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# A COMPUTERIZED ECONOMIC MODEL TO CALCULATE BEEF CARCASS VALUE FROM ELECTROMAGNETIC SCANNING

C.R. CALKINS, D.E. BURSON, and T.M. GUEST
University of Nebraska, P.O. Box 830908, Lincoln, NE 68583-0908, USA

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## BACKGROUND:

Previous research (Gwartney et al., 1993, 1994) has demonstrated the feasibility of electromagnetic scanning (also known as ToBEC, after Total Body Electrical Conductivity) to determine lean content of beef primal cuts, quarters and sides. Similar estimates of composition are also obtained from U.S. Department of Agriculture (USDA) beef yield grades. However, the yield grading system is applied by human graders and thus is subject to human error. Some individuals have expressed a desire for objective instrumentation to determine yield. An instrument grading approach to development of a value (lean) based marketing system would require calculation of overall carcass value. Given the strengths of electromagnetic scanning to provide lean yield information, this research sought to initiate development of a computerized economic model to determine beef carcass wholesale value based on the estimated weight of the subprimal cuts from beef carcasses.

## OBJECTIVE:

The objective of this research was to determine the efficacy of developing a computerized economic model for determination of beef carcass wholesale value based on results of electromagnetic scanning.

## METHODS:

Hindquarters of 60 heifers and 40 steers were scanned in a model MQ-25 electromagnetic scanner (Meat Quality, Inc., Springfield, IL) as previously described (Gwartney et al., 1994). USDA yield grades were determined on each carcass by measuring ribeye area, fat thickness, and carcass weight and from estimating kidney, pelvic, and heart fat. Equations relating yield grade, marbling score, breed type, and sex class to percentage of carcass weight as subprimal cuts (Griffin et al., 1992) were used to estimate subprimal cut weight in the steer and heifer carcasses. The peak of the electromagnetic scanning curve of the hindquarters was then coupled with carcass weight and meat temperature to create equations to predict estimated subprimal weight. Separate equations were established for steer and heifer carcasses. Thus, estimates of carcass percentage as subprimal cuts could be made on subsequent carcasses either by electromagnetic scanning of beef hindquarters or from USDA yield grades.

These equations were incorporated into a computerized economic model to determine wholesale value of beef carcasses. Prices of subprimal cuts reported during 1993 by the USDA Agricultural Marketing Service were used. Because some of the subprimal prices were unavailable, it was necessary to obtain current industry prices for our calculations. Prices for the outside skirt, 50% lean beef trimmings, shank meat, the pastrami square, fat, bone and by-products are our best estimates. The majority of reported prices are for commodity trimmed subprimals, containing up to 2.5 cm of trimmable fat. Few prices are reported for subprimals with 1.3 cm and 0.64 cm of trimmable fat. As a result, the computer model was programmed to calculate these prices from commodity prices by adjusting for labor costs and yield differences. Beef steer hind quarters (n=100) were scanned and USDA yield grades were calculated. These data were evaluated using the computerized economic model. Results of the final calculations are presented here.

## RESULTS AND DISCUSSION:

Carcass characteristics of the steer carcasses revealed an 11% coefficient of variation (cv) in live weight and a 12% cv of carcass weight (Table 1). Yield grades ranged from a 1.26 to a 5.1. Across the entire population, estimated total wholesale value ranged from \$595.80 to \$1168.48 estimated by electromagnetic scanning technology and from \$586.30 to \$1182.11 using USDA yield grades (Table 1). When expressed on a dollars per hundred pounds of carcass weight basis (\$/45.4 kg), as commonly used in the U.S. livestock industry, wholesale values ranged from \$118.46 to \$133.46 (cv from 1.59 to 1.90%) when estimated from electromagnetic scanning and from \$117.70 to \$135.74 (cv from 1.77 to 2.31%) using yield grades. Across the entire population, total wholesale value estimates from electromagnetic scanning tended to be lower and less variable than estimates derived from yield grades. Conversely, when wholesale value was expressed on a dollars-per-hundred pounds basis, estimates of value were more variable when yield grades were used to determine wholesale value.

