

THE CORRELATION BETWEEN LIVE HOG SCORES
AND CARCASS MEASUREMENTS

by

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TABLE OF CONTENTS

INTRODUCTION.....	1
REVIEW OF LITERATURE.....	2
METHODS AND PROCEDURES.....	17
DISCUSSION AND RESULTS.....	22
SUMMARY.....	33
ACKNOWLEDGMENT.....	35
LITERATURE CITED.....	36

INTRODUCTION

The production of hogs that will yield a high percentage lean cuts in relation to fat has received growing interest within the past decade. Consumer preference for leaner cuts of meat, competition of vegetable oils and the increase in number of hogs slaughtered has led to lower lard prices, hence a decrease in value of the lard-type hog. From 1908 to 1938 prime steam rendered lard sold for an average of 2.25 dollars more, but at the present time 4.00 dollars less than the price of live hogs per hundred weight.

Until merit buying or pen-to-pen selling was initiated in 1948, all hogs were sold on a live weight basis. Under this method, price is determined by weight alone for healthy slaughter hogs. Dressing percentage largely determined the slaughter value of hogs to the packer buyer. This procedure provided scant allowance for the differences in value of pork products among the various types of market hogs. Studies have shown that dressing percentage is not a true indicator of value. The ratio of lean to fat rather than yield itself determines value in pork carcasses. The major portion of the lean is contained in the four lean cuts, the ham, loin, Boston butt and picnic. At the present time the trimmed four lean cuts comprise from 65 to 75 per cent of the total carcass value and half of the carcass weight.

The packer frequently ignores the variation in cut-out value from hog to hog and from one market lot of hogs to another if differences are not too great. The cut-out value is reflected in the live value of the hog. The current lack of adequate compensation by the processor for leaner hogs has provided no incentive to the producer to raise meaty hogs which will produce the pork consumers prefer.

There is a growing interest among farmers, marketing agencies, educational personnel, and processors to establish more accurate pricing methods for slaughter hogs. The success of merit selling or pen to pen buying is generally dependent upon the ability of the buyer to evaluate carcass characteristics. Even with hogs that appear similar on foot there may be a variation in the appearance of the carcass as well as variation in their cut-out value. Differences in fatback thickness and carcass length seem to effect most of the variation in percent lean cuts which in turn is closely related to the cut-out value. The ability of buyers to associate these characteristics with the type of hog that will cut-out a large portion of lean cuts is the ultimate goal of parties in pork production.

The purpose of this study was to determine the accuracy with which individuals can estimate the factors which influence cut-out value of slaughter hogs. Various carcass characteristics were also studied as indicators of percent lean cuts.

REVIEW OF LITERATURE

Objective carcass standards for hogs, inaugurated in 1949 and revised in 1955 by the U.S.D.A., were adopted to predict with some degree of accuracy, the amount of high value cuts which may be realized from a carcass of a specified grade. High value cuts may be expressed as the trimmed, four lean cuts (ham, loin, Boston butt, and picnic) which ordinarily comprise 65 to 75 per cent of the total carcass value. Primal or preferred cuts comprising the four lean cuts plus the belly is sometimes referred to as the high value cuts. These five cuts represent approximately 80 to 85 per cent of the value of the carcass. The grades have been designated as U.S. No. 1,

2, 3, medium, and cull and are based on average fatback thickness, carcass weight, and/or length. In marketing hogs an attempt has been made to refer these standards to the live hog in order to produce a usable live grading system.

According to Bratzler and Margerum (1953) the specific factors that determine the yield of preferred cuts are weight, body length, thickness of backfat, and dressing percentage. In a study by Naive, et al. (1957), 20 buyers were questioned as to what factors they considered first when estimating live grade of hogs. Trimness and conformation were listed first by 45 per cent, length of body by 30 per cent, slope of back by 15 per cent, weight by 5 per cent, and shoulder was considered most important by 5 per cent.

Bratzler and Margerum (1953) reported simple correlation coefficients between the estimates of three experienced judges for body length, backfat, and yield of preferred cuts and the actual measurements on 265 hogs of several breeds and crossbred classifications in the weight range 201 to 220 pounds. The correlations between the judges estimate of body length and actual carcass length were .39, .42, and .29, respectively. Correlations between backfat thickness estimate and actual thickness were .42, .42, and .50, respectively. The correlations between estimates of the yield of preferred cuts and the actual yield of preferred cuts were low, being .08, .13, and .22, respectively. In the same study correlations between judges estimates and actual measurements for the 181 to 200 lb. group were approximately the same as the 201 to 220 lb. group while those of the 221 to 240 lb. group were generally lower.

Bogart, et al. (1940), studying the carcass yield of 69 Poland China

hogs in relation to the scores and measurements for various characteristics in the live animals, found that scores and measurements were of little value in predicting the yield of ham, loin, shoulder, or belly. The same authors (1940a), working with 127 Poland China hogs reported significant correlations between carcass score as determined by visual inspection of eight carcass items and the scores for certain items in the live animals. However, score for grade was found to be the only item of practical value for estimating carcass score.

Phillips, et al. (1939), working with a group of 145 market hogs obtained highly significant correlations between the scores for various characteristics in the live hogs and the yields of several different carcass cuts. None of the correlations, however, were large enough to be very important from the practical standpoint.

Naive, et al. (1957), conducted a study using twenty buyers to estimate live grades and dressing percentage of slaughter hogs. He found that there was a relationship of (1) a buyers' live grading experience and his ability to accurately grade live hogs; (2) buyers with some experience in carcass grading generally were better graders than those buyers with no carcass grading experience; (3) buyers were more accurate when estimating the number of hogs in each grade for a lot than when estimating the grade of each hog; (4) there was no correlation between grading accuracy and length of marketing experience; (5) there was no correlation between estimated yield and estimated grade.

