# 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 statistical techniques applied 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 relatively 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The main object of this paper is to apply some experimental techniques to unpublished data from the March 1958 land value survey made by the U.S. Department of Agriculture.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 Ezekiel'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 Washington State (Snohomish, Chelan, and Douglas Counties), Garrison  $(\underline{4})$  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 ( $\frac{4}{4}$ , 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 buildings 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 ( $\underline{6}$ ) was to select several variables that would have <u>a priori</u> 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-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 hard-surfaced 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, 1947-48, 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 techniques. 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  $(\underline{8})$  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 mile 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 buildings. Land on dirt roads had \$5.24 per acre of buildings value; land on all other road types had buildings 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 isolate 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 entire 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

Distance		N	Size		Sales (\$)		Pr	ice per Acre	(\$)	Pr	ce per Farm	(\$)
from Nearest Town (mi)	Acres	Number of Sales	of Tract (acres)	Including Improve- ments	Excluding Improve- ments	Improve - ments	Including Improve- ments	Excluding Improve- ments	Improve- ments	Including Improve- ments	Excluding Improve- ments	Improve ments
					(a) On H	ard-Surface	d 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	95, 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	36	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	90,007	78,070	11,937	147	127	19	15,001	13,012	1,990
Total Average	7,705	80	96	1, 185, 531	920, 614	264,917	154	119	34	14, 819	11, 508	3,311
<u> </u>					(b) Or	Gravel Roa	de					
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
	3 247	26	126	490, 140	391,242	98, 898	150	120	30	18,852	15,048	3,804
	3,201	19	113	230 593	180 320	50, 273	114	89	25	12.811	10, 618	2,793
8 - 10	2,020	6	92	82, 136	63,406	18,730	150	115	34	13,689	10, 568	3,122
10 - 12		-			•	· •	-	-	-	-	-	-
12 - 14	178	2	89	19, 176	15, 736	3,440	108	88	19	9,588	7,868	1, 720
Total Average	10, 120	92	110	1,356,769	1,082,260	274, 509	134	107	27	14, 747	11, 764	2, 984
<u> </u>					(c) Or	n Dirt Road	5					
0 - 2	405	6	. 68	57, 594	49, 530	8,064	142	122	20	9,599	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
6 - 8	293	3	98	26,690	24,684	2,006	91	84	7	8,897	8, 228	689
8 - 10	645	4	161	38, 767	38,667	100	60	60	-	9,692	9,667	25
10 - 12	010	-				-	-	-	-	-	-	-
12 - 14	-	-	-	-	-	-	-	-	-	-	-	-
Total	3 968	42		375, 230	352,948	22,282	-					
Avorage	0,000		94	,	,,,,,,		95	89	6	8,934	8,404	531

'Adapted from unpublished worksheets (8)

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.

25

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 one-half 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 farming areas, generalized 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 different 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 <u>net</u> effects of different types of roads on sales prices, with other price 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 identification and measurement of the substantial number of factors that influence sales prices, particularly those of a qualitative and subjective nature (9, 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 experimental 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) available 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<sup>1</sup>

	Malaada	S	ale Price of Pr	operty (\$)
Land Quality	Trading Center	On Dırt Road	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	<sup>2</sup>	214	2 <sup>2</sup>
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	<sup>2</sup>
	7 - 8	<sup>2</sup>	89	<sup>2</sup>
	9 - 10	<sup>2</sup>	92	2

<sup>1</sup>Source: (9), Table 8, p. 17. Based on 2,231 sales reported by farm real estate reporters in March surveys; most sales probably occurred in the 6 mo preceding date of surveys.

<sup>2</sup>Less than 10 sales reported.

### 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 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 1s 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 1s 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

Distance <sup>2</sup>	Code	Hard-Surfaced		Gra	avel	D	irt	Т	otal
(m1)		No.	%	No.	ø	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
<b>21 - 3</b> 0	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

#### NUMBER AND PERCENT OF SALES BY DISTANCE (EXTREME ITEMS INCLUDED)<sup>1</sup>

TABLE 3A

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (10).

## <sup>2</sup>From nearest trading center.

#### TABLE 3B

PERCENT OF SALES BY	DISTANCE
---------------------	----------

	Distance from Nearest Trading Center (mi)							
Percent Sales	Hard-Surfaced	Gravel	Dırt	Total				
25	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 mi 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 mi 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. Taking 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 on gravel roads

	AC	RES SOLD	BYT	YPE OF	ROAD	BI DISTA	ANCE		
Distance	0.10	Hard-Sur	faced	Grave	el	Dirt		Total	
(mi) <sup>2</sup>	Code	Acres	*	Acres	%	Acres	<u>%</u>	Acres	%
			(a	) By Dist	ance			665 050	10 0
1 - 2	1	113,953	20.0	80,025	11.7	29,095	7.6	223,073	13 6
3 - 4	2	111,627	19.6	139, 198	20.4	40, 178	10 5	291,003	17.9
5 - 6	3	69,543	12 2	126,985	18 6	51,827	13 6	248,355	15 2
7 - 8	4	64,700	11 3	59,186	87	35,265	9.2	159,151	9.1
9 - 10	5	57,001	10.0	44,220	6.5	31,173	8.2	132,394	0.1
11 - 15	6	50,950	89	73,334	10.8	63,195	16.6	107,479	11.5
16 - 20	7	26,290	4.6	72, 523	10.6	32, 532	0.0	131,345	5 2
21 - 30	8	42,021	74	14,252	2.1	29,095	101	176 257	10 8
31 and over	9	34,825	<u>6.1</u>	72,314	10 6		10.1	170,257	10.0
Total		570, 910	100.1	682,037	100.0	381,478	99 9	1,634,425	100 0
		(b) By	) Distar	nce Exclu	ding Co	orn Belt			
1 - 2	1	90, 903	18.1	46,870	9.4	25,116	7 2	162,889	12.0
3 - 4	2	89,890	17.9	79,941	16.0	31, 387	90	201, 218	14 9
5 - 6	3	55,638	11.1	81, 414	16 3	43, 129	12 3	180, 181	13 3
7 - 8	4	59,355	11 8	38, 311	7.7	31,545	9.0	129, 211	9.5
9 - 10	5	55,433	11 0	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	14 0	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	19 7	176,257	<u>13 0</u>
Total		503,261	100.0	500, 310	100.1	350, 090	100.0	1,353,661	100.0
<del></del>		) By Dista	nce Exc	cluding Tr	acts o	ver 500 A	cres		
			20 0	80 025	18 1	20 005	17 1	204 685	21 7
1 - 2	1	90,000	29.0	120 108	31 4	39 478	23 1	270,066	28.6
3 - 4	2	91,390	21.0	07 832	22 1	34 456	20.2	201,831	21 4
5-6	3	09,040	21.1 0 c	50 186	13 4	21 348	12 5	108, 839	11.5
7 - 8	4	16 794	5 1	33 413	75	18 225	10 7	68, 362	7 3
9 - 10	2	21 559	6 6	20,806	4 7	23 222	13.6	65,586	7.0
11 - 15	0 7	21,550	1 2	9 526	2 1	3, 127	1 8	16,623	18
10 - 20	6	3,310	04	2,020	07	960	0.6	5,175	0.5
21 - 30 31 and over	9	695	0.2	164	· ·	630	0.4	1,489	02
Total	Ū	329,033	100.0	443,082	100 0	170, 541	100.0	942,656	100 0
(d)		stance Evo	luding	Corn Bel	t and	Tracts ov	er 500	Acres	
	- <u> </u>	BO EIE	08 8	Ac 970	17 0	25 116	18.0	144 501	21.8
1 - 2	1	12,010	21.7	70 041	30.6	30,687	22.1	180, 281	27.2
5 - 4	2	55 639	20.0	52 261	20.0	25 758	18.5	133,657	20.2
0-0 7 9	3	22,030	8 9	38 311	14.7	17.628	12 7	78, 899	) 11 9
1 - 0	5	15 156	5.8	21 879	8.4	15,065	10 8	52,050	) 79
9 - 10 11 - 15	5	10 007	76	12 084	4 6	20. 182	14 5	52.173	7.9
16 - 20	7	3 577	14	6, 963	2.7	3,127	2.2	13,66'	7 2 1
21 - 30	8	1, 283	0.5	2.932	1 1	960	07	5, 175	50 <u>8</u>
31 and over	· 9	695	0.3	164		630	05	1,489	0 2
Total	-	261,384	100.0	261,355	100.0	139, 153	100 0	661, 892	2 100. 0

TABLE 4 TRES SOLD BY TYPE OF ROAD BY DISTANCE

 $^1$  Adapted from tabulations compiled from March 1958 survey for  $(\underline{10})$   $^3$  From nearest trading center.

