

November 25, 1969

To the Graduate Council:

I am submitting herewith a thesis written by Joe Jack Dement entitled "Correlations Among Variables Measured on Live Beef Cattle and Variables Measured on Their Carcasses." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

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CORRELATIONS AMONG VARIABLES MEASURED ON LIVE BEEF CATTLE
AND VARIABLES MEASURED ON THEIR CARCASSES

A Thesis .
Presented to
the Graduate Council of
The University of Tennessee

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Joe Jack Dement
December 1969

ACKNOWLEDGMENTS

The author wishes to express his sincere appreciation to the following persons for their generous contributions to this thesis:

To Dr. Robert R. Shrode, major professor, for his encouragement, able guidance and generous assistance in collecting data and preparing the manuscript.

To Drs. R. L. Murphree and C. C. Chamberlain for serving on the graduate committee, for their counsel and for reviewing this manuscript.

To Mr. William L. Brown for his guidance and assistance in analyzing the data.

To his professors, fellow students and secretaries whose many courtesies have made graduate study a pleasant and worthwhile experience.

To the personnel at Middle Tennessee State University for the Grant-in-Aid that made graduate study possible.

To his wife, Geraldine, and children, Robert, Ann, Edwin, and Joey for their patience, understanding and encouragement throughout the course of graduate study.

ABSTRACT

A study of 48 yearling Angus bulls was undertaken to examine the possibility of estimating an animal's own carcass merit from certain easily obtainable live-animal measurements. A step-wise regression procedure was used to construct equations for predicting dressing percent, marbling score, kidney fat, carcass grade and percent yield from linear combinations of live-animal variables which included age; birth weight; slaughter weight; heart girth; distances along dorsal midline from withers to last rib, from last rib to hooks, and from hooks to pins and width at hooks.

Dressing percent was best predicted by a combination of age, heart girth, width and birth weight ($R = 0.48$). Marbling score and carcass grade were best predicted by the same combination of independent variables, viz., age, heart girth, and slaughter weight ($R = 0.39$ and 0.28 , respectively). Percent kidney fat was best predicted by a combination of age, heart girth, width and slaughter weight ($R = 0.50$). Percent yield was best predicted by age, width and birth weight ($R = 0.41$). It was concluded that the results provide a sound hypothetical basis for planning further studies of this kind.

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CHAPTER I

INTRODUCTION

Breeders of meat animals have been plagued for many years with the necessity of sacrificing potentially good breeding animals in order to collect accurate carcass data with which to evaluate the genetic merit of relatives of slaughtered animals. Obtaining actual carcass data from an animal himself obviously precludes his use as a breeder. Reliable information concerning carcass merit is essential if progress in improving carcass merit by selective breeding is to be maximized. Nutrition, management and breeding have greatly enhanced the production and quality of meat animals, but further improvement could be made with more adequate methods of preslaughter evaluation. There is a great need for easily and practically obtainable objective live animal measurements as predictors of various aspects of carcass merit.

The present study was undertaken to evaluate the utility of certain of these practically obtainable live animal measurements as predictors of various aspects of carcass merit.

CHAPTER II

REVIEW OF LITERATURE

Although there have been numerous studies conducted in the area of meats research which have included the recording of various live-animal variables as well as carcass variables, not many of them had the same primary objective as the present study, namely, to assess the utility of various practically obtainable live-animal measurements as predictors of carcass merit. Hence, the following review is not exhaustive and includes only selected papers which bear more or less directly on the points of interest in the present study.

Hultz (1927) conducted an experiment to determine (a) the relationship between visual selection of calves for type and the body measurements made on these calves, (b) which types make the most rapid gains, (c) whether calves change in type or quality during a six-month feeding period, and (d) whether low-set or rangy calves fatten more economically. Eight body measurements were recorded for each calf. These were: (1) body length (poll to tailhead), (2) height at withers, (3) heart girth, (4) paunch circumference, (5) width of hips, (6) circumference of cannon, (7) depth of chest and (8) distance from chest floor to ground. Height at withers, depth of chest and circumference of paunch were found to be the best measurements for determining low-setness. Lower-set calves had a higher ratio of depth of chest and paunch circumference to height at withers. Calves that had larger paunches were more rapid gainers but had lower dressing percentages.

