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Socio-Economic Factors Affecting The Regional Growth Potential Of the Cattle Feeding Industry

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In general, the interregional competition in the location of cattle feeding is determined not only by beef demand, supply of factors, climate, slaughter capacity, etc., but also by emerging patterns of feedlot management compatible with large scale feeding operations and consistent with current development in beef production and marketing.

Previous Work

Many previous studies on regional location of beef cattle considered the availability of resources necessary for finishing cattle, slaughter capacity, demand for beef, transfer function, and productive process as the primary determinants of a feedlots location. Schrader and King, [25] using linear programming techniques, developed a spatial equilibrium model to estimate the optimum location of beef cattle feeding for 20-regions breakdown of the U.S. The determinants of location used were: (1) regional demand for beef; (2) supply of factors necessary for cattle feeding; (3) regional production process; (4) supply of non-fed beef; and (5) transfer functions. Langemeier, using Schrader and King's basic model adopted two additional constraints-regional slaughter capacity and separated demand into fed and non-fed beef. [20] Both analyses show a discrepency between optimum and actual marketing and also contrast sharply with each other.

Hassler, studying the U.S. feed concentrate-livestock economy's demand structure, suggests that cattle feeding should be most economically located in the surplus feed grain supply area with the processed animals products moving to excess demand areas. [14] However, the supply and costs of the agricultural resources necessary for finishing cattle do not seem to explain the whole scope of the cattle feeding industry past growth pattern. Some areas with a cost advantage and surplus supply of these resources have shown only slow to moderate growth, while others with a deficit and relatively high costs have maintained rapid growth rates [1, 2].

Hasbargen, evaluating the competitive position of cattle feed in the Northern Corn Belt, concludes that given the potential for the production of fed cattle, the profitability of cattle feeding among areas is significantly influenced by management practices, scale of operation, and extent of specialization. [13] Williams indicates that external cost savings, in addition to those associated with internal economies of size, are becoming increasingly important with the development of large scale feeding operations. [33] Goodwin, analyzing Oklahoma's opportunities in cattle feeding predicts that the development of large-scale feeding operations between the deficit feed supply areas and their source of raw materials will increase the high operating costs of feedlots there, depressing the profit margin further and gradually shifting the industry back to the source of raw materials. [12]

Marketing channels affect the rate of return of cattle feeding. Direct buying and selling provide substantial savings for cattle feeders. [9, 11] However, direct marketing of slaughter animals and direct buying of feeder animals is positively associated with size. [9]

Experiments indicate that the comfort zone of domestic breed of cattle is between 30° and 75° F. [18] Hot climates reduce the rate of daily gain, causes high sickness and death rate, and necessitates additional costs to protect the animals from the heat and thermal radiation [22, 24]. On the other hand, a cold environment does not appear to be a problem for beef cattle [32]. The impact of precipitation on the performance of beef animals has not been firmly established. In this context, the weather elements may not be a decisive factor for beef cattle feeding in Missouri.

Objectives of the Study

It is obvious that the number of cattle placed on feed annually is determined by the amount of inputs devoted to the production of finished beef. But, the extent to which resources are committed is determined by their opportunity costs and the managerial socio-economic characteristics. In this bulletin, the extent of specialization and operation size in beef cattle feeding are assumed as a function of the manager decision which is influenced by his attitude, ability, and the social-psychological-economic decision-making environment. With this in mind, the goals of this study are:

1. To estimate the supply response for fed beef in the U.S.
2. To estimate the supply response for fed beef in Missouri.
3. To determine the factors affecting the distribution of feedlots among areas in Missouri.
4. To develop indices to measure the socio-economic characteristics of feedlot managers as related to size; and to determine whether operators of various sizes differ significantly with respect to their socio-economic behavior.
5. To determine whether cattle-feeders differ significantly from other farm-operators with respect to their socio-economic characteristics.