In studying man's ability to estimate the actual value of market hogs, Fox, et al. (1953), found that the men who scored the hogs generally underestimated the high yielding (48 to 55 per cent primal cuts, percent of live

weight) hogs. Also, hogs with poor conformation were more difficult to grade because the carcass backfat thickness varies greatly. In this study two animal husbandry specialists and an experienced hog buyer made the appraisals on (1) degree of finish, (2) length of hog, (3) quality, (4) general conformation, and (5) percent of five primal cuts to live weights.

Henning and Evans (1953) found that the four graders, who were assigned to live grade 105 hogs, were fairly consistent in their estimation of average backfat thickness, length of hind leg, and body length. The graders estimated average backfat thickness within ± 0.2 inches of actual measurements for 75 per cent of the hogs. Fluctuations between weight groups were small. From 50 to 80 per cent of the hogs were placed within ± 1.0 inch of the actual measurements for length of hind leg and body length. The graders were assigned to grade 773 hogs divided into 16 lots, at a rate comparable to normal buying conditions. The results indicated that live grading of hogs on this basis can be accomplished with grading accuracy being dependent upon experience. The most accurate grader, when grading by lots, placed from 40.5 to 64.4 per cent of the hogs in the correct grade.

According to Zobrisky, et al. (1954), the probe or carcass backfat measurements offer a reasonably accurate estimate of the live hog's value. Yield of fat can be more easily and accurately determined than the yield of lean.

In a study by Hetzer, et al. (1956), the averages of the probe measurements showed significant negative correlations with percentage preferred cuts. The accuracy of measurements taken at 225 pounds differed little from that of measurements taken at the lighter weights. The correlation between the average of the three live probe measurements at 225 pounds and percentage

preferred cuts was -.28. At both 175 and 225 pounds weight the measurement at the middle of the back was most accurate as a measure of yield of preferred cuts. While the live hog measurements studied do not show the accuracy desired as a criteria of carcass value, the results suggest that when taken at weights between 175 and 225 pounds they are generally as accurate for these measurements as for carcass backfat measurements. The results also suggest that live hog measurements have greater accuracy for measuring fatness than for measuring percentage preferred cuts or percentage lean meat in hams.

DePape and Whatley (1956) indicated that the measurement of backfat thickness on pigs at a live weight of about 210 pounds, using the average measurement of six probes, was more highly correlated with percentage primal cuts, carcass index, and ham specific gravity than was backfat thickness measured on the carcass. The probes were over the longissimus dorsi on both sides, behind the shoulder, at the middle of the back, and at the middle of the loin.

Body measurements on 154 day old hogs were made by Robinson, et al. (1957). Measurements of width at shoulder and loin, backfat at shoulder and loin, circumference of shin, fore leg, and belly, length of fore leg, and weight were taken. The thickness of backfat at the shoulder and at the loin gave the best two combinations. Multiple correlation coefficients with percent lean cuts were .52 and .43 respectively.

Hazel and Kline (1952) obtained a correlation of .81 between the average of four backfat measurements taken on live hogs and actual carcasses fatback measurements. Measurements made on 96 live hogs were slightly more accurate as indicators of leanness and percentage primal cuts than were carcass

measurements of backfat thickness. Of the four locations (the first three, 1 1/2 inches off the midline and the fourth on the midline) (1) immediate behind the shoulder, (2) middle of back, (3) middle of the loin, and (4) middle of the loin, the (1) and (3) locations were the most accurate indicators of leanness and percentage primal cuts.

Pearson, et al. (1957), reported that there is little difference in usefulness of the live probe or lean meter in regard to estimating backfat thickness and percentage of either lean or primal cuts. However, the higher relationship for the live probe with both loin lean areas and with fat trim indicated the live probe to be a more reliable measure for estimating carcass leanness.

Hetzer, et al. (1950), found that depth of middle was the most important item in determining the yield of the five primal cuts for both barrows and gilts. The eight measurements taken were: (1) length ear to tail, (2) height at shoulders, (3) width at shoulders, (4) width at middle, (5) width at hams, (6) depth at chest, (7) depth of middle, and (8) circumference at chest. Next in importance to depth of middle was width of middle and height at shoulders for barrows and height at shoulders and width at shoulder for gilts. For analysis of lean meat in hams it was found that width of hams was most important for barrows and gilts. They concluded that the predictive value of the measurements studied was not as great as might be desired, however, the use of certain body measurements offers possibilities of being a valuable tool in estimation of carcass yields from the live animal.

According to Warner (1934) three types of measurements seem particularly adapted for determining the actual fatness of a pork carcass. They are as follows in order of accuracy: (1) chemical analysis of some single cut,

(2) weight of particularly fat or lean cuts in relation to the weight of the entire carcass, and (3) measurements of parts of the carcass especially the fat portions, such as thickness of fat on the ham, shoulder, and back.

Experiments have shown that there was a consistent relationship between the content of fat in the edible portion of the hog carcass and the percentage that the weights of certain cuts bear to the carcass weight. The percent yield of the fat cuts (belly, leaf fat, and skinned fatback and trimmings) increased with an increase in fat content. The combined weight of the belly, leaf and skinned fatback and trimmings, expressed as percent of the cold carcass weight, is offered as a simple and practical index of the fatness of hog carcasses. The fat index applied showed barrows to be somewhat fatter than gilts of the same weight.