There was little difference between low-set and rangy calves with respect to economy of gain. As to change in type, more short calves develop larger frames than rangy ones become low-set. The conclusion was that rangy calves are equal to or superior to short calves of equal quality with respect to weight gain, dressing percent and carcass grade. A study of type of two-year-old steers (Hultz and Wheeler, 1927) revealed that compact (low-set) two-year-old steers made more rapid and economical gains than rangy steers. Visual type of these steers did not change during a 156-day feeding period. Toward the end of the feeding trial, steers of different types had a tendency to become more uniform in visual appearance and body measurements.

Changes in eight body measurements of 185 steers during an intensive fattening period were recorded by Lush (1928) showing the following percentage increases or decreases relative to live weight gain: chest width, 9.29; loin width, 5.18; chest girth, 1.55; flank girth, 0.97; paunch girth, -0.35; depth of chest, -1.95; length of body, -3.53 and height at withers, -5.68. He indicated that body measurements were of little importance as compared to weight changes in determining changes in steers during a fattening period.

Heart girth measurements for estimating weights of beef and dual purpose cattle were studied by Knapp (1937). The weights of good grade cattle were more accurately predicted from heart girth measurements than those of cattle grading above or below this grade. In a similar study Knapp (1939) studied the use of weights and measurements to predict slaughter grades of beef cattle. A study of data from 167 steers showed that a multiple curvilinear relationship existed among

height at withers, weight and slaughter grade. It was concluded that no weights or measurements were likely to be as satisfactory as competent cattle graders in determining slaughter grades of beef cattle.

Black et al. (1938) studied the correlation of body measurements of slaughter steers with rate and efficiency of gain and with certain carcass characteristics of 50 steers of beef, dual purpose and dairy breeding. Animals used in this experiment were of approximately the same weight (900 ± 20 lbs.). Animals which had less height, shorter legs and shallower bodies were more efficient converters of feed and had higher dressing percentage and cutability than the taller, longer, deeper bodied animals. Length of body showed higher correlation with efficiency and rate of gain than height at withers but a low correlation with dressing percentage. The ratio of heart girth to height at withers had a significant correlation with dressing percentage, percent edible meat, percent of fat and slaughter grade but not with efficiency or rate of gain.

The "Minnesota Method" for estimating livestock weight from linear body measurements was described by Johnson (1939). The formula for estimating the weight of beef cattle is as follows: $(\text{heart girth})^2 \times \text{length} \div 300 = \text{weight in pounds}$. This length measurement was taken from the point of the shoulder to the pin bone. This formula has an error of about 3.6 percent. It may be applied also to horses, swine, sheep and goats with the following modification:

For swine. Length is measured from the base of the tail to a point midway between the ears. There is an error of approximately 3.6 percent with the following adjustments being made: under 150 lbs. add 7 lbs. to

the calculated weight, 150 lbs. to 400 lbs. no adjustment, over 400 lbs. subtract 10 lbs. from the calculated weight for each 25 lbs. increase in weight.

For horses. Add 50 pounds to the calculated weight. There is about a 3-percent error.

For sheep and goats. Part the fleece when taking the heart girth measurement. A 7-percent error is expected.

Wanderstock and Salisbury (1946) took eight body measurements on 145 Angus and Hereford 4-H steers to investigate the reliability of various body measurements in predicting the weight of beef cattle. The data were classified by weight groups and breeds. Animals weighing more than 1000 lbs. were called "heavy," those weighing 900 to 999 lbs. were called "medium" and those weighing less than 899 lbs. were called "light." Highly significant correlations were found between: (1) heart girth and height at withers, (2) heart girth and body length, (3) heart girth and weight, (4) height at withers and body length, (5) height at withers and weight and (6) body length and weight. A study of the data indicated that the weights of lighter animals could be more accurately predicted than the weights of heavier animals.