Analysis

Three analytical procedures were used in achieving the above objectives. Stepwise multiple regression [7] was used in estimating the functional effect of the variables, related to supply and demand, necessary for the production and marketing of fed beef relative to the number of cattle placed on feed in a national and state models. The same analytical procedure was used to determine the factors affecting the distribution of cattle feeding among areas in Missouri. Discriminant analysis [23] was used in testing the difference between operators of various sizes with respect to the combined effect of their socio-economic characteristics. Duncan's multiple range test [8] was employed in testing the difference between operators of various size-groups with respect to each character alone.

Part II

Supply Response in Beef Cattle Feeding

The economic analysis underlying the three models used in this section implies that the growth and development and thus the location of beef cattle feeding is determined by: (1) the economic potential for fed beef production—mainly the availability and costs of the factor-inputs; and (2) climatological, economic organization, and institutional variables.

Model I

The mathematical model used to explain the functional effect of the economic variables relative to the number of cattle placed on feed in 26 cattle feeding states[3] was

(1.1) $$Y = a_o + a_1X_1 + \ldots + a_n X_n + U_i$$

Where

Y = total number of cattle and calves fed, year t,
X_1 = average price of beef received by farmers, year t-1/2,
X_2 = average price of hog received by farmers, year t-1/2,
X_3 = average price of corn, year t,
X_4 = quantity of corn-equivalent produced, year t,
X_5 = number of beef-breed feeder calves available for feeding, year t,[4]
X_6 = beef-corn price ratio, year t-1/2,
X_7 = beef-corn price ratio, year t,
X_8 = hog-corn price ratio, year t-1/2,
X_9 = hog-corn price ratio, year t,
X_{10} = beef-hog price ratio, year t-1/2,
X_{11} = beef-hog price ratio, year t,
X_{12} = average price of milk received by farmers, year t,
X_{13} = milk-feed price ratio, year t-1,
X_{14} = milk-feed price ratio, year t,
X_{15} = farm wage, $/hour without room or board, year t,
X_{16} = supply shifter, a 0 for build-up years and 1 for liquidation years in the beef cattle cycle,
X_{17} = time in years (1946 = 0), and
U_i = disturbance term.

[3]The states included were: Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, and California.

[4]The following identity equation was constructed to estimate the number of feeder animals available for feeding:

$$Y = (Z_1 - Z_2) - (S_1 + S_2 + S_3 + S_4)$$

Where

Y is the number of feeder calves available, year t,

a_1 is the number of beef cows and heifers two years or older on farms, year t-1,
a_2 is the calving rate, percentage of calves born from beef cows and heifers two years or older, year t-1,
$Z_1 = (a_1 \cdot a_2)$ is the number of beef calves born, year t-1,
Z_2 is the beef calves death, year t-1,
$(Z_1 - Z_2)$ is the net beef calves available, year t-1,
S_1 is the heifer calves kept for herd replacement at year t, 15 percent of net beef calves available at year t-1,
S_2 is beef calves kept for bull replacements at year t, 25 percent of bulls on farm at year t,
S_3 is the number of beef calves slaughtered on farms, year t [26], and
S_4 is beef calves death at year t, 2 percent of net beef calves available at year t.

Since the above equation attempts to estimate the state's potential for the production of feeder animals, the number of calves slaughtered commercially was ignored.

Variables representing prices received by farmers were deflated by the Index of Prices Received by Farmers (1957-59 = 100). Wages were deflated by the Consumer Price Index (1957-59 = 100). Twenty-two annual (time-series) observations (1946-1968) were analyzed. The following supply response equation, along with the coefficient of multiple determination, was estimated.

The Estimated Supply Equation for the U.S.: $R^2 = .912$

$$Y = 2648.68 + \underset{(1.22)}{6.06X_1} + \underset{(6.72)}{23.39X_6} + \underset{(.23)}{.64X_4} - \underset{(.07)}{.20X_8} \tag{1.2}$$

Model II

The purpose of this model is to estimate the functional effect of the variables identified in Model I on the number of cattle placed on feed in Missouri. The estimated supply equation along with the coefficient of multiple determination is

$$Y = 265.30 + \underset{(89.07)}{211.15X_3} \qquad R^2 = .158 \tag{2.1}$$

Model III

This model attempts to determine the functional effect of a set of economic, climatological, and institutional variables in relation to the number of cattle placed on feed in 67 cattle feeding counties in Missouri.[5] The data utilized in this model was for 1964, the latest period for which county's data for all variables considered was available. All variables are county's averages. The following variables are identified for the purpose of statistical analysis.