According to McMeekan (1940), the total weight of bone, muscle, and fat in the bacon-pig can be estimated with a high degree of accuracy from the respective weights of these tissues in either the loin or the leg. The combination of these two joints provide even higher correlations in each case than either one alone. In all cases the correlation coefficients approach unity and are strongly significant at the 1 per cent level.

External carcass measurements, taken by McMeekan (1940), are shown to be mainly indicative of the degree of skeletal development. The fact that these measurements are influenced by the flesh cover of the animal reduces their value even for this purpose. The combined weight of the cannon bones provides a better index of total weight of skeleton than any linear measurement.

Suitable combinations of internal linear measurements of muscle obtained on the cross section at the junction of thorax and loin are highly correlated

with the weight of muscle in the carcass and are capable of providing a reliable basis for its estimation. The "eye" muscle measurement (length x width), with a correlation coefficient of .9339 shows up best in this respect. Linear external carcass measurements are not strongly correlated with total muscle.

McMeekan has also shown that correlations between various measures of the thickness of backfat and the total weight in the carcass are particularly strong, and for the most part closely approach unity. Fat at the shoulder gives the lowest and the rump the highest coefficient of the single measures, but the latter is exceeded by the mean back fat thickness (shoulder, loin and rump measurements) with and equal to .9552. It is contended that the relationships established will, because of their biological basis, apply in principle, though not necessarily with the same mathematical constants to all pigs of the same body weight, whatever their origin, breed, or type.

Brough and Shepherd (1955) computed the ratio of the weights of the four high value lean cuts to the total carcass weight. This ratio (the index of lean) is a measure of the relative values of the hog carcasses. The higher the index of lean, the higher the value of the carcass, until the point is reached where the carcasses are discounted for lack of quality. Average backfat thickness proved to be most closely associated with the index of lean for any weight grouping of carcasses. Length of carcass was second.

According to Wiley, et al. (1951), the backfat thickness is the single most important fact related to percentage lean cuts, much more important than carcass weight as a determinant.

A study by Fox, et al. (1953), showed that dressing percent is not always a true indicator of value. Value is determined by what makes up the yield—the percentage of fat to lean—and not the yield itself. The study of hog carcasses and valuation of the trimmed cuts proved conclusively that backfat thickness was a definite indicator of live hog values. This study confirmed the principle that live hog values should decline as backfat thickness increases. Longer hogs of the same weight carried less backfat thickness. Increase in length seemed to cause a more even distribution of fat on the carcass. Exceptionally broad shoulders were an indication of excess fat in this area.

According to Stothart (1938), in simple correlations it was noted that length of side, depth of shoulder, and backfat increased with increases in weight while the area of lean, or the product of length and width of the loin muscle, decreased with increased depth of shoulder fat.

According to Henning and Evans (1953) the four most important physical factors which explain variation in the lean cuts are: (1) average backfat thickness, (2) hind leg length, (3) body length, and (4) carcass weight. Average backfat thickness explained 66.9 per cent of the variation.

Wiley, et al. (1951), have shown that there were differences as great as 18 per cent in the percent lean cuts among hogs of the same weight.

Each of the six states participating in the North Central Livestock Marketing Research Committee reported that average backfat thickness in all weight groups proved to be the best single measure in explaining variations in the percent lean cuts. Body length was second and the other measures such as thickness of belly pocket, length of ham, circumference of ham, width through ham, and width through shoulders were less important.

According to the North Central Livestock Marketing Research Committee (1952) the measures of lean cuts varies inversely with the degree of finish. Predicted percent lean cuts vary from 40.6 per cent at 2.4 inches of backfat in the fat extreme to 58.5 per cent at 1.0 inch backfat or the lean extreme.

Several carcass measurements were taken by Engleman, et al. (1950). These measurements include average backfat thickness, length of body, length of ham, thickness through shoulders, thickness through hams and belly pocket thickness. Statistical analysis were applied to determine which measure or measures could best be used to estimate percentage of the high value cuts (hams, loins, picnics, butts, and bellies) and lean trimmings in the carcass. The combined percentage of these high value cuts and trimmings were called the "index of lean." Average backfat thickness proved to be the best single measure in explaining variations in the index of lean. Body length was second and the other measures were less important.

Pearson, et al. (1958), obtained results indicating that simple cut indices involving a minimum number of weights and adapted to large scale usage may be utilized in evaluating swine carcasses. The loin index appears to be more promising than the trimmed loin-fatback ratio or the percentage

$$\text{Loin Index} = \frac{\text{trimmed loin}}{\text{rough loin}} \times 100$$

trimmed loin on either the live or carcass basis. A comparison of the loin index and backfat thickness as measures of lean cuts (carcass basis) justifies the conclusion that loin index more accurately reflects percentage lean cuts. Although percentage skinned ham (both live and carcass basis) and percentage New York shoulder (both basis) indicate cut-out nearly as well as the various loin indices, all loin indices were superior as indicators of loin lean area.

On the other hand, the percentage trimmed belly was a poor indicator of all cut-outs and loin lean area.

Pearson, et al. (1958), have shown that carcass length and percentage loin are positively correlated, yet variation in length accounted for only 17 to 18 per cent of the variability in percentage loin. Carcass length did not appear to influence percentage belly, percentage ham, or percentage New York shoulder, which explains the low relationship between carcass length and cut-outs.

