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A Procedure for Developing a Carcass Merit Program for the Pork Industry

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A PROCEDURE FOR DEVELOPING A CARCASS MERIT

PROGRAM FOR THE PORK INDUSTRY

by

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A Procedure for Developing a Carcass Merit

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A stratified sample of 420 market hogs representing the seven 10-pound incremental carcass weight classes from 140 lbs. to 210 lbs., and the nine last rib backfat classes from less than .8 inches to 1.5 inches, or greater, within each weight class were analyzed to determine carcass value and yield of wholesale cuts. Simple correlation coefficients were calculated between each of the carcass measurements. The carcass yield data were manipulated by multiple regression procedures to achieve a series of equations for predicting the weights of the primal cuts. The benefits of being able to predict the weights of the primal cuts were discussed. A procedure for developing a premium/discount matrix was explained. The formulae for developing the matrix were explained. The necessary assumptions were also explored. A procedure for evaluating a premium/discount matrix was developed. The impact of an industry-wide carcass merit program was discussed.

(56 pages)

INTRODUCTION

The ultimate goal of all hog producers is to sell their hogs for the greatest possible profit. Producers have three methods to sell their hogs: by the head, live weight, and carcass weight and grade (carcass merit) (Shepherd et al., 1940). By selling hogs on the basis of carcass merit, the amount of money paid to the producer more closely represents the actual value of the hog (Shepherd, 1937; Shepherd et al., 1940). The actual value of a carcass is defined as the net return to the packer from the sale of the carcass components (gross return minus packaging and processing costs) (Grisdale et al., 1984b).

Carcass merit programs have been in use in various parts of the world since the mid- to late 1920's. The hog industry of Denmark instituted a mandatory carcass merit program in the mid-1920's. During the three years following the stock market crash of 1929, the hog producers in Great Britain developed and implemented a nationwide hog carcass marketing program (Shepherd, 1937). The Canadian hog producers had optional carcass merit programs from 1934 to 1868 (NPPC, 1981). The first carcass merit program in the United States was introduced in 1945. At the present time, there is no standardization among the carcass merit programs in use in the United States (USDA, 1984a). The marketing of hogs on carcass merit programs in the United States is strictly voluntary (Hayenga et al., 1985).

Carcass merit programs have some advantages over live hog marketing. The producer is paid for the actual value of his hogs (Shepherd et al., 1940). Every hog marketed on a carcass merit program can be traced back to its owner (USDA, 1984a). By paying a premium (an amount above the base price), producers are encouraged to raise and market the type of hogs the packer desires (Hayenga et al., 1985). The incentives for marketing animals with an excessive amount of fill are removed (USDA, 1984a). Producers can evaluate the merits of their herds by the quality of carcasses they market (NPPC, 1981).

Although the number of hogs marketed on carcass merit programs has increased in recent years, there is still a considerable amount of resistance to this method of marketing (Hayenga et al., 1985).

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Although the number of hogs marketed on carcass merit programs has increased in recent years, there is still a considerable amount of resistance to this method of marketing (Hayenga et al., 1985). Producers are reluctant to market on carcass merit programs for several reasons (USDA, 1984a):

1. They are satisfied with the live marketing system.
2. The seller has to sort closely and sell hogs which weigh in a packer's preferred weight range.

3. There is not enough incentive to produce good quality hogs.
4. The producers are not sure that the packers are paying them what their hogs are worth.

Carcass value is determined by the sum of the value of each wholesale carcass cut. The value of the carcasses in each carcass grade normally utilized by the packer can be determined in this fashion (Grisdale et al., 1984b). These values, by regression analysis, can be adjusted to create a premium/discount matrix to encourage the production of the type of hogs desired by the packer (Hayenga et al., 1985).

The specific objectives of this study were:

1. To collect and analyze data on 400 market hogs to determine the wholesale market value of pork carcasses of different quality.
2. To develop a new premium/discount matrix for Tri-Miller Packing Company (Hyrum, Utah).

LITERATURE REVIEW

Selling Hogs

There are three methods of selling market (slaughter) hogs. The first method, sale by the head, is the oldest, simplest, and least reflective of the actual value of the hog of the three. When selling by this method, it is required to estimate the weight, yield (dressing percent), and grade (quality) of the animal. The second method, selling by the live weight, is the most popular method in the United States. The weight of the animal is determined by scales, and the buyer and seller only need to estimate the yield and grade of the hog. The third method, sale by carcass weight and grade (carcass merit), most accurately reflects the value of the hog. The weight and grade of the carcass can be accurately determined after the carcass has been eviscerated. The yield factor is eliminated because the seller is paid by pounds of carcass instead of the pounds of live weight (Shepherd et al., 1940).

The Origins of Carcass Merit Marketing

Carcass merit programs were originally developed in Denmark in the mid- to late 1920's. These programs were developed to help standardize carcasses that were raised for the export trade. With the advent of the Great Depression in 1929, many countries set up tariffs to restrict imports. The British import restrictions cut pork imports to less than two-thirds of the previous levels. These restrictions forced the British hog industry to increase its production levels. The "Pigs Marketing Scheme" was enacted by the British Parliament as a part of the Agricultural Marketing Acts of 1931. This program was set up to coordinate the marketing and grading of all hog carcasses produced in Great Britain. The main emphasis of this program was to ensure the continued availability of quality pork products for the British market place (Shepherd, 1937). The Canadian hog industry has been marketing on carcass merit programs since 1934, with the introduction of a carcass merit program at a plant in Peterboro, Ontario. In 1968 the Canadian government instituted a mandatory nationwide carcass merit program (NPPC, 1981).

U.S. Entry into Carcass Buying

The United States is a relative latecomer to the idea of marketing hogs on a carcass basis. The first major packer to introduce a carcass merit program was the George A. Hormel Company in 1945 (USDA, 1984a). At the present time, only 10-12% of all hogs sent to packers are sold based on carcass merit programs (Hayenga et al., 1985). The major difference between the carcass merit programs of these other countries and programs in the United States is the fact that the foreign programs are mandatory and the domestic programs are voluntary (USDA, 1984a).

Benefits of Carcass Merit Programs

Shepherd (1937) cited two benefits of marketing hogs on a carcass merit program:

1. Premiums or discounts paid for hogs can accurately reflect their quality.
2. The origin of each lot of hogs is known.

Quality Determinations. Carcass merit programs enable packers to more accurately determine the degree and quality of finish of the hogs they process. Each carcass is evaluated separately and receives a premium or discount based on its own merit.

Identification. Every hog marketed on a carcass merit program is tattooed with tattoo mark unique to the owner of the hog. The advantages of this are as follows (Shepherd et al., 1940):

1. Hogs with unacceptable levels of residues can be traced to a specific producer.
2. Hogs with excessive bruising or abscesses can be identified and the producer notified.
3. Hogs with diseases can be traced to the owner.
4. The producer can receive information on the quality of his hogs.