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  $^{12}$ 

Price per					Acres	Sold						
Acre (\$)	1-2 Mi	3-4 Mi	5-6 Mi	7-8 Mi	9-10 Mi	11-15 Mi	16-20 Mi	21-30 Mi	Over 30 N	li Total	Corn	Total E
					(a) Dirt	Roads				_	1 Den	TCOINB
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	3,855 3,272 9,523 2,521 (2,636) 6,006 1,862		400 19,891 6,331 (7,589) 13,277 6,680 2,626	8,000 6,859 8,122 5,621 (3,720) 4,918	60 15,738 8,733 (2,760) 3,958 120 260	(3, 040) 51, 076 1, 291 9, 455 63 720	6,000 16,642 9,070 	10,460 16,880 1,755 -	67,528 630 960 - -	92,448 132,796 47,757 53,562 25,081 15,419	3,040 	92, 129, 47, 43, 13, 12,
175 - 200 200 - 225 225 - 250 250 - 275 275 - 300 300 - 325 325 - 350 350 - 375	140 	) 306	1, 414 (1, 109) 19	1,545	1, 784 120 - - - - -	152				3,500 1,924 120 1,566 3,194 1,109 19 573	1,343 1,109	3,: 1,5 1,5 1,8
375 - 400 400 - 425 425 - 450 450 - 475 475 - 500 Over 500		(1, 044)			(400)	438				200 400 1,044 - 766	400 1,044	
Total Corn belt Total excl.	29,095 3,979	40, 178 8, 791	51,827 8,698	35,265 3,720	31, 173 3, 160	63, 195 3, 040	32,532	29,095	69,118	381,478	31,388	
Corn belt	25,116	31, 387	43, 129	31,545	28,013	60, 155	32, 532	29,095	69,118	-	-	350,0
<u></u>	- 14				(b) Grave	l Roads						
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	12,602 2,672 14,837 594 10,701 (25,872) 26,683	31, 751 13, 823 14, 650 18, 214 1, 268 (40, 924)	891 29, 153 7, 167 19, 134 21, 424 1, 185 (35, 398) 36, 093	8, 105 12, 280 5, 495 5, 609 6, 648 (16, 639)	8, 280 13, 622 1, 701 363 8, 630 (10, 919)	36, 875 (8, 642) 30, 149 850 552 848 (80) 3, 042	62,997 1,261 2,615 (2,563) 5,490 - 160	(1, 020) 3, 080 9, 832 810 370 50	72, 150 64 - 100 -	$139, 118 \\106, 172 \\98, 394 \\49, 635 \\57, 485 \\36, 279 \\42, 569$	1,020 	$ \begin{array}{c c} 138,0\\ 106,1\\ 89,7\\ 47,0\\ 57,4\\ 36,2\\ 14,9 \end{array} $
200 - 225 225 - 250 250 - 275	4,121	-	(10, 173) 11, 293	(4,236)	(665)	500	1	-	-	103,850 	102, 194	1,6 5,7
275 - 300 300 - 325 325 - 350 350 - 375	372 (7, 283) 7, 373	(18, 333)	645		-	485	-	1	-	18,705 7,858	18,333 7,283	3
375 - 400 400 - 425 425 - 450 450 - 475 475 - 500 Over 500		40 - - - 195	-	160 - - - 14				-		645 200 - -		6-2
Total Corn belt Total excl.	80, 025 33, 155	139, 198 59, 257	126,985 45,571	59, 186 20, 875	44, 220 11, 584	73, 334 8, 722	72,523 2,563	14,252 1,020	72,314	682,037		3
Corn belt	46,870	79,941	81,414	38,311	32, 636	64,612	69,960	13,232	72, 314	-	-	499,2
					(c) Hard-Surf	aced Roads						
0 - 25 25 - 50 50 - 75 75 - 100 100 - 125 125 - 150 150 - 175 175 - 200 200 - 225 225 - 250	(5, 502) 18, 388 2, 079 6, 246 20, 776 17, 215 9, 072 (12, 079) 22, 079	20, 237 24, 656 7, 796 8, 196 8, 953 (11, 315) 14, 406	8,918 10,261 1,918 8,793 15,366 (7,260) 7,640	27,920 14,180 774 4,029 (2,440) 9,927 570 -	$\begin{array}{r} -\\ 25,960\\ 14,437\\ 1,981\\ 4,356\\ 1,276\\ 5,601\\ 905\\ (540)\ 616\end{array}$	27, 800 1, 762 347 13, 165 290 (200) 661 (1, 451) 2, 056		29,536 - 5,970 6,277 - - 238 -	25,750 8,515 - - - - - -	83,086 100,792 50,664 60,371 56,141 28,453 47,799 21,920 44,741	5,502 - - 2,640 294 1,451 31,194	83,00 95,29 50,66 60,37 56,14 25,8 47,56 20,46 13,54
250 - 275 275 - 300 300 - 325 325 - 350 350 - 375 375 - 400 400 - 425 425 - 450	814 818 - 256 (10,971)	2,502 5,275 - (10,422) - 8,650	1, 419 744 (6, 645) 7, 839	160 3,297 (2,905) 	(1, 028) 130 711	4,869 - - - - -	(99) 118 - -		(560)	462 12,901 8,998 1,871 7,618 11,451 19,521	2,905 1,127 6,645 10,422 10,971	40 12,90 6,00 74 97 1,02 8,55
450 - 475 475 - 500 Over 500	5,239	- 232		-	-			-	-	8,650	-	8,65
Total Corn belt Total excl	113,953 28,552	111,627 21,737	69,543 13,905	64,700 5,345	57,001 1,568	50,950 1,651	26,290	42,021	- 34, 825	5,471	-	5,47
Corn belt	85,401	89,890	55,638	59,355	55, 433	49,299	25, 897	42,021	34, 825	-	-	497,75

Adapted from tabulations compiled from March 1958 survey for (10). Figures in parenthesis are acres in Corn Belt.

		FRICE FER	ACID DI DIOTI	NOD DI NOMBI						_		
per							10.00.10	21. 20. 14	Over 30	Total	Corn	Total Ex
3010	1-2 MI	3-4 Mi	5-6 Mi	7-8 Mi	9-10 Mi	11-15 Mi	16-20 MI	21-30 MI	MI	MI		
				(	a) Dirt Roads				<u> </u>	760		760
25	2 855	1 225	400	300 642	2,790	(3. 040) 11. 103	847	960	630	24, 572	3,040	21,532
75	3, 333	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 25,081	10,349	43,213
125	2,521	(7, 747) 10, 779	6,680 2,626	(3,720) 4,918	260	720	820	-	-	15,419	2,636	12,783
175	1,862	1,638	2,020	-		-		-	-	3,500	-	3,500
200	140	· •	-	•	1, 784	-	-	-		1,924	-	1,924
225	-	:	1.414	-	120	152	-	1	-	1,566	-	1,566
275	(1,343)	306		1,545	-	-	-	-	-	3, 194	1,343	1,851
300	- 1	-	(1, 109)	-	- '	-	-		:	1,109	1,109	19
325	- 573	-	- 19	-		-	-	-	-	573	-	573
375	-	-	-	200	-	-	-	-	-	200	-	200
400	-	-	-	-	(400)	-	-	-		400	400	1 -
425		(1.044)	-	-	- (400)	-	•	-		1,044	1,044	- 1
475	-	•	-	•	-	-	-	-	-	-	-	-
500	-	-	-	-	•	438	-	-		766		766
500		248		· · ·	·				1 1			
	29,095	39, 478	34,456	21, 348	18,225	23, 222	3,127	960	630	170, 541	31,388	-
belt	3,979	8, 791	8,698	3, 720	3,160	3,040	-	-		•	-	1
excl n belt	25, 116	30, 687	25, 758	17,628	15,065	20, 182	3, 127	960	630	-	•	139, 153
					b) Gravel Roads	μ						
25		-	891		-		-	2,060		2,951	-	2,951
50	12,602	-	-	8, 105	360	3,818	1,261	342	64	26,552	9 642	26,552
75		31,751	7,167	12,280	13,622	(8,642) 13,640	2,615	370	100	49,635	2,563	47.072
100	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	27 618	33,392
175	10,701	1,268	(15 198) 16 093	(16,639)	(10, 919)	(80)		1 110		103,850	102, 194	1,656
200	(25, 872) 20, 085	- (40, 524)		-		-	-	-	-			
250	4, 121	-	(10, 173) 11, 293	(4, 236)	(665)	500	-	-	•	20, 815	15,074	5,741
275	-	(19 223)	-	-	1 :	1 :	-	1 -	1 1	18,705	18, 333	372
300	3/2	(10, 333)		.			-	- 1	-	-	-	
350	(7, 283) 7, 373	-		-	1 -	485	-	-	-	7,858	7,283	575
375	-	40	645	160		1 -	-	]		200		200
425	:	-	-	-	-		-	-	-	-	- 1	-
450	-		-	-	-	- 1	-	1 :		-	1 :	1 :
475		1 ]	:	-		.		- 1	-	-	- 1	-
500	70	195	- 1	14	-	33	· _ ·	· ·	<u> </u>	312	<u> </u>	312
	80, 025	139, 198	97,832	59, 186	33,413	20, 806	9,526	2,932	164	443,082	-	
belt	33, 155	59,257	45, 571	20,875	11,584	8, 722	2,563				181, 727	-
excl	46 870	79,941	52.261	38,311	21,829	12, 084	6,963	2,932	164	-	- 1	261,355
n ben	40,010		1		<u> </u>	l	• • • • • • •	· ··		·	<u></u>	
	·	·	T	(e	c) Hard-Surface	I Roads	r				<del></del>	T
25		-	-	-	.:			136	1	136	- 1	136
50		· ·		5 705	120	1,762	660		135	2,677	1 :	17.049
100	6,246	1 :	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	2 640	56, 141
150		7,796	8,793	(2,440) 9,927	1,276	(200) 661	(294) 1, 183	238	1 - 1	47,799	2,040	47.505
200	9,072	8,953		570	905	(1,451) 2,056	364	-		21,920	1,451	20, 469
225	(12,079) 22,079	(11, 315) 14, 406	(7, 260) 7, 640	-	(540) 616	-	-		[ -	44,741	31, 194	13,547
250		302	1 419	160	1 :	4,869	-	1 1	1 :	12,901	1 1	12.901
300	818	5, 275	1,415	(2,905)	-		-	-	· ·	8,998	2,905	6,093
325	•	-	744		(1,028	- 10	(99)			1,871	1,127	744
350	256	(10 422)	(6, 645)	855	130	1 :	-	1 1	560	11,451	10,422	1,029
400	(10,971)	-	7,839	- 1	711		- 1		-	19,521	10,971	8,550
425	1				- 1	· ·	1 - 1	1 -	1 :	8 650	1	8 850
450	1	8,650		1 :	1	:	1 :	:	1 :		1 -	}
500	1 -	1	1 -	1 -				•	· ·		- 1	
500	5,239	232	<u> </u>				· _ ·	I	<u> </u>	5,471	I <u> </u>	5,471
Ļ	95, 565	91, 390	69,543	28, 305	16,724	21,558	3,970	1, 283	695	329,033	67 840	
belt	23,050	21, 737	13,905	5, 345	1,568	1,001	393	-		· ·	01,049	-
rn belt	72,515	69,653	55,638	22,960	15, 156	19,907	3,577	1, 283	695	<u> </u>		261,384