Lasley, et al. (1956), computed all possible correlation coefficients among shrunk (24 hour) live weight, carcass weight, ham weight, loin weight, picnic weight, Boston butt weight, bacon weight, weight of four lean cuts, weight of five primal cuts, carcass length, carcass backfat, backfat measured by live probe and loin eye (at 10th rib) for 222 barrows. Carcass weight was more highly correlated with most traits than was shrunk live weight due to greater part-whole constriction and the tendency for fatter barrows to yield heavier carcasses. Exceptions were found for ham weight and carcass length. Squared multiple correlation coefficients of particular interest for predicting lean cuts were: (1) shrunk live weight and probe, .44; (2) carcass weight, backfat and length, .50; (3) carcass weight backfat and loin eye area, .69; (4) carcass weight, backfat, length, and loin eye area, .70; (5) carcass weight and ham weight, .80; (6) carcass weight, backfat and ham weight, .82; and (7) carcass weight, backfat, length, loin eye area, and ham weight, .91. It would be difficult to exceed the last value because weight of lean cuts is not estimated without error.

Price, et al. (1957), found that the specific gravity of the untrimmed right ham was closely related with the specific gravity of the entire carcass,

the correlation coefficient being .86. However, cut-out percentages, chemical composition of the ham, loin lean areas, and fat thickness measures, were not as closely predicted by ham specific gravity as by carcass specific gravity. The correlation coefficient obtained between ham specific gravity and the above mentioned items were all highly significant.

In this study contrary to previous work, carcass cut-out was more closely associated with live probe and backfat thickness than with specific gravity of the ham. However, specific gravity of the untrimmed ham more closely predicted its chemical composition than lean areas of the loin, carcass length, live probe or backfat thickness.

Results indicated that specific gravity of the ham or carcass was a more reliable indicator of muscling or actual meatiness, than live probe or backfat thickness. This conclusion was based on a higher correlation of specific gravity and loin lean areas than between fat thickness and lean areas. Carcass length showed no significant relationship with cut-out, chemical composition, or external fat thickness. Carcass length combined with backfat thickness or live probe gave little advantage over the use of backfat or live probe alone.

Bratzler, et al. (1947), in using 478 hogs from 17 breeds and crossbred groups, collected and tabulated the following data on each hog: live weight; cold carcass weight; carcass length from aitch bone to first rib; weight on each of the primal cuts, trimmed loin, belly, skinned ham and New York style skinned shoulder; and weight of the fatback. A highly significant correlation coefficient of .820 was found between the yield of primal cuts from the carcass and the relationship of the trimmed loin to fatback. Also a highly significant, although somewhat lower correlation coefficient of .561 was found between

the yield of primal cuts on a live weight basis and the relationship of trimmed loin-fatback ratio. These results indicate that the trimmed loin-fatback ratio is a reliable index for estimating the yield of primal cuts from a hog carcass.

Pearson, et al. (1956), in this study, investigated the fat-lean ratio in cross section of the rough loin at the last rib as a possible measure of carcass leanness. Correlation coefficients of approximately $-.60$ between the fat-lean ratio and several measures of carcass cut-out indicated the relationship may be high enough to be useful when it is impossible to obtain cut-out information. However, the area of lean at the 10th rib to last rib was only slightly less reliable than the ratio of fat to lean for estimating cut-out values.

Consideration of the relationship between either carcass length or dressing percentage and carcass cut-out indicates that major emphasis should be placed on other methods of measuring leanness..

Kline and Hazel (1955) studied loin areas at the tenth and last ribs, percent lean cuts and percent loin for both right and left sides on 23 carcasses. Differences between pigs were striking for all carcasses traits studied, while differences between sides and the interactions were negligible. The loin area at the last rib averaged $.43$ square inch greater than that at the tenth rib, a large and highly significant difference.

There was no difference among the correlations between percent lean cuts and loin area at the tenth and last ribs, although the latter area was slightly more closely related to percent loin. All of these correlations varied from $.65$ to $.75$. There was no difference among the correlations as to whether the traits considered were measured on the same or different sides

of the body. Because of the high correlations between loin areas on the same carcass there is little increase in accuracy of predicting lean cuts from measuring the loin area in more than one place.

Pearson, et al. (1956), in determining suitability of specific gravity of three untrimmed cuts, the ham, loin, and shoulder, as measures of carcass leanness, found that the specific gravity of each of the cuts was closely associated with the specific gravity of the entire carcass. The correlation coefficients were .94, .96, .92 for the ham, loin and shoulder respectively, when both cuts from the same carcass were used. However, on a single cut, corresponding values were .93, .91, .87.

The somewhat higher correlations for specific gravity of a single ham to other measures of carcass leanness indicated that the untrimmed ham was a more reliable index of the entire carcass than either a single rough loin or untrimmed shoulder. Specific gravity of either the entire carcass or a single ham proved to be superior to backfat thickness as a measure of carcass leanness.

In examination of correlation coefficients by weight groups indications were obtained that both backfat thickness and length of carcass were better measures of leanness for lighter weight pigs.

Brown, et al. (1951), studied carcass data from two groups of hogs to investigate the possibility of using specific gravity as a means of estimating the fat or lean content of the carcass. Group I included 34 Duroc and Group II included 32 Duroc hogs, both groups were slaughtered at weights ranging from 202 to 230 pounds.

The average specific gravity for the 66 carcasses was 1.027. Intra-group correlations of specific gravity with area of loin eye, percentage primal

cuts, percentage lean cuts, and carcass length were positive and highly significant. Highly significant negative correlations were found between specific gravity and average fatback thickness, percentage fat cuts and chilled carcass weight.

The correlations calculated in the study indicate that the fat or lean content of the carcass may be as accurately estimated by the specific gravity as by the percentage fat cuts or percentage lean cuts.

Partial correlations indicated that differences in carcass weights in the data had little effect on correlations between the various items measured.