- F = number of cattle placed on feed, year t,
- V_1 = percent of feedlots having the capacity and equipment necessary to feed 500 head and over throughout a fattening period[6], year t,
- V_2 = average farm size, year t,
- V_3 = value per acre, year t,
- V_4 = quantity of corn equivalent produced, year t,
- V_5 = quantity of hay produced, year t,
- V_6 = quantity of silage produced, year t,
- V_7 = number of acres of pasture land, year t,
- V_8 = percentage of farm land in class I, year t,
- V_{10} = accessibility to slaughtering plants[7], year t,
- V_{11} = accessibility to consumer market[7], year t,
- V_{12} = number of days at which temperature exceeded 85°F, year t, and
- V_{13} = annual precipitation, year t.

[5]The counties included were: Atchison, Audrain, Barton, Benton, Boone, Buchanan, Caldwell, Callaway, Camden, Cape Girardeau, Carroll, Cass, Chariton, Clay, Clinton, Cooper, Daviess, Dekalb, Dunklin, Franklin, Gentry, Grundy, Harrison, Henry, Holt, Howard, Jackson, Jefferson, Johnson, Knox, Laclede, Lafayette, Lawrence, Lewis, Lincoln, Linn, Livingston, Macon, Mississippi, Moniteau, Monroe, Montgomery, Morgan, New Madrid, Nodaway, Oregon, Perry, Pettis, Phelps, Pike, Platte, Ralls, Randolph, Ray, St. Charles, St. Genevieve, Saline, Schuyler, Scott, Shelby, Stoddard, Sullivan, Vernon, Warren, Webster, Worth, and Wright.

[6]Virtually all non-feed costs savings associated with scale were exhausted at a lot size of 500 head, see [6].

[7]Two criteria, transportation distance and capacity, were used in estimating accessibility. The following coding producer was employed in ranking counties accessibility:

Excellent	Very Good	Good	Fair	Poor	Very Poor
11	9	7	5	3	1

The estimated predictive equation with the associated coefficient of multiple determination is

$$Y = -644.25 + \underset{(2.83)}{21.73V_1} + \underset{(.004)}{.002V_4} \qquad R^2 = .462 \tag{3.1}$$

Results

The results of the models developed in this section indicate that the production and cost of the resources necessary for cattle feeding significantly influence the number of cattle placed on feed annually in the U.S. However, these factors do not explain the variation in the number of cattle placed on feed in Missouri nor do they explain the variation in the number of cattle placed on feed between areas within the state of Missouri. The economic structure of the cattle feeding industry seems to account for most of the explained variation in the number of cattle placed on feed in 67 cattle feeding counties in Missouri.

Part III

Managerial Socio-Economic Characteristics and Size of Operation in Beef Cattle Feeding

The results of the analysis presented in Part II and the implications of previous research outlined in Part I suggest that the growth potential of the cattle feeding in any area is affected by the size distribution of feedlots and not necessarily by the availability and costs of factor-inputs.

Previous studies pertaining to operation size claim that cost-savings are associated with size in beef cattle feeding [6, 10, 16, 17, 19, 34]. However, these studies considered only the physical factors associated with production and marketing of beef, completely ignoring managerial ability and its probable effect on size of operation. Real or imaginary, the internal and external cost-savings factors associated with size have been considered the incentive for the increase in the size of feedlots [33]. Other studies have indicated that willingness to assume risk and uncertainty and possession of scientific and economic know-how characterize the managers of large-size feeding operations [4, 5, 21]. These studies suggest that a large-size feedlot is not necessarily a product only of internal and external factors associated with size, but that it is also affected by the socio-economic characteristics of the managerial input.

