 31 \\ 1,181 \end{array}$ | $\begin{array}{r} 9 \\ 2,689 \end{array}$ | $\begin{array}{r} 44 \\ 199 \end{array}$ |
| Average price per acre excluding cors belt (\$) | 98 | 98 | 73 | 62 | 59 | 51 | 42 | 30 | 11 | 54 |
| Average size of tract excluding corn belt (acres) | 211 | 168 | 250 | 292 | 324 | 503 | 794 | 1,985 | 4,609 | 394 |
| Median price per acre excluding corn belt (\$) | 89 | 88 | 55 | 53 | 47 | 40 | 40 | 31 | 9 | 41 |
| Median size of tract excluding corn belt (acres) | 185 | 150 | 195 | . 214 | 306 | 265 | 537 | 1,181 | 2,689 | 206 |
| Average price per acre excluding sales over 500 acres ( $\$$ ) | 109 | 116 | 105 | 68 | 68 | 73 | 42 | 30 | 39 | 99 |
| Average slze of tract excluding gales over 500 acres (acres) | 185 | 165 | 190 | 198 | 219 | 227 | 208 | 475 | 325 | 193 |
| Median price per acre excluding sales over 500 acres (\$) | 94 | 98 | 90 | 82 | 68 | 60 | 62 | 38 | 39 | 87 |
| Median alze of tract excluding sales over 500 acres (acres) | 171 | 158 | 193 | 208 | 196 | 244 | 185 | 475 | 325 | 182 |
| Average price per acre encluding corn belt and sales over 500 acres ( $\$$ ) | 98 | 105 | 98 | 93 | 77 | 78 | 42 | 38 | 39 | 93 |
| Average size of tract excluding corn belt and sales over 500 acres (acres) | 211 | 165 | 185 | 172 | 229 | 218 | 208 | 475 | 325 | 195 |
| Median price per acre excluding corn belt and sales over 500 acres (\$) | B9 | 89 | 82 | 74 | 63 | 77 | 62 | 38 | 39 | 81 |
| Median size of tract excluding corn belt and sales over 500 acres (acres) | 185 | 150 | 176 | 194 | 250 | 237 | 185 | 475 | 325 | 182 |

${ }^{1}$ adapted from $t$ abulations complled fron March 2958 survey for (10)

TABLE 9
PRICE PER ACRE AND SIZE OF TRACT BY MILES FROM NEAREST TRADNG CENTER, GRAVEL ROADS

| Price or Size | Miles from Nearest Trading Center |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-15 | 16-20 | 21-30 | Over 30 | Avg |
| Average price per acre (\$) | 183 | 148 | 122 | 116 | 99 | 59 | 21 | 36 | 13 | 99 |
| Average size of tract (acres) | 173 | 198 | 214 | 194 | 256 | 550 | 1,818 | 683 | 9,038 | 278 |
| Median price per acre (\$) | 172 | 138 | 108 | 117 | 78 | 50 | 14 | 35 | 13 | 74 |
| Median size of tract (acres) | 161 | 177 | 166 | 171 | 222 | 283 | 432 | 559 | 2,632 | 174 |
| Average price per acre excluding corn belt (\$) | 118 | 97 | 79 | 83 | 75 | 58 | 18 | 38 | 13 | 64 |
| Average size of tract excluding corn belt (acres) | 183 | 221 | 262 | 204 | 276 | 650 | 2,056 | 683 | 9,038 | 351 |
| Median price per acre excluding corn belt (\$) | 114 | 90 | 80 | 73 | 65 | 47 | 14 | 35 | 13 | 51 |
| Median size of tract excluding corn belt (acres) | 144 | 187 | 167 | 157 | 245 | 500 | 444 | 533 | 2,632 | 182 |
| Average price per acre excluding sales over 500 acres (\$) | 163 | 148 | 147 | 116 | 113 | 75 | 75 | 33 | 68 | 138 |
| Average size of tract excluding sales over 500 acres (acres) | 173 | 198 | 175 | 194 | 216 | 232 | 288 | 195 | 75 | 190 |
| Median price per acre excluding sales over 500 acres (\$) | 172 | 138 | 131 | 117 | 128 | 62 | 79 | 18 | 80 | 128 |
| Median size of tract excluding sales over 500 acres (acres) | 161 | 177 | 162 | 171 | 217 | 250 | 367 | 175 | 75 | 172 |
| Average price per acre excluding corn belt and sales over 500 acres (\$) | 118 | 97 | 88 | 83 | 85 | 83 | 75 | 33 | 68 | 97 |
| Average size of tract excluding corn belt and sales over 500 acres (acres) | 183 | 221 | 190 | 204 | 215 | 205 | 242 | 195 | 75 | 198 |
| Median price per acre excluding corn belt and sales over 500 acres (\$) | 119 | 90 | 82 | 73 | 69 | 54 | 71 | 18 | 80 | 90 |
| Median size of tract excluding corn belt and sales over 500 acres (acres) | 144 | 187 | 153 | 157 | 209 | 208 | 200 | 175 | 75 | 168 |

'Adepted fron tabulations cospiled fron Karch 1958 survey for (i0)

TABLE 10
PRICE PER ACRE AND SIZE OF TRACT BY MILES FROM NEAREST TRADING CENTER, HARD-SURFACED ROADS ${ }^{1}$

| Price or Size | Miles from Nearest Trading Center |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-15 | 16-20 | 21-30 | Over 30 | Avg. |
| Average price per acre (\$) | 185 | 194 | 185 | 92 | 80 | 66 | 55 | 32 | $19^{2}$ | 128 |
| Average size of tract (acres) | 174 | 196 | 179 | 332 | 527 | 488 | 1,328 | 862 | 3,678 | 274 |
| Medıan price per acre (\$) | 164 | 160 | 158 | 58 | 54 | 23 | 43 | 18 | $17^{2}$ | 96 |
| Median size of tract (acres) | 134 | 148 | 153 | 149 | 217 | 211 | 454 | 150 | 1,264 | 144 |
| Average price per acre excluding corn belt (\$) | 165 | 173 | 164 | 81 | 75 | 62 | 53 | 32 | $19^{2}$ | 109 |
| Average size of tract excluding corn belt (acres) | 183 | 212 | 190 | 374 | 563 | 518 | 1,354 | 862 | 3,678 | 311 |
| Median price per acre excluding corn belt (\$) | 151 | 125 | 144 | 53 | 53 | 22 | 43 | 18 | $17^{2}$ | 83 |
| Median size of tract excluding corn belt (acres) | 132 | 149 | 161 | 156 | 219 | 200 | 244 | 150 | 1,264 | 83 147 |
| Average price per acre excluding sales over 500 acres (\$) | 181 | 216 | 185 | 156 | 161 | 134 | 124 | 94 | $50^{2}$ | 185 |
| Average size of tract excluding sales over 500 acres (acres) | 150 | 168 | 179 | 164 | 187 | 218 | 214 | 94 | 225 | 167 |
| Median price per acre excluding sales over 500 acres (\$) | 179 | 189 | 158 | 134 | 153 | 94 | 98 | 89 | $50^{2}$ | 164 |
| Median size of tract excluding sales over 500 acres (acres) | 129 | 146 | 153 | 141 | 208 | 193 | 231 | 90 | 262 | 141 |
| Average price per acre excluding corn belt and sales over 500 acres (\$) | 145 | 195 | 164 | 141 | 149 | 130 | 116 | 94 | $50^{2}$ | 161 |
| Average size of tract excluding corn belt and sales over 500 acres (acres) | 159 | 175 | 190 | 170 | 188 | 222 | 211 | 94 | 225 | 176 |
| Median price per acre excluding corn belt and sales over 500 acres (\$) | 160 | 157 | 144 | 127 | 147 | 84 | 80 | 76 | $50^{2}$ | 144 |
| Median size of tract excluding corn belt and sales over 500 acres (acres) | 131 | 146 | 161 | 142 | 209 | 188 | 225 | 90 | 262 | 143 |

${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10).
${ }^{2}$ Two sales omitted in code 19-9, Califormia specialty, at $\$ 351$ per acre.
property on gravel roads is worth on the average only 11 percent more than on dirt roads. Except for sales of properties within 2 ml of the nearest trading center, there is little significant difference between the median price of farm properties located on gravel roads as compared with dirt roads (Fig. 3). It would appear in this last analysis that the point of importance hes not in the fact that farm land along hard-surfaced roads is worth so much more than on gravel roads but that, exclusive of the corn belt and size of parcels over 500 acres, property located on gravel roads is hardly worth more than on dirt roads when subjected to this type of analysis.

The factors that increase the price per acre of farm real estate located on dirt roads when large tracts and corn belts are excluded are (a) that 87 percent of all farm acreage of large tracts lies beyond 15 ml from the nearest trading center, and (b) that sales of farm properties in the corn belt were of small tracts and none were located 10 mi from the nearest trading center. Thus, the inclusion of substantial amounts of land on gravel roads and small quantities of land on dirt roads in the corn belt in the sample studied tends to obscure the true differential between price per acre of properties by the two types of road. In Table 12, this deficiency has been adjusted by the use of an index weighting system.

The percentage distribution of land that was sold along hard-surfaced roads was chosen as constant weights to compare prices by distance for different types of road surface because the acreage located on both dirt and gravel roads tended to be bimodal (Table 4). For total acres sold, average price per acre using constant weights was $\$ 17$ per acre greater for dirt than using "own" weights and $\$ 10$ an acre greater for gravel. For total acres sold, excluding corn belt, the dufferentials were $\$ 14$ for dirt and $\$ 12$ for gravel. But, when constant weights were used, the price differentials between dirt and gravel roads were negligible.