Multiple correlations indicated that specific gravity when combined with some of the other measures of fatness or leanness was no more closely correlated with the fat or lean content of the carcass than was specific gravity alone.

In comparing the carcass quality characteristics of market barrows and gilts, Herbert and Crown (1956), found that gilt carcasses yielded a higher percentage of ham, higher percentage of loin, larger loin area, and a higher percentage of separable lean in hams than did the barrows. These differences were found to be highly significant. The thickness of lean in hams was significantly greater in gilts than that in barrows. The average backfat thickness of barrows was highly significantly greater than that of gilts. The percentage of separable fat in the hams of barrows was significantly greater than that in gilts.

Hetzer, et al. (1950), found that gilts yielded about 1.0 per cent (live weight basis) more of the five primal cuts and about .72 per cent more lean meat in the hams than barrows of the same weight and breeding.

Fredeem and Lamboughton (1956), found that in the Canadian Yorkshire breed, females are longer and leaner than barrows.

Lacy (1932), observed that gilts on the average had more ham and loin and about the same portion of belly. But the barrows had a larger proportion of the fatty cuts—fatback, clear plate, internal fat, and cutting fat. The difference between average dressing percentage was less than .3 per cent in favor of the barrows, however, this is not significant.

METHODS AND PROCEDURES

This experiment was originally designed with the idea that several buyers on a terminal market would score a larger number of hogs than used in this study. Conflicts caused the alteration of the problem to that outlined below.

The 39 barrows evaluated in this study were entries in the Beloit, Kansas, spring barrow show held March 19, 1958. The entries included Berkshire, Duroc, Hampshire, Tamworth, and Yorkshire breeds plus crossbreds. The barrows were entered the morning of the show and paint branded with a number for identification. They were weighed on portable scales by one individual. Immediately after weighing, the hogs were probed 1.5 inches off the midline, behind the shoulder, at the last rib, and at the hip bone. The mean of the three measurements was recorded as average fatback thickness. The barrows were tattooed after probing for carcass identification. The hogs were individually appraised by six scorers. The information requested of each appraiser was as follows: hog number, scorer number and a check for their estimate of average fatback thickness, carcass length, percent lean cuts and live grade. An example of the score card appears in Form I. The scorers

Form I. One of the cards used by scorers to estimate carcass characteristics.

LIVE HOG SCORE CARD

Judge No. _____ Date _____
 Estimated Wt. _____ Hog No. _____
 Actual Wt. _____ Breed _____
 Sex _____

FATBACK THICKNESS

less than 1 _____
 1.01 -- 1.2 _____
 1.21 -- 1.4 _____
 1.41 -- 1.6 _____
 1.61 -- 1.8 _____
 1.81 -- 2.0 _____
 2.01 -- 2.2 _____
 over 2.2 _____
 (inches) _____

PERCENTAGE LEAN CUTS

less than 42% _____
 42.1 -- 45% _____
 45.1 -- 48% _____
 48.1 -- 51% _____
 51.1 -- 54% _____
 over 54% _____

CARCASS LENGTH

less than 27 _____
 27.1 -- 28 _____
 28.1 -- 29 _____
 29.1 -- 30 _____
 30.1 -- 31 _____
 31.1 -- 32 _____
 32.1 -- 33 _____
 over 33 _____
 (inches) _____

LIVE GRADE

No. 1 _____
 No. 2 _____
 No. 3 _____
 Med. _____

LOIN EYE AREA

less than 3 _____
 3.01 -- 3.5 _____
 3.51 -- 4.0 _____
 4.01 -- 4.5 _____
 over 4.5 _____
 (inches) _____

included three staff members and a graduate student from the Animal Husbandry Department at Kansas State College and two prominent commercial hog breeders. Each scorer was familiar with grading and evaluating market hogs. The scorers were identified by a number only, which was recorded on each card. A separate score card was used by each scorer for each barrow evaluated.

At the termination of the show the barrows were transported to a local packing plant and slaughtered. The carcasses were allowed to chill approximately 44 hours. Carcass measurements were obtained by one individual on the right side of each carcass, except where otherwise specified. Carcass length was measured to the nearest tenth of an inch from the anterior edge of the aitch bone to the anterior edge of the first rib with a steel tape. Fatback thickness was measured with a metal ruler to the nearest tenth of an inch at the first and last rib and last lumbar vertebra. These three measurements were averaged and recorded as fatback thickness. The lean tissue which lies in the vicinity of the lumbar-sacral vertebrae junction is hereafter termed "lumbar lean". The area of the lumbar lean on both sides of each carcass was traced on acetate paper. The areas of the tracings were measured with a compensating polar planimeter. The average of the two areas was determined for subsequent correlation with other carcass characteristics. The area designated as lumbar lean is illustrated in Plate I.

Each side of the carcass was weighed with the leaf fat and ham facings left intact. Leaf fat was then removed and weighed. Weight of the leaf fat was deducted from the above determined carcass weight plus leaf fat to obtain the chilled carcass weight of the packer-style dressed carcasses.

The carcasses were separated into the four trimmed lean cuts and belly by five pork-cut personnel. Each was responsible for the removal, trimming,

EXPLANATION OF PLATE I

The area indicated by the letter A was
traced and termed lumbar lean.

PLATE I



and weighing of a particular cut. All cuts were weighed to the nearest ounce, on the same scale, by the same individual and recorded. The carcass data card is shown in Form II.

The cutting procedures used follow those described by the pork evaluation committee at the 1951 Reciprocal Meat Conference with the exception of the ham which was trimmed to approximately a quarter of an inch of fat. Lean cuts were calculated as percent of the chilled carcass weight.