TABLE 6 PRICE PER ACRE BY DISTANCE BY NUMBER OF ACRES SOLD EXCLUDING SALES OVER 500 ACRES 1/2

r scil 72,515 69,653 55,638 pred from tabulations compiled from March 1958 survey for (<u>10</u>) ares in parentheses are acres in Corn Belt

TABLE (							
SIZE OF TRACT	BY DISTANCE BY NUMBER	OF SALES'''					

					1	lumber of	Sales					
Size of Tract (acres)	1-2 Mi	3-4 Mi	5-6 Mi	7-8 Mi	9-10 Mi	11-15 Mi	16-20 M	i 21-30 Mi	Over 30	Total Mi	Corn Belt	Total Exci Corn Belt
			_		(	a) Dirt Ro	ads			•		·
0 ~ 50 50 - 100	1	4	4	:	:	1	-	- 1	- "	9	-	9
100 - 150	(33) 50	(9) 75	(9) 58			9		- 1	- 1	55	-	55
150 - 200	59	(39) 95	42	17	(16) 24		1 2	-	-	229	50	179
200 - 250	24	4	(36) 80	(18) 43	1 (10) 24		3		-	246	55	191
250 - 300	-	12	-	11	1 ř	36	1	1 1		191	24	137
300 - 350	5	20	- 1	5	27	(9) 9			-	69		50
350 - 400	14		5	-	1 1	1	- 1	_	-	19		10
400 - 450	9	- 1	5	- 1	- 1	- 1	2	- 1	-	16		16
450 - 500			-	-	-	- 1	-	2	-	2	-	2
Over 500	-	1	31	18	20	38	26	19	13	166	- 1	166
Total	172	234	223	122	104	135	41	91	15	1 047		
Corn belt	33	48	44	18	16	100	1	10	19	1,007	1	- 1
Total excl			1		}	l i	-	-	-	-	100	-
corn belt	139	186	179	104	88	126	41	21	15	-	-	899
_			-		(ь)	Gravel Ro	ads					
0 - 50	1	7	-	2	1	1	-	1	-	13		13
50 - 100	34	4	8	6	11	(1) 5	6		2	76	1	75
100 - 150	(57) 149	118	(75) 196	94	(5) 10	11	-	1 1	- 1	579	137	442
150 - 200	(172) 215	(373) 446	(196) 264	(126) 167	26	5	3	1	-	1.127	867	260
200 - 250	24	17	3	29	(52) 92	19	-	-	-	184	52	132
250 - 300	] 1	61	16	- 1		(33) 36	2	-	-	116	33	83
300 - 330			40		1	-	-	2	-	51	-	51
400 - 450		1 11	-	17	17	-	3		-	114		114
450 - 500	30			20		4	(6) 10	-	-	64	6	58
Over 500	1 ]		10	1		1		1.0.1	-	24	-	24
						48		(1) 13	6	139	1	138
Total	460	738	575	342	175	130	41	18	8	2.487	-	-
Corn belt	229	373	271	126	57	34	6	1	- 1	_	1.097	-
Total excl											-,	
corn belt	231	365	304	216	118	96	35	17	8	-		1,390
					(c) Har	d-Surfaced	Roads					
U - 50	11	9	-	-	2	2	+	•	•	24	-	24
50 - 100	28	5	7	10	4	(3)6	1	5	-	66	3	63
100 - 100	(173) 480	(76) 278	(54) 181	(22) 87	(5) 18	27	5	3	1	1,080	330	750
200 250		(69) 155	(43) 96	(13) 38	12	. 15	1	-	-	317	125	192
250 - 300	50	42	40	10	(5) 53	(6) 7	4	-	-	217	11	206
300 - 350	<b>F</b> 0	66	32	11	-	10	(1) 6	-	2	107	1	106
350 - 400			3	-	-	16	2	-	-	21	-	21
400 - 450	29	90	14	-	-	13	-	-	-	23	•	23
450 - 500			.1	° _		-	-	-	- 1	81	-	81
Over 500	(5) 16	25		27	19	-			ā			
Total						<u> </u>		<u> </u>				120
Company	044	566	388	191	108	103	42	16	9	2,067	-	-
Total evol	119	142	97	35	10	9	1	- [	-	-	475	-
corn helt	468	421	201	150								
	200	161	291	100	98	94	41	16	9	-	- 1	1.592

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (<u>10</u>) <sup>3</sup>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

				Miles	from	Neares	st Tradi	ng Center		
Price or Size	1-2	3-4	5-6	7-8	9-10	11-15	16-20	21-30	Over 30	Avg
Average price per acre (\$) Average size of tract (acres)	109 195	110 168	80 241	68 282	66 301	50 491	42 794	30 1,385	11 4,609	60 361
tedian price per acre (\$) fedian size of tract (acres)	94 171	98 158	72 206	59 219	50 264	40 272	40 537	31 1, 181	9 2,689	44 199
verage price per acre excluding corn belt (\$)	98	98	73	62	59	51	42	30	11	54
verage size of tract excluding corn belt (acres)	211	168	250	292	324	503	794	1, 385	4,609	394
fedian price per acre excluding com belt (\$)	89	88	55	53	47	40	40	31	9	41
fedian size of tract excluding corn belt (acres)	185	150	195	214	306	265	537	1, 181	2,689	206
verage price per acre excluding sales over 500 acres (\$)	109	116	105	68	68	73	42	30	39	99
sales over 500 acres (acres)	195	165	190	198	219	227	208	475	325	193
fedian price per acre excluding sales over 500 acres (\$)	94	98	90	82	68	60	62	38	39	87
fedian size of tract excluding sales over 500 acres (acres)	171	158	193	208	196	244	185	475	325	182
verage price per acre excluding corn belt and sales over 500 acres (\$) verage size of tract excluding	98	105	98	93	77	78	42	38	39	93
corn belt and sales over 500 acres (acres)	211	165	185	192	229	218	208	475	325	19
fedian price per acre excluding corn belt and sales over 500 acres (\$) fedian size of tract excluding	89	89	82	74	63	77	62	38	39	- <b>8</b>
corn belt and sales over 500 acres (acres)	185	150	176	194	250	237	185	475	325	18

TABLE 8 PRICE PER ACRE AND SIZE OF TRACT BY MILES FROM NEAREST TRADING CENTER, DIRT ROADS'

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (10)

.