Objections to Carcass Merit Programs

American hog producers have several reasons for not selling on a carcass merit program. These factors were outlined in a Packers and Stockyards Administration Report (USDA, 1984a). The primary reasons are the following:

1. They are satisfied with the live marketing system.
2. The seller has to sort closely and sell hogs which weigh in a packer's preferred weight range.
3. There is not enough incentive to produce good quality hogs or disincentive to discourage the production of poor quality hogs.
4. Producers are not sure that the packers are paying them what their hogs are worth.

Live Marketing. Producers that are satisfied with the live marketing system can be divided into two categories. The first category is composed of producers who have not sold any animals or who have sold only limited numbers of animals on carcass merit programs. These producers have not given carcass merit programs an opportunity to prove the worth of their hogs (USDA, 1984a). The second category, probably the larger of the two, is characterized by producers who have tried carcass merit programs and have been dissatisfied with the results. The main reason for the dissatisfaction has been the lack of standardization among the carcass merit programs from various packers (NPPC, 1981). The Packers and Stockyards Administration Report (USDA, 1984a) also suggested that the unhappy producers were people that consistently marketed overly fat hogs and subsequently received discounts.

Increased Management Levels Needed. Some producers dislike carcass merit marketing becuase they do not like to sort their hogs (USDA, 1984a). It takes a higher level of management to market animals on a carcass merit program (Shepherd et al., 1940). The producer must know the preferred carcass weight range of the packer and know how to calculate the live weights to fit this range. After calculating the live weight range, the producer must carefully sort the animals to fit this range to be able to receive the highest levels of premiums offered by the packer (USDA, 1984a).

Lack of Incentives. The major function of a carcass merit program is to encourage the production and marketing of the types of hogs desired by packers (Chabluk and Beaton, 1985). To encourage producers to breed and market lean, meaty hogs, a carcass merit program must pay a significantly higher amount for these types of hogs than it pays for overly fat hogs (Shepherd et al., 1940). Present carcass merit programs provide, at the most, an 18% increase in carcass price per hundred weight between the very best animal and the worst animal (USDA, 1984a). This pricing can be further divided. The maximum pricing spread from the base or average hog to the best hog is only five percent. The spread from the worst hog to the base hog is 13%. The NPPC Report (1981) concluded that while packers do not want to pay for extra fat in a hog, they also do not want to pay for the extra quality of the best animals. Chabluk and Beaton (1985) found because of the relative scarcity of the best quality hogs as compared with the relative abundance of average to poor quality animals, packers could conceivably set their premiums higher than actual value of the animal to encourage increased production of higher quality hogs.

Determining Carcass Value. Many producers feel that packers are not paying them for the actual value of their hogs under present carcass merit programs (USDA, 1984a). Part of this problem can be explained by the difficulty in determining carcass value. Each packer operates in a different market situation and may utilize a different type of hog or may process the hog in a different way. This diversity results in a slightly different value for a particular hog between several packers. However, the procedure for determining the fair market value for different packers is the same. The procedure was outlined by Grisdale et al., (1984b). A representative sample of carcasses from each of the packer's carcass grades is selected. Each carcass is then broken down into wholesale cuts that the packer normally sells or utilizes to make in-house products. The carcass values are calculated from the weights of the wholesale cuts multiplied by the seasonally adjusted prices for these cuts. These prices must be established by the individual packer to be valid for that specific market. The actual carcass value per hundred weight can be calculated from the following formula:

$$V_i=(([W_1 + W_2 + W_3 \ldots + W_n] - P)/C_i)100$$

V_i = Net value

$W_1 \ldots W_n$ = Value of each wholesale cut (weight in pounds times price per pound for each cut)

P = Packer's overhead costs (labor packaging, depreciation, etc. per carcass)

C_i = Hot carcass weight (in pounds)

Similar formulae were reported by Couvillion and DuBov (1973), Hayenga et al. (1985), and Pearson et al. (1970).

Calculating Incremental Price Adjustments

After carcass value is determined, it is necessary to convert the differences in value due to weight and grade into incremental price adjustments. These price adjustments can be used to create a premium/discount schedule that can communicate the value differences to the producer. In a study by Hayenga et al. (1985), carcass value was regressed against easily measured carcass characteristics, last rib backfat, hot carcass weight, and a USDA muscling score to calculate the price adjustments. This study reported that backfat and carcass weight measurements accounted for 76% of the variability in carcass value. The addition of a three-score muscling index increased R^2 to .79. Grisdale et al. (1984b) reported similar results, with R^2 being equal to .77 for these three measurements. The addition of a carcass length measurement and/or loin eye area measurement at the tenth rib did not significantly change R^2 ($p < .01$) in either study. In contrast to these two studies, a report by Pearson et al. (1970) reported that the combination of carcass weight and backfat thickness accounted for only 55% of the variation in carcass value. The addition of a carcass length and loin eye area measurement increased R^2 to .69. Pearson et al. (1970) reported no significant curvilinear relationships among the data and subsequently assumed that all relationships were linear. The studies by Grisdale et al. (1984b) and Hayenga et al. (1985) found certain nonlinear functions, primarily quadratic, to estimate carcass value more closely. However, these researchers agreed with Couvillion and DuBov (1973) that the increase in accuracy obtained by using the nonlinear relationships was not sufficient to justify the effort of processing the extra data required to measure the nonlinear effects. They concluded from their research that a linear regression equation containing measurements of carcass weight, last rib backfat, and muscling score was sufficiently accurate in predicting price adjustments to enable the development of a premium/discount schedule.

Converting Value to Index

Chabluk and Beaton (1985) described a procedure for converting the value of each carcass grade to an index. These researchers used a regression equation containing hot carcass weight, last rib backfat and muscling score to create a table showing the value of each carcass grade. This table was converted to a premium/discount index matrix by the following formula: Index = (Net value of the individual carcass/Net value of the average hog killed by the packer) x 100 (Chabluk and Beaton, 1985). The index was used in the following formula to determine the actual amount to be paid to the producer (Chabluk and Beaton, 1985; Hayenga et al., 1985):

$$AP = HCW \times I \times CP$$

AP refers to the actual amount to be paid to the producer,

HCW refers to the hot carcass weight,

I refers to the index value,

CP refers to the carcass price per pound.

The carcass price per pound is determined by the prevailing market conditions and adjusted by the packer.

MATERIALS AND METHODS

Animals

A stratified sample of 420 market hogs representing the seven 10 pound incremental carcass weight classes from 140 lbs. to 210 lbs., and the nine last rib backfat thickness classes from less than .8 inches to 1.5 inches, or greater, within each weight class were used in this study. Appendix Table 7 represents this design and the number of animals in each cell. As the data were collected, it was attempted to have a minimum of five animals in each of the cells. The aniamls were mostly crossbreeds. However, 8% of the animals were purebred. The animals were slaughtered in accordance with current USDA regulations and standard packing house procedures. The data were collected at the Tri-Miller Packing Company in Hyrum, Utah, between February and November of 1985.

Measurements

Hot Carcass Weight. The carcasses were higher to determine the hot carcass weight (HCW) immediately prior to being placed in the blast cooler. The weight was taken after the hair was removed from the carcass by scraping. The head, viscera, and leaf lard were also removed prior to weighing the carcass. Carcasses with more than two pounds of trim due to the presence of bruises or abscesses were excluded from this study. Carcasses were also split down the center of the backbone from the tail to the neck before they were weighed.