The dilemma faced by economists studying economies of scale may involve violation of the *ceteris paribus* conditions—the analysis fails to hold everything except for scale constant. If the socio-economic characteristics of management are related to size of operation, then the phenomenon which some studies identified as economies of scale may not be true economies of scale but simply a reflection of the superior managerial capabilities of the large-size operator. However, the extent to which the manager's socio-economic characteristics are related to size—that is, the extent to which the *ceteris paribus* conditions are violated—has not been quantified or empirically tested.

In this section indices are developed to measure the socio-economic characteristics of feedlot managers as related to size. Discriminant analysis is used to test the hypothesis that operators of various sizes differ significantly with respect to their socio-economic characteristics.

Method and Study Area

A stratified random sample of cattle feeders in Missouri was interviewed in an attempt to determine whether cattle feeders in various size-groups differ with respect to their socio-economic characteristics. Cattle feeders were stratified by size of operation, and a random sample was proportionally drawn from each strata. A 100 percent response was obtained. A random sample of other farm operators (non-cattle feeders) was interviewed in order to determine whether cattle feeders differ from other farm operators in their socio-economic characteristics.

The following criteria (as developed by Hobbs in consultation with a panel of psychologists and sociologists [9]) were adopted in this study as a measure of the operator's attitude toward risk, science, economics, and independence in making decisions.

Risk Aversion

This criterion was utilized as a measure of the degree to which the managers are oriented toward security and conservatism; that is, whether or not they are reluctant to make decisions perceived as involving the element of risk and uncertainty.

Economic Motivation

This criterion was employed as a measure of the degree to which farm managers value economic ends and the degree to which occupational "success" is defined by economic criteria.

Scientific Orientation

This criterion was used as a measure of the degree to which the managers are positive in their attitude toward science and the use of scientific method in decision-making.

Independence

This criterion was employed as a measure of the degree to which managers positively value independence in decision-making and the degree to which the individual is willing to deviate from neighborhood norms.

The managers were asked to respond to a number of questions on each of these four criteria.[8] For statistical analysis, a coding procedure was developed to quantify the verbal responses of the managers.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	3	4	5	7

The spread in scoring between 1 and 3 and 5 and 7 was adopted as a method to homogenize the variance of the subject's response on individual items and on total scores. The total score for each manager was computed for each of the four sets of items. The greater the individual total score for any one of these sets, the greater value he is assumed to place on that criterion.

Model IV

Since the work of R. A. Fisher in the thirties the technique of discriminant analysis has been modified for application to more than two group classifications [23, pp. 237-258]. While the technique has been frequently used in biometric research, its application in economic research has been limited to two group classifications as originally developed by Fisher. A survey of literature on Fisher's discriminant function and its applications to economic problems may be found in Tintner's application of multivariate analysis to economic data [26]. Blood and Baker [3] applied Fisher's discriminant function to classify production situations in Northern Great Plains into wheat production and range forage production. They computed the linear discriminant function, Z, and used analysis of variance of Z between and within groups for test of significance. They also compared this result with results obtained from the application of linear multiple regression and linear probability functions.

Discriminant analysis as applied in this paper links the problem of discriminating between more than two groups, the test of significance, and the associated probability estimates in one methodological procedure. Its kinship with analysis of variance is rather obvious since both deal with data which can be classified into discrete categories. Analysis of variance relates outcomes, a continuous variable, to discrete catagories of treatments and shows whether or not the treatments are significantly different with respect to that variable. Discriminant analysis is conceptually the inverse, relating discrete categories of results to continuous treatment variables, to show whether or not the discrete categories are significantly different with respect to the combined effect of the treatment variables.