TABLE 9									
PRICE PER ACRE AND SIZE OF	TRACT BY MILES FROM GRAVEL ROADS <sup>1</sup>	NEAREST TRADING CENTER,							

				Mile	s from	Neare	st Tradi	ng Cente	r	
Price or Size	1-2	3-4	5-6	7-8	9-10	11-15	16-20	21-30	Over 30	Avg
Average price per acre (\$) Average size of tract (acres)	163 173	148 198	122 214	116 194	99 256	59 550	21 1,818	36 683	13 9,038	99 278
Median price per acre (\$) Median size of tract (acres)	172 161	138 177	108 166	117 171	78 222	50 283	14 432	35 559	13 2,632	74 174
Average price per acre excluding corn belt (\$)	118	97	79	83	75	58	18	38	13	64
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
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
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 (\$) Average size of tract excluding	118	97	88	83	85	83	75	33	68	97
corn belt and sales over 500 acres (acres)	183	221	190	204	215	205	242	195	75	196
Median price per acre excluding corn belt and sales over 500 acres (\$) Median size of tract excluding	119	90	82	73	69	54	71	18	80	90
corn belt and sales over 500 acres (acres)	144	187	153	157	209	208	200	175	75	168

35

٠

## TABLE 10 PRICE PER ACRE AND SIZE OF TRACT BY MILES FROM NEAREST TRADING CENTER, HARD-SURFACED ROADS<sup>1</sup>

Druce or Size				Mil	es fro	m Near	est Trad	ng 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 size of tract (acres)	185 174	194 196	185 179	92 332	80 527	66 488	55 1,328	32 862	19 <sup>2</sup> 3,678	128 274
Median price per acre (\$) Median size of tract (acres)	164 134	160 148	158 153	58 149	54 217	23 211	43 454	18 150	$17^{2}$ 1, 264	96 144
Average price per acre excluding corn belt (\$) Average size of tract excluding	165	173	164	81	75	62	53	32	19 <sup>2</sup>	109
corn belt (acres)	183	212	190	374	563	518	1,354	862	3,678	311
Median price per acre excluding corn belt (\$) Median size of tract excluding	151	125	144	53	53	22	43	18	17 <sup>2</sup>	83
corn belt (acres)	132	149	161	156	219	200	244	150	1,264	147
Average price per acre excluding sales over 500 acres (\$) Average size of tract excluding	181	216	185	156	161	134	124	94	50 <sup>2</sup>	185
sales over 500 acres (acres)	150	168	179	164	187	218	214	94	225	167
Median price per acre excluding sales over 500 acres (\$) Median size of tract excluding	179	189	158	134	153	94	98	89	50 <b>°</b>	164
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 (\$) Average size of tract excluding corn belt and sales over	145	195	164	141	149	130	116	94	50²	161
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 (\$) Median size of tract excluding corn belt and sales over	160	157	144	127	147	84	80	76	50 <sup>2</sup>	144
500 acres (acres)	131	146	161	142	209	188	225	90	262	143

Adapted from tabulations compiled from March 1958 survey for (10).

"Two sales omitted in code 19-9, California 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 mi 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 lies 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 mi 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 differentials 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<sup>1</sup>

				Mil	es from	Neares	st Trad	ing Cent	ter	
Price or Ratio	1-2	3-4	5-6	7-8	9-10	11-15	16-20	21-30	Over 30	All Distances
Price per acre, total (\$). Hard-surfaced Gravel Dirt Ratio of total price per acre. Hard-surfaced to gravel Hard-surfaced to dirt	164 172 94 0.953 1 745	160 138 98 1.159 1 633	158 108 72 1.463 2.194	58 117 59 0.496 0.983	54 78 50 0.692 1.080	23 50 40 0.460 0.575	43 14 40 3.071 1.075	18 35 31 0.514 0.581	17 <sup>8</sup> 13 9 1.308 1.889	96 74 44 1.297 2.182
Gravel to dirt	1.830	1.408	1.500	1 983	1.560	1 250	0 350	1.129	1 444	1.682
Price per acre excluding corn belt (\$). Hard-surfaced Gravel Dirt Ratio-of price per acre excluding corn belt.	151 114 89	125 90 88	144 80 55	53 73 53	53 65 47	22 47 40	43 14 40	18 35 31	17 <sup>2</sup> 13 9	83 51 41
Hard-surfaced to gravel Hard-surfaced to dırt Gravel to dırt	$1.349 \\ 1 697 \\ 1.281$	$1.389 \\ 1.420 \\ 1 023$	1.800 2.618 1.455	0.726 1.000 1.377	0 815 1.128 1.383	$0.468 \\ 0.550 \\ 1.175$	3 071 1.075 0 350	$0.514 \\ 0.581 \\ 1.129$	$1.308 \\ 1.889 \\ 1.444$	$1.627 \\ 2.024 \\ 1.244$
Price per acre excluding sales of tracts over 500 acres (\$): Hard-surfaced Gravel Dirt Ratio of price per acre excluding sales of tracts over 500 acres. Hard-surfaced to gravel Hard-surfaced to dirt	179 172 94 1.041 1.904	189 138 98 1.370 1.929	158 131 90 1.206 1.756	134 117 82 1.145 1.634	153 128 68 1.195 2.250	94 62 60 1.516 1 567	98 79 62 1.241 1.581	89 18 38 4.944 2.342	50 <sup>3</sup> 80 39 0.625 1.282	164 128 87 1.281 1.885
Gravel to dirt Price per acre excluding corn belt and sales of tracts	1.830	1.408	1.456	1.427	1.882	1.033	1.274	0.474	2.051	1.471
over 500 acres (\$): Hard-surfaced Gravel Dirt Ratio of price per acre	160 119 89	157 90 89	144 82 82	127 73 74	147 69 63	84 54 77	80 71 62	76 18 38	50 <sup>8</sup> 80 39	144 90 81
excluding corn belt and sales of tracts over 500 acres Hard-surfaced to gravel Hard-surfaced to dirt Gravel to dirt	1.345 1.798 1.337	1.744 1.764 1.011	1.756 1.756 1.000	1.740 1 716 0.986	2.130 2.333 1.095	1.556 1.091 0.701	1.127 1.290 1.145	4.222 2.000 0.474	0.625 1.282 2.051	1.600 1.778 1.111

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (<u>10</u>).

<sup>3</sup>Two sales were omitted in California specialty at \$351 per acre.



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. Median price per acre of farm real estate by type of road surface, by distance in miles 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'	

Acres Sold by	Aver	age Prie	ce per Acre (\$)		Ratio Ol	otained	l fro	om Means	Ratio Ob	tained fro	m Medians
Type of Weights	Dirt	Gravel	Hard-Surfaced	HS/	Gravel	HS/D	ırt	Gravel/Dirt	HS/Gravel	HS/Dirt	Gravel/Dirt
Total acres sold											
Constant weights	77	109	130	1	193	1 6	88	1 416			
Own weights	60	99	130	1	313	2 10	67	1.650	1 329	2.235	1 682
Total acres sold excluding corn											
Constant weights	68	76	110	1	447	1 6	18	1 118			
Own weights	54	64	110	1	719	2 0	37	1.185	1 719	2 057	1 243
Total acres sold excluding sales over 500 acres		•-									
Constant weights	101	141	185	1	312	1.8	32	1 396			
Own weights	99	138	185	1	341	1.8	69	1 394	1 282	1 886	1 471
Total acres sold excluding corn belt and sales over 500 acres											
Constant weights	95	5 97	161	1	660	16	95	1 021			
Own weights	93	3 97	161	1	660	17	31	1 043	1 599	1 777	1 111

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 statistically significant, may in fact add little to the

explanation of total variance yet unexplained. 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 little to the knowledge of circumstances that govern the general pattern. It cannot be expected that a simplified 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 guide lines 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 gratifying 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.