Data were collected on 50 steers of predominantly Hereford, Angus and Shorthorn breeding to determine the relationship between linear body measurements and carcass cuts of beef (White, 1951). Thirty-nine live-animal measurements were studied along with 18 carcass measurements. Width and depth measurements showed a higher degree of relationship with other measurements and with the weights of carcass cuts than did the

length measurements. White and Green (1952) conducted a similar study of 50 beef-type steers ranging in weight from 800 to 1445 pounds and in grade from choice to medium. Live-animal measurements were taken at points associated with carcass cuts as well as those used in visual appraisal. Calculated correlations indicated that the actual weights of live-animal parts from which wholesale cuts are produced can be accurately predicted by the use of body measurements. Length measurements as taken along the back of the animal contributed little to the accuracy of the prediction of rib and loin cuts, and deletion of these measurements caused little or no change in R values for these cuts. In a further study of the same group of steers, Green (1953) concluded that maximum width at shoulders and circumference of heart girth were good predictors of the actual weights of round, loin and rib. Width at shoulders and width at hooks also appeared to be of importance in the estimation of both primal and wholesale cuts. Green (1954) made a more thorough study of the 50 steers involved in previous studies. A primary objective of this work was to find, if possible, combinations of measurements which would give a reasonably accurate estimate of the weights of carcass cuts which might be useful aids in selection of superior breeding animals. Carcass cuts were grouped into two categories: (1) the round, trimmed loin and rib and (2) the round, trimmed loin and rib plus the cross-cut for the purpose of finding the live-animal measurements which would correlate most highly with the weights of these groups of primal cuts. Width at shoulders again was a good predictor of preferred cuts and was rather highly correlated with depth of twist (0.69), live weight (0.76), heart girth (0.75), width of crops (0.78), width of thighs (0.72) and with

width at hooks (0.92). Apparently, shoulder width is a reasonably good measure of muscling as a cross section of this area would show little variation caused by variation in other parts in this particular region. Width at hooks was found to be of importance in the prediction of the weight of the round even though it is not a part of that wholesale cut. Width at hooks was shown to be a good estimate also of the weight of trimmed loin. Depth of chest and linear measurements along the dorsal mid-line were found to have very low correlation with the weights of individual wholesale cuts and would give little indication of the muscling or meatiness of animals involved in this study.

The relationships of 19 body measurements to eight meat production factors taken on 101 beef Shorthorn steers and 62 Milking Shorthorn steers were studied by Yao et al. (1953). All width and circumference measurements were positively correlated with slaughter and carcass grade and were considered to be measures of meatiness. Height and length measurements showed a negative correlation with slaughter grade and were called skeletal measurements. Birth weight was closely related to the height and length measurements or skeletal measurements but was negatively correlated with the width measurements. Heavier birth weights resulted in fewer days to weaning or 500 lbs., quicker final finishing, greater daily gains, higher feed efficiency and poorer beef characteristics. A formula which could aid in the selection of animals for beef character from body measurements was proposed as follows:

$$\text{Index for beef character} = \frac{\text{width at hips} \times \text{circumference of chest}}{\text{height at withers} \times \text{length of body}}$$

Woodward et al. (1954), explored the relationship between

preslaughter and postslaughter evaluations of 635 Hereford steers during the period 1942-51. He found that heavier calves at birth had slightly larger rib eyes and less fat than calves with lighter birth weights. He concluded also that too much emphasis is given the amount of external fat and not enough emphasis given to rib eye area and muscling in assigning carcass grade. Body length was closely related to length of leg; but when weight was held constant, there was a reduced relationship which would indicate that body growth is not proportionate. Length of body and length of leg were both significantly related to rib eye area but not to fat thickness. In this study, long-bodied steers produced as desirable carcasses as short-bodied steers.

Ten linear body measurements were taken on 64 heifers and 59 steers by Tallis et al. (1957) to investigate the relationship of nine ratios involving live weight and linear measurements to carcass characteristics. The ratios of height to weight and weight to length were the best predictors of dressing percentage, rib eye area and edible portion. In both steer and heifer data, the two ratios were positively correlated with rib eye area and negatively correlated with edible portion. These ratios were positively correlated with dressing percent in steers but not in heifers.