Methods followed in the statistical analysis are in accordance with those described by Snedecor for simple correlation coefficients. To simplify calculations, each actual and estimated measurement range represented by a three digit number was coded by substituting a one digit number. The correlation coefficients were computed to four places then rounded to two places following Kellys' rule.

DISCUSSION AND RESULTS

The hogs available for this study could hardly be considered a representative sample of an average run on a terminal market because they were selected as the top from each herd by the consigner for the show. The average percent lean cuts, 51.33; fatback thickness, 1.64; and carcass length, 30.66, show that these measurements were higher (fatback thickness less) than average market hogs.¹ Many of the consignees had entered barrows in previous shows and were aware of the type hog desired. The rations, method of fitting, breeding, and weight were not considered in any analysis of the results. Weight variations ranged from 170 to 276 pounds live weight.

¹Confidential information supplied by a commercial packing house.

Form II. The card on which all carcass data was recorded.

CARCASS EVALUATION

Live Wt. _____ Breed _____ Date _____
Sex _____ Hog No. _____

CARCASS WT.

hot _____ rightside _____ leftside _____
cold _____

BACKFAT THICKNESS

1st rib _____ last rib _____ last lumbar vert. _____ avg. _____

CARCASS LENGTH

LUMBAR LEAN AREA _____

traced _____ length _____ width _____

LOIN EYE AREA at tenth rib _____

CARCASS GRADE

WT. LEANCUTS

rightside leftside

ham _____

picnic _____

loin _____

butt _____

total _____

AVERAGE PERCENT of lean cuts for right and left sides _____

The simple correlation coefficients between estimated and actual carcass measurements are shown in Table 1 for each scorer.

Table 1. Correlation coefficients between estimated and actual carcass measurements.

	Scorers					
	1	2	3	4	5	6
Fatback	.73**	.65**	.68**	.56**	.36*	.68**
Length	.37*	.62**	.45**	.62**	.45**	.82**
Percent lean cuts	.07	.23	.25	.06	.11	.12

*Significant at the 5% level

**Significant at the 1% level

The correlations for fatback were either significant or highly significant for all scorers. This indicates that individuals can estimate the thickness of fatback with a fair degree of accuracy. These results are in agreement with Bratzler and Margerum (1953). The scorer with the lowest correlation, .36, although familiar with the system had never actually estimated fatback previously. All others had scored hogs in this manner before in one or more marketing schools. The two commercial breeders with correlations of .73 and .68 had been consistently high in estimation of fatback thickness in the schools they attended. They have an above average interest in hog production and have followed many of their own hogs through the cooler. The other three scorers from the Animal Husbandry Department of the college had experience in estimating fatback thickness and their correlation coefficients, .65, .68, and .56 respectively, were all highly significant.

The correlations for carcass length were either significant or highly significant for all scorers. This concurs with the work done by Henning,

and Evans (1953), and Bratzler and Margerum (1953). There is variation in the scorers correlations for carcass length and it is interesting to note that the scorer with the lowest correlation for carcass length had the highest correlation for fatback thickness. Here again all scorers had considerable experience estimating length in the various market schools. One commercial breeder had the highest and the other the lowest correlation. Both had approximately the same experience in estimating each of these characteristics.

As Table 1 indicates none of the correlations between estimated and actual percent lean cuts were significant for any individual; however, two of the scorers were approaching statistical significance. Bratzler and Margerum (1953) have also shown this character to be the most difficult, of the ones scored, to appraise on the market barrow. None of the scorers had actually estimated percent lean cuts previously, although all were familiar with the cuts. Evidently scorers do not associate percent lean cuts with fatback thickness and carcass grade, both of which are highly significantly correlated with percent lean cuts. This may be because the appraisers were trying to estimate muscling and lean in the hogs rather than use an association. It would seem logical at least that percent lean cuts could be fairly accurately estimated.

Tables 2 to 5 present percentage figures and a range for each characteristic studied. Each scorer had a range of 3 percent for estimating percent lean cuts, .2 of an inch for average fatback thickness and one inch for carcass length estimation.

The comparison of estimated and actual carcass grade for each scorer appears in Table 2. Approximately 65 percent of the hogs were placed in

Table 2. Comparison of estimated grade with actual carcass grade.

	Scorers					
	1	2	3	4	5	6
Correct grade %	64.1	69.2	66.7	61.5	61.5	64.1
1* under %	15.4	20.5	30.8	30.8	25.6	30.8
over %	20.5	10.2	2.6	7.7	12.9	5.2

*One grade from the correct grade

the correct grade by the scorers. The variation being from 61.5 to 69.2 percent. This agrees with the work of Wiley, et al. (1951), and Henning and Evans (1953). The work of Henning differed in that live grade was estimated for groups of hogs rather than individuals. According to Naive, et al. (1957), scorers were more accurate when estimating the number of hogs in each grade for a lot than when estimating the grade for each hog. In the present study all of the barrows were placed within one grade of the correct carcass grade. According to the percentage figures, carcass grade is much easier to estimate than any of the characteristics comprising grade.

The results presented in Tables 3, 4 and 5 are equivalent to those presented in Table 1. The only difference is in the form presented. In Tables 3 to 5 the data are expressed in percent; whereas in Table 1 correlation coefficients are presented between these same characteristics. Tables 3, 4 and 5 list the scorers, the percent of each item scored correctly, and the percent for each range from correct estimated by the scorer. It is difficult to estimate the correlation coefficients by looking at the percentage figures, however, the fewer ranges from correct estimated by a scorer seem to give a higher correlation. Also the scorer with the largest percent correct may not have the highest correlation.