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 inordinate 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 mi 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,  $X_1$ ; distance to nearest trading center,  $X_2$ ; total acres sold,  $X_3$ ; and number of sales,  $X_4$ . These coefficients were arranged in a matrix and were solved by eliminating 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:

$$\frac{X_1}{\sigma_1} = \beta_{12,034} \frac{X_2}{\sigma_2} + \beta_{13,024} \frac{X_3}{\sigma_3} + \beta_{14,023} \frac{X_4}{\sigma_4}$$

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.

$$\mathbf{r}_{12,3} = \frac{\sum \mathbf{x}_{1,3} \mathbf{x}_{2,3}}{\sigma_{1,3} \sigma_{2,3}} = \frac{\mathbf{r}_{12} - \mathbf{r}_{13} \mathbf{r}_{23}}{\sqrt{(1 - \mathbf{r}_{13}^2)(1 - \mathbf{r}_{23}^2)}}$$

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

Coefficient or Variance <sup>2</sup>	Dirt	Gravel	Hard-Surfaced
Zero order coefficients:			· · · · · · · · · · · · · · · · · · ·
<b>F</b> 18	-0.188441	-0.234564	-0.382419
Г <u>1</u> 3	+0.935545	+0,966996	+0.935668
Γ14	+0.900364	+0.971124	+0.941812
r <sub>23</sub>	-0.045785	-0.244488	-0.401072
<b>Г</b> 94	-0.316444	-0.275983	-0.424529
Г34	+0.841700	+0.983802	+0.952435
First order coefficients:			- ~
r <sub>13, 2</sub>	+0.944817	+0.965041	+0.924237
r <sub>14,2</sub>	+0.902446	+0.970077	+0.931712
<b>Г34. 2</b>	+0.872940	+0.983191	+0.943052
r 12, 3	-0.412675	+0.007508	-0.022116
Γ14.3	+0.592073	+0.433319	+0.470996
r24.3	-0.515235	-0.203977	-0.152365
Second order coefficients:			
r12, 34	-0.155814	+0.108688	+0.056945
<b>F</b> 13, 94	+0.747228	+0.254252	+0.377316
r14.23	+0.486055	+0.444224	+0.473247
r <sup>2</sup> r <sub>12, 34</sub>	+0.024278	+0.011813	+0.003243
r <sup>2</sup> , 24	+0.558350	+0.064644	+0.142367
r <sup>2</sup> 4, 23	+0.236249	+0.197335	+0.223963
Multiple coefficients squared:			
R <sup>2</sup> <sub>1, 234</sub>	+0.920945	+0.947893	+0.903412
R <sup>2</sup> <sub>1, 23</sub>	+0.896490	+0.935084	+0.875534
R <sup>2</sup> <sub>1,24</sub>	+0.820999	+0.944292	+0.887379
$R_{1_4}^2$ 34	+0.918977	+0.947271	+0.903098
Variances (\$):			
Total $\sigma_1^2$ :	33, 572, 998, 399	1, 318, 348, 968, 334	142, 349, 398, 932
Explained $\sigma_{1234}^2$	30, 918, 885, 011	1,249,653,758,641	128, 600, 155, 188
Unexplained $\sigma_{1,234}^2$	2,654,113,388	68,695,209,693	13, 749, 243, 744

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (10). <sup>2</sup>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.

- - - - <sup>1</sup>

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  $r_{12}^2 = 0.146244$ . 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  $R^2_{1,34}$ , 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,  $R^2_{1,234}$ , multiple coefficient of determination, = 0.903412 for hard-surfaced roads, taking into account the influence of distance, acres, and number of sales, and  $R^2_{1,34} = 0.903098$ , 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 1s, therefore,

$$\mathbf{r}^{2}_{12,34} = \frac{\mathbf{R}^{2}_{1,234} - \mathbf{R}^{2}_{1,34}}{1 - \mathbf{R}^{2}_{1,34}}$$
$$= \frac{0.000314}{0.096902}$$
$$= 0.003240$$

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.,

$$r^{2}_{14,3} = \frac{R^{2}_{1,34} - r^{2}_{13}}{1 - r^{2}_{13}}$$
$$= \frac{0.903098 - 0.875475}{1 - 0.875475}$$
$$= 0.221827$$

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.,

$$r^{2}_{13,4} = \frac{R^{2}_{1,34} - r^{2}_{14}}{1 - r^{2}_{14}}$$
$$= \frac{0.903098 - 0.887010}{1 - 0.887010}$$
$$= 0.142384$$

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.

4	6
-	~

	,										
Distance <sup>2</sup> (Mi)	Number of Areas Sampled	Total Number of Acres	Number of Sales	Size of Tract (acres)	Total S	ales (\$)	Average	Sales (\$)	Price P	er Acre (\$)	Percent Error in Price per
_	L	3010			Actual	Computed	Actual	Computed	Actual	Computed	Acre
						(a) Dirt Roa	ds				
10	14	19,873	136	146 1	2, 149, 450	2,058,750	15 804 78	15 137 87	108 16	103 60	
30	14	28, 814	188	153 3	3,052,880	2,948,550	16,238 72	15 683 78	105 95	102 33	. 25
50	12	29,664	161	184 2	2,712,933	2 800 192	16 850 51	17 302 50	01 46	102 33	+ 3 5
7 0	13	18, 263	1 102	179 0	1 414 620	1 574 692	13 969 92	15 429 16	77 40	94 40	- 31
9 0	9	8,427	47	179 3	598 858	615 589	12 741 66	12 007 62	71 00	00 24	- 10 2
12 5	9	14,579	60	243 0	1 003 202	1 043 075	16 720 03	17 794 50	60 01	73 00 1	- 27
17 5	5	9,917	15	661 1	600 159	518 497	40 010 60	24 566 47	60 61	61 00	- 38
25 0	1	960	2	480 0	43 000	15 738	21 500 00	7 960 00	44 70	16 20	+ 10 0
35 0	-	-	-	-	40,000	15, 750	21,000 00	1,009 00	44 79	10.39	+ 173 2
Total	77	120 407					_	-	-	-	-
Total	1 11	130,497	711		11,575,102	11, 575, 083					
Avg		1		183 5			16,280 03	16,280 03	88 70	88 70	0 0
				•	•	(b) Gravel Ro:	ads			ــــــــــــــــــــــــــــــــــــــ	
10	18	62,818	445	141 2	11, 298, 477	10.969.575	25 389 84	24 650 73	170 86	174 29-1	
30	18	112, 521	662	170 0	18,851,849	18,730,003	28,477 18	28 293 06	167 54	166 46	+ 30
50	17	87, 320	499	175 0	13,061,707	14.047.603	26, 175 77	28 151 51	149 58	160 87	- 70
70	16	44,600	261	171 0	6.477.822	6,694,824	24, 819 24	25,650,67	145 24	150 11	- 70
90	15	23,046	118	195 3	3,050,176	2,620,983	25,848 95	22 211 72	139 35	113 73	- 32
12 5	15	20, 279	72	281 7	1,992,271	1, 725, 895	27,670 43	23 970 76	98 24	85 11	+ 10 4
17 5	11	12, 195	25	487 8	760, 200	753,073	30,408.00	30 122 92	62 34	61 75	+ 13 4
25 0	9	3,243	11	294 8	382,100	258, 437	34, 736 36	23 494 27	117 82	79 69	. 47 0
350	2	181	2	90 5	19,675	93,962	9,837 50	46.981 00	108 70	519 13	- 79 1
Total	121	366 203	2 095		55 804 977	EE 904 9EE		,		010 10	- 15 1
Avg.		1,	2,000	174 8	00,004,217	33,034,335	26 679 85	26 679 88	159 69	150 69	
					(c) H	lard-Surfaced	Roads	10,010 00 1	102 00	102 00 1	00
10	15	43.118	303	142 3	6 985 723	7 199 061	99 055 10	00 EGO 4E 1	100.01		
30	15	48,914	325	150 5	8 945 300	7 808 479	23,000 19	23, 300 45	162 01	165 20	- 19
50	16	41,596	265	157 0	6 032 480	6 510 281	21,024 00	24,302 99	162 88	161 48	+ 13 3
70	16	22,018	154	143 0	3 545 045	3 532 570	22, 104 00	24,001 00	145 03	156 73	- 75
9.0	16	17.618	95	185 5	2 550 543	2 405 011	25,015 11	22,930 02	161 00	160 44	+ 04
12 5	16	12.639	68	185 9	1 412 650	1 718 601	20,041 21	20,010 90	144 77	136 51	+ 61
17 5	10	7,627	22	346 7	669 433	820 241	30 499 77	20,214 00	111 77	135 98	- 17 8
250	4	769	- 8	96 1	91 850	183 525	11 481 25	31,203 00	07 17	107 54	- 18 4
350	1	135	1	135 0	6,775	39,060	6,775.00	39 059 52	50 10	238 00	- 50 0
Total	109	194 434	1 241		30 330 000	20.020.000	-,	00,000 02	00 10	203 33 1	- 02 /
Avg	100	101,101	1, 411	156 7	30, 239, 090	30,239,920	24 367 36	24 367 39	155 59	166 69	
			(4) Com				_ 21,001 00	21,001 00 1	100 00	100 00	0.0
				olnea To	al Dirt, Grave	and Hard-Sur	faced Roads in	Rural Areas			
30	47	125,809	884	142 3	20,433,650	20, 151, 386	23, 114 99	22, 795 69	162 42	160 17	+ 14
50	45	150,249	1,175	161 9	30, 850, 128	29, 577, 025	26,255 43	25,171 93	162 16	155 46	+ 43
70	45	200,000	920	171 4	21,807,120	23, 367, 076	23,575 26	25,261 70	137 51	147 35	- 67
in l	40	40 001	960	104 2	11,437,487	11,802,095	22,122 80	22,828 04	134 75	139 04	- 31
12 5	40	47 407	200	100 0	0, 199, 577	5,641,583	23,844 53	21,698 40	126 29	114 92	+ 99
17 5	26	20 720	200	470 0	4,408,123	4,487,661	22,040 62	22,438 31	92 81	94 48	- 18
25 0	14	4 079	21	419 7	2,029,792	2,091,811	32,738 58	33,738 88	68 25	70 34	- 30
35 0	3	2,916	21	236 8	516,950	457, 700	24,616 67	21,795 24	103 97	92 06	+ 12 9
				100 3	26,450	133, 022	8,816 67	44,340 67	83 70	420 96	- 801
Fotal	307	691,134	4,047		97, 709, 277	97, 709, 359					
Avg				170 8			24, 143 63	24, 143 65	141 38	141 38	0 0

TABLE 14 SUMMARY OF ACTUAL AND COMPUTED DATA BY MULTIPLE REGRESSION TECHNIQUES

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (<u>10</u>)

<sup>2</sup>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 inversely 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.