Wesell et al. (1958) found that live animal measurements were not correlated closely enough with rib eye area to be useful in selecting meatier animals. Indications were that well marbled steers need not be overfat. Greater fat thicknesses were accompanied by smaller rib eyes.

Thirty-two live-animal measurements were correlated with nine carcass measurements to ascertain their relationship to weights and

percentages of wholesale cuts (Orme et al. 1959). Corresponding live-animal and carcass measurements were correlated whenever possible. Carcasses were not split at slaughter so that more accurate comparison of certain width and length measurements could be obtained. After whole-body data were taken, the carcasses were processed according to a recommended procedure. Heart girth, the best single indicator of weight accounted for 81 percent of the variation in rib eye. Other circumference measures also were significantly related to rib eye area. There was a slight tendency for steers with larger live-animal measurements to have a lower percent of primal cuts. Height and length measurements showed an inverse relationship to rib eye area and were not considered of value in predicting meatiness of animals.

A study of live-animal and carcass data by Backus et al. (1960) showed that fat thickness at the twelfth rib was significantly correlated with carcass grade but showed little or no correlation with other values. Rate of gain on test was more highly correlated with carcass length than any other live-animal observation. Length of carcass and length of leg were significantly related to length of loin, circumference of round, width and depth of chest, rib eye area and width of round.

An analysis of live-animal and carcass data from a special group of 674 Angus, Hereford and Shorthorn steers in three weight groups selected by Good et al. (1961) from the on-foot carcass show at the 1956-57-58 International Livestock Exposition indicated that heavy-boned, broad-headed animals with large rounds have less fat and more lean than smaller-boned animals. Dressing percent increased as fat cover, marbling and rib eye area increased. Greater fat coverage was accompanied by increased marbling and decreased rib eye area.

Wilson et al. (1964) compared the predictive accuracy of six graders in estimating the cutability of 135 grade Hereford steer carcasses. A study of correlations of the various live estimates and carcass traits suggested that a single estimate of fat thickness is of as much value in predicting carcass cutability as any combination of estimates made by the six judges.

Data collected from 51 steers from the Fort Reno herd were analyzed by Brackelsburg and Willham (1968) to explore the relationships among various live-animal measurements and actual carcass muscle, fat trim and bone. Carcass measures were found to be more accurate estimators of carcass composition than live-animal measurements; but on-foot measurements were accurate enough to be of considerable value in predicting carcass composition.

Early workers reported that low-set, compact calves produced higher grade carcasses and made more economical gains than rangy calves. Findings in later studies have been in conflict with these earlier results. Recent trends in consumer preference have warranted the production of meatier animals with less fat coverage on their carcasses. Live-animal measurements that seem to be good predictors are width and circumference measurements which show higher correlations with carcass cuts than length measurements.

Though published long ago, the statements of Lush (1932) rather accurately reflect the current consensus concerning desirable body shape of beef cattle. He studied the correlations among 23 live-animal measurements and subsequent gain, dressing percent and carcass value of 241 feeder steers. Relatively speaking, a shallow chest associated

with a large heart girth, a wide loin, a large flank girth, a small paunch girth, a low height at hips, a narrow head at the eyes, and a heavy initial weight were the best indicators of a high dressing percent and carcass value. Long bodied animals that were tall at the withers, large around the paunch, small around the flank and narrow across the loin made maximum gains. His conclusions were that steers of many shapes gain well and that there is much variation in body conformation of steers that gain the same. Dressing percent and carcass value were found to vary accordingly and had a higher correlation with conformation than with rate of gain.