Backfat Depth. Three measurements of backfat depth were collected. All three were measured on the cut surface perpendicular to the outer skin surface and included the skin and both the outer and middle layers of subcutaneous fat. A determination of the fat depth to the nearest tenth of an inch at the third lumbar vertebra was made on the hot carcass. After the carcasses had chilled for six to eight hours, the fat depth at the last rib and a second third lumbar fat depth measurement were recorded.

Carcass Length. The length of the chilled carcass was measured from the anterior edge of the first rib to the anterior edge of the cut surface of the aitch bone to the nearest one-half inch.

Muscling Score. The chilled carcasses were visually appraised to ascertain a muscling score of thin = 1, average = 2, or thick = 3. The standard for the muscling score were outlined by the USDA (USDA, 1984b).

USDA Grade. The USDA grades were calculated in accordance with the USDA standards (USDA, 1984b).

Wholesale Carcass

The weights of the following wholesale carcass cuts were recorded.

Boneless Leg. The leg was removed from the loin and belly by a cut three inches anterior to the aitch bone, at a 90^{0} angle to the long axis of the vertebral column of the carcass, as shown by Marchello (1983). The skin and all external fat were removed and each weighed separately. The shank was separated from the leg, deboned, and the weight of the shank muscle recorded. After the femur, ischium, and ilium were removed, the weight of the boneless leg was recorded. The meat that remained on the bones of the leg (that was missed in the deboning process) was trimmed off the bone. This meat, together with the odd lean pieces that were accidentally trimmed during the preceding operations, constituted the lean leg trim.

Loin. The loin was fabricated in the usual commercial manner (second rib to the junction with the leg) with the fatback removed and the fat trimmed to a 1/4" depth on loin.

Picnic. The picnic shoulder and Boston butt were separated from each other midway between the brachial artery and the ventral side of the exposed surface of the scapula. The picnic was faced to remove the lip and breast flap with the skin, and the bloody and loose tissue trimmed. The fresh hock was removed from the ventral side of the picnic shoulder.

Jowl. The jowl was removed along the natural junction of the neck and shoulder.

Front Feet. The feet were removed by making a cut at a right angle to the long axis of the shank proximal to the knee joint.

Neck Bone. The neck bones were closely trimmed from the shoulder.

Boston Butt. The portion of the shoulder remaining after the removal of the neck bone, jowl, and picnic was the Boston butt. The clear plate was removed, leaving a fat covering of 1/4 inch.

Spare Ribs. The spare ribs were removed from the belly and the diaphragm muscle was removed.

Belly. The pork belly was trimmed to leave square corners, the nipples were removed, and the belly was flattened by a roller.

Loin, Belly and Butt Fat. This fat trim consisted of the pieces of trim collected after the loin, belly, and Boston butt were fabricated.

Shoulder Fat. The shoulder fat was the clear plate and the fat from the picnic.

Hind Feet. The hind feet were removed from the hind leg just below the hock joint.

Backfat. The fat back was weighed with the skin on and consisted of all the fat trimmed from the loin.

Offal. Because it was not feasible to measure the offal (intestines, lungs, liver, heart, etc.) for each animal, the value of the offal was calculated on the first 30 animals and the average applied to all the animals.

Carcass Value

Carcass value was calculated for each carcass by multiplying the weight of each cut by its wholesale value as reported by Tri-Miller Packing Company Marketing and Sales Department. Carcassess were priced on each of three seasonal prices (April, August, and December) for each cut and the 1985 average price (calculated by averaging the seasonal prices). Because of some problems in data collection, the weights of some of the minor cuts could not be collected for each carcass. An analysis of variance was performed on the data for these cuts. The weights were not found to vary ($p<.01$) between carcasses. Based on this, the value of each carcass was adjusted for the missing cuts.

Statistical Analysis

A data analysis program, available through the Utah State University Computer Center, was used to evaluate the data. This program, Minitab, was developed at Pennsylvania State University (Ryan et al., 1985).

Data Summary. The minimum, maximum, and mean values for each measurement and the standard deviation of each measurement were calculated.

Correlations. Minitab was used to correlate the carcass measurements with each other and with the carcass values.

Regressions. The effects of independent variables (hot carcass weight, last rib backfat, carcass length, and muscling score) upon the dependent variables (April 1985 carcass value, August 1985 carcass value, December 1985 carcass value, and 1985 average carcass value) were evaluated using a stepwise regression analysis. The following model was proposed to be evaluated:

$(\text{Carcass value})_i = a + b_1W_i + b_2F_i + b_3L_i + b_4M_i$ where

i refers to carcass "i,"

a refers to the intercept,

W refers to the hot carcass weight,

F refers to the last rib backfat,

L refers to the carcass length,

M refers to the muscling score, and

b_i refers to the regression coefficient associated with each independent variable.

RESULTS AND DISCUSSION

Data

A summary of the data utilized in this research is given in Table 1. The mean, minimum, and maximum values, together with the standard deviation of each measurement, are given in this table.

Correlations

The simple correlation coefficients between each of the carcass measurements are given in Table 2. Hot carcass weight was positively correlated with the backfat measurements, carcass length measurement, muscling score and USDA grade. Hot carcass weight was significantly correlated with the weight of the lean cuts (Boston butts, picnic shoulders, loins, and boneless legs), total weight of the primal cuts (lean cuts and bellies). The correlation between the hot carcass weight and the weights of the Boston butts, picnic shoulders, loins and bellies was high. In contrast to this, the correlation between the hot carcass weight and the boneless leg was low. The high positive correlation between the hot carcass weight and the measures of total carcass value is due, in part, to the manner by which total carcass value was derived, total carcass value equals the sum of the weight of each cut times the price for each cut.

Last rib backfat was negatively correlated with carcass length and muscling score. These results are similar to those reported by Fahey et al. (1977) and Grisdale et al. (1984a). The highly positive correlation between last rib backfat and the USDA grade reflects the degree of emphasis on backfat when calculating the USDA grade (USDA, 1984b). The last rib backfat was positively correlated with the total weights of the