In our case, the discrete categories are four size-groups of cattle feeders:

K_1 is size category with feeding capacity at any one feeding period of 35-99 head,[9]

K_2 is size category with feeding capacity at any one feeding period of 100-199 head,

K_3 is size category with feeding capacity at any one feeding period of 200-399 head, and

K_4 is size category with feeding capacity at any one feeding period of 400-10,000 head.[10]

The treatment variables are the following eight indices measuring the socio-economic characteristics of each operator:

x_1 is the number of years of formal education the manager completed,

x_2 is the age of the manager,

x_3 is the manager's risk aversion,

x_4 is the manager's scientific orientation

x_5 is the manager's independence,

x_6 is the manager's economic motivation,

x_7 is the income distribution preferred by the manager during the year, and

x_8 is the percentage of the feeding operation owned by others.

The generalized Mahalanobis D^2, γ, statistic is employed in testing the significance of difference among groups with respect to their socio-economic characteristics

$$(4.1) \quad \gamma = \sum_{i=1}^{m} \sum_{j=1}^{m} \lambda_{ij} \sum_{k=1}^{g} n_k (\bar{x}_{ik} - \bar{X}_i)(\bar{x}_{jk} - \bar{X}_j)$$

Where

j = 1,2,. . .,m are variables,

g = number of groups,

n_k = sample size in the k^{th} group,

$\bar{x}_{jk} = \dfrac{\sum_{i=1}^{n_k} x_{ijk}}{n_k}$ is the mean of the j^{th} variable in the k^{th} group,

$\bar{X}_j = \dfrac{\sum_{k=1}^{g} n_k \bar{x}_{jk}}{\sum_{k=1}^{g} n_k}$ is the common mean of the j^{th} variable for all groups combined, and

[8]For a complete listing of the items in each criteria see [1].

[9]Operators with feeding capacity below 35 head were excluded from the study on the basis that their beef enterprise did not constitute a significant portion of their farm income.

[10]The lower boundary of 400 head was chosen on the assumption that 2.5 is an average annual turnover and 1,000 head and over annual production considered large feeding operation. Farmer-feeders were defined as those operators with under 1,000 head capacity at the end of each year.

λ_{ij} = the inverse element of the pooled dispersion matrix D

Where

$$D = \frac{\sum_{k=1}^{g} S_k}{\sum_{k=1}^{g} n_k - g}$$

Where

S_k = $[S^k_{jl}] = \Sigma\, (x_{ijk} - \bar{x}_{jk})\, (\bar{x}_{ilk} - \bar{x}_{lk})$ is the sum of the cross products of deviations from means

Where

$j = 1, 2, \ldots, m$
$l = 1, 2, \ldots m$

A set of linear discriminant functions, f_k , that serves as indices for classifying an individual manager into k groups were obtained.

$$(4.2) \quad f_k = \sum_{j=1}^{m} C_{jk}\, x_{ijk} + C_{ok}$$

Where

$C_{jk*} = \sum_{j=1}^{m} \lambda_{ij}\, \bar{x}_{jk}$ is the coefficient of the j^{th} variable associated with the $k{*}^{th}$ discriminant function,

$C_{ok*} = -1/2 \sum_{j=1}^{m} \sum_{i=1}^{m} \lambda_{ji}\, \bar{x}_{jk}\, \bar{x}_{ik}$ is the constant associated with the $k{*}^{th}$ discriminant function, and

$k = 1, 2, \ldots, g$

The probability associated with the largest discriminant function, P_L, was estimated by the following equation:

$$(4.3) \quad P_L = \frac{1}{\sum_{k*=1}^{g} e^{(f_{k*} - f_L)}}$$

Where

f_L = the value of the largest discriminant function

Model V

This model, using the same analytical procedure outlined in Model IV, attempts to determine the significance of difference between farm operators other than cattle feeders operating 200 acres and over, K_1, and cattle feeders with feeding capacity of 100 head and over, K_2, with respect to the following socio-economic variables: education (X_1), age (X_2), risk aversion (X_3), scientific orientation (X_4), independence (X_5), economic motivation (X_6), and income distribution preferred (X_7).

Interpretation of Results for Model IV

The group means and the common means for each socio-economic index are shown in Table 1. The generalized Mahalanobis D^2 statistic, γ, is used as chi-square with m(g-1) degree of freedom to test the differences among the mean values of g size-groups for the m socio-economic variables. The computed value of γ is 314.49 which is significant at $P \leqq .01$, indicating that the four size-groups, and any pairs of them, do differ in the specified characteristics, though not necessarily in each characteristic tested singly.