From these considerations, it would appear that analysis of the sample can be divided into three parts: (a) price differentials between farm properties for average size of tracts over 500 acres; (b) price differentials between farm properties for average size of tract of 500 acres or less; and (c) price differentials between farm properties for average size of tract of 500 acres or less excluding the corn belt.

TABLE 11
COMPARISON OF MEDIAN PRICES PER ACRE OF RURAL PROPERTIES AND RATIOS BY TYPE OF ROAD SURFACE AND BY DISTANCE FROM NEAREST TRADING CENTER ${ }^{1}$

| Price or Ratio | Miles from Nearest Trading Center |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  | Over | AII |
|  | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-15 | 16-20 | 21-30 | 30 | Distances |
| Price per acre, total (\$). |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced | 164 | 160 | 158 | 58 | 54 | 23 | 43 | 18 | $17^{9}$ | 96 |
| Gravel | 172 | 138 | 108 | 117 | 78 | 50 | 14 | 35 | 13 | 74 |
| Dirt | 94 | 98 | 72 | 59 | 50 | 40 | 40 | 31 | 9 | 44 |
| Ratio of total price per acre. |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced to gravel | 0.953 | 1.159 | 1.463 | 0.496 | 0.682 | 0.460 | 3.071 | 0.514 | 1.308 | 1.297 |
| Hard-surfaced to dirt | 1745 | 1633 | 2.194 | 0.983 | 1.080 | 0.575 | 1.075 | 0.581 | 1.889 | 2.182 |
| Gravel to dirt | 1.830 | 1.408 | 1.500 | 1983 | 1.560 | 1250 | 0350 | 1.129 | 1444 | 1.682 |
| Price per acre excluding corn belt (\$). |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced | 151 | 125 | 144 | 53 | 53 | 22 | 43 | 18 | $17^{2}$ | 83 |
| Gravel | 114 | 90 | 80 | 73 | 65 | 47 | 14 | 35 | 13 | 51 |
| Dirt | 89 | 88 | 55 | 53 | 47 | 40 | 40 | 31 | 9 | 41 |
| Ratio-of price per acre excluding corn belt. |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced to gravel | 1.349 | 1.389 | 1.800 | 0.726 | 0815 | 0.468 | 3071 | 0.514 | 1.308 | 1.627 |
| Hard-surfaced to dirt | 1697 | 1.420 | 2.618 | 1.000 | 1.128 | 0.550 | 1.075 | 0.581 | 1.889 | 2.024 |
| Gravel to dirt | 1.281 | 1023 | 1.455 | 1.377 | 1.383 | 1.175 | 0350 | 1.129 | 1.444 | 1.244 |
| Price per acre excluding sales of tracts over 500 acres (\$): |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced | 179 | 189 | 158 | 134 | 153 | 94 | 98 | 89 | $50^{2}$ | 164 |
| Gravel | 172 | 138 | 131 | 117 | 128 | 62 | 79 | 18 | 80 | 128 |
| Dirt | 94 | 98 | 90 | 82 | 68 | 60 | 62 | 38 | 39 | 87 |
| Ratio of price per acre excluding sales of tracts over 500 acres. |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced to gravel | 1.041 | 1.370 | 1.206 | 1.145 | 1.195 | 1.516 | 1.241 | 4.944 | 0.625 | 1.281 |
| Hard-surfaced to dirt | 1.904 | 1.929 | 1.756 | 1.634 | 2.250 | 1567 | 1.581 | 2.342 | 1.282 | 1.885 |
| Gravel to dirt | 1.830 | 1.408 | 1.456 | 1.427 | 1.882 | 1.033 | 1.274 | 0.474 | 2.051 | 1.471 |
| Price per acre excluding corn belt and sales of tracts over 500 acres (\$): |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced | 160 | 157 | 144 | 127 | 147 | 84 | 80 | 76 | $50^{2}$ | 144 |
| Gravel | 119 | 90 | 82 | 73 | 69 | 54 | 71 | 18 | 80 | 90 |
| Dirt | 89 | 89 | 82 | 74 | 63 | 77 | 62 | 38 | 39 | 81 |
| Ratio of price per acre excluding corn belt and sales of tracts over 500 acres. |  |  |  |  |  |  |  |  |  |  |
| Hard-surfaced to gravel | 1.345 | 1.744 | 1.756 | 1.740 | 2.130 | 1.556 | 1.127 | 4.222 | 0.625 | 1.600 |
| Hard-surfaced to dirt | 1.798 | 1.764 | 1.756 | 1716 | 2.333 | 1.091 | 1.290 | 2.000 | 1.282 | 1.778 |
| Gravel to dirt | 1.337 | 1.011 | 1.000 | 0.986 | 1.095 | 0.701 | 1.145 | 0.474 | 2.051 | 1.111 |

[^1]

Figure 2. Median price per acre of farm real estate by type of road surface, by distance in miles from nearest trading center excluding sales of tracts over 500 acres.


Figure 3. Medzan price per acre of farm real estate by type of road surface, by distance in mıles from nearest trading center excluding corn belt and sales of tracts over 500 acres.

TABLE 12
COMPARISON OF AVERAGE PRICE PER ACRE USING CONSTANT WEIGHTS WITH AVERAGE PRICE PER ACRE USING OWN WEIGHTS AND RATIOS OBTAINED FROM THE MEANS AND MEDIANS ${ }^{1}$

${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10).

From (a) and (c) the price differential of farm real estate located on gravel roads is not more than 11 percent above that on dirt roads, and the price per acre of farms located on hard-surfaced roads is not less than 60 percent more than land located on gravel roads on the average for all distances. From (b) it can be concluded that the weight of the corn belt raises the differential between price per acre of properties located on gravel roads over dirt roads by at least 35 percent and reduces the differential between price per acre of properties located on hard-surfaced roads over gravel roads by 32 percent.

## Correlation Analysis of Rural Land Values in the United States

There are many theoretical difficulties involved in correlation analysis. However, the most that can be expected in this type of analysis is to reproduce the data in the dependent variable. The extent to which this can be accomplished, so far as land values are concerned, depends on the degree of linearity that can be found between land values as the dependent variable and some other relationship as the independent variable. For example, if price per acre is a monotonic decreasing function of size of tract, high coefficients of correlation cannot be obtained by linear regression analysis. Regarding nonlinear forms, variables that are averages being derived from totals are almost never linear. Sometimes the problem of nonlinearity can be overcome by correlating the totals instead of the averages.

Totals were used by the authors in correlating land values with acres sold, distance, and number of sales in the U.S. Department of Agriculture sample. These variables then provide prices per acre, size of tract, and price per farm on distance from the nearest trading center by type of road surface.

Determination of the price of land is not unlike any other kind of economic good. Hence, total value of sales correlated with total number of acres sold should explain a major percentage of total variance of land values. Average size of tract can be computed from the regression of the number of acres sold on number of sales by distance. Average price per farm can be computed from the regression of value of sales on number of sales. Whatever other variables are brought into the analysis (such as distance from nearest trading center) would depend on how much precision is desired in explaining the remainder of total variance.

If total sales value and total acres sold by distance yield high coefficients, these other variables, although statıstically significant, may in fact add little to the
explanation of total variance yet unexplaned. In any case, the supply and demand for land for specific uses will dominate the price that land will obtain. Whatever other factors are brought in will be subsidiary to this premise.

To say that the price of land is determined by the supply and demand for specific uses is, of course, conditioned by a multitude of parameters such as population, level of income, and tastes of the consumer, all of which leave the researcher almost completely unarmed when it comes to stating what the exact price per acre of a specific plot of land will be through mathematical or statistical means.

If land value can be largely explained for the mass of data, then it is up to the individual to explain specific cases of deviation from the "normal" trend. It seems clear that unusual factors which apply to individual cases would add inttle to the knowledge of circumstances that govern the general pattern. It cannot be expected that a simplufied model within the realm of reasonable human comprehension could reproduce the exact value of any given piece of property.

What can be done is to set up some gude hnes of relationships that will approximate the general case, the general case being established as the norm of a set of specific cases. Judgment based on these general conclusions may give as good an approximation of the true value of a specific item as can be obtained by a mathematical or statistical model sufficiently simple to be understood without great effort.

The correlation analysis presented here could best be applied to local farming areas. If, however, a schema could be devised that would apply to most of the farming areas of the United States combined, this would be ample evidence that the same schema would apply with much more gratufying results to individual areas.


Figure 4. Correlation scattergram of number of acres sold by number of sales of farm real estate located on dirt roads.


Figure 5. Correlation scattergram of total sales value by number of sales of farm real estate located on dirt roads.


NUMBER OF ACRES SOLD $\left(X_{3}\right)$
Figure 6. Correlation scattergram of total sales value by number of acres sold of farm real estate on dirt roads.

Correlation scattergrams were plotted by type of road for acres sold by number of sales, total sales by number of sales, and total sales by acres sold. The general nature of the scattergrams is shown in Figures 4, 5, and 6 for farm real estate located on dirt roads. No attempt was made to include identical items for the types of roads, so that lines of regression will not necessarily indicate comparable price per acre. The basis for inclusion or exclusion of certain areas and items within areas was whether certain types of farming areas were distinct and apart from the main body of the data. Areas omitted such as northern and southern range livestock produced excellent correlation scattergrams but belonged to a different universe.