CHAPTER III

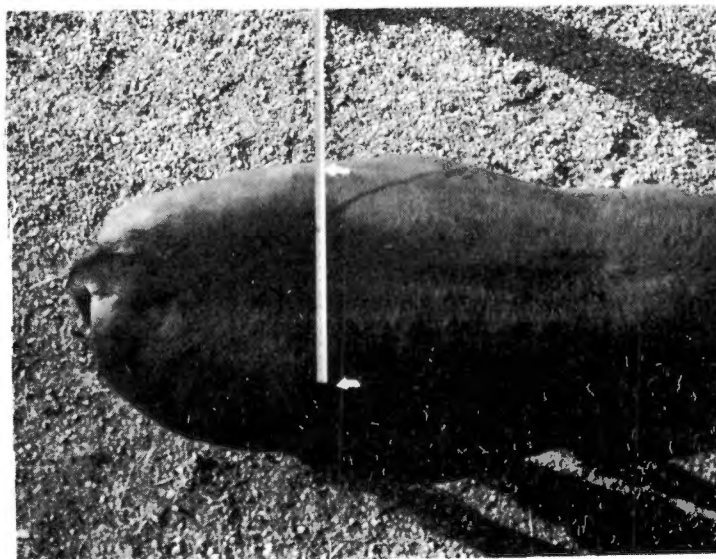
EXPERIMENTAL PROCEDURE

The data used in this study were collected from a group of 48 yearling Angus bulls at the Plateau Experiment Station of the Tennessee Agricultural Experiment Station at Crossville. These bulls were removed from the herd because they did not meet the average daily gain standard required by the University performance testing program. They were full-fed on a balanced grain ration until they reached a desirable finish. After reaching a slaughter grade of "Good" to "Choice," they were slaughtered at East Tennessee Packing Company at Knoxville, Tennessee.

Seven live-animal measurements were taken the day before the bulls were taken to the packing plant. The seven measurements recorded were: (1) slaughter weight, (2) length of body, (3) heart girth, (4) distance from withers to last rib, (5) distance from last rib to hooks, (6) distance from hooks to pins and (7) width at hooks. Each bull was weighed individually to the nearest five pounds. After weighing, each individual was confined in a chute for taking linear measurements to the nearest half inch using a flexible steel tape. The animals were encouraged to stand as squarely as possible on all four feet with the head and neck in a relaxed, level position since it was discovered that raising and lowering of the head varied the dorsal midline measurements considerably. Live length was taken along the dorsal midline from the highest feather bone (thoracic vertebra) between the shoulders to a line even with the prominence of the pin bones (Figure 1). Heart girth was



a. Location of live-animal length measurements.



b. Location of live-animal width measurements.

Figure 1. Location of live-animal length and width measurements.

taken as body circumference measured just behind the front legs (Figure 2). Body length was divided into three measurements; withers to last rib (the distance from the highest vertebra between the shoulders to the posterior side of the last rib), last rib to hook (measured from the posterior side of the last rib to a point in the center of a line between the most prominent points of the hips or hooks) and rump (the distance from the point between the hips to a point even with the posterior prominences of the pin bones, as shown in Figure 1).

Since the emphasis was to be on securing easily obtainable measurements, a standard ten-foot flexible steel tape was used to take all of the body measurements rather than specially constructed measuring devices. In addition to these data collected prior to slaughter, all of the usual variables of record such as birth weight, pedigree, etc., were available from the Experiment Station records.

The cattle were held off feed and water for 12 hours prior to trucking to Knoxville. Upon arrival at the packing plant, the cattle were weighed and transferred to holding pens until slaughter. As the cattle were slaughtered, the carcasses were identified and hot carcass weights recorded. Carcasses were shrouded and stored in coolers for 48 hours.

The following carcass data were secured after a 48-hour chill: carcass length, back length, loin length, rump length, rib eye area, fat thickness, conformation grade, marbling score, carcass grade, percent kidney fat and yield grade. Carcass length was measured from the anterior side of the aitch bone to the anterior side of the first rib. The back measurement corresponds to the live-animal measurement,