TABLE 1. MEANS FOR CARCASS WEIGHTS AND MEASUREMENTS

Measurement Weight (Lb.)	Mean	Deviation	Minimum	Maximum
Hot Carcass Weight	175.46000	15.06000	140.50000	209.50000
Last Rib Backfat[1]	1.17380	0.29060	0.20000	2.10000
Third Lumbar Backfat[1]	1.36760	0.29560	0.40000	2.30000
Carcass Length[1]	32.36000	1.27300	21.00000	36.00000
Muscling Score[2]	2.22380	0.67510	1.00000	3.00000
USDA Grade[3]	2.14290	1.13250	1.00000	4.00000
Lean Cuts[4]	78.95000	7.66000	53.00000	104.50000
Fat Cuts[5]	22.65700	5.02000	11.60000	37.50000
Primal Cuts[6]	104.38000	9.64000	79.30000	128.40000
% Primal Cuts[7]	59.53600	3.20500	50.24400	81.01000
Boneless Legs	19.60300	3.03100	11.10000	28.80000
Boneless Shanks	1.46120	0.19040	0.40000	2.20000
Fat Leg Trim	4.73310	1.28040	1.80000	9.60000
Lean Leg Trim	3.52550	0.73280	1.90000	6.50000
Loins	30.63100	3.02500	19.60000	39.80000
Boston Butts	13.58200	1.49300	10.20000	19.90000
Picnics	15.14300	1.54000	11.10000	21.30000
Fresh Hocks	1.48880	0.22430	0.80000	2.10000
Neck Bones	3.84260	0.49000	2.50000	5.50000
Front Feet	1.68260	0.27630	0.80000	2.70000
Spare Ribs	6.73620	0.72190	4.40000	8.80000
Hind Feet	3.59000	0.37510	2.60000	5.50000
Loin Trim	2.05260	1.15690	0.10000	9.30000
Belly and Butt Trim	1.78790	1.12260	0.30000	9.10000
Jowls	5.35760	1.31080	1.30000	9.00000
Bellies	25.42100	5.01100	15.50000	38.80000
Shoulder Fat	4.44690	1.49440	1.00000	9.90000
Fat Back	9.63700	3.48200	3.00000	22.30000

[1]Recorded in inches.
[2]See Materials and Methods.
[3]USDA, 1984b.
[4]Boneless legs, loins, picnic shoulders, Boston butts.
[5]Fat leg trim, loin trim, belly and butt trim, jowls, shoulder fat, fatback.
[6]Boneless legs, loins, picnic shoulders, Boston butts, bellies.
[7]% of hot carcass weight.

TABLE 2. CARCASS CORRELATION COEFFICIENTS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Hot Carcass Weight														
2.	Last Rib Backfat	0.415													
3.	Third Lumbar Backfat	0.436	0.934												
4.	Carcass Length	0.418	-0.356	-0.240											
5.	Muscling Score	0.084	-0.290	-0.290	0.246										
6.	USDA Grad	0.257	0.810	0.767	-0.301	-0.669									
7.	Lean Cuts	0.649	-0.086	-0.088	0.470	0.320	-0.198								
8.	Fat Cuts	0.512	0.641	0.658	-0.105	-0.206	0.538	-0.009							
9.	Primal Cuts	0.821	0.207	0.217	0.376	0.182	0.072	0.857	0.387						
10.	% Primal Cuts	-0.173	-0.285	-0.301	-0.021	0.173	-0.267	0.443	-0.139	0.419					
11.	Boneless Legs	0.284	-0.297	-0.291	0.300	0.360	-0.380	0.844	-0.289	0.376	0.841				
12.	Boneless Shanks	0.324	-0.252	-0.225	0.333	0.231	-0.264	0.605	-0.095	0.450	0.257	0.547			
13.	Fat Leg Trim	0.022	0.026	0.037	0.114	0.152	-0.089	-0.140	0.037	-0.189	-0.349	-0.103	-0.047		
14.	Lean Leg Trim	0.356	0.264	0.267	-0.006	-0.011	0.239	0.216	0.356	0.336	0.018	0.015	0.184	-0.083	
15.	Loins	0.663	-0.002	-0.019	0.502	0.251	-0.107	0.898	0.110	0.835	0.367	0.631	0.524	-0.168	0.358
16.	Boston Butts	0.699	0.111	0.124	0.376	0.166	0.026	0.770	0.201	0.786	0.241	0.470	0.406	-0.096	0.377
17.	Picnics	0.688	0.056	0.054	0.397	0.230	-0.053	0.803	0.112	0.745	0.185	0.536	0.510	-0.072	0.271
18.	Fresh Hocks	0.434	0.061	0.072	0.350	0.072	0.009	0.350	0.129	0.414	0.023	0.155	0.287	-0.027	0.218
19.	Neck Bones	0.345	-0.195	-0.181	0.435	0.189	-0.197	0.493	-0.063	0.374	0.083	0.353	0.349	-0.149	0.107
20.	Front Feet	0.159	-0.044	-0.058	0.185	0.090	-0.071	0.145	-0.062	0.106	-0.071	0.085	0.126	0.174	-0.015
21.	Spare Ribs	0.516	-0.037	-0.029	0.419	0.176	-0.097	0.533	0.056	0.495	0.033	0.326	0.398	0.145	0.232
22.	Hind Feet	0.207	-0.063	-0.066	0.270	0.028	-0.061	0.160	-0.002	0.166	-0.049	0.067	0.128	0.025	0.010
23.	Loin Trim	0.104	0.206	0.231	-0.203	-0.108	0.222	0.103	0.375	0.152	0.102	0.102	0.036	-0.183	0.240
24.	Belly and Butt Trim	0.056	0.088	0.087	-0.076	-0.007	0.089	0.064	0.258	0.059	0.013	0.019	0.185	-0.074	0.285
25.	Jowls	0.422	0.374	0.390	0.099	-0.247	0.377	0.093	0.531	0.419	0.055	-0.119	-0.049	-0.069	0.118
26.	Bellies	0.587	0.529	0.552	0.005	-0.140	0.442	0.120	0.759	0.615	0.128	-0.182	-0.060	-0.149	0.316
27.	Shoulder Fat	0.453	0.504	0.518	-0.048	-0.207	0.446	0.020	0.743	0.398	-0.029	-0.261	-0.119	-0.252	0.252
28.	Fat Back	0.483	0.602	0.609	-0.081	-0.226	0.514	-0.025	0.902	0.388	-0.098	-0.306	-0.140	-0.121	0.264
29.	April 1985 Carcass Value	0.831	0.268	0.284	0.336	0.143	0.134	0.804	0.499	0.986	0.380	0.523	0.437	-0.151	0.403
30.	August 1985 Carcass Value	0.802	0.154	0.165	0.399	0.212	0.021	0.906	0.352	0.983	0.421	0.665	0.520	-0.153	0.360
31.	December 1985 Carcass Value	0.839	0.253	0.266	0.363	0.149	0.122	0.820	0.473	0.991	0.376	0.519	0.450	-0.149	0.402
32.	1985 Average Carcass Value	0.828	0.228	0.241	0.367	0.160	0.094	0.846	0.446	0.992	0.394	0.570	0.470	-0.158	0.391