For that reason, area 8, spring wheat, with 91 sales representing 70, 705 acres; and areas 15 and 16 , northern and southern range livestock, with 136 sales representing 159,435 acres, were omitted from the calculations on farm properties located on dirt roads. The eastern corn belt dirt roads seemed considerably out of line with other data
presented and would have exerted mordinate influence on the regression equations computed by the least squares criterion. Also, 29 sales in area 6, eastern corn belt, representing 3,896 acres, were omitted because prices were so far out of line with those located on gravel and hard-surfaced roads as to make the data appear doubtful.

In all, computations on dirt roads included sales amounting to \$11,575,102 for 13,497 acres, covering some 711 sales of parcels of real estate.

As for gravel roads, two items in area 5, general farming area, from 9 to 15 ml from the nearest trading center were excluded. All of the corn belt was included. Areas 8 , spring wheat, and 15 , northern range livestock, were excluded. An item of eight sales, involving 22,320 acres, was excluded from area 16 , southern range livestock. And an item in area 18, northwest dairy, involving one sale of 40,000 acres, was excluded.

In all, correlation analysis of farm real estate on gravel roads involved some $\$ 55,894,277$ in sales, 366,203 acres, covering some 2,095 parcels.

Correlation analysis of farm real estate on hard-surfaced roads excluded all parcels located on roads of three or more lanes. The reason for this is simply that there were less than 100 sales recorded. In addition, sales in the eastern corn belt through 6 mi from the nearest trading center, along with sales through 4 mi in the western corn belt, were omitted. Areas 8, 15, and 16 were also omitted. These areas were mentioned previously.

For hard-surfaced roads, the correlation analysis covered some $\$ 30,239,898$ in total sales, 194, 434 acres, and 1, 241 parcels of land.

The estimates for three types of roads covered by correlation analysis involved some $\$ 97,709,277$ in sales, 691,134 acres, and 4,047 parcels of land.

Regression equations computed for the total may not be applicable to each individual type of farming area for the same reason that the "normal trend" may not be taken to represent a single specific case. Correlation coefficients were first computed for all land with excellent results. But the omissions were made primarily to make the lines of regression pass as near through the origin as possible to take into account a larger number of smaller parcels. A few negative values appeared with these omissions. The acreage involved in sales of smaller land parcels of 100 acres or less was only about 1 percent of total.

An objection might be raised to use of totals instead of averages on the grounds that larger values will dominate the scattergrams and will therefore produce high coefficients for this reason alone. However, because the larger values were in line with the smaller values, this objection does not apply here.

For property located along each type of road, correlation coefficients of zero order were computed for dollar sales, $\mathrm{X}_{1}$; distance to nearest trading center, $\mathrm{X}_{2}$; total acres sold, $X_{3}$; and number of sales, $X_{4}$. These coefficients were arranged in a matrix and were solved by elıminatıng the leading element of each column by division and subtraction to obtain the $\beta$ coefficients arranged in the following form to obtain the multiple regression equation:

$$
\frac{\mathrm{x}_{1}}{\sigma_{1}}=\beta_{12,34} \frac{\mathrm{x}_{2}}{\sigma_{2}}+\beta_{13,24} \frac{\mathrm{X}_{3}}{\sigma_{3}}+\beta_{14,23} \frac{\mathrm{X}_{4}}{\sigma_{4}}
$$

The coefficient of multiple correlation was derived directly from the $\beta$ coefficients computed from the matrix:

$$
\beta_{12.34} r_{12}+\beta_{13.24} r_{13}+\beta_{14,23} r_{14}
$$

The partial coefficients were computed by the Yule system of partial correlation, which is an extension of the product-moments approach.

$$
r_{12.3}=\frac{\sum X_{1.3} X_{2,3}}{\sigma_{1.3} \sigma_{2.3}}=\frac{r_{12}-r_{13} r_{23}}{\sqrt{\left(1-r_{13}^{2}\right)\left(1-r_{23}^{2}\right)}}
$$

Needless to say, the Yule system of partial correlation becomes increasingly difficult beyond the rank of second order coefficients at which time other approaches, one of which is described below, become more profitable to use.

A tabulation of correlation coefficients of zero, first, and second order appears in Table 13, along with multiple coefficients of determination as well as total, explained, and unexplained variances, by type of road surface.

Distance is not a dominant factor in determining price per acre. For instance, on hard-surfaced roads the correlation between value of sales and distance is highest, $r_{12}=-0.38$, which means that distance explains only about 14.6 percent of the total

TABLE 13
SIMPLE, PARTIAL AND MULTIPLE CORRELATION COEFFICIENTS AND VARIANCES FOR RURAL LAND VALUES BY TYPE OF ROAD SURFACE ${ }^{1}$

| Coefficient or Variance ${ }^{2}$ | Dirt | Gravel | Hard-Surfaced |
| :---: | :---: | :---: | :---: |
| Zero order coefficients: |  |  |  |
| $\mathrm{r}_{12}$ | -0.188441 | -0.234564 | -0.382419 |
| F19 | +0.935545 | +0.966996 | +0.935668 |
| $\mathrm{r}_{19}$ | +0.900364 | +0.971124 | +0.941812 |
| $\mathrm{ras}_{8}$ | -0.045785 | -0.244488 | -0.401072 |
| res | -0.316444 | -0.275983 | -0.424529 |
| $\mathrm{r}_{34}$ | +0.841700 | +0.983802 | +0.952435 |
| First order coefficients: |  |  |  |
| $\mathrm{rasia}_{19}$ | +0.944817 | +0.965041 | +0.924237 |
| $\mathrm{r}_{14,2}$ | +0.902446 | +0.970077 | +0.931712 |
| Ts, 2 | +0.872940 | +0.983191 | +0.943052 |
| $\mathrm{ra}_{12 \mathrm{~S}}$ | -0.412675 | +0.007508 | -0.022116 |
| F14.3 | +0.592073 | +0.433319 | +0.470996 |
| re4.3 | -0.515235 | -0.203977 | -0.152365 |
| Second order coefficients: |  |  |  |
| $\mathrm{r}_{18.34}$ | -0.155814 | +0.108688 | +0.056945 |
| $\mathrm{r}_{29} \mathrm{SA}_{6}$ | +0.747228 | +0.254252 | +0.377316 |
| $\mathrm{r}_{14,28}$ | +0.486055 | +0.444224 | +0.473247 |
| $\mathrm{r}_{18.94}^{2}$ | +0.024278 | +0.011813 | +0.003243 |
| r ${ }_{19}{ }^{24}$ | +0.558350 | +0.064644 | +0.142367 |
| $\mathrm{r}_{14.23}$ | +0.236249 | +0.197335 | +0.223963 |
| Multiple coefficients squared: |  |  |  |
| $\mathbf{R}_{1.294}^{2}$ | +0.920945 | +0.947893 | +0.903412 |
| $\mathbf{R}_{1,23}^{2}$ | +0.896490 | +0.935084 | +0.875534 |
| $\mathbf{R}_{\mathbf{L}^{2} \text { 24 }}$ | +0.820999 | +0.944292 | +0.887379 |
| $\mathrm{R}_{1_{0}{ }^{2} \times 4}$ | +0.918977 | +0.947271 | +0.903098 |
| Variances (\$): |  |  |  |
| Total $\boldsymbol{\sigma}^{2}{ }^{2}$ : | 33, 572, 998, 399 | 1, 318, 348, 968, 334 | 142, 349, 398, 932 |
| Explained $\sigma^{234}$ | 30, 918, 885, 011 | 1,249,653, 758,641 | 128, 600, 155, 188 |
| Unexplained $\sigma_{10}{ }^{2} \mathbf{2 9 4}$ | 2,654, 113, 388 | 68,695, 209, 693 | 13, 749, 243, 744 |

[^2]variance of land values about the mean of land values. (This means that the coefficient of determination, ratio of explained variance to the total variance, or $\mathrm{r}_{12}{ }^{2}=0.146244$. The value of $r_{12}$ appears in the first item of the last column of Table 13.) For gravel roads distance explains 5.5 percent of total variance. And for dirt roads distance explains only 3.6 percent of total variance.

But these total sales are also influenced by number of acres sold and the number of sales as well as by distance. If the influence of the number of acres sold and the influence of the number of sales are eliminated through partial correlation procedures, distance explains only 0.3 percent of total variance on hard-surfaced roads, 1.2 percent on gravel roads and 2.4 percent on dirt roads.

The concept of partial correlation can be explained as follows: given $\mathbf{R}_{1_{0} 34}$, how much would be added to the explained variance or how much would be subtracted from the unexplained variance as percents of total variance if another variable (namely, distance) were added to the system. For instance, $\mathrm{R}^{2}{ }_{10234}$, multiple coefficient of determination, $=0.903412$ for hard-surfaced roads, taking into account the influence of distance, acres, and number of sales, and $\mathrm{R}_{1_{10} 34}=0.903098$, multiple coefficient of determination, taking into account acres and number of sales. The amount that the multiple coefficient of determination has increased by the addition of distance to the entrance of the property from the nearest trading center is $0.903412-0.903098=$ 0.000314 . The percent of the unexplained variance that the addition of the factor of distance has accounted for 1 s , therefore,

$$
\begin{aligned}
\mathbf{r}_{12,34}^{2} & =\frac{\mathbf{R}_{10234}^{2}-\mathbf{R}_{1,34}^{2}}{1-\mathbf{R}_{1.34}^{2}} \\
& =\frac{0.000314}{0.096902} \\
& =0.003240
\end{aligned}
$$

The percent of the total variance remaining yet to be explained by the addition of one more variable (i.e., distance) is conditioned by the other variables already taken into consideration.