	Dir		Gra	vel	Haro Surfa	d- ced
Total	Price per Farm (\$)	Size of Tract (acres)	Price per Farm (\$)	Size of Tract (acres)	Price per Farm (\$)	Size of Tract (acres)
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						
corn belt	\$18.000	194	\$20,300	209	\$28,700	178

#### TABLE 15

## PRICE PER FARM AND SIZE OF TRACT 1

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (<u>10</u>).

#### 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 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.

	CE <sup>R</sup> PROM NEAREST TRADING CENTED DIET DOLLED	
	DISTANC	
. م	<b>UNA</b>	
	SALES	
91	5	
BLE	BER	
£.	MUN	
	ВΥ	
	ACT	
	Ĕ	ĺ
	ю а	
	Z18	l
	ą	l
	GRE	
	ERA	
	R R	
	Ē	
	TEEN	
	E H	
ļ	8	
	ONSH	
ļ		
- 2	뷛	

*,* .

,

Size of 1	ract								Price	e per A	cre														
(acre:	<u>10</u>	-25 25-5(	0 50-7	5 75-1(		100-		150-	200		-	4						ļ	ľ	ľ				Medians	
	+					135	22	175	5 6 6 6	35 25	200	5 300	325	325-	350-	375- 400	400-425	425- 450	450- 475	475- 500	Over 500	Total	Price per Total	c Acre (\$) Excluding	Dia- tance
0	25	·	-																1	$\uparrow$		1		Corn Belt	(ml)
25 -	60				$\left  \right $	╡	╞	+	╀	╀	$\downarrow$	$\downarrow$	4					1	+	$\neg$	I.a	n	400	400	55
20-	75 14		3,24	1,		1e 1e 3a	-	3	┢	-	le							1		┥	2	8	139	139	35
75 -	100		12,34	5.3,2,		, s		<u> </u>	┝	;	5							ϯ	╎		1.	ន	129	129	34
901	135				Ť			-	+		-	_									5	32	133	133	3
		10%0	176).1	917 52	-	2 8	<u>,</u>	15 <sub>8</sub> 17,	-									(8)	[	†	4	1	136	E	35
- 125 -	150 24	2,14	5=4.	8,25,1	11	4 12					(10]	(8)						$\uparrow$	$\uparrow$		╈	(32)	l a	84	
150 -	176		16.8,	8. 2218.		1.0	2015,	┢	-	-	-	$\downarrow$						+	╈	╉	┥	1 <u>9</u>		5	
	╉	+	+	24,214	+	╉	-			-	_						_					143	86	86	3 1
175 -	200		46133	2a (14s)	2	39.) (2)		<u> </u>						1431			(25)		1	+	┢	101	5	Ę	
200 -	225	276	13,47	214		3	$\left  \right $	+-	+	$\downarrow$	$\downarrow$	$\downarrow$	Ţ		T		1	+	+	╉	┥	(22)		2	;
				(36a)						-												120	82	8)	6 9
	+		_	14	_									_								È	$\left( \right)$	\	
225 -	250	4	8653	14,10,	25	ۍ ٤	╞		-	-	_			1	T		1	╀	╈	╀	╉				
250 -	275	3	3	6	┢	╀	╀	-	+-	$\downarrow$			Ţ	╎	T			-†	┥	+		7	66	66	44
275 -	8				╀	+	╀	=	-	+	8			╡	7							35	63	83	6 6
006		:		8719AT	╀	╉	+	╉	_	$\downarrow$	4											31	72	72	6 01
	2	9914	141244	*	╉	+	-				_										┢	\$	62	63	
- 926	092	a (-							_										╞	┝	╞	52	41	5	5 6
350 -	5				+	╀	+	+	+	+	+	Ţ			1	1		-	-	-	_	(8)	_	:	2 1
375 -	100 14			-	14	+	╀	╀	1	#	1	Ţ	Ţ		1		+	+	-			4	49c	249c	5 0
400 -	125	4,2,			┢	-	╀	╀	$\downarrow$		$\downarrow$	T		╎	1	1	╋	+	-	-	_	5	50	20	11
425 - 4	50	J.	-	-	╀	+	+	+	$\downarrow$	_	-		1	_†	+	1	+	+			-	8	40	40	15
450 - 4	12			+	+	+-	+	╉	$\downarrow$	_	_			-+	1	1		-	_			10	30	30	2 0
475 - 5	8	2			+	+	╀	+		_				1		-		_	_	_		•		,	.
500 - 1,(	10,	1. 18.1,20	a5, 2alala	-	+	╀	+	+	$\downarrow$	$\downarrow$			+	╈	╡	1	┨	+		$\square$		~	45	45	25 0
		16,5,8,	6,8,															-				120	81	19	0 6
1,000 - 1,5	8 8				╞	+-	╀	╀	$\downarrow$				╉	+	╉	+		╡	+	$\rightarrow$	-	-			
1,500 - 2,6	8	1548	2		╀	+	+	+	$\downarrow$	$\downarrow$			╉	╉	┫	+	+	+		-	_	5	3	22	25 0
2,000 - 5,C	00 10,				╞	╀	╞		$\downarrow$		Ţ		╋	┥	╡	┥	-	+	┥	-	_	28	15	15	14 7
5, 000 - 10, 0	00 1,13	1,			╞	-	-	╞			Γ		╎	╀	╉	╉	╉	+	╉	+	+	9		٥ م	rer 30
Total	41	206	192	278	1	1	:	4	<u> </u> .	<u> </u> .			╋	$\dagger$	╀	╀	+	+	+	-	-	-	9	91 19	/er 30
Corn Be	=	<b>e</b>		(50)	[2]		*	<u>-</u>	_	-	21	∞ (§	- -	+	+		-	+	-+	=	-	- 19	-	,	
<sup>a</sup> Subscripte	the codes	for distance						-			(01)	(0)		-		5	<u>e</u>	_	_	_	-	(89)			
bare acres 1	The corr	belt	מיוח הפדבו	st trading c	conter	(I) 1-2	m1, (2) \$	- 1 III, (3	) 5-6 g	al, (4) 7.	-8 mt, (;	5) 9-10 m	11, (6) 11-	-15 ml,	(7) 16-	20 mi, (	8) 21-3(	) ml, (9)	31 mia	nd over	Figur	ea in pa	rentheses		`
c Four sales	m tabulat Californi:	tions complit a specialty	ed from Marc	th 1958 sur-	vey for	<u>9</u>																			

•

48

.

17
TABLE

;

)