TABLE 2. (CON'T) CARCASS CORRELATION COEFFICIENTS

	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
16. Boston Butts	0.631																
17. Picnics	0.647	0.692															
18. Fresh Hocks	0.344	0.394	0.376														
19. Neck Bones	0.435	0.406	0.508	0.127													
20. Front Feet	0.139	0.098	0.207	0.183	0.114												
21. Spare Ribs	0.508	0.522	0.503	0.376	0.263	0.221											
22. Hind Feet	0.132	0.160	0.249	0.224	0.150	0.253	0.147										
23. Loin Trim	0.135	-0.022	0.070	-0.070	0.005	-0.065	-0.053	-0.130									
24. Belly and Butt Trim	0.124	-0.022	0.061	-0.009	0.066	-0.020	0.082	-0.142	0.315								
25. Jowls	0.155	0.334	0.147	0.300	-0.047	-0.040	0.164	0.140	-0.074	-0.172							
26. Bellies	0.215	0.336	0.205	0.262	-0.034	-0.019	0.137	0.075	0.134	0.014	0.444						
27. Shoulder Fat	0.106	0.272	0.139	0.205	0.023	-0.090	-0.000	0.065	0/124	-0.030	0.606	0.736					
28. Fat Back	0.090	0.222	0.085	0.136	-0.069	-0.092	0.019	0.040	0.122	-0.004	0.610	0.704	0.711				
29. April 1983 Carcass Value	0.707	0.749	0.696	0.416	0.336	0.098	0.314	0.151	0.233	0.122	0.466	0.669	0.440	0.466			
30. August 1983 Carcass Value .	0.861	0.782	0.750	0.415	0.404	0.121	0.355	0.160	0.180	0.122	0.363	0.507	0.321	0.324	0.978		
31. December 1983 Carcass Valud	0.814	0.760	0.712	0.432	0.356	0.106	0.320	0.161	0.195	0.114	0.450	0.634	0.444	0.431	0.997	0.961	
32. 1983 Average Carcass Value	0.824	0.769	0.722	0.433	0.366	0.109	0.335	0.150	0.207	0.120	0.433	0.615	0.408	0.418	0.997	0.991	0.998

fat cuts and the primal cuts. Last rib backfat was negatively correlated with the weights of the boneless legs and the loins and positively correlated with the weights of the Boston butts, picnic shoulders, and bellies. Edwards et al. (1981) reported similar results.

Carcass length and muscling score were positively correlated. This research found a negative correlation between carcass length and the USDA grade. The total weights of the lean cuts and primal cuts were positively correlated with carcass length. In addition, carcass length was positively correlated with the weights of the boneless legs, loins, Boston butts, picnic shoulders, bellies, and with carcass value. Carcass length was negatively correlated with the total weight of the fat cuts.

Muscling score was shown to be negatively correlated with the USDA grade. This shows the manner in which the muscling score affected the USDA grade. A high muscling score (3=thick) results in a better carcass or a lower number for the USDA grade (1 or 2 vs. 3 or 4). Muscling score was found to be positively correlated with the total weight of the lean cuts and the primal cuts and with each of the lean cuts taken separately. The fat cuts and the bellies were both negatively correlated with the muscling score. The correlation between the weight of the bellies and the boneless legs was negative. However, the correlation between the bellies and the loins, Boston butts, and picnic shoulders was positive.

Backfat Measurements

A comparison of the third lumbar backfat measurement and the last rib backfat measurement was performed as a part of this study. A measurement of the backfat thickness in both locations on each carcass was gathered. An analysis of variance was performed on this data set. This analysis showed a significantly ($\underline{p}<.05$) higher variability in the third lumbar backfat measurement. Further investigation revealed a possible reason for the higher variability. As the carcasses were split from the tail to the neck, a large number of the carcasses were incompletely separated. The skin and part of the fat layer in the lumbar-sacral region were left intact. As the technician measured the third lumbar backfat, the intact skin pulled on the backfat in the third lumbar region. This caused the backfat to be thicker than when the skin was completely separated. To calculate the last rib measurement from the third lumbar backfat determination, .1938 inches must be subtracted from the third lumbar measurement.

Determination of Carcass Value

There are several carcass traits that can be used as predictors of the quantity of lean in a carcass and, thus, as predictors of carcass value. These traits (hot carcass weight, backfat thickness, carcass length, and muscling score) can readily be measured in spite of the high chain speeds in meat packing plants. In a manner similar to that reported by Grisdale et al. (1984b), three sets of 1985 seasonal prices and the 1985 average prices were regressed, by stepwise regression analyses, on the four previously mentioned carcass traits. The resulting equations for each set of prices can be derived from Table 3. Using the equations to predict the 1985 average carcass values for comparison, hot carcass weight accounted for 68.55% of the difference in carcass value (Equation 9). The addition of a last rib backfat

TABLE 3. RESULTS OF MULTIPLE REGRESSION TO PREDICT CARCASS VALUE[a]

Predictors	Partial Regression Coefficients			Standard Deviation of Carcass Value ($)
	X	Slope	R^2 (%)	
April 1985 Carcass Value				
1. Hot Carcass Weight[b]	29.83	.678	69.02	6.85
2. Hot Carcass Weight and	28.93	.709	69.72	6.78
Last Rib Backfat[c]	-3.900			
3. Hot Carcass Weight and	48.02	.744	70.10	6.74
Last Rib Backfat	-5.400			
Carcass Length[c]	.730			
August 1985 Carcass Value				
4. Hot Carcass Weight	35.35	.599	64.26	6.73
5. Hot Carcass Weight and	33.43	.665	68.09	6.37
Last Rib Backfat	-8.300			
6. Hot Carcass Weight and	31.50	.650	68.73	6.31
Last Rib Backfat	-7.000			
Muscling Score[d]	1.430			
December 1985 Carcass Value				
7. Hot Carcass Weight	28.61	.655	70.32	6.41
8. Hot Carcass Weight and	27.55	.692	71.39	6.30
Last Rib Backfat	-4.600			
1985 Average Carcass Value				
9. Hot Carcass Weight	31.26	.644	68.55	6.57
10. Hot Carcass Weight and	29.97	.689	70.16	6.41
Last Rib Backfat	-5.600			
11. Hot Carcass Weight and	28.54	.677	70.48	6.38
Last Rib Backfat	-4.600			
Muscling Score	1.060			

[a] N = 420.
[b] Recorded in pounds.
[c] Recorded in inches.
[d] 1 = thin, 2 = average, 3 = thick.

measurement increased R^2 to 70.16%. These results differ slightly from the study by Grisdale et al. (1984b) who found an R^2 of 73% for the equation contrasting hot carcass weight and last rib backfat. A similar study by Hayenga et al. (1985) found an R^2 of 76% for the same equation. In these two studies, R^2 increased to 77% and 79%, respectively, with the addition of a subjective muscling score to the equation. In the present study, the addition of a muscling score to the equation only increased R^2 to 70.48%. This contrasts a statement made by Grisdale et al. (1984b): "Although the increase in R^2 was not great in this sample, it may be greater in a more diverse population . . ." (p. 886).

Animals chosen for this study were selected as being as diverse as possible. Because of the subjective nature of the muscling score and its minimal impact on R^2, the equation containing the muscling score was not used in the calculations in the remainder of this paper. The inclusion of carcass length did not significantly improve the predictive accuracy of this equation ($\underline{p}<.05$). Table 4 values represent the predicted gross dollar return per carcass for the average carcass within each weight and backfat cell. Table 5 was created by applying equation 10 from Table 3 to the weight and backfat classes utilized in this study. These values are directly related to the weights, and the corresponding values, of the primal cuts.