For instance, the coefficient of determination of value and acres is +0.875475 . The multiple coefficient of determination, taking the influence of acres of land and number of sales into account, on value is 0.903098 . Addition of the variable, number of sales, to total value and acres of land accounts for 22 percent of the unexplained variance which acres failed to account for when correlated with value; i.e.,

$$
\begin{aligned}
r_{14.3}^{2} & =\frac{R_{1_{6}, 34}^{2}-r_{13}^{2}}{1-r_{13}^{2}} \\
& =\frac{0.903098-0.875475}{1-0.875475} \\
& =0.221827
\end{aligned}
$$

The addition of the variable of number of acres of land sold to total value and number of sales accounts for 14 percent of the remaining unexplained variance; i.e.,

$$
\begin{aligned}
\mathbf{r}_{13.4}^{2} & =\frac{\mathbf{R}_{1.34}^{2}-r_{14}^{2}}{1-r^{2}{ }_{14}} \\
& =\frac{0.903098-0.887010}{1-0.887010} \\
& =0.142384
\end{aligned}
$$

Although distance alone explains 14.6 percent ( $r_{12}=-0.382419$ ) of the total variance of value about the mean on hard-surfaced roads, it explains only 0.3 percent after the variables of acres sold and number of sales have been taken into account. Even though a coefficient of -0.38 is statistically significant for the number of variables involved, it implies that values by distance can be explained better or more accurately than by use of the variable of distance directly.

Computed data and actual data were cumulated from the worksheets by distance for each type of road. That linear regression techniques can be used to approximate nonlinear relations is amply borne out by Figure 7. Although the linear measure of association between distance and value was low for each type of road, linear multiple regression techniques faithfully approximated the actual values for nearly all distances for each type of road. Evidence of this is given in Table 14.


Figure 7. Actual and computed sales value of farm real estate on gravel roads by number of miles from nearest trading center.

TABLE 14
SUMMARY OF ACTUAL AND COMPUTED DATA BY MULTIPLE REGRESSION TECHNIQUES ${ }^{1}$

| Distance ${ }^{2}$ <br> (Mi) | Number of Areas Sampled | Total Number of Acres Sold | Number of Sales | Size of Tract (acres) | Total Sales (\$) |  | Average Sales (\$) |  | Price Per Acre (\$) |  | Percent Error in Price per Acre |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | Actual | Computed | Actual | Computed | Actual | Computed |  |
| (a) Dirt Roads |  |  |  |  |  |  |  |  |  |  |  |
| 10 | 14 | 19,873 | 136 | 1461 | 2,149,450 | 2,058, 750 | 15,804 78 | 15, 13787 | 10816 | 10360 | + 44 |
| 30 | 14 | 28,814 | 188 | 1533 | 3,052,880 | 2, 948,550 | 16, 23872 | 15,683 78 | 10595 | 10233 | $+\quad 35$ |
| 50 | 12 | 29,664 | 161 | 1842 | 2, 712,933 | 2, 800, 192 | 16,850 51 | 17, 39250 | 9146 | 9440 | - 31 |
| 70 | 13 | 18, 263 | 102 | 1790 | 1,414,620 | 1,574,692 | 13, 86882 | 15,438 16 | 7746 | 8624 | - 102 |
| 90 | 9 | 8,427 | 47 | 1793 | 598,858 | 615,589 | 12,74166 | 13, 09763 | 7106 | 7305 | - 27 |
| 125 | 9 | 14,579 | 60 | 2430 | 1,003, 202 | 1,043, 075 | 16, 72003 | 17,384 58 | 6881 | 7155 | - 38 |
| 175 | 5 | 9,917 | 15 | 6611 | 600, 159 | 518,497 | 40,010 60 | 34,566 47 | 6052 | 5228 | + 158 |
| 250 350 | 1 | 960 | 2 | 4800 | 43, 000 | 15,738 | 21,500 00 | 7,869 00 | 4479 | 1639 | +1732 |
| Total Avg | 77 | 130,497 | 711 | 1835 | 11,575, 102 | $\overline{11,575,083}$ | 16,280 03 | 16,280 03 | 8870 | 8870 | 0 |

(b) Gravel Roads

(c) Hard-Surfaced Roads

(d) Combined Total Dirt, Gravel and Hard-Surfaced Roads in Rural Areas

| 10 | 47 | 125.809 | 884 | 1423 | 20,433,650 | 20, 151, 386 | 23, 11499 | 22,795 69 | 16242 | 16017 | 14 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 30 | 47 | 190,249 | 1,175 | 1619 | 30, 850, 128 | 29,577, 025 | 26, 25543 | 25, 17193 | 16216 | 15546 | + 43 |
| 50 | 45 | 158,580 | 925 | 1714 | 21, 807, 120 | 23, 367, 076 | 23,575 26 | 25,261 70 | 13751 | 14735 | $+\quad 47$ |
| 70 | 45 | 84,881 | 517 | 1642 | 11,437,487 | 11, 802, 095 | 22, 12280 | 22, 82804 | 13475 | 13904 | - $\quad 31$ |
| 90 | 40 | 49,091 | 260 | 1888 | 6,199, 577 | 5,641, 583 | 23,844 53 | 21,698 40 | 12629 | 11492 | $-\quad 31$ $+\quad 99$ |
| 125 | 40 | 47,497 | 200 | 2375 | 4,408, 123 | 4,487, 661 | 22, 04062 | 22,438 31 | 9281 | 9448 | $\begin{array}{r}+\quad 99 \\ \hline\end{array}$ |
| 175 | 26 | 29,739 | 62 | 4797 | 2,029, 792 | 2,091, 811 | 32,738 58 | 33,738 88 | 6825 | 7034 | 188 $-\quad 30$ |
| 250 | 14 | 4,972 | 21 | 2368 | 516,950 | 457, 700 | 24,616 67 | 21,795 24 | 10397 | 9206 | $\begin{array}{r}120 \\ \hline+129\end{array}$ |
| 350 | 3 | 316 | 3 | 1053 | 26,450 | 133, 022 | 8,816 67 | 44,340 67 | 8370 | 42096 | +129 -801 |
| Total | $\overline{307}$ | $\overline{691,134}$ | $\overline{4,047}$ | 1708 | 97, 709, 277 | 97, 709,359 | 24,143 63 | 24,143 65 | 14138 | 14138 | 00 |

${ }^{2}$ Adapted from tabulations compled from March 1958 survey for (10)
${ }^{2}$ From the nearest trading center

In these tables price per acre is compared with computed price per acre by type of road. Number of sales divided into computed and actual values by distance give computed and actual sale per parcel. The size of tract varies unversely with the price per acre by distance. Although price per acre decreases with distance from nearest trading center, the average amount spent per parcel sold remains fairly constant with respect to distance.

More accurate comparisons between prices paid per farm by type of road can better be shown in Table 15, which is a complete tabulation of all parcels included in the sample. From this table it would appear that the addition of the corn belt and the inclusion of roads of three or more lanes raises the differential price per farm as between dirt and gravel roads about $\$ 2,100$ and reduces the differential between gravel and hard-surfaced roads by about $\$ 150$ per parcel.

TABLE 15
PRICE PER FARM AND SIZE OF TRACT ${ }^{1}$

| Total | Dirt |  | Gravel |  | HardSurfaced |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Price per Farm (\$) | $\begin{aligned} & \hline \begin{array}{l} \text { Size } \\ \text { of } \\ \text { Tract } \\ \text { (acres) } \end{array} \\ & \hline \end{aligned}$ | $\begin{gathered} \hline \text { Price } \\ \text { per } \\ \text { Farm } \\ (\$) \\ \hline \end{gathered}$ | Size of Tract (acres) | $\begin{gathered} \hline \text { Price } \\ \text { per } \\ \text { Farm } \\ (\$) \\ \hline \end{gathered}$ | $\begin{aligned} & \text { Size } \\ & \text { of } \\ & \text { Tract } \\ & \text { (acres) } \end{aligned}$ |
| Total | \$21,600 | 360 | \$27, 100 | 274 | \$36,750 | 287 |
| Total excluding corn belt | \$21, 200 | 393 | \$24,600 | 385 | \$34,400 | 316 |
| Total excluding tracts over 500 acres | \$15,000 | 192 | \$25,800 | 187 | \$33,500 | 181 |
| Total excluding tracts over 500 acres and corn belt | \$18.000 | 194 | \$20,300 | 209 | \$28,700 | 178 |

${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10).

## Index Number Approach

The concept of index number techniques as applied to land value increases has already been discussed. Also, the price per acre at which land was sold is not necessarily an index of what land is worth that remains unsold, especially if the land is not comparable in location, size of tract, land use, etc. To say that the average price per acre of farm real estate sold located on dirt roads is $\mathbf{X}$-amount; that on gravel roads is Y -amount; that on hard-surfaced roads is Z -amount; and that the averages X , $Y$, and $Z$ represent the true property value differentials by type of road depends upon the characteristics of the property being compared. For instance, distribution of acreage sold or number of sales by price and type of road would determine the weighted average price by distance and by type of road.

Correlation analysis has indicated that the number of acres sold and the number of sales, as indicators of supply and demand for land by distance, is highly related to the total value of land and, therefore, the price per acre.

An initial attempt was made to compare price per acre by type of road surface by taking into account type of farming area. Relative prices between properties located on dirt, gravel, and hard-surfaced roads were computed by distance by type of farming area.