Table 1. Group Means and the Common Means for Each Socio-Economic Index

Size Categories	Sample Size	Mean Values							
		Ed.	Age	Risk Aversion	Scient. Orient.	Indep.	Econ. Motiv.	Income Dist.	Ownership
K_1	28	11.28	49.57	55.03	66.82	69.68	56.36	3.25	1.17
K_2	22	12.18	48.23	58.00	70.77	74.23	59.70	3.09	10.77
K_3	13	11.77	44.54	60.54	76.54	75.46	65.46	3.23	21.61
K_4	12	13.75	48.75	70.42	80.42	74.92	70.58	3.33	56.58
Common Mean		12.03	48.17	59.32	71.84	72.85	61.16	3.21	16.40

Table 2. Mean Comparison of the Socio-Economic Variables With Respect to Size-Groups

Groups Comparison	Means							
	Ed.	Age	Risk Aversion	Scient. Orient.	Indep.	Econ. Motiv.	Income Dist.	Ownership
K_1 vs K_2								
K_1 vs K_3			*	*	*	*		*
K_1 vs K_4	*		*	*	*	*		*
K_2 vs K_3				*		*		
K_2 vs K_4	*		*	*		*		*
K_3 vs K_4	*		*			*		*

* Significant at $P \leq .01$. Lowering the probability level to $P \leq .10$ did not change the outcome.

This result does not specify where significant differences occur, and whether the groups differ in each of the socio-economic characteristics. Duncan's multiple range test is used to compare the mean value of each socio-economic variable in one size-group to its mean value in all other size-groupings. Table 2 shows where these means differ significantly.

Interpretation of the Duncan Results

The Duncan test results indicate that managers in size-group four are significantly different from managers in size-groups one, two and three in education, risk aversion, scientific orientation, economic motivation, and type of ownership. More specifically, managers in size-group four appear to (1) have completed more years of formal education; (2) be more willing to accept risk; (3) be more scientifically oriented; (4) be more economically motivated; and (5) have larger proportions of their feeding operation owned by others. Managers in size-group four are also significantly more independent in making decisions than managers in size-group one. Similarly, managers in size-group three relative to those in size-group one seem to (1) be less oriented toward risk aversion; (2) be more scientifically oriented; (3) be more economically motivated; (4) be more independent in making decisions; and (5) have a higher percentage of their feeding operation owned by others.

On the basis of the individual analyses of the socio-economic factors there was no significant difference between groups one and two with respect to any of the variables, while groups two and three were significantly different with respect to two variables only, scientific orientation and economic motivation. However, such individual analyses and their indication of the relative importance of factors are sometimes misleading. There is an effective linear combination of factors which distinguishes successfully between the pairs of groups. The results of the discriminant analysis for two group classification indicate that these pair groups are significantly different with respect to the total effect of the socio-economic factors. The computed value of γ for groups one and two is 32.87 and for groups two and three is 27.23, both of which are significant at $P \leqq .01$.

Classification and Probability Estimates

Since people are diverse, and perhaps because of factors not considered in this study, many operators are actually members of one size-group but have socio-economic characteristics which seem to qualify them for membership in other size-groups. The discriminant analysis can be used to classify observations according to which size category their socio-economic characteristics would seem to fit them. A set of linear discriminant functions was obtained to serve as indices for classifying an individual manager into K groups and in estimating the probability of his being associated with this suggested size-grouping. The following discriminant functions were developed for the four size-groupings:

$$f_1 = 2.06x_1 + .66x_2 + 1.78x_3 + .94x_4 + 2.33x_5 + .94x_6 + 9.08x_7 + .03x_8 - 232.32$$

$$f_2 = 2.27x_1 + .67x_2 + 1.80x_3 + 1.07x_4 + 2.47x_5 + 1.01x_6 + 8.43x_7 + .10x_8 - 256.08$$

$$f_3 = 2.21x_1 + .62x_2 + 1.79x_3 + 1.26x_4 + 2.51x_5 + 1.11x_6 + 8.44x_7 + .16x_8 - 276.03$$

$$f_4 = 2.63x_1 + .68x_2 + 2.18x_3 + 1.39x_4 + 2.49x_5 + 1.09x_6 + 7.79x_7 + .34x_8 - 332.42$$