Table 3. Comparison of estimated and actual carcass fatback thickness.

		Scorers					
		: 1	: 2	: 3	: 4	: 5	: 6
Correct %		30.8	48.7	38.5	28.2	33.3	46.2
1*	under %	33.3	20.5	35.9	33.3	20.5	25.6
	over %	17.9	17.9	12.8	20.5	20.5	7.6
2	under %	15.4	7.6	7.6	12.8	17.9	12.8
	over %	2.6					2.6
3	under %		5.1	5.1	5.1	5.1	2.6
	over %						2.6
4	under %						
	over %						
5	under %						
	over %					2.6	

*Each number denotes the number of ranges from correct that the scorer estimated fatback thickness. A .2 inch range is represented by each number.

Tables 2 to 5 show there is a tendency for scorers to underestimate rather than overestimate the items scored. This was particularly true for percentage lean cuts and carcass length. Fox, et al. (1953), also noted that appraisers generally underestimated primal cuts of high yielding (48 to 55 per cent of live weight) hogs.

An explanation for this particular experiment may be that the whole group of barrows were above average and selected for the show rather than an average run of market hogs. This is shown by the grade breakdown of the group of hogs: 21 graded U.S. No. 1, 16 No. 2, 1 No. 3 and 1 carcass graded medium.

Table 4. Comparison of estimated and actual carcass length.

		:			Scorers									
		:	1	:	2	:	3	:	4	:	5	:	6	
Correct %			38.5		30.8		17.9		28.2		12.8		30.8	
1*	under %		41.0		41.0		38.5		38.5		38.5		38.5	
	over %		5.1				2.6		5.1				10.3	
2	under %		12.8		17.9		28.2		23.1		35.9		15.4	
	over %													
3	under %		2.6		10.3		10.3		5.1		2.6		5.1	
	over %													
4	under %										10.3			
	over %													
5	under %						2.6							
	over %													

*Each number denotes the number of ranges from correct that the scorer estimated carcass length. A one inch range is represented by each number.

Table 5. Comparison of estimated and actual percent lean cuts.

		:	Scorers										
		:	1	:	2	:	3	:	4	:	5	:	6
Correct %			38.5		23.1		23.1		33.3		23.1		35.9
1*	under %		25.6		48.7		46.2		35.9		43.6		35.9
	over %		10.3		5.1		2.6		5.1		2.6		5.1
2	under %		23.1		23.1		28.2		23.1		28.2		20.5
	over %		2.6						2.6				2.6
3	under %										2.6		
	over %												

*Each number denotes the number of ranges from correct that the scorer estimated percent lean cuts. A 3 percent range is represented by each number.

Live probe correlated with percentage lean cuts was highly significant $-.66$, which was the highest of any characteristics correlated with percent lean cuts. Hetzer, et al. (1956), and Pearson, et al. (1957), also observed that live probe was highly correlated with percent lean cuts. It was noted in the chilled carcass that the actual probe sites were at approximately the 7th to 8th rib, last rib and between the 5th and 6th lumbar vertebrae.

Table 6. Correlation coefficients between live probe and some carcass characteristics.

	: Percent Lean Cuts	: Fatback
Live probe	$-.66^{**}$	$.84^{**}$
Lumbar lean	$.29$	$.11$
Fatback	$-.51^{**}$	
Length	$.28$	
Grade	$-.60^{**}$	

** Significant at the 1% level

The correlation between average fatback thickness and percent lean cuts was $-.51$. Engleman, et al. (1950), Wiley, et al. (1951), Henning, and Evans (1953), Brough and Shepherd (1955), plus others have found that the fatback thickness was closely associated with the percent lean cuts.

The correlation between live probe and average carcass fatback thickness $.84$, was highly significant. A comparison of correlations for live probe and carcass fatback thickness indicates that live probe is more highly correlated with lean cut yield than carcass fatback measurements. This is in accord with the findings of DePape and Whatley (1956) and Pearson, et al. (1958).

Lumbar lean as shown in Plate I is not significantly correlated with percent lean cuts, the actual correlation was .29. Some investigators in using the term lumbar lean refer to the combined musculature in the sacro-lumbar region. The correlation of lumbar lean with carcass fatback, .11, was not significant.

Carcass length correlated with percent lean cuts, .28, was not significant.

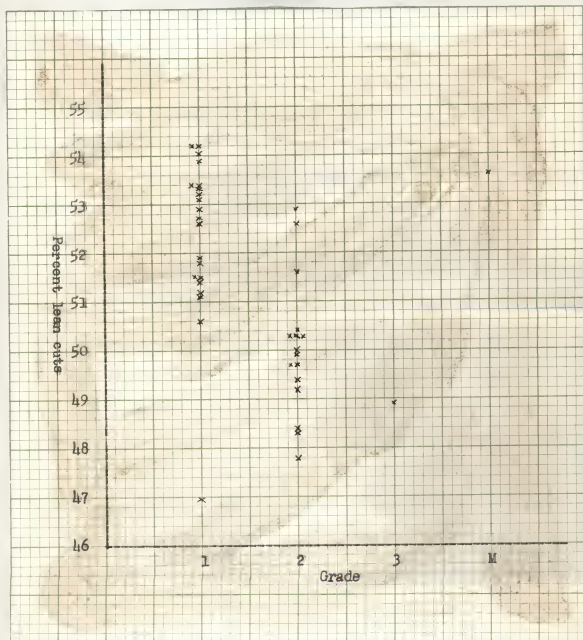
Plate II shows the range for percent lean cuts within each carcass grade. There is overlapping between grades, however the mean for each grade is different. The mean for U.S. No. 1 is approximately 52.5 per cent, for No. 2, 50 per cent. One U.S. No. 1 grade barrow appears inconsistent with other No. 1 barrows and the reason is not known. It's possible that the barrow actually did cut low or an error in weighing or cutting may have occurred. Only one hog graded U.S. medium and U.S. No. 3, respectively; consequently no conclusions can be made concerning the percent lean cuts except to say that the medium yielded a higher percent lean cuts than the mean of the U.S. No. 1 hogs and the U.S. No. 3 yielded a lower percent lean cuts than the No. 2's. These results are in agreement with Self, et al. (1957).