Number of acres sold on hard-surfaced roads were used as constant weights applied to price per acre by distance from the nearest trading center and by type of farming area with the following results. Farm properties on hard-surfaced roads were worth 8.4 percent more than on gravel roads, and 34.0 percent more than on dirt roads. Farm properties located on gravel roads were 23.6 percent more valuable than those on dirt roads. In a number of farming areas reported in the sample the price per acre on dirt roads was higher than on hard-surfaced roads in five areas. Thus, comparison of prices of farm real estate between types of road surface by type of farming area failed to produce consistent results mainly because of discrepancies of sales data in the southern range livestock area. For example, though 12,886 acres were sold within 2 mi of the nearest trading center at $\$ 11$ per acre on hard-surfaced roads, the corresponding price per acre on gravel roads was $\$ 173$ per acre, with sales of 749 acres.

There remains a fundamental conclusion that in explaining price in the study, size of tract appears to be more important than type of farming area. As previously stated, distance has little direct measurable influence on value; furthermore, quantities of land sold and sizes of parcels by distance and by type of farming area are variable for each type of road surface. Therefore, one way to produce results by use of index number procedures would be to compare price per acre by size of tract and by type of road, irrespective of distance or type of farming area.
relationships between price per acre and size of tract by number of sales and distances prom nearest traddng center, dirt roads ${ }^{\text {b }}$

relationships between price per acre and size of tract by number of sales and distance ${ }^{\text {a }}$ from nearest trading center, gravel roads ${ }^{b}$

| $\begin{aligned} & \text { Size of Tract } \\ & \text { (acres) } \end{aligned}$ | Price per Acre (dollars) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Medians |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 0-25 | 25-50 | 50-75 | 75-100 | 100- | $\begin{array}{\|c} 125- \\ 150 \end{array}$ | $\begin{array}{r} 150- \\ 175 \end{array}$ | $\begin{array}{r} 175-1 \\ \hline 200 \end{array}$ | ${ }_{225}^{200-}$ | $\begin{array}{r} 225- \\ 250 \end{array}$ | $\begin{array}{\|c\|} 250- \\ 275 \end{array}$ | $\begin{array}{r} 275- \\ 300 \end{array}$ | $\begin{gathered} 300- \\ 325 \end{gathered}$ | $\begin{array}{\|c} 325- \\ 350 \end{array}$ | $\begin{array}{r} 350- \\ 375 \end{array}$ | $\begin{array}{\|c} 375- \\ 400 \end{array}$ | ${ }_{425}^{400-}$ | ${ }^{425-5}$ | $\begin{array}{r} 450- \\ 475 \end{array}$ | $\begin{array}{r} 475- \\ 500 \end{array}$ | $\begin{aligned} & \text { Over } \\ & 500 \end{aligned}$ | Total |  |  | $\begin{array}{\|l} \text { Dis- } \\ \text { tance } \\ (\text { mi) }) \\ \hline \end{array}$ |
| $0-\quad 25$ |  |  |  | 1. |  |  |  |  |  |  |  |  |  |  |  | 22 |  |  |  |  | 1. | 4 |  |  |  |
| $25-50$ |  |  |  | 1. | 1,1, |  |  | 1. |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 388 | 388 | 20 |
| 50- 75 |  | 1. |  |  | 10 |  |  |  |  |  |  | 5 |  |  |  |  |  |  |  |  | $1{ }^{1} 5$ | 10 | $630^{\circ}$ | $630^{\text {c }}$ | 34 |
| 75-100 |  |  | 3842 | $4,188_{3}$ |  |  | (10) |  |  | ${ }^{21}$ |  |  |  | ${ }^{1}$ |  |  |  |  |  |  | $1{ }_{1}$ | 8 | 183 | 183 | 13 |
|  |  |  |  |  |  | 5,70 |  |  |  |  |  |  |  | $\mathrm{I}_{1}$ |  |  |  |  |  |  |  | ${ }^{68}$ | 136 | 136 | 45 |
| 100-125 | $8_{4}$ |  |  | 10, | $\begin{aligned} & 22,2, \\ & 2,3_{\mathrm{s}} \\ & \hline \end{aligned}$ | $\begin{aligned} & 11,144 \\ & 1, \\ & \hline \end{aligned}$ | 43,11, | 1. |  |  |  |  |  |  |  |  |  |  |  |  |  | 128 | 141 | 141 | 63 |
| 125-150 |  |  | 4076 | 10.55, | ${ }^{\text {ent }}$ | $\begin{aligned} & 22_{2} 2_{4} \\ & 71227_{4} \\ & 3 . \end{aligned}$ |  |  |  | $\begin{aligned} & (50) \\ & (75,5) \end{aligned}$ |  |  |  | (57) |  |  |  |  |  |  |  | $\begin{gathered} 452 \\ (137) \end{gathered}$ | 132 | 118 | 40 |
| 150-175 |  | $2 *_{1}$ | 122, | $6,3,99_{1}$ <br> $8_{5}$ | $\begin{aligned} & 67,350 \\ & 38 \end{aligned}$ | 15 | (98) | $\begin{array}{r} (172) \\ \left(255_{2}\right) \\ \hline \end{array}$ | 28. |  |  | 118, |  | $3_{6}$ | 40 | 14 |  |  |  |  |  | $\begin{gathered} 819 \\ (871) \\ \hline \end{gathered}$ | 185 | 110 | 29 |
| $175-200$ <br> $200-225$ |  | ${ }^{4}$ | 103 | ${ }^{28824} 4$ | ${ }^{23} 3$ | 13,36 | ${ }^{4} 2^{27}$, | (196) |  |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{gathered} 309 \\ (196) \end{gathered}$ | 180 | 115 | 30 |
| $200-$ <br> $225-250$ |  |  | 12. | 4. | 1. |  | (52) | 4: |  |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{gathered} 73 \\ (52) \\ \hline \end{gathered}$ | 155 | 72 | 24 |
| 225 - 250 |  | 15 | $\begin{aligned} & 5,172 \\ & 25, \\ & \hline \end{aligned}$ | ${ }^{184}$ | ${ }^{20}$ | 10. |  | ${ }^{3}$ |  |  |  |  |  |  |  |  |  |  |  |  |  | 111 | 72 | 72 | 61 |
| $250-\quad 275$ <br> $275-300$ |  |  | $6_{1}$ <br> $\left(33_{0}\right)$ |  |  | 21, |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{array}{r} 60 \\ \text { (33) } \\ \hline \end{array}$ | 69 | 134 | 58 |
| 275 - 300 |  |  | $\begin{array}{\|l\|} \hline 34,123 \\ 2, \\ \hline \end{array}$ |  |  | 3. |  |  |  | $4_{3} 1_{1}$ |  |  |  |  |  |  |  |  |  |  |  | 56 | 65 | 65 | 56 |
| $300-325$ |  |  | $\mathrm{B}_{3}$ | 1. | 34, |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 325 - 350 |  | 1. |  | $1{ }^{\text {a }}$ | $\mathrm{B}_{1}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ${ }_{4} 1$ | 110 | 110 | 50 |
| $350-375$ |  |  | $388_{28}$ |  |  |  |  |  |  | $\mathrm{f}_{\mathbf{3}} \mathrm{S}_{7}$ |  |  |  |  |  |  |  |  |  |  |  | 10 | 109 | 109 | 33 |
| 375 - 400 |  |  | 12,17. | 33, |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 52 | 63 | 63 | 31 |
| 400- 425 |  | 30,2 ${ }_{4}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 62 | 77 | 77 | 39 |
| 425-450 |  |  | 4847 | (6) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 50 | 38 | 38 | 1.6 |
| 450 - 475 |  |  | 78, ${ }_{2}$ | $10_{3}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ${ }_{(6)}^{14}$ | 53 | 58 | 161 |
| 475 - 500 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 23 | 72 | 72 | 51 |
| 500-1,000 |  | 38,70, 140176 | $20_{12}$ |  |  | 3. |  |  |  | 1. |  |  |  |  |  |  |  |  |  |  |  | 1 | 250 | 250 | 125 |
| 1,000-1,500 | (1) |  |  |  |  |  | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 100 | 34 | 34 | 74 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 15 | 13 | 13 | 184 |
| 1,500-2,000 | 17 |  | 1. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | (1) |  |  |  |
| 2,000-5,000 |  | $B_{0}$ |  | 1, |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 15 | 15 | 150 |
| 5,000-10,000 | $7{ }^{7} 5$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 9 | 38 | 38 | 128 |
| 10,000-20,000 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 12 | 18 | 18. | 143 |
| 20,000-40,000 | 1. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | - | $\cdot$ | - | - |
| Total | 35 | 163 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 3 | 3 Ov | er 300 |
|  |  |  | 2 | 218 | 337 | 225 | 238 | 632 | 28 | 116 | - | 123 | - | 61 | 4 | 3 | - | - | - | - | 8 | 2,489 | - | - | - |
| Corn Beld | (1) |  | (33) | (6) | - | - | (151) | (623) | (28) | (80) |  | (118) |  | (57) |  |  |  |  |  |  |  | $(1,097)$ |  |  |  |