When the socio-economic scores of an individual are inserted in these equations, the equation producing the highest value for f_i identifies the size-grouping by these socio-economic characteristics. His probability of association with that group is estimated by equation (4.3).

Table 3 shows which size-grouping an observation is actually a member of, and the size-grouping suggested by his scores on the socio-economic characteristics along with the estimated probability of his being associated with that particular group. All observations in size-group four show a high probability of association with the discriminant function 4, implying a higher degree of homogeneity in socio-economic characteristics than observations in the other size-groups. In general, observations in size-groups three, two and one show lower probabilities of association with their respective discriminant functions. Some managers in these size-groups, because of factors not considered in this study, demonstrate socio-economic behavior that qualifies them for membership in other size-groups.

Table 3. Size-Group Predicted and Probability of Prediction for Each Operator According to Socio-Economic Characteristics

K_g											
K_1			K_2			K_3			K_4		
Obs.	f_L	P_L	Obs.	f_L	P_L	Obs.	f_L	P_L	Obs.	f_L	P_L
1	2	.75	1	2	.61	1	2	.52	1	4	1.00
2	1	.82	2	2	.57	2	3	.73	2	4	.95
3	1	.90	3	2	.50	3	3	.51	3	4	.99
4	1	.54	4	3	.41	4	2	.62	4	4	.99
5	2	.47	5	1	.51	5	2	.65	5	4	.90
6	1	.31	6	3	.75	6	3	.74	6	4	.81
7	1	.55	7	3	.50	7	3	.85	7	4	.81
8	1	.92	8	3	.84	8	3	.72	8	4	.99
9	1	.98	9	3	.93	9	3	.95	9	4	.85
10	1	.94	10	1	.98	10	3	.35	10	4	.99
11	2	.45	11	2	.64	11	4	.62	11	4	.99
12	1	.59	12	1	.57	12	3	.84	12	4	.99
13	1	.83	13	2	.62	13	3	.68			
14	1	.69	14	2	.76						
15	1	.72	15	2	.68						
16	1	.27	16	2	.76						
17	1	.91	17	2	.55						
18	1	.63	18	2	.51						
19	1	.81	19	2	.62						
20	1	.63	20	2	.75						
21	2	.56	21	2	.65						
22	1	.81	22	1	.47						
23	2	.60									
24	1	.88									
25	1	.88									
26	1	.78									
27	2	.63									
28	1	.65									

Interpretation of Results for Model V

The group means and the common means for each socio-economic index is shown in Table 4. The computed value of γ is 7.46 which is not significant at $P \leqq .10$, indicating that cattle feeders with 100 head and over do not differ from other farm operators in the totality of their socio-economic characteristics.

Table 4. Group Means and the Common Means for Each Socio-Economic Index

Groups	Sample Size	Mean Values						
		Ed.	Age	Risk Aversion	Scient. Orient.	Indep.	Econ. Motiv.	Income Dist.
K_1	35	11.54	47.08	58.65	74.77	74.31	64.42	3.36
K_2	41	12.29	47.14	61.46	74.17	74.90	64.09	3.15
Common Mean		11.95	47.11	60.17	74.44	74.63	64.25	3.26

Classification and Probability Estimate

The following linear discriminant functions were developed for the two groups to serve as indices for classifying an individual operator into one of the two groups and in estimating the probability of his being associated with this suggested group.

$$f_1 = 2.04x_1 + .56x_2 + .26x_3 + .65x_4 + 1.54x_5 + .69x_6 + 6.98x_7 - 137.05$$

$$f_2 = 2.13x_1 + .56x_2 + .36x_3 + .63x_4 + 1.65x_5 + .63x_6 + 7.43x_7 - 139.83$$

When the socio-economic scores of an individual are inserted in these two equations, the equation producing the highest value for f_i identify the group suggested by these socio-economic characteristics. His probability of association with that group is estimated by equation (4.3). Table 5 shows which group an observation is actually a member of, and the group suggested by his scores on the socio-economic characteristics along with the estimated probability of his being associated with that particular group.