Predicting Weights of Primal Cuts

When a packer processes a carcass, he is especially concerned with weights of two of the primal cuts. If a carcass yields small or light loins, the packer may have a difficult time marketing them. If a belly

TABLE 4. TOTAL (GROSS) DOLLAR RETURN PER CARCASS CALCULATED WITH 1985 AVERAGE PRICES

Last Rib Backfat (Inches)	Carcass Weight Classes (Lbs.)						
	140-149.5	150-159.5	160-169.5	170-179.5	180-189.5	190-199.5	200-209.5
<.8	125.96	132.85	139.74	146.63	153.52	160.41	167.30
.8	125.40	132.27	139.18	146.07	152.96	159.85	166.74
.9	124.84	131.73	138.62	145.51	152.40	159.29	166.18
1.0	124.48	131.17	138.06	144.95	151.84	158.73	165.62
1.1	123.72	130.61	137.50	144.39	151.28	158.17	165.06
1.2	123.16	130.05	136.94	143.83	150.72	157.61	164.50
1.3	122.60	129.49	136.38	143.27	150.16	157.05	163.94
1.4	122.04	128.93	135.82	142.71	149.60	156.49	163.38
≥1.5	121.48	128.37	135.26	142.15	149.04	155.93	162.82

TABLE 5. NET DOLLAR RETURN PER CARCASS HUNDRED WEIGHT ([GROSS - OVERHEAD]/HCW) X 100

Last Rib Backfat (Inches)	Carcass Weight Classes (Lbs.)						
	140-149.5	150-159.5	160-169.5	170-179.5	180-189.5	190-199.5	200-209.5
<.8	61.25	61.74	62.18	62.56	62.90	63.21	63.49
.8	60.86	61.37	61.84	62.24	62.60	62.92	63.21
.9	60.48	61.02	61.50	61.92	62.30	62.64	62.94
1.0	60.23	60.66	61.16	61.60	61.99	62.35	62.67
1.1	59.70	60.30	60.82	61.28	61.69	62.06	62.40
1.2	59.32	59.94	60.48	*60.96	61.39	61.77	62.12
1.3	58.93	59.57	60.14	60.64	61.09	61.49	61.85
1.4	58.54	59.21	59.80	60.32	60.78	61.20	61.58
≥1.5	58.16	58.85	59.46	60.00	60.48	60.91	61.30

*Average hog slaughtered.

is too thick or too heavy, the belly may not fit in the packer's processing equipment. The five primal cuts were regressed on hot carcass weight, last rib backfat, carcass length, and muscling score to obtain the prediction equations given in Table 6. The regression analysis was performed on the data as a whole and on data separated into the seven weight classes. The equations with the highest R^2 values are shown in this table. Because of the low R^2 values for the prediction equations for the boneless leg, no attempt was made to predict the weight of this cut. Table 7 shows the predicted weights of the loins, Boston butts, picnics, and bellies for varying amounts of backfat within the 190-199.5 lb. weight class. The tables for the other weight classes are given in the Appendix.

Construction of the Premium/Discount Matrix

The amount of lean in a carcass is directly related to the value of the carcass (Grisdale et al., 1984b). The values resulting from equation 9 from Table 6 were divided by the hot carcass weight to create Table 8. This formula,

> Percent Lean Cuts = ((18.44 + .421 (hot carcass weight in lb.) - 11.3 (last rib backfat in inches))/(hot carcass weight in lb.),

is used to create an integral part of the maxtrix formula. The following formula is the premium/discount matrix formula. The application of this formula to the weight and backfat classes utilized in this study results in Table 9.

> Index = (55 + percent lean cuts) - (light loin discount) - (heavy belly discount) + (weight range premium).

TABLE 6. REGRESSION RESULTS FOR PREDICTING WEIGHTS OF PRIMAL CUTS

Equation	Predicted Cut	Intercept	B_1	B_2	R^2-%
1	Loins	6.4410	.16122	-3.4907	53.3
2	Boston Butts	1.1614	.07823	-1.1130	52.8
3	Picnic Shoulders	2.4633	.08209	-1.4693	53.6
4	Bellies	-7.4950	.14785	5.9420	44.3
5	Boneless Legs	8.3750	.09896	-5.2276	28.9
6	Leg 170-179.5 lb. wt. class	-24.3000	.29200	-5.9800	29.9
7	Leg 180-189.5 lb. wt. class	-4.1000	.17100	-6.0800	37.9
8	Leg 200-209.5 lb. wt. class	55.6000	-.13600	-4.8300	40.5
9	Lean Cuts	18.4400	.42100	-11.3000	57.3
10	Primal Cuts	10.945	.56800	5.3600	69.5

B_1 = Hot carcass weight variable.
B_2 = Last rib backfat variable.
To predict the weight of a particular cut, select the appropriate equation and add the intercept, the B_1 factor multiplied by the hot carcass weight, and the B_2 factor multiplied by the last rib backfat.

TABLE 7. PREDICTED WEIGHTS OF PRIMAL CUTS FOR THE 190-199.5 LB. WEIGHT CLASS[a,b]

BF	Loins	Boston Butts	Picnics	Belly
<.8	35.43	15.64	17.44	25.50
.8	35.09	15.53	17.30	26.09
.9	34.74	15.42	17.15	26.86
1.0	34.39	15.30	17.00	27.28
1.1	34.04	15.19	16.86	27.87
1.2	33.69	15.08	16.71	28.47
1.3	33.34	14.97	16.56	29.06
1.4	32.99	14.86	16.41	29.65
≥1.5	32.64	14.75	16.27	30.25

[a]Weights in pounds
[b]BF in inches

TABLE 8. PERCENT LEAN CUTS CALCULATED FROM REGRESSION FORMULA

Last Rib Backfat (Inches)	Carcass Weight Classes (Lbs.)						
	140-149.5	150-159.5	160-169.5	170-179.5	180-189.5	190-199.5	200-209.5
<.8	49.36	48.89	48.48	48.12	47.79	47.50	47.24
.8	48.58	48.16	47.80	47.47	47.18	46.92	46.69
.9	47.80	47.44	47.11	46.83	46.57	46.34	46.13
1.0	47.02	46.71	46.43	46.18	45.96	45.76	45.58
1.1	46.24	45.98	45.74	45.53	45.35	45.18	45.03
1.2	45.47	45.25	45.06	44.89	44.74	44.60	44.48
1.3	44.69	44.52	44.37	44.24	44.13	44.02	43.93
1.4	43.91	43.79	43.69	43.60	43.52	43.44	43.38
≥1.5	43.13	43.06	43.00	42.95	42.91	42.86	42.83

TABLE 9. PREMIUM/DISCOUNT MATRIX[1,2]

Last Rib Backfat (Inches)	Carcass Weight Classes (Lbs.)						
	140-149.5	150-159.5	160-169.5	170-179.5	180-189.5	190-199.5	200-209.5
<.8	104.4	103.9	108.5	108.1	107.8	102.5	102.2
.8	103.6	103.2	107.8	107.5	107.2	101.9	101.7
.9	102.8	102.4	107.1	106.8	106.6	101.3	97.1
1.0	102.0	101.7	106.4	106.2	106.0	100.8	96.6
1.1	101.2	101.0	105.7	105.5	105.4	100.2	96.0
1.2	82.5	100.3	105.1	104.9	104.7	95.6	95.5
1.3	81.7	99.5	99.4	99.2	99.1	95.0	94.9
1.4	80.9	98.8	98.7	98.6	94.5	94.4	94.4
≥1.5	80.1	98.1	98.0	98.0	93.9	93.9	93.8

[1]The units are calculated index values
[2]The boxed area represents the weight and backfat of carcasses desired by Tri-Miller Packing Company.