TABLE 18
RELATIONSHIPG bETWEEN PRICE PER ACRE AND SIZE OF TRACT by NUMBER OF SALE AND DISTANCE FROM NEAREST TRADING CENTER HARD-SURFACED ROADS

| Slzo of Tract (acres) | Prico per Acto (dollara) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Medians |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 0-25 | 25-50 | 50-75 | 75-100 | $\begin{gathered} 100- \\ 125 \end{gathered}$ | $\begin{aligned} & 125- \\ & 150 \end{aligned}$ | $\begin{array}{\|c} 150- \\ 176 \end{array}$ | ${ }_{200}^{175-}$ | $\begin{array}{r} 200- \\ 223 \end{array}$ | $\begin{array}{r} \text { 225- } \\ 250 \end{array}$ | $\left.\begin{array}{r} 230- \\ 275 \end{array} \right\rvert\,$ | $\begin{array}{\|c} 275- \\ 300 \end{array}$ | $\left\|\begin{array}{c} 300- \\ 325 \end{array}\right\|$ | $\begin{gathered} 325- \\ 350 \end{gathered}$ | $\left\|\begin{array}{r} 350- \\ 375 \end{array}\right\|$ | $\left\|\begin{array}{c} 375- \\ 400 \end{array}\right\|$ | $\left\|\begin{array}{c} 400- \\ 425 \end{array}\right\|$ | $\left\|\begin{array}{r} 425- \\ 450 \end{array}\right\|$ | 450- | $\left\|\begin{array}{c} 473- \\ 500 \end{array}\right\|$ | $\begin{array}{\|l\|l\|l} \hline \text { Over } \\ 800 \end{array}$ | Total | Price per Acre (\$) |  | $\begin{array}{\|l} \hline \text { Mas- } \\ \substack{\text { tance } \\ (a n!)} \end{array}$ |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Total | $\begin{aligned} & \text { Exchuding } \\ & \text { Corn Belt } \end{aligned}$ |  |
| 0.25 |  |  |  |  |  |  |  | 1. |  |  |  |  |  |  |  |  |  |  |  |  | 4 | 5 | 380 | 388 | 32 |
| 25- 80 |  |  |  |  | 1. |  |  |  | 2,24 |  |  |  |  |  | $\mathrm{O}_{1}$ |  |  |  |  |  | $3_{7}$ | 10 | 285 | 293 | 17 |
| 80- 75 |  |  |  |  |  |  | 45 |  | $T_{1}$ |  | 7 | 12. |  |  | 2. |  |  |  |  |  |  | 32 | 261 | 261 | 17 |
| 75-100 |  | 14 |  | 13036 | 4 | (2.) | 5 | 44 | 01 | 2 |  |  | (1, |  | 1. |  |  |  |  |  |  | $\begin{aligned} & 34 \\ & \text { (3) } \end{aligned}$ | 181 | 181 | 68 |
| 100-125 |  | 1. |  | 849 | $\begin{array}{\|l} 171 \\ 1+13_{2} \\ \hline \end{array}$ | $24_{4}$ | 30, | $\begin{aligned} & 2550 \\ & 37 \end{aligned}$ | (5.) | 3 s | $\mathrm{B}_{5}$ |  |  | b $\left(5 A_{2}\right)$ |  | (89) |  |  |  |  |  | $\begin{gathered} 280 \\ (147) \\ \hline \end{gathered}$ | 332 | 151 | 42 |
| 125 - 150 | 1. | 1. |  | 20220 | $\begin{aligned} & 154 \\ & 16,34 \end{aligned}$ | 5\% | $\begin{aligned} & 28,27_{1} \\ & 7,80 \\ & 45,4,71 \end{aligned}$ | $\begin{aligned} & 68_{1} \\ & 855_{1} \end{aligned}$ | $\begin{aligned} & 68_{1} \\ & \left(8 s_{\mathrm{D}}\right. \end{aligned}$ |  | 6, | $\mathrm{a}_{2}$ <br> (22) |  | $0^{4}$ | (78) |  |  |  |  |  | 41, | $\begin{gathered} 800 \\ (189) \end{gathered}$ | 185 | 170 | 23 |
| $150 \cdot 173$ |  |  |  | 177, | 133 | 3. |  |  | $\begin{aligned} & \left(69_{2}\right) \\ & (192) \\ & (435) \end{aligned}$ |  | 13/ |  |  |  |  |  |  |  |  |  |  | $\begin{gathered} 188 \\ (1123) \end{gathered}$ | 212 | 208 | 38 |
| 173-200 |  | 50 | 124 | 17376 | $28.0{ }_{0}$ | 12 <br> (13) <br> $\mathrm{Br}_{4} \mathrm{C}_{2} \mathrm{~S}_{4}$ |  |  | 4 |  |  | 23: | 4 |  |  | 4 |  |  |  |  |  | 149 (19) | 126 | 122 | 53 |
| $200 \cdot 223$ |  |  |  | 7,23, | $\begin{aligned} & 33_{1} \\ & 10 \end{aligned}$ | 11, ${ }^{\text {a }}$ | So47 |  |  |  |  |  | (54) |  |  |  |  | 42, |  |  |  | $\begin{array}{r} 146 \\ (5) \\ \hline \end{array}$ | 125 | 124 | 28 |
| 225 - 230 |  |  |  | 2 | 1. | 8 | 16 | $44_{4}$ |  |  |  |  |  |  |  | $34{ }^{\text {c }}$ |  |  |  |  |  | 71 ( $\theta$ ) | 198 | $209{ }^{\text {c }}$ | 63 |
| $250-275$ |  | 3. | 0,102 | $\mathrm{Br}_{5} \mathrm{~S}_{2}$ | 22. | 13. | 18. |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 01 | 108 | ${ }^{108}{ }^{\text {d }}$ | 40 |
| 275-300 |  |  |  | 21 |  |  | (1r) |  |  |  | 11.4 |  |  |  | 2. |  |  |  |  |  |  | 18 | 208 | $281{ }^{\text {d }}$ | 78 |
| 300 - 325 |  |  |  |  |  |  |  |  |  |  | 15.9 |  |  |  |  |  |  |  |  |  |  | 18 | 253 | $252{ }^{\circ}$ | 125 |
| 325-350 |  | 27 | 1. |  |  | 3. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 6 | 80 | 80 | 60 |
| 350 - 373 |  |  |  | 13. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 13 | 82 | 82 | 123 |
| 375- 100 |  |  | 10 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 10 | 61 | 51 | 80 |
| 400- 425 |  |  |  | 14, | $2 \mathrm{~Pa}_{1}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 43 | 101 | 101 | 15 |
| 425 - 450 |  |  | $0_{4}$ |  | $3{ }^{3}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 38 | 89 | 89 | 33 |
| 450 - 475 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | - - | - | - | - |
| 473- 500 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | $\stackrel{-}{-}$ | $\cdots$ | - | - |
| 500 - 1,000 |  | 57 | 4,16,1, | 4,15 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 44 | 70 | 70 | 28 |
| 1,000-1,800 |  | ( $B_{1}$ ) $a_{2}+\cdots+11_{1}$ | 4. | 10 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 4 | 42 | 18 |
| 1,500-2,000 |  | 1. | $\mathrm{O}_{1}$ | 3. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 15 | 68 | 68 | 04 |
| 2,000-8000 |  | O2, ${ }^{\text {9,3 }}$ | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 24. | 38 | 38 | 82 |
| 5,000-10,000 | 4.3. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 7 | 13 | 13 | 144 |
| 10,000-20,000 | 2. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 13 | 13 | 250 |
| Total | 10 | 69 | 03 | 179 | 235 | 169 | 332 | 188 | 311 | 0 | 62 | 65 | 10 | 61 | 90 | 128 | - | 42 | - | - | 50 | 2,007 | - | - | - |
| Corn Bolt |  | (8) |  |  |  | (15) | (1) | (6) | (208) |  |  | (23) | (6) | (5) | (76) | (88) |  |  |  |  |  | (478) |  |  |  |
|  <br> bin parenthesea are ecres in the corn bolt <br>  <br> CIncludos 34 zates Colitornia specialiy at 3388 per acre <br> flacludes 11 ezies Caltiornla apecialiy as $\$ 257$ per acre <br> onctudes 15 maler Caltorila apeciality ai $\$ 252$ per acro |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Bivariate frequency distributions between price per acre, size of tracts, and number of sales by type of road surface are given in Tables 16, 17, and 18. The prices per acre appear along the X -axis, the size of tracts along the Y -axis, and the number of sales with subscripts representing coded distances appear in the cells. For example, in Table 16, in the row, 50 to 75 acres, column, 0 to 25 dollars per acre, appears one sale coded distance 5 . The footnote at the bottom of the table indicates that code 5 represents 9 to 10 mi from the nearest trading center. In the row, 50 to 75 acres, column, 50 to 75 dollars, appear two sets of sales-one set of three sales occurring at coded distance 1 ( 1 to 2 mi ) from the nearest trading center and another set of two sales coded distance 4 ( 7 to 8 ml ) from nearest trading center. These tables may be interpreted in the following way: the number of sales multiphed by the corresponding size of tract equals total number of acres sold. The total number of acres sold multiplied by corresponding price per acre equals total value of sales.

The last four columns represent total number of sales, median price per acre (both including and excluding corn belt), and median distance to entrance of property by size of tract from nearest trading center. Visual inspection of the data reveals little correspondence between distance and size of tract for most of the number of sales. For
larger-size tracts, the factor of distance begins to make itself manifest. On dirt roads, distance begins to increase with size of tracts over 475 acres, whereas on gravel roads distance and size of tract begin to be correlated positively at 425 acres. But, on hardsurfaced roads, median distance for tracts of 1,000 to 1,500 acres was still only 2.9 mi , and for gravel roads the median distance for tracts of 1,000 to 1,500 acres was 18.4 mi as compared to 25.0 mi on dirt roads. This particular characteristic of the U.S. Department of Agriculture March 1958 sample demonstrates that it would be appropriate to use a comparison other than simple average prices for two or more time periods or for road types. Such comparisons clearly relate as much to differentials in size of tract as to price differentials because of road surface improvement.