The correlation between carcass grade and percent lean cuts is -.60. This is to be expected as carcass grade is determined to a large extent by average fatback thickness.

EXPLANATION OF PLATE II

Range of percent lean cuts within each U.S.D.A. grade.

PLATE II



SUMMARY

Thirty-nine barrows from the Beloit, Kansas, spring barrow show representing five breeds plus crossbreds were used in the study. The variation in live weight ranged from 170 to 276 pounds.

Six persons, three staff members and a graduate student of the Animal Husbandry Department from Kansas State College and two prominent commercial hog breeders scored the barrows. The hogs were scored individually by each scorer for the following items: fatback thickness, carcass length, percent lean cuts and live grade. At the termination of the show the hogs were slaughtered, chilled, measured and cut to determine the actual measurements needed for the correlation with those estimated by the scorers.

The simple correlation coefficients for the estimated and actual fatback and length measurements were highly significant for five of the scorers and significant for one scorer (not the same individual) in each of the measurements. The correlation for estimation of fatback thickness varied from .36 to .73. The range for carcass length was from .37 to .82. All of the scorers, except one, had previous experience scoring fatback thickness, carcass length and grade. None had estimated percent lean cuts previously. The estimates of percent lean cuts were not significantly correlated with the actual percent lean cuts. The correlations varied from .06 to .25.

There seemed to be a tendency for all scorers to underestimate the characteristics scored. This may have been due to the fact that the barrows selected were for a show and above the average run at a market.

The following characteristics are listed with the correlation coefficient

for percent lean cuts: live probe, $-.66$; grade $-.60$; average fatback thickness, $-.51$; lumbar lean, $.29$; and carcass length, $.28$. Lumbar lean and carcass length were the only two not significantly correlated with percent lean cuts.

Correlations between average fatback thickness and lumbar lean were not significant, $.11$.

Live probe and fatback thickness were highly significantly correlated, $.84$.

The data included in this study indicates that individuals may estimate some of the characteristics which influence the cut-out value of hogs fairly accurately. Percent lean cuts apparently is the most difficult characteristic to evaluate but it is felt that with continued experience in selecting hogs for this characteristic the individual could become more proficient. It is recognized that due to limited numbers involved in this study definite conclusions can not be drawn. Future observations of this nature should be made with a larger number of scorers and a much larger number of hogs.

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THE CORRELATION BETWEEN LIVE HOG SCORES
AND CARCASS MEASUREMENTS

by

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B. S., Kansas State College
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The need to evaluate the cut-out of live market hogs has developed with the change in method of buying. When hogs were sold on the live weight basis, dressing percent determined the value to the packer. The decrease in lard prices and consumer preference has shifted the emphasis from the lard-type hog to one that will yield a high percent lean cuts.

The accuracy with which man can estimate percent lean cuts and other related characteristics has presented a problem for marketing agencies, educational personnel and processors. Various carcass measurements such as fatback and length have been correlated with percent lean cuts in an attempt to determine an accurate estimator of cut-out value.

It is the purpose of this study to correlate man's estimate for fatback, length, percent lean cuts and grade with the actual measurements. Various carcass characteristics were also correlated with percent lean cuts and fatback thickness.

The 39 barrows used in this study were consigned to a spring barrow show in central Kansas. The hogs were individually scored by six scorers, three staff members and a graduate student from Kansas State College and two prominent hog breeders. The information requested of each appraiser was as follows: hog number, scorer number and a check for their estimate of average fatback thickness, carcass length, percent lean cuts and live grade.

At the termination of the show the barrows were slaughtered, dressed packer style, and chilled 44 hours. Prior to cutting the carcass fatback thickness and length were measured and area of lumbar lean traced. The carcass was broken into the wholesale cuts and the weight for the four lean cuts, the ham, Boston butt, picnic and loin recorded. The four lean cuts

were calculated as percent of the chilled carcass weight to derive percent lean cuts. Correlations between the various carcass measurements and percent lean cuts were also computed.

The correlation coefficients for the estimated compared to the actual fatback thickness and carcass length were either significant or highly significant for all scorers and varied from .36 to .73 and .37 to .82, respectively. This indicates that individuals can estimate these particular characteristics with a fair degree of accuracy.

Estimation of percent lean cuts was not significantly correlated for any scorer. The range was .07 to .25 with two individuals approaching significance.

The scorers correctly estimated live grade for approximately 65 per cent of the hogs. The range for all scorers was 61.5 to 69.2 per cent which was higher than any other characteristic when all were computed by percent.

There was a tendency for all scorers to underestimate those traits not correctly scored rather than overestimate.

The following characteristics are listed with the correlation coefficient for percent lean cuts: live probe, $-.66$; grade, $-.60$; average fatback thickness, $-.51$; lumbar lean, $.29$; and carcass length, $.28$. Lumbar lean and carcass length were the only two characteristics not significantly correlated.

Average fatback thickness and lumbar lean were not significantly correlated, $.11$.

Live probe and fatback thickness were highly significantly correlated, $.84$.