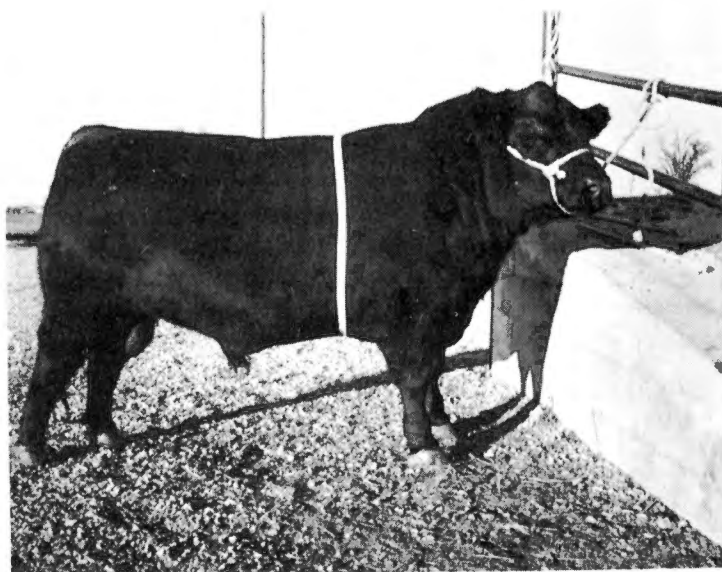


Figure 2. Location of live-animal circumference measurements.

i.e., from the high point between the shoulders to the last rib and was hence taken from the posterior side of the last rib at the vertebral column to the anterior side of the first rib. The loin length was measured from the anterior side of the first lumbar vertebra to the anterior side of the first sacral vertebra. Rump length was the distance from the last lumbar vertebra to the posterior side of the pin bone located by palpation as the carcasses hung on the rail. Rib eye tracings were made of a cross section of the longissimus dorsi muscle between the 12th and 13th rib on the left side of the carcass. Acetate paper was used to secure the rib eye tracings. A grid was used to determine the rib eye area in square inches. Fat thickness was measured between the 12th and 13th rib where beef carcasses are normally "ribbed" or quartered, using a rule graduated in millimeters at a point three-fourths the length of the l. dorsi muscle from the chine end as described by Ramsey et al. (1962).

Conformation grade, marbling score, carcass grade and percentage of kidney fat were estimated by an official U.S.D.A. grader.

Dressing percent was calculated as $\frac{\text{hot carcass weight}}{\text{slaughter weight}} \times 100$.

Yield grade was determined by using a Beef Carcass Yield Grade Finder scale made available by the Livestock Division of the Consumer and Marketing Service of the U.S.D.A. Percent yield was recorded from the same scale as percent of the carcass weight in boneless, closely trimmed, retail cuts from the round, loin, rib and chuck.

The data were analyzed by simple correlation procedures as described in textbooks on statistical methods, e.g., Snedecor and

Cochran (1967) and step-wise regression procedures as described by Draper and Smith (1966) to determine the relationship between certain live-animal measurements and measurements on the carcasses.

The stepwise regression procedure starts with the simple correlation matrix shown in Table I and incorporates into a regression model the independent variable most highly correlated with the dependent variable in question. The advantage of this method over other commonly used procedures is that the equation is re-examined at each step of the computation as each additional independent variable is added to the model. The best single variable entered at an early stage may later be superfluous due to the relationship between it and other variables that have been subsequently added. At each step an F value measuring the improvements in predictive value attained by adding each independent variable is calculated and compared with a pre-set F value. The contribution made by each additional variable added to the model can be evaluated as though it has been the most recent addition to the equation. The process is continued until no more variables are entered into or deleted from the model. The equation resulting from this final step in the computations is the equation describing the best possible prediction of the dependent variable in question using a linear combination of the independent variables available for use in the prediction.