This formula was created to yield an index value of 100 (excluding the weight range premium) for the average hog slaughtered on this study.

In deriving the matrix formula, the following assumptions were made:

1) Light loins decrease carcass value 18%. This was determined by calculating the difference in value between acceptable loins and loins that must be used for sausage meat. The weight of light loins in this study was 13 pounds or less.
2) Heavy bellies decrease carcass value 4%. This was determined by calculating the difference in value betwen acceptable bellies and bellies that must be used for sausage meat. The weight of heavy bellies was 26 pounds or greater.
3) Carcasses with more than 1.2 inches last rib backfat would not receive an index higher than 100. It was felt that a carcass that graded a U.S. #3 or U.S. #4 should not receive a premium.
4) Each packer has a certain range of carcasses that best fit his processing equipment and his marketing situation. To encourage pork producers to market animals to fit this range, a packer can offer a premium for animals that fit his desired range. For the purposes of this paper, the desired range was from 160 lbs. to 189.5 lbs. carcass weight with less than 1.2 inches last rib backfat. The premium was set at 5% after discussion with the management from Tri-Miller Packing Company. This discussion included their costs, expected profits, and what they calculated they could afford to pay to obtain the quality of market hogs that best fit their needs.

5) The carcasses that would have light loins or heavy bellies can be predicted from the equations in Table 6.

The premium/discount matrix can be used by a packer to determine how much to pay a producer for his hogs. The matrix is used in the following manner:

Amount paid to the producer = hot carcass weight x quoted carcass price x index value.

The amount to pay a producer for a carcass weighing 186 lbs. with .9 inches backfat can be calculated as follows:

186 x .88 x 104.7% = $171.37

where

186 = pounds of carcass

.88 = base carcass price as determined by prevailing market conditions.

104.7% = index value (amount of base carcass price).

The index value is calculated by the following formula:

(55 + 44.74) + 5 = 104.7

where

55 = constant

44.74 = percent lean cuts

5 = weight range premium

An example of the index value for a carcass that receives a discount is given next. For a carcass in the 190 to 199.5 pound weight class with a last rib backfat measurement of 1.3 inches, the index would be:

95.0% = 55 + 44.02 - 4

where

55 = constant

44.02 = percent lean cuts

4 = heavy belly discount

The ratio of loin weights and belly weights to the hot carcass weight can also be calculated from the equations in Table 6. Equations 1 and 4 were used to create Tables 10 and 11. Loins as a percentage of hot carcass weight and bellies as a percentage of hot carcass weight, respectively.

The value in each cell of the premium/discount matrix represents the percent of the base carcass price paid for the carcass with the characteristics of that cell. The "payback" of the premium/discount matrix is defined as the percent of gross return from the sale of carcass cuts minus the packer's overhead. This payback is calculated over the entire matrix. The optimum payback, from a producer's viewpoint, is 100% minus the packer's desired percentage profit (typically 1 to 2%). The payback is calculated by multiplying each premium or discount by the percentage of animals killed (Table 12) within that cell. The resulting values are added together to give the total percent payback to producers on a weeks kill.

The payback of the matrix shown in Table 9 is 101.21%. This means that if the packer is paying the current market price for the live hogs, he would be paying out to the producers 1.21% more than he is making from the sale of the wholesale cuts from the pork carcass. The packer will want to reduce the premiums or increase the discounts to reduce the payback to 98% to 99% to insure a one to two percent profit. This can be done by reducing the base carcass price, however, market conditions (competition) can affect this.

TABLE 10. LOINS AS A PERCENTAGE OF HOT CARCASS WEIGHT

Last Rib Backfat	Carcass Weight Class (Lbs.)						
	140-149.5	150-159.5	160-169.5	170-179.5	180-189.5	190-199.5	200-209.5
<.8	18.88	18.70	18.54	18.41	18.28	18.17	18.07
.8	18.64	18.48	18.33	18.21	18.09	17.99	17.90
.9	18.40	18.25	18.12	18.01	17.91	17.81	17.73
1.0	18.16	18.03	17.91	17.81	17.72	17.63	17.56
1.1	17.92	17.80	17.70	17.61	17.53	17.46	17.39
1.2	17.68	17.58	17.49	17.41	17.34	17.28	17.22
1.3	17.43	17.35	17.28	17.21	17.15	17.10	17.05
1.4	17.19	17.12	17.06	17.01	16.96	16.92	16.88
≥1.5	16.95	16.90	16.85	16.81	16.77	16.74	16.71

TABLE 11. BELLIES AS A PERCENTAGE OF HOT CARCASS WEIGHT

Last Rib Backfat	Carcass Weight Class (Lbs.)						
	140-149.5	150-159.5	160-169.5	170-179.5	180-189.5	190-199.5	200-209.5
<.8	12.48	12.63	12.76	12.88	12.98	13.07	13.16
.8	12.89	13.02	13.12	13.22	13.30	13.38	13.45
.9	13.30	13.40	13.48	13.56	13.62	13.68	13.74
1.0	13.71	13.78	13.84	13.90	13.95	13.99	14.03
1.1	14.12	14.17	14.20	14.24	14.27	14.29	14.32
1.2	14.53	14.55	14.56	14.58	14.59	14.60	14.61
1.3	14.94	14.93	14.92	14.92	14.91	14.90	14.90
1.4	15.35	15.32	15.28	15.26	15.23	15.21	15.19
≥1.5	15.76	15.70	15.64	15.60	15.55	15.51	15.48

TABLE 12. PERCENTAGE OF TOTAL KILL CLASSIFIED BY WEIGHT CLASS AND BACKFAT THICKNESS FOR HOGS SLAUGHTERED AT TRI-MILLER PACKING COMPANY FOR THE WEEK OF DECEMBER 16-20, 1985 (3,253 HOGS)

Last Rib Backfat	Carcass Weight Class (Lbs.)							Total
	140-149.5	150-159.5	160-169.5	170-179.5	180-189.5	190-199.5	200-209.5	
<.8	0.2459	0.2767	0.3689	0.3689	0.1230	0.0000	0.0000	1.3834
.8	1.1374	1.8752	2.2133	1.5985	0.3689	0.1230	0.0922	7.4085
.9	0.4611	1.4141	1.3526	1.1682	0.6456	0.9022	0.0614	5.1953
1.0	0.7378	3.3508	7.6852	5.0108	2.1519	1.0144	0.3996	20.3505
1.1	0.6456	1.9367	5.1337	4.5871	2.3670	1.1989	0.2767	17.2457
1.2	0.4611	2.0289	5.0108	6.0167	4.6111	1.9674	1.1374	22.1334
1.3	0.1230	0.7378	2.3056	2.3670	2.4593	1.1682	0.7378	9.8987
1.4	0.0615	0.3996	0.9222	1.6600	2.0289	0.9222	0.6148	6.6092
≥1.5	0.3070	0.3996	1.3833	2.3670	2.3978	1.7522	1.4448	9.7754
TOTAL	3.9041	12.4194	26.3745	27.1442	17.1535	8.2385	4.7648	100.0001