The bottom rows of the tables give the total number of sales by price per acre for total and for corn belt. The number of sales for prices per acre of $\$ 50$ or less were 247 for dirt roads, 198 for gravel roads, and 79 for hard-surfaced roads.

The bottom row gives size of tract by price per acre and the right hand columns represent price per acre by size of tract. Were the scattergrams within the tables highly correlated, values so computed would tend to show a 1 to 1 correspondence as described by the lines of regression.

The most that can be expected from the tables is to give a comparison between price per acre by comparable size of tract for type of property located along each type of road surface. Median price per acre by size of tract on hard-surfaced roads was divided by median price per acre for corresponding size of tract on gravel roads. Similar ratios were taken of hard-surfaced roads to dirt and gravel roads to dirt.

Median prices per acre by size of tract by type of road surface are summarized in Table 19. Ratios of median price per acre by size of tract by type of road are given in Table 20. The number of sales by size of tract used as weights against price relatives are given in Table 21.

It was decided to use weights multiplied by ratios to obtain percentage differentials between types of road surfaces. Although some of the ratios appear out of line, these discrepancies can be largely accounted for by the presence of a few sales from the California specialty farming area. Thus, such discrepancies multiplied by a small number of sales are given little weight in the averages so computed.

To set up the weights, consideration was given to the sales for the types of roads being compared. For instance, relatives of hard-surfaced to gravel were multiplied by number of sales of hard-surfaced plus gravel, etc. (Table 21). This procedure would be somewhat analogous to having moving weights from year to year in index numbers and therefore would be subject to similar criticisms, as there would be no fixed base for comparison, only comparisons from year to year-in this case from road-type to road-type.

If $P_{1}$ and $S_{1}$ represent median price per acre and number of corresponding sales by size of tract on hard-surfaced roads and if subscript 2 represents gravel roads; and subscript 3 represents dirt roads, then comparison between hard-surfaced roads and gravel would be

$$
\sum_{i}^{n} \frac{P_{1}}{P_{2}}\left(S_{1}+S_{2}\right)
$$

comparison between hard-surfaced roads and dirt,

$$
\sum_{i}^{n} \frac{P_{1}}{P_{3}}\left(S_{1}+S_{3}\right)
$$

and comparison between value of farm real estate located on gravel roads with farm properties located on dirt roads,

$$
\sum_{i}^{n} \frac{P_{2}}{P_{3}}\left(S_{2}+S_{3}\right)
$$

TABLE 19
MEDIAN PRICE PER ACRE BY SIZE OF TRACT FOR EACH T'YPE OF ROAD ${ }^{\text {a, }}$ b

| Size of Tract (acres) | Hard-surlaced Roads |  |  | Gravel Roads |  |  | Dirt Roads |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Total (\$) | Excluding Corn Belt (\$) | Total Number of Sales | Total (\$) | Excluding Corn Belt (S) | Total <br> Number of Sales | Total (\$) | Excluding Corn Belt (\$) | Total <br> Number of Sales |
| 0- 25 | 386 | 386 | 5 | 388 | 388 | 4 | 400 | 400 | 3 |
| 25-50 | 295 | 295 | 19 | $630^{\text {c }}$ | $630^{\text {c }}$ | 10 | 139 | 139 | 6 |
| 50-75 | 261 | 261 | 32 | 183 | 183 | 8 | 129 | 129 | 23 |
| 75-100 | 181 | 181 | (3) 34 | 136 | 136 | (1) 68 | 133 | 133 | 32 |
| $100-125$ | 332 | 151 | (147) 280 | 141 | 141 | 128 | 136 | 111 | (32) 117 |
| 125-150 | 183 | 170 | (183) 800 | 132 | 118 | (137) 452 | 99 | 94 | (18) 112 |
| 150-175 | 212 | 208 | (112) 168 | 185 | 110 | (671) 819 | 98 | 98 | 143 |
| 175-200 | 126 | 122 | (13) 149 | 180 | 115 | (196) 308 | 113 | 70 | (55) 103 |
| 200- 225 | 125 | 124 | (5) 146 | 155 | 72 | (52) 73 | 82 | 59 | (54) 120 |
| 225-250 | $196{ }^{\text {c }}$ | $208{ }^{\text {d }}$ | (6) 71 | 72 | 72 | 111 | 99 | 99 | 71 |
| 250- 275 | 106 | 106 | 91 | 69 | 134 | (33) 60 | 63 | 63 | 35 |
| $275-300$ | $268{ }^{\text {c }}$ | $261^{\text {c }}$ | (1) 16 | 65 | 65 | 56 | 72 | 72 | 31 |
| $300-325$ | $252{ }^{\text {e }}$ | $252^{\text {e }}$ | I5 | 110 | 110 | 41 | 62 | 62 | 46 |
| 325 - 350 | 80 | 80 | 6 | 109 | 109 | 10 | 41 | 65 | (9) 22 |
| $350-375$ | 82 | 82 | 13 | 63 | 63 | 52 | 2498 | 249 f | 4 |
| $375-400$ | 51 | 51 | 10 | 77 | 77 | 62 | 50 | 50 | 15 |
| $400-425$ | 101 | 101 | 43 | 38 | 38 | 50 | 40 | 40 | 6 |
| 425 - 450 | 89 | 89 | 38 | 53 | 58 | (6) 14 | 30 | 30 | 10 |
| $450-475$ | - | - | - | 72 | 72 | 23 | - | - | - |
| 475 - 500 | - | - | - | 250 | 250 | 1 | 45 | 45 | 2 |
| 500-1,000 | 70 | 70 | 44 | 34 | 34 | 100 | 61 | 61 | 120 |
| 1,000-1,500 | 44 | 42 | (5) 41 | 13 | 13 | (1) 15 | 22 | 22 | 5 |
| 1,500-2,000 | 68 | 68 | 13 | 15 | 15 | 2 | 15 | 15 | 28 |
| 2,000-5,000 | 38 | 38 | 24 | 38 | 38 | 9 | 9 | 9 | 10 |
| 5,000-10,000 | 13 | 13 | 7 | 18 | 18 | 12 | 16 | 16 | 3 |
| 10,000-20,000 | 13 | 13 | 2 | - | - | - | - | - | - |
| 20,000-40,000 | - | - | - | 3 | 3 | 1 | - | - | - |
| Total 500 acres or less | - | - | (470) 1,936 | - | ( | $(1,096) 2,350$ | - | - | (168) 901 |
| Grand total | - | - | (475) 2, 067 | - | - | $(1,097) 2,489$ | - | - | (168) 1,067 |

${ }^{a}$ Adaped from tabilations compled from 'arch 2958 aurvey (10).
Figures in parertt:eses and acres in Corn Belt
dThere were 5 sales at 478 per are me Cailfor:ila speciaity.
dotal of 3 , sales Calufornia speci:ilty
${ }^{\text {f Total }}$ of 26 sales Californza specialty.
four sales Callforria specialty.

Differentials between price per acre by type of road appear at the bottom of Table 20. Including the corn belt, price per acre of hard-surfaced roads over gravel was 48.9 percent; of hard-surfaced over dirt, 95.3 percent; of gravel over dirt, 45.2 percent. Excluding the corn belt, price per acre of hard-surfaced roads over gravel roads was 61.9 percent; of hard-surfaced over dirt, 92.4 percent; and gravel over dirt, 21.2 percent. Exclusion of sales over 500 acres reduced the differential slightly as it could be expected that price per acre of large tracts of land on hard-surfaced roads was considerably greater than that on gravel or dirt roads. Inclusion or exclusion of the corn belt had little influence on the relation of hard-surfaced to dirt roads but had considerable influence between gravel and hard-surfaced roads and gravel and dirt roads.

To test the consistency of the relationships of price per acre by size of tract between types of road surface, correlation coefficients were computed on median price per acre excluding corn belt and California specialty. The coefficient between gravel and hard-surfaced roads was +0.916 ; between dirt and gravel, +0.946 ; and between dirt and hard-surfaced roads, +0.886 .