TABLE I

COEFFICIENTS OF SIMPLE CORRELATION AMONG LIVE-ANIMAL CARCASS VARIABLES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1 Age	1.00	.04	.25	-.17	.23	.14	-.15	-.28	-.32	-.22	.03	.15	-.12	.02	-.28	-.01	-.36	-.08	.05	-.09	.09	-.08	.27
2 Live Length		1.00	.35	.80	.45	.41	.46	.53	.48	.11	.62	.42	.61	.31	-.04	-.05	-.15	-.02	.05	.07	.21	-.22	.14
3 Heart Girth			1.00	.25	.10	.27	.42	.81	.81	.34	.44	.15	.41	.18	.45	.24	.41	.32	.18	.41	.13	-.14	.07
4 Last Rib				1.00	-.04	.10	.25	.37	.34	.08	.33	.27	.45	.17	-.08	-.03	-.01	-.02	.11	-.02	.17	-.18	-.03
5 13th Rib to Hook					1.00	-.05	.34	.30	.26	.03	.46	.30	.28	.25	.04	-.09	-.25	.02	-.11	-.02	.01	-.02	.23
6 Hook to Pins						1.00	.29	.24	.24	.09	.36	.18	.33	.18	-.01	.05	-.03	-.04	.07	.26	.19	-.18	.15
7 Width of Hooks							1.00	.62	.52	-.04	.59	.09	.58	.39	.01	.14	-.05	.01	.07	.27	.31	-.31	.10
8 Slaughter Weight								1.00	.94	.26	.74	.33	.57	.42	.40	.09	.19	.13	.02	.23	.11	-.12	.13
9 Carcass Weight									1.00	.57	.61	.29	.49	.34	.57	-.03	.35	.12	.02	.26	-.06	.05	.17
10 Dressing Percent										1.00	-.04	.05	.01	-.06	.66	-.33	.54	.03	.02	.16	-.04	.44	.17
11 Carcass Length											1.00	.46	.66	.61	.04	-.01	-.30	-.15	-.10	.01	.20	-.20	.09
12 Carcass Back												1.00	.02	.10	-.02	.05	-.12	.03	-.01	-.05	.14	-.15	.24
13 Carcass Loin													1.00	.39	.09	.03	-.09	-.03	-.07	.21	.17	-.18	-.08
14 Carcass Rump														1.00	.07	-.19	-.18	-.21	-.03	.03	.00	.01	.09
15 Rib Eye Area															1.00	-.25	.39	-.08	-.16	.07	-.70	.69	.20
16 Fat Thickness																1.00	.20	.61	.53	.54	.75	-.75	-.14
17 Conformation Grade																	1.00	.46	.33	.50	.01	-.01	.08
18 Marbling Score																		1.00	.66	.53	.47	-.49	-.09
19 Carcass Grade																			1.00	.42	.46	-.46	-.02
20 Percent Kidney Fat																				1.00	.52	-.51	.08
21 Yield Grade																					1.00	-.99	-.12
22 Percent Yield																						1.00	.14
23 Birth Weight																							1.00

CHAPTER IV

RESULTS AND DISCUSSION

Means and standard errors of the variables on which the data were collected are shown in Table II. Among the carcass variables on which data were collected, the five which are most indicative of carcass value are dressing percent, marbling score, carcass grade, percent kidney fat and percent yield. Thus, these were chosen as the variables to be estimated from live-animal measurements. The live-animal variables incorporated into the regression models were birth date (the indication of age which was deliberately included in all the equations), heart girth, width, slaughter weight and birth weight, the last four of these being chosen for inclusion by the stepwise regression procedure.

The final multiple regression equations obtained are shown in tabular form in Table III. For example, the equation for predicting dressing percent would be:

$$\begin{aligned} \text{Predicted dressing percent} = & 30.126 - .013 (\text{birth date}) \\ & + .236 (\text{heart girth}) - .479 (\text{width}) + .484 (\text{birth weight}). \end{aligned}$$

The R values shown in Table III for each dependent variable are the successive ones obtained as each of the independent variables are shown in the table. The single exception to this is in the equation for predicting percent kidney fat in which live weight was incorporated into the model before width.