•

J

ľ -RELATIONSHIPS BETWEEN PRICE PER ACRE AND SIZE OF TPACT BY NUMBER OF SAIES

$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Size of Trac									Field Field	IT ACTE										CENTE	Y CKA	ж Ля	SON		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	(acres)	;				$\left  \right $		-	╞		are)													X	ledians	
		6-7	5 25-50	20-1	5 75-100	_	100- 125 125 15	12 <u>20</u>	175	- 200-	225- 250	250- 275	275- 300	300- 325	325- 350	350- 375	375- 400	400- 425	425-	450- 4	22-02	Ver 19	dal I	vice per	r Acre (S) xcluding	Dis- tance
3 80 $1.$	6	25		_	1,													1	1	╞	'	+			orn Belt	(mi)
	25 -	50			-	13	 _	-	-						ſ		5	1	1	+	-	-	4	368	388	2 0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	50 -	75	1,			-		╞					5				T		╞	╈		5	<u> </u>	630 <sup>c</sup>	630 <sup>C</sup>	34
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	- 52	00	173e17	3,44	47 1 eBs		1461	1s (1e)	-	_	21,						1		$\uparrow$	+-			B 88	183	183	4 5
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	100 -	125 8,			101	21	34 191 191	44 4341	-	-					1				-+-	+	┽	-	Ξ	+		
						2,3	1																128	141 /	141	63
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	125 -	150		4.7.	10,55,	09	45s 22s2				(2°)				(571)				-	╞	-		22	132	811	0 4
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $						đ	71±2 3+	5			(15,)												(j)			•
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	150 - 1	175	2031	1.27	62391	67.	354 17	(98,	(172	J 28.			118,		36	\$	1	+		┼	╈		619	181		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$					æ	e,	-+	+	(255	<u>-</u>				i									(12)	2		4
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	175 - 2	8	2	10,	28,24	23	13,3	4 4 27	(196	(e							-	$\vdash$	-	┢	┢	2 m :	8	180	115	3 0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	200 - 2	25		12	4.	1		(52s)	4	<b> </b>						1		+		+	╀		196)	155	1	4 6
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	225 - 2	50	15.	5.17.	4	ś	4	╞	-					+	╞	╞	+	+	+	+	-		52)			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $				25,	5	3	5		5											•		1	=	72	72	6 1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	250 - 2	75		<b>5</b>			21s									F	1			-	╞	-	68	69	134	5 8
	275 - 3	8		34-12		4.	-	-			-						╡	1	-	-	-	_	33)			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $				2,			5				4311		_										56	65	65	5 8
	300 - 3	25		-6	1.	34s			Ĺ				ſ	1-	┢	-	t	┢	+-	╉	+	+	+			
390-         394, 373-         400         394, 373-         394, 475-         394, 776-         396, 776-         396, 776	325 - 3	20	1.	_	1,	2								t	$\left  \right $	t	╀	╀	╀	┝	╀	+	;;;			20
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	350 - 3	75		38 <sub>2</sub> 5 <sub>6</sub>							8 <sub>1</sub> 37		1	1	†-	t	†-	+		╀	╀		2 5	3	8	33
400         435         30,20,4 $44^{1}$ (5)         (5)         (5)         (7)         <	375 - 4	8		12,17,	33,	_	_									T			+		╞		2 5	2 1	2 I	1
425 - 450         441         (6)         441         (6)         3         441         (6)         3         44         (6)         3         9         48         10          450 - 475         76         10         76         10	400 - 4	25	30,20,										†-	-	+-	1	+-	╀╌	+-	╉	╀			F 1	5	3 9
450         473         174         104         104         1 </td <td>425 - 4</td> <td>20</td> <td></td> <td>4s47</td> <td>(6,)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td><u> </u></td> <td></td> <td> </td> <td></td> <td>†</td> <td>-</td> <td>+</td> <td></td> <td>+</td> <td>+</td> <td></td> <td>14</td> <td>38 23 38</td> <td>28 38</td> <td>61</td>	425 - 4	20		4s47	(6,)							<u> </u>				†	-	+		+	+		14	38 23 38	28 38	61
415 - 500         33,14417         201         1         1         1         1         1         23         72         72         73         51           500 - 1,000         33,14417         2014         2         3         1         1         250         1250         23         1         25         250         125         3         7         7         7         7         50         13         1         1         250         230         125         3         7 <td>450 - 4</td> <td>75</td> <td></td> <td>746</td> <td>10</td> <td> </td> <td>-</td> <td></td> <td> </td> <td></td> <td></td> <td></td> <td>T</td> <td>t</td> <td><math>\dagger</math></td> <td><math>\dagger</math></td> <td>-</td> <td>╀</td> <td>╈</td> <td>+</td> <td>-</td> <td>+</td> <td>) ()</td> <td></td> <td></td> <td></td>	450 - 4	75		746	10		-						T	t	$\dagger$	$\dagger$	-	╀	╈	+	-	+	) ()			
500 - 1,000 $337$ , 144, 17 $204_1$ $367$ , 144, 17 $204_1$ $367$ , 144, 17 $204_1$ $367$ , 144, 17 $204_1$ $367$ , 144, 17 $204_1$ $367$ , 144, 17 $204_1$ $367$ , 144, 17 $204_1$ $100$ $367$ , 144, 17 $100$ $367$ , 144, 17 $100$ $367$ , 144, 17 $100$ $367$ , 144, 17 $100$ $367$ , 144, 17 $100$ $367$ , 144, 17 $100$ $367$ , 144, 17 $100$ $367$ , 17 $100$ $367$ , 17 $100$ $367$ , 17 $100$ $367$ , 17 $100$ $367$ , 17 $100$ $367$ , 17 $100$ $367$ , 17 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $367$ , 18 $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$ $100$	475 - 5(	8				-		-	-		-		t	$\dagger$	╞	╋	╞	╎	+	+	+		2	12	2	1
	500 - 1, 0	00	38s7a14a1	7. 20el.		L	5					T	T	╋	╞	╀		╀	╉	+	-	+	-	250	250	35
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	1,000 - 1,5	00 (1.) 4.6727	 			<u> </u>		4				$\uparrow$			+	+	+	+				<u> </u>	8 5	34	34	94
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	1,500 - 2,0(	0 1,		-		1	-	Ļ				1		╀	╁	$\dagger$	+	┽	+	-	+	+	Ξ	-+		
5,000-10,000       75a       9       38	2,000 - 5,00	2	28		-	_	-		-			╎	Ť	-	╉	┽	+		┥	+	+	_	7	15	15 15	0
10,000 - 20,000     1     12     18     18     18     18     18     14       20,000 - 40,000     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1     1     1     1     1     1       20,000 - 40,000     1     1     1     1     1     1	5,000 - 10,00	0 7.5.		<b> </b>		L	-				T		T	╀	╀	$\dagger$	+	+	+	┥	+		•	88	38 12	8
20,000     4.     20,000     4.     20,000     4.     2.     3.     2	10, 000 - 20, 00	2					╞	-	1		1	T	+-	╀	+	+	╉	╉	┥	+	+	-	~	<b>8</b>	18 14	3
Total     35     163     286     218     337     225     238     632     28     116     -     123     -     61     4     3     -     -     8     2480     -     1     3     3     0wer 30       ComBell<(1)     (1)     (33)     (6)     -     -     (116)     (116)     (116)     (57)     -     -     8     2,460     -     -     -	20,000 - 40,00	10 1.							L		1	+	╞	+	+	╋	╀	+	╀	+	+	+	-	+	-	
ComBell (1)     (33)     (6)     -     -     (151)     (23)     (10)     (11	Total	35	163	298	218	337	225	23.8	613	â		┢		-		+	+-		╀	+	+	-	_	~	3 Ove	T 30 0
	ComB	(E)		(33)	(9)	:	·	(151)	(803)	(96)	100	1		+		╞	~	+	-	+	•	- 5,4	8	+	•	
					-		-	(Ter)	(020)	(07)	(00)	-	(811)	-	57)	-	-	_	-		_	(1,0	97)	-	-	

. . .

49

1 1 4114 State

b<sup>are</sup> acres in the corn belt c<sup>Adapted</sup> from tabulations compiled from March 1958 survey for (<u>10</u>) chickness five calles California specially at \$781 per acre