The slope of the line of regression of median price per acre by size of tract of farm real estate located on gravel roads on median price per acre of farm properties located on hard-surfaced roads would give the percentage differential between price per acre by type of road for all tracts provided the constant in the equation were zero. For

TABLE 20
RATIOS OF MEDIAN PRICE PER ACRE BY SIZE OF TRACT BY TYPE OF ROAD ${ }^{1}$

| Size of Tract (acres) | Ratios of Medtan Price per Acre |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | HardSurfaced to Gravel Total | HardSurfaced to Gravel Excluding Corn Belt | HardSurfaced to Dirt Total | HardSurfaced to Dirt Excluding Corn Belt | Gravel to Dirt Total | Gravel to Dirt Excluding Corn Belt |
| 0- 25 | 0.995 | 0.995 | 0.965 | 0.965 | 0.970 | 0.970 |
| $25-50$ | 0.468 | 0.468 | 2.122 | 2.122 | 4.532 | 4.532 |
| $50-75$ | 1.426 | 1.426 | 2.023 | 2.023 | 1.419 | 1.419 |
| 75 - 100 | 1.331 | 1.331 | 1.361 | 1.361 | 1.023 | 1.023 |
| 100-125 | 2.354 | 1.071 | 2.441 | 1.360 | 1.037 | 1.270 |
| 125-150 | 1.386 | 1.441 | 1.848 | 1.809 | 1.333 | 1.255 |
| 150-175 | 1.146 | 1.891 | 2.163 | 2.122 | 1.888 | 1.122 |
| 175-200 | 0.700 | 1.061 | 1.115 | 1.743 | 1.593 | 1.643 |
| 200-225 | 0.806 | 1.722 | 1.524 | 2.102 | 1.890 | 1.220 |
| 225-250 | 2.722 | 2.889 | 1.636 | 1.586 | 0.727 | 0.727 |
| 250- 275 | 1.536 | 0.791 | 1.683 | 1.683 | 1.095 | 2.127 |
| 275-300 | 4.123 | 4.015 | 3.722 | 3.625 | 0.903 | 0.903 |
| $300-325$ | 2.291 | 2.291 | 4.065 | 4.065 | 1.774 | 1.774 |
| 325 - 350 | 0.734 | 0.734 | 1.951 | 1.231 | 2.658 | 1.677 |
| $350-375$ | 1.302 | 1.302 | 0.329 | 0.329 | 0.253 | 0.253 |
| 375 - 400 | 0.662 | 0.662 | 1.020 | 1.020 | 1.540 | 1.540 |
| $400-425$ | 2.658 | 2.658 | 2.525 | 2.525 | 0.950 | 0.950 |
| 425 - 450 | 1.679 | 1.534 | 2.967 | 2.967 | 1.767 | 1.933 |
| $450-475$ | - | - | - | - |  |  |
| 475 - 500 | - | - | - | - | 5.555 | 5.555 |
| 500-1,000 | 2.059 | 2.059 | 1.148 | 1.148 | 0.557 | 0.557 |
| 1,000-1,500 | 3.385 | 3.231 | 2.000 | 1.909 | 0.591 | 0.591 |
| 1,500-2,000 | 4.533 | 4.533 | 4.533 | 4.533 | 1.000 | 1.000 |
| 2,000-5,000 | 1.000 | 1.000 | 4.222 | 4.222 | 4.222 | 4.222 |
| 5, $000-10,000$ | 0.722 | 0.722 | 0.813 | 0.813 | 1.125 | 1.125 |
| 10, $000-20,000$ | - | - |  | - | - | - |
| 20, $000-40,000$ | - | - | - | - | - | - |
| Avg. total | 1.489 | 1.619 | 1.953 | 1.924 | 1.452 | 1.212 |
| Avg. excl. sales over 500 acres | 1.441 | 1.563 | 1.938 | 1.903 | 1.508 | 1.261 |

${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10).
example, if $\dot{X}_{1}=$ price per acre on gravel roads, and $\mathbf{X}_{2}=$ price per acre on hardsurfaced roads, then $X_{1}=+0.878 \mathrm{X}_{2}-\$ 10.41$ per acre. Because the smaller-size tracts sold for more per acre than the larger-size tracts, the constant in the equation indicates that the price differential between gravel and hard-surfaced roads was greater for larger-size tracts than for smaller-size tracts. Aside from this, there are reasons for rejecting the slope of the line of regression as an indicator of price differential between types of road surface. For instance, only about 1 percent of total acreage involved and from 3 to 6 percent of the number of sales was in tracts of 100 acres or less which would give undue weight to the areas of little consequence. Inasmuch as

TABLE 21
NUMBER OF SALES BY SIZE OF TRACT USED AS WEIGHTS FOR MEDIAN PRICE RATIOS ${ }^{1}$ OF HARD-SURFACED TO GRAVEL, HARD-SURFACED TO DIRT, AND GRAVEL TO DIRT ${ }^{2,3}$

| Size of Tract (acres) | Total |  |  | Total Less Corn Belt |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | HardSurfaced + Gravel | HardSurfaced + Dirt | Gravel <br> + Dirt | HardSurfaced + Gravel | HardSurfaced + Dirt | $\begin{gathered} \text { Gravel } \\ \text { + Dirt } \end{gathered}$ |
| $0-25$ | 9 | 8 | 7 | 9 | 8 | 7 |
| $25-50$ | 29 | 25 | 16 | 29 | 25 | 16 |
| $50-75$ | 40 | 55 | 31 | 40 | 55 | 31 |
| $75-100$ | (4) 102 | (3) 66 | (1) 100 | 98 | 63 | 99 |
| $100-125$ | (147) 408 | (179) 397 | (32) 245 | 261 | 218 | 213 |
| 125-150 | (320) 1,252 | (201) 912 | (155) 564 | 932 | 711 | 409 |
| 150-175 | (783) 987 | (112) 311 | (671) 962 | 204 | 199 | 291 |
| 175-200 | (209) 459 | (68) 252 | (251) 411 | 248 | 184 | 160 |
| 200-225 | (57) 219 | (59) 266 | (106) 193 | 162 | 207 | 87 |
| 225-250 | (6) 182 | (6) 142 | 182 | 176 | 136 | 182 |
| 250- 275 | (33) 151 | 126 | (33) 95 | 118 | 126 | 62 |
| $275-300$ | (1) 62 | (1) 47 | 87 | 61 | 46 | 87 |
| $300-325$ | 56 | 61 | 87 | 56 | 61 | 87 |
| 325 - 350 | 16 | (9) 28 | (9) 32 | 16 | 19 | 23 |
| $350-375$ | 65 | 17 | 56 | 65 | 17 | 56 |
| 375 - 400 | 72 | 25 | 77 | 72 | 25 | 77 |
| 400 - 425 | 93 | 49 | 56 | 93 | 49 | 56 |
| 425 - 450 | (6) 52 | 48 | (6) 24 | 46 | 48 | 18 |
| 450 - 475 | 23 | - | (6) 23 | 23 | - | 23 |
| 475 - 500 | 1 | 2 | 3 | 1 | 2 | 3 |
| 500-1,000 | 144 | 164 | 220 | 144 | 164 | 220 |
| 1,000-1,500 | (6) 56 | (5) 46 | (1) 20 | 50 | 41 | 19 |
| 1,500-2,000 | 15 | 41 | 30 | 15 | 41 | 30 |
| 2,000-5,000 | 33 | 34 | 19 | 33 | 34 | 19 |
| 5,000-10,000 | 19 | 10 | 15 | 19 | 10 | 15 |
| 10, $000-20,000$ | 2 | 2 | - | 2 | 2 | - |
| 20,000-40,000 | 1 | - | 1 | 1 | - | 1 |
| Total 500 acres |  |  |  |  |  |  |
| and less | 4,276 | 2,837 | 3,250 | 2,710 | 2, 199 | 1,987 |
| Grand total | 4,546 | 3,134 | 3,554 | 2,974 | 2,491 | 2,291 |

[^3]the line of regression is not a perfect fit, together with the fact that neither the quantity of land sold by size of tract nor the number of sales is equally distributed, it would appear that the correlation analysis proves only that the system of price relatives is consistent.

Similar computations were made for total exclusive of California specialty only with coefficients of +0.854 for gravel and hard-surfaced roads, +0.886 for dirt and hardsurfaced roads, and +0.935 for dirt and gravel roads.

The index number approach described here indicates that the system of weights used is always an important consideration and illustrates another statistical means of making comparisons of land value data.

## REFERENCES

1. "Final Report of the Highway Allocation Study." 87th Congress, 1st Session, House Document 72 (1961).
2. "Third Progress Report of the Highway Cost Allocation Study." 86th Congress, First Session, House Document 91 (1961).
3. Ezekiel, M., "Factors Affecting Farmers' Earnings in Southeastern Pennsylvania." U.S. Department of Agriculture Bull. 1400 (1926).
4. Garrison, W.L., "The Benefits of Rural Roads to Rural Property." "Allocation of Road and Street Costs, " Pt IV, Univ. of Washington (June 1956).
5. Carroll, D.D., Borchert, J.R., Schwinden, J., and Raup, P. M., "The Economic Impact of Highway Development upon Land Use and Value ." Univ. of Minnesota (Sept. 1958).
6. "The Effect of the Louisville-Watterson Expressway on Land Use and Land Values." Bureau of Business Research, College of Commerce, Univ. of Kentucky (1959).
7. Vargha, L. A., "Effects of Highway Development on Rural Lands." Studies I and V, East Lansing, Mich. (Aug. 1959).
8. Adkins, W.G., Frierson, J.E., and Thompson, R. H., "Farm Land Values and Rural Road Service in Ellis County, Texas, 1955-58." Texas Transportation Institute, A. and M. College of Texas (June 1960).
9. "Relation of Type of Road and Location to Sales Prices of Farm Real Estate." Agricultural Research Service, U.S. Department of Agriculture (Nov. 1960).
10. "The Economic Impact of Highway Improvement." Agricultural Research Service, U.S. Department of Agriculture, unpublished report (1958).

[^0]:    ${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10)
    ${ }^{2}$ From nearest trading center.

[^1]:    ${ }^{1}$ Adapted from tabulations compiled from March 1958 survey for (10).
    ${ }^{2}$ Two sales were omitted in Callfornia specialty at $\$ 351$ per acre.

[^2]:    ${ }_{1} 1$ Adapted from tabulations compiled from March 1958 sarvey for (10).
    ${ }^{2}$ Subscripts are codes for variables: 1 for value of sales; 2 for distance in miles from nearest trading center; 3 for number of acres sold; 4 for number of sales.

[^3]:    ${ }^{1}$ Ratios are shown in Table 20.
    ${ }^{3}$ Adapted from tabulations compiled from March 1958 survey for (10).
    ${ }^{3}$ Figures in parentheses are for Corn Belt.