TABLE II
MEANS AND STANDARD ERRORS OF VARIABLES STUDIED

Trait	Mean	Standard Error
Age (Birth Date)(Days after Jan. 1)	60.75000	4.044473
Live Length (in.)	42.31250	.228304
Heart Girth (in.)	70.66667	.314036
First Rib to last Rib (in.)	18.32292	.194092
Last Rib to Hooks (in.)	7.68750	.104720
Hooks to Pins (in.)	16.30208	.079175
Width of Hooks (in.)	17.62500	.116657
Live Weight (lbs.)	897.81250	8.915717
Carcass Weight (lbs.)	543.52080	6.039391
Dressing Percent	60.49999	.239346
Carcass Length (in.)	45.23958	.178143
First Rib to last Rib (in.)	24.50000	.127407
Loin (in.)	10.75000	.099891
Rump (in.)	14.87500	.098838
Rib Eye Area (sq. in.)	11.94583	.169574
Fat Thickness (mm.)	4.75000	.247646
Conformation Grade	11.97917	.108528
Marbling Score	3.60416	.079057
Carcass Grade	9.64583	.241699
Percent Kidney Fat	1.55208	.075477
Yield Grade	1.50208	.063951
Percent Yield	53.43041	.143494
Birth Weight (lbs.)	62.06250	1.133620

TABLE III
EQUATIONS FOR PREDICTING MEASURE OF CARCASS VALUE
FROM LIVE-ANIMAL AND CARCASS VARIABLES

Dependent Variable	Intercept	Independent Variables				R	Standard Error of Estimate
		Birth Date	Heart Girth	Width	Slaughter Weight	Birth Weight	
Dressing Percent	30.126	-.013	.236	-.479		.484	1.5436
Marbling Score	.273	-.002	.1035		-.0043		.6737
Carcass Grade	6.472	.0032	.1781		-.0107		1.9150
Percent Kidney Fat	-6.746	-.0017	.1019	.1955	-.0025		.4872
Percent Yield	59.026	-.0029		-.405		.028	.9551

The R values for all the predictive formulas except the equation for estimation of carcass grade are significant at the .05 level of probability of chance occurrence. The significance of these R values indicated that there is some degree of merit in predicting carcass value by using combinations of easily obtainable live-animal measurements.

The results of this limited study justify conducting future studies of this kind with other groups of cattle to test the hypotheses suggested by this analysis and to develop refinements to improve the accuracy of estimation of carcass merit from live-animal measurements which any beef cattle producer could feasibly record and utilize to select breeding animals effectively, giving some attention to estimates of their own carcass merit.

Data should be obtained from a larger number of animals. Measurements obtained on animals from other herds and breeds would be of value in developing more accurate predictive formulas and in determining whether different formulas would be required in different situations with respect to breed, herd and management regime. The utility of other measurements in addition to those taken in this study should be determined. Other measurements that could be included are circumference of the body at the paunch and at the rear flank, width at point of shoulders, width at the thurl joint and width at the pin bones. A measurement using a flexible tape could be taken from the point of the hip or hook around the posterior side of the round, continuing around the inside of the leg, passing under the flank and crossing over the outside of the leg to the pin bone.

At the present time, few producers are in a position to record ultrasonic measurements of fat and muscle thickness on live animals. Such data should be included in future research to determine how much they would add to the accuracy of estimation of carcass variables as compared to the accuracy attainable using only skeletal measurements. Any improvement which ultrasonic measurements might yield should be assessed in the light of the cost of obtaining such data.

CHAPTER V

SUMMARY AND CONCLUSIONS

A study of 48 yearling Angus bulls was undertaken to examine the possibility of estimating an animal's own carcass merit from certain easily obtainable live-animal measurements. A stepwise regression procedure was used to construct equations for predicting dressing percent, marbling score, kidney fat, carcass grade and percent yield from linear combinations of live-animal variables which included age; birth weight; slaughter weight; heart girth; distances along dorsal midline from withers to last rib, from last rib to hooks, and from hooks to pins and width at hooks.

Dressing percent was best predicted by a combination of age, heart girth, width and birth weight ($R = 0.48$). Marbling score and carcass grade were best predicted by the same combination of independent variables, viz., age, heart girth, width and slaughter weight ($R = 0.50$). Percent yield was best predicted by age, width and birth weight ($R = 0.41$). It was concluded that the results provide a sound hypothetical basis for planning further studies of this kind.

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