RELATIONS	HIPO .	DE 1 # 66	n Flue					_												······					
	_									Pric (d	o per <i>i</i> lollars	Acre )												Modians	
Size of Tract									<b>—</b>		[	T				L					~		Price pe	r Acre (\$)	Dis-
(acres)	0-25	25-50	50-75	75-100	100- 125	125- 150	150- 175	175- 200	200- 225	225- 250	250- 275	300	300-	325-	375	400	425	450	475	500	500	Total	Total	Excluding Corn Beit	tance (ml)
					-				_			<u> </u>									4.	5	388	386	3 2
0 - 25								10							<b>a</b> .	<u>+</u>	<u> </u>				5.	19	295	295	17
25 - 50					1.			<u> </u>	4)44			1.0			2.							32	261	261	17
50 - 75							4.		<u>n</u>	-		<u>**</u> *	711		-	├	<u>├</u>		<u> </u>			34	181	181	6.6
75 - 100		la la		1,3,3,	2	(2)	5	4	۰, v	24			0.0		l "							(3)			
									(3.)		<u> </u>					/09			-			280	332	151	42
100 - 125		1.		5,9,	17,	264	392	2454	(54)	3:	69					(00)					ł	(147)			
					1-13-			3,				-	<u> </u>	(21)	(70)		<del> </del> —		<u> </u>		41.	800	183	170	23
125 - 150	1.	1.		2,224	15.	53, :	28,27,	68,	68,	1	6,	0g			1 (105)	1						(183)			
					16.3.		7₂6Q	65,	(65)			(224)			1	1					ł				i i
			<u> </u>	ļ			45,4,71		<u> </u>			+	—		–		<u> </u>		<u> </u>			148	212	208	3.6
150 - 175				1,7,	113	3.	1		(692)		15%						1					(112)			1
									(192)					1									l i		
							<u> </u>	╞	(43,)		+		<u> </u>	<u> </u>	<u> </u>	+		<u></u> −	<u> </u>	<u>├</u> ──	<u> </u>	140	194	122	6.3
175 - 200		5.	12.	17.7.	23,8,	12,			2.			23.				1.		l I	1	1		(19)			1
						(134)				1			1												
			L			8,625.	<u> </u>				<u> </u>	+−	+	+		+			-	+			1.98	194	2.8
200 - 225				7,23,	33,	11,6,	5.4,				ł		(5)			1		14			]	140			••
				1	10,		L		<u> </u>		<u> </u>	<u> </u>						<b>i</b> —	<u> </u>		<u> </u>	(3)	1	2000	1
225 - 250				2,	1.	8,	16.	4,6,	L	I	<b> </b>	<u> </u>			+	345		<u> </u>	—	<u>+</u>		1	190	1.00	4 0
250 - 275		34	8,193	5,54	22,	139	16,		-	<b> </b>	<u> </u>		-	<u> </u>	+		+						100	100 m	2.0
275 - 300			1	24			(1,)	•	1		114	1	1		2.				1			(1	400	201	
100 101		<u> </u>		<u> </u>	<u> </u>	1			<u> </u>		15		1	1		Τ.		1	T			15	252	252 <sup>e</sup>	12 5
300 - 345	—	1	1.			3.		<u>† –</u>	<u> </u>				1	-	1		1	$\square$	1			6	80	80	60
350 - 375				13.						1-					1	1						13	82	82	12 5
379 400		I	10			†	<u> </u>					1					T					10	51	51	80
400 495		<u> </u>	1	14.	29.	<u> </u>		<u> </u>	1	1		1			1	1						43	101	101	1 5
438 - 450	<u> </u>	<u> </u>	R.		30.		1	1		1			1	1	1							38	89	89	33
480 - 475			<u> </u>			1	1	1	1		1						T						<u> </u>	<u> </u>	
475 - 500	<u> </u>	<b> </b>		1	1	†		<u> </u>	1	1	1											-		<u> </u>	╞
500 - 1.000	1	5	4-16-1	3.15		<u> </u>						1					Τ.					44	70	70	28
1 000 + 1,500	-	(5.)	4.	10.		1	1	1				T		T		1	Т		1			41	44	42	39
1,000 - 1,000	1	8.9.11.		1			1									1		I _				(5	)		
1 100 - 2 000	+	1.	0.	1.			<u> </u>	-		-	1				1						T	13	68	68	94
1,000 - 5,000	<del>.</del>	9.2.9	<u>†.</u>	+	1	t - t	1	1	1	1	1		1-	1								24	38	38	8 2
8,000 - 10,000	4.34	1000000	₩ <u> </u>	+	+	+	1	1		1	1		1		1			1				1	13	13	14 4
	1.	<u> </u>	+	+	+	+	1	1	1	1	1	1	1	1	1	Τ						1 2	13	13	25 0
10,000 - 20,000	1.	40	03	179	235	169	332	158	311	5	62	65	10	61	90	126	-	42	-		50	2,067	- 1	<u> </u>	
1011	1.0	(8)	1	1		(15)	0	(0)	(202	1	1	(22)	(6)	(54)	(76)	(81	1)	$T^{-}$	T			(47)	0		
Com Bau		1 101						1 107		· •										_	_		_		_

TABLE 18 TRACT BY NUMBER OF SALES AND DISTANCE<sup>®</sup> FROM NEAREST TRADING CENTER, HARD-SURFACED ROADS ACRE AND SIZE OF

<sup>8</sup> Subscripts are codes for distance from nearest trading center (1) 1-2 ml, (2) 3-4 ml, (3) 8-6 ml, (4) 7-8 ml, (5) 9-10 ml, (6) 11-15 ml, (7) 16-20 ml, (8) 21-30 ml, (8) 31 ml and over Figures Adapted from tabulations compiled from Match 1935 murvey for (10) Chickles 31 asise California specially at 350 per scree <sup>3</sup> Chickles 31 asise California specially at 350 per scree <sup>3</sup> Chickles 31 asise California specially at 3525 per scree <sup>3</sup> Chickles 31 asise California specially at 3252 per scree

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 m1) from nearest trading center. These tables may be interpreted in the following way: the number of sales multiplied 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 hard-surfaced 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

$$\begin{array}{c} n \\ \Sigma \\ i \end{array} \frac{P_1}{P_2} (S_1 + S_2)$$

comparison between hard-surfaced roads and dirt,

$$\begin{array}{c} n \\ \Sigma \\ i \end{array} \quad \frac{P_1}{P_3} \quad (S_1 + S_3) \\ \end{array}$$

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

$$\frac{n}{\Sigma} \quad \frac{P_2}{P_3} \quad (S_2 + S_3)$$

		Ha	ard-surfaced	l Roads		Gravel Ro	ads		Dirt Roa	ds
Size of ' (acre	Tract es)	Total (\$)	Excluding Corn Belt (\$)	Total Number of Sales	Total (\$)	Excluding Corn Belt (\$)	Total Number of Sales	Total (\$)	Excluding Corn Belt (\$)	Total Number of Sales
0 -	25	386	386	5	388	388	4	400	400	3
25 -	50	295	295	19	630 <sup>C</sup>	630 <sup>c</sup>	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 <sup>c</sup>	208d	(6) 71	72	72	111	99	99	71
250 -	275	106	106	91	69	134	(33) 60	63	63	35
275 -	300	268 <sup>0</sup>	261 <sup>e</sup>	(1) 16	65	65	56	72	72	31
300 -	325	252 <sup>e</sup>	252 <sup>e</sup>	15	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	249 <sup>1</sup>	249 <sup>1</sup>	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 - 1	10.000	13	13	7	18	18	12	16	16	3
10,000 - 2	20,000	13	13	2	-	-	-	-	-	-
20,000 - 4	10, 000	-	-	-	3	3	1		-	-
Total 500	acres		•		_					
or les	s	-	-	(470) 1,936	-	- (	1,096) 2,350	-	-	(168) 901
Grand to	ital		-	(475) 2,067	-	- (	(1,097)2,489	-	-	(168) 1,067

TABLE 19 MEDIAN PRICE PER ACRE BY SIZE OF TRACT FOR EACH TYPE OF ROAD<sup>a, b</sup>

<sup>a</sup>Adapted from tabulations compiled from March 1958 survey (<u>10</u>). Figures in parentheses and acres in Corn Belt There were 5 sales at \$781 per acre in California specialty. Total of the cale California specialty.

<sup>d</sup>Total of 34 sales California specialty <sup>e</sup>Total of 26 sales California specialty.

Four sales California 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 acreof 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<sup>1</sup>

		Ratio	os of Media	n Price per	Acre	
Size of Tract (acres)	Hard- Surfaced to Gravel Total	Hard- Surfaced to Gravel Excluding Corn Belt	Hard- Surfaced to Dirt Total	Hard- Surfaced to Dirt Excluding Corn Belt	Gravel to Dirt Total	Gravel to Dirt Excluding Corn Belt
0 - 25	5 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	5 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	5 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	5 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	5 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.	11 100	1.010	1.000	1.043	1,104	1,414
500 acres	1.441	1.563	1.938	1.903	1.508	1.261

<sup>1</sup>Adapted from tabulations compiled from March 1958 survey for (10).

example, if  $\dot{X}_1$  = price per acre on gravel roads, and  $X_2$  = price per acre on hardsurfaced roads, then  $X_1$  = +0.878 $X_2$  - \$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

			Total	·	Total	Less Corn	Belt
Size of 7 (acre	Fract s)	Hard- Surfaced + Gravel	Hard- Surfaced + Dirt	Gravel + Dirt	Hard- Surfaced + Gravel	Hard- Surfaced + Dırt	Gravel + Dirt
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	-	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
<b>5,0</b> 00 - 3	10,000	19	10	15	19	10	15
10,000 - 2	20, 000	2	2	-	2	2	-
20,000 - 4	40, 000	1	-	1	1	-	1
Total 500	acres	4 655	o 00-				
and less	5	4,276	2,837	3,250	2,710	2, 199	1,987
Grand	a total	4, 546	3,134	3,554	2,974	2,491	2, 291

#### NUMBER OF SALES BY SIZE OF TRACT USED AS WEIGHTS FOR MEDIAN PRICE RATIOS<sup>1</sup> OF HARD-SURFACED TO GRAVEL, HARD-SURFACED TO DIRT, AND GRAVEL TO DIRT<sup>2,3</sup>

<sup>1</sup>Ratios are shown in Table 20.

<sup>3</sup>Adapted from tabulations compiled from March 1958 survey for (10).

<sup>3</sup>Figures in parentheses are for Corn Belt.

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 hard-surfaced 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.

- "Final Report of the Highway Allocation Study." 87th Congress, 1st Session, House Document 72 (1961).
- "Third Progress Report of the Highway Cost Allocation Study." 86th Congress, First Session, House Document 91 (1961).
- Ezekiel, M., "Factors Affecting Farmers' Earnings in Southeastern Pennsylvania." U.S. Department of Agriculture Bull. 1400 (1926).
- Garrison, W.L., "The Benefits of Rural Roads to Rural Property." "Allocation of Road and Street Costs," Pt IV, Univ. of Washington (June 1956).
   Carroll, D.D., Borchert, J.R., Schwinden, J., and Raup, P.M., "The Eco-
- 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).
- 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).