It was of interest to determine if the differences in relative value were consistent across all yield grades classes. The population contained a singe yield grade five carcass whose wholesale value fell within the range of those carcasses in the yield grade four category, so it was included with the yield grade fours (Table 2) for the analysis. Within yield grades one, two, and three, estimates of total wholesale value were lower and slightly less variable for estimates derived from electromagnetic scanning than from yield grades. However, within the yield grade four category, value estimates were higher and more variable when electromagnetic scanning technology was employed. It is unclear if these differences reflect a greater ability of electromagnetic scanning to partition fatter carcasses on the basis of value or if a narrower value than predicted actually exists. Further research is needed to validate the results of this model.

## TABLE 1: CHARACTERISTICS OF STEER CARCASSES SCANNED FOR DETERMINATION OF TOTAL WHOLESALE VALUE

| Trait[a] | Mean | Standard deviation | Minimum | Maximum | Coefficient of variation |
|---|---|---|---|---|---|
| Live weight, kg | 546.7 | 62.58 | 354.1 | 730.9 | 11.45 |
| Carcass weight, kg | 332.5 | 39.80 | 214.3 | 443.1 | 11.97 |
| USDA Yield grade | 3.00 | 0.74 | 1.26 | 5.10 | 24.72 |
| ToBEC value, 2.5 cm fat, $ | 901.20 | 98.37 | 595.80 | 1177.60 | 10.92 |
| ToBEC value, 1.3 cm fat, $ | 914.90 | 98.96 | 609.97 | 1187.90 | 10.82 |
| ToBEC value, .64 cm fat, $ | 924.18 | 100.13 | 621.70 | 1196.37 | 10.83 |
| Yield grade value, 2.5 cm fat, $ | 904.93 | 99.49 | 586.30 | 1168.48 | 10.99 |
| Yield grade value, 1.3 cm fat, $ | 919.76 | 100.61 | 597.46 | 1175.94 | 10.94 |
| Yield grade value, .64 cm fat, $ | 930.68 | 102.61 | 606.22 | 1182.11 | 11.03 |

[a] ToBEC value is wholesale value estimated from electromagnetic scanning and Yield grade value was estimated from USDA Yield grades.

## CONCLUSIONS:

A computerized economic model to determine wholesale value of beef carcasses based on estimated weight of subprimal cuts was developed. Value estimates were in the same range as those derived from yield grades estimates, but tended to be lower and less variable. The exception to this situation was carcasses within the yield grade four category. It appears that this approach to value determination can be an effective method to determine value. Validation of the model is needed.

## TABLE 2. ESTIMATES OF TOTAL WHOLESALE VALUE FOR STEER CARCASSES DISTRIBUTED ACROSS YIELD GRADES

| | Yield grade 1 | | Yield grade 2 | | Yield grade 3 | | Yield grade 4 | |
|---|---|---|---|---|---|---|---|---|
| Trait | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard Mean |
| Number of observations | 9 | --- | 39 | --- | 42 | --- | 11 | --- |
| ToBEC value, 2.5 cm fat, $ | 873.36 | 68.15 | 861.09 | 104.06 | 920.47 | 73.45 | 1001.78 | 106.34 |
| ToBEC value, 1.3 cm fat, $ | 891.67 | 71.04 | 875.34 | 105.44 | 933.24 | 74.55 | 1013.78 | 106.73 |
| ToBEC value, .64 cm fat, $ | 904.40 | 71.69 | 885.82 | 107.24 | 940.91 | 76.52 | 1021.32 | 109.24 |
| Yield grade value, 2.5 cm fat, $ | 886.82 | 73.83 | 866.68 | 108.39 | 923.53 | 76.65 | 992.25 | 104.49 |
| Yield grade value, 1.3 cm fat, $ | 907.60 | 76.11 | 882.79 | 111.20 | 937.31 | 78.68 | 1001.21 | 104.47 |
| Yield grade value, .64 cm fat, $ | 926.76 | 81.34 | 895.02 | 113.99 | 946.48 | 81.94 | 1006.94 | 106.48 |

Note: A single yield grade 5 carcass was included in the yield grade 4 category.

## PERTINENT LITERATURE:

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