Conclusions and Implications

The growth potential of beef cattle feeding in any area is influenced not only by demand, supplies and costs of raw materials, availability of market outlets, climatological factors, etc., but also by the economic structure of the fed beef industry. Interregional competition studies ignoring the structural aspect of the beef industry fail to account for a significant factor affecting the location pattern of feedlots among areas. Shift in cattle feeding from the deficit feed and feeder animals supplies areas to surplus feed and feeder animals supply areas, where rapid developments of large-scale feeding operations have been taken place, is evident between and within regions [2].

While economies of size may be an incentive for increasing the size of feedlot, it is not the sole criteria. Large-scale feedlots require managerial input with socio-economic characteristics compatible with large-size operation. Managers of large-size feeding operations demonstrate a common socio-economic behavior which definitely distinguish them from the farmer-feeders. Their managerial behavior is characterized by willingness to accept a higher degree of risk, appreciation for and application of

Table 5. Comparison of Actual Group and Group Predicted and Probability of Prediction for Each Operator According to Their Socio-Economic Characteristics

K_g					
K_1			K_2		
Obs.	f_L	P_L	Obs.	f_L	P_L
1	1	.53	1	1	.63
2	1	.83	2	2	.58
3	1	.83	3	1	.54
4	1	.65	4	1	.55
5	1	.62	5	1	.70
6	2	.68	6	2	.50
7	1	.68	7	1	.54
8	1	.52	8	2	.50
9	1	.70	9	1	.66
10	1	.70	10	1	.56
11	1	.52	11	1	.51
12	1	.67	12	1	.51
13	1	.52	13	2	.52
14	1	.70	14	1	.61
15	1	.59	15	2	.50
16	2	.57	16	1	.76
17	1	.76	17	2	.51
18	2	.69	18	2	.75
19	1	.61	19	2	.73
20	1	.56	20	2	.81
21	2	.71	21	2	.69
22	2	.53	22	2	.68
23	2	.55	23	2	.74
24	1	.65	24	1	.57
25	2	.52	25	1	.53
26	1	.53	26	1	.51
27	2	.61	27	2	.89
28	2	.53	28	2	.50
29	2	.54	29	2	.60
30	2	.68	30	2	.58
31	1	.67	31	2	.67
32	2	.66	32	2	.57
33	1	.50	33	1	.52
34	1	.55	34	2	.56
35	2	.57	35	2	.66
			36	2	.59
			37	2	.62
			38	1	.56
			39	2	.74
			40	1	.55
			41	2	.58

scientific and economic criteria in decision making, higher level of formal education, and willingness to accept a lesser degree of ownership. Farmer-feeders, on the other hand, seem to place higher value on risk aversion and sole ownership (being my own boss). They are also less economically and scientifically oriented and have less formal education. In general, significant difference is apparent between managers of the four-size groups considered in this study with respect to combined effect of their socio-economic characteristics.

The results of this study show that size of operation is related to the managerial socio-economic characteristics. Economies of scale studies which ignores this relation err by failing to hold constant everything except for the aspect of scale being studied. If the socio-economic characteristics of management are related to size, as indicated in this study, then research suggesting economies of size in beef cattle feeding may be reflecting only the superior management of such units.

Although discriminant analysis is applied to cattle feeders in this study, it has a wide application in social science research, especially where human factors are involved, and where the combined effect of a set of factors is more relevant than the effect of each factor alone. In general, discriminant analysis permits the investigator to weigh several factors according to their importance, and to allow for interrelationship between factors, a job which is done imperfectly by approaches such as analysis of variance or regressions with dummy variables.

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