SUMMARY AND CONCLUSIONS

The most accurate method for a producer to sell high quality animals and receive the fair market value for those animals is by selling on a carcass merit program. By using two easily obtainable measurements, each carcass can be evaluated for its potential yield of carcass lean. This study has shown hot carcass weight and last rib backfat to be accurage indicators of the lean in a carcass and thus as indicators of carcass value. These results are similar to those reported by Grisdale et al. (1984a) and Edwards et al. (1981). Although muscling score and carcass length were shown to slightly increase the accuracy of the prediction equations for carcass value, the added time, difficulty, and expense of collecting this information does not justify the minimal increase in accuracy. Each class of carcass has a different intrinsic value to every packer. The varied market conditions imposed on each packer has led to a diversification of the types of carcasses desired by the packers. Some packers desire lighter carcasses while others like heavier carcasses. This difference in demand causes competition among the packers in the classes where the demand overlaps. When this occurs, the producer can elect to market his animals to the packer with the best price. Packers that have carcass merit programs generally pay more accurately what the animal is worth. The basis for the carcass merit programs is the value of each class of carcass to the individual packer. The value of each carcass is directly related to the amount or percent of lean in that carcass. Using the formulas presented for calculating the percent lean, a table can be created that can be adjusted to create the premium/discount matrix. A large portion of the value of each carcass is derived from the five primal cuts; legs, loins, picnic shoulders, Boston butts, and bellies. Two of these cuts, the loins and bellies, are of concern to the packer. Light loins and heavy bellies cause processing and marketing difficulties for the packer. The regression equations presented here can be used to predict which carcasses will yield light loins or heavy bellies. This information can be used as the premium/discount matrix is developed to insure that discounts are placed on the appropriate classes. After the premium/discount matrix is created, the percent payback can be calculated to determine the correctness of the matrix. This research has shown a method for creating a premium/discount matrix to be used in a carcass merit program. These programs are beneficial to the entire pork industry. The producer is benefited by receiving financial rewards for raising quality animals. The packer benefits by paying for value received and by not paying for overly finished animals. The consumer benefits by having more quality pork to select from at the supermarket. While this study has shown that marketing hogs within a prescribed range in a carcass merit program can increase the gross revenue for a producer, further research needs to be conducted to determine if these types of animals are the most efficient to raise.

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APPENDIX

APPENDIX TABLE 1A. PREDICTED WEIGHTS OF PRIMAL CUTS FOR THE 140-149.5 LB. WEIGHT CLASS

BF	Loin	Boston Butts	Picnic	Belly
<.8	27.37	11.73	13.34	18.10
.8	27.02	11.61	13.19	18.70
.9	26.68	11.50	13.04	19.25
1.0	26.33	11.39	12.90	19.89
1.1	25.98	11.28	12.75	20.48
1.2	25.63	11.17	12.60	21.07
1.3	25.28	11.06	12.46	21.67
1.4	24.93	10.95	12.31	22.26
≥1.5	24.58	10.84	12.16	22.86

APPENDIX TABLE 2A. PREDICTED WEIGHTS OF PRIMAL CUTS FOR THE 150-159.5 LB. WEIGHT CLASS

BF	Loin	Boston Butts	Picnic	Belly
<.8	28.99	12.51	14.16	19.58
.8	28.64	12.40	14.01	20.18
.9	28.29	12.29	13.87	20.77
1.0	27.94	12.17	13.72	21.36
1.1	27.59	12.06	13.57	21.96
1.2	27.24	11.95	13.42	22.55
1.3	26.89	11.84	13.28	23.15
1.4	26.54	11.73	13.13	23.74
≥1.5	26.19	11.62	12.98	24.33

APPENDIX TABLE 3A. PREDICTED WEIGHTS OF PRIMAL CUTS FOR THE 160-169.5 LB. WEIGHT CLASS

BF	Loin	Boston Butts	Picnic	Belly
<.8	30.60	13.29	14.98	21.06
.8	30.25	13.18	14.83	21.65
.9	29.90	13.07	14.69	22.25
1.0	29.55	12.96	14.54	22.84
1.1	29.20	12.85	14.39	23.44
1.2	28.85	12.73	14.25	24.03
1.3	28.50	12.62	14.10	24.62
1.4	28.15	12.51	13.95	25.22
≥1.5	27.81	12.40	13.80	25.81

APPENDIX TABLE 4A. PREDICTED WEIGHTS OF PRIMAL CUTS FOR THE 170-179.5 LB. WEIGHT CLASS

BF	Loin	Boston Butts	Picnic	Belly
<.8	32.21	14.07	15.80	22.54
.8	31.86	13.96	15.65	23.13
.9	31.51	13.85	15.51	23.73
1.0	31.16	13.74	15.36	24.32
1.1	30.81	13.63	15.21	24.91
1.2	30.46	13.52	15.07	25.51
1.3	30.12	13.41	14.92	26.10
1.4	29.77	13.29	14.77	26.70
≥1.5	29.42	13.18	14.63	27.29

APPENDIX TABLE 5A. PREDICTED WEIGHTS OF PRIMAL CUTS
FOR THE 180-189.5 LB. WEIGHT CLASS

BF	Loin	Boston Butts	Picnic	Belly
<.8	33.82	14.86	16.62	24.02
.8	33.47	14.74	16.48	24.61
.9	33.12	14.63	16.33	25.21
1.0	32.78	14.52	16.18	25.80
1.1	32.43	14.41	16.03	26.39
1.2	32.08	14.30	15.89	26.99
1.3	31.73	14.19	15.74	27.58
1.4	31.38	14.08	15.59	28.18
≥1.5	31.03	13.97	15.45	28.77

APPENDIX TABLE 6A. PREDICTED WEIGHTS OF PRIMAL CUTS FOR THE 200-209.5 LB. WEIGHT CLASS

BF	Loin	Boston Butts	Picnic	Belly
<.8	37.05	16.42	18.26	26.97
.8	36.70	16.31	18.12	27.57
.9	36.35	16.20	17.97	28.16
1.0	36.00	16.09	17.82	28.76
1.1	35.65	15.98	17.68	29.35
1.2	35.30	15.86	17.53	29.94
1.3	34.95	15.75	17.38	30.54
1.4	34.60	15.64	17.24	31.13
≥1.5	34.25	15.53	17.09	31.73

APPENDIX TABLE 7A. EXPERIMENTAL DESIGN DISTRIBUTION OF ANIMALS BY WEIGHT AND BACKFAT CLASS (NUMBER OF ANIMALS IN EACH CELL)

Last Rib Backfat	Carcass Weight Class (Lbs.)						
	140 - 149.5	150 - 159.5	160 - 169.5	170 - 179.5	180 - 189.5	190 - 199.5	200 - 209.5
<.8	3	6	7	5	1	1	1
.8	1	5	12	7	3	0	1
.9	1	7	14	9	2	0	1
1.0	3	7	18	16	8	6	2
1.1	2	12	16	13	8	8	1
1.2	1	3	14	14	11	7	4
1.3	2	4	5	16	18	9	1
1.4	0	0	8	2	10	6	4
≥1.5	1	2	10	17	14	18	12