REVIEW OF MARKETING AND AGRICULTURAL ECONOMICS
VOL. 48, NO. 3 (*December*, 1980)

The Accuracy of Market Reporters in the Estimation of Carcass Weight and Fat Cover for Cattle

John Naughtin*

In this paper the results of a trial to test the accuracy of livestock market reporters in estimating carcass weight and fat cover are reported. It is concluded that the current performance of the reporters in carcass weight estimation is satisfactory, but there is scope for improvement in the estimation of fat cover. The importance of a continuing training programme for market reporters to main tain and improve on current standards of accuracy is emphasised.

Introduction

The efficient performance of a competitive marketing system depends on accurate and timely market information. Livestock producers have long been concerned about the quality of the information they have traditionally received about livestock prices. The Department of Agriculture, Victoria has introduced a Livestock Market Reporting Service (L.M.R.S.) in an attempt to improve the quality of the market information provided to livestock producers. Similar services have been introduced or will soon be introduced in other States.

The distinctive features of the L.M.R.S. Market Report are—

(1) livestock are classified using clearly defined criteria based on the characteristics of age, sex, estimated carcass weight, and estimated fat thickness (cattle) or condition score (sheep);

(2) the classes are uniform between States;

(3) price quotations are given in three forms—cents per kilogram carcass weight, cents per kilogram liveweight and dollars per head;

(4) the L.M.R.S. is a source of information independent of the price formation process.

The L.M.R.S. classes are specified in terms of carcass attributes, and the ability of the market reporters to estimate these attributes with a reasonable degree of accuracy is critical to the quality of the market information produced. There has been no information published to date in Australia on the accuracy of market reporters.

The Victorian market reporters undertake an on-going programme of testing their skills in carcass weight and fat cover estimation. The results of a trial to test the accuracy of the market reporters with young cattle are presented in this note. The aim of this paper is to report on current standards of accuracy, and to consider what implications these standards may have for the quality of the market information produced by the L.M.R.S.

* Agricultural Economist, Department of Agriculture Victoria, Melbourne.

The accuracy of market reporters could be evaluated at three levels:

(i) the accuracy of individual market reporters in the estimation of carcass weight and fat cover for individual animals;

(ii) the accuracy of individual market reporters in the estimation of average carcass weight and fat cover for pens of animals;

(iii) the average accuracy of a group of market reporters in the estimation of carcass weight and fat cover for a given set of pens of animals.

The appropriate level at which to evaluate the accuracy of market reporters depends on the purposes for which the evaluation is required. The most rigorous test of the reporters' skills in estimation is at the level of individual animal estimates, and accuracy tests at this level are useful in training market reporters. However, the principal concern of this paper is with the quality of the market information produced by the L.M.R.S. In practice, it is uncommon for market reporters in Victoria to have to estimate carcass weight and fat cover for individual animals at the metropolitan and country saleyards covered. The market reporters normally have the task of estimating average carcass weight and fat cover for a pen of animals rather than for individual animals. Country sales are covered by one reporter, while Newmarket is covered by two or more reporters whose estimates are combined in producing the one market report. The most relevant level at which to assess accuracy for price reporting purposes in the Victorian context is that of the individual reporter estimating average carcass weight and fat cover for pens of animals. For sales covered by more than one reporter, such as Newmarket, the most relevant level at which to assess accuracy for price reporting purposes is that of the average performance of a group of reporters with a given set of pens of animals. A preferred experimental design for a trial to test the accuracy of market reporters would be one that enabled an assessment of accuracy at each of these three levels.

The performance of an individual market reporter in estimates of average carcass weight and fat cover for pens of animals can be expected to be superior to his performance in individual animal estimates. Errors in individual animal estimates will tend to cancel, and the less biased the estimates the greater the tendency to cancel.

Methodology

Cattle are currently sold at Newmarket on both a liveweight and a per head basis. If cattle are sold on a per head basis, the market reporters are required to estimate the average carcass weight and fat cover from an observation of the pen of live animals, and record the age/sex class and price in dollars per head. If cattle are sold on a liveweight basis, the market reporters know the liveweight of the pen and are required to estimate average dressing percentage and fat cover and record the age/sex class and price in cents per kilogram liveweight. This information is used to classify animals for price reporting purposes. The majority of cattle now are sold liveweight, but per head sales still account for a significant proportion of sales of lighter weight cattle. The trial reported below relates to the reporters' skills in the per head sale situation where liveweight is unknown at (or after) the time of sale.

The observation of the age and sex of a pen of animals presents few difficulties, but the difficulties in accurately estimating carcass weight and fat cover are well known. The accuracy of the market reporters was examined in a

trial at the premises of R. J. Gilbertson Pty Ltd, Melbourne, on 25th July, 1979. The reporters' estimates of carcass weight and fat cover of an unweighed live animal, or a pen of unweighed live animals, were compared with actual measurements from the carcass(es). A line of 28 young cattle within the weight range 121 to over 200 kg and from traditional British beef breeds was split into three pens. The market reporters' estimated average (cold) carcass weight and fat cover for the pens of animals, and then returned to estimate carcass weight and fat cover for individual animals. Carcass weights (fats in) were obtained at slaughter the following day. The scales used automatically adjusted hot wet carcass weight downwards by 2.5 per cent to read out an equivalent cold dry carcass weight. The fat cover at the 10/11th rib position was measured by caliper measurements on chilled quartered carcasses.

Three criteria of the accuracy of weight and fat estimates are adopted—the mean error, the mean absolute error and the mean percentage error. The mean error measures the average value by which the estimated value differed from the true value. The mean error is a measure of bias in the reporters' estimates. The mean absolute error measures the average absolute value by which the estimated value differed from the true value. The mean absolute error is a measure of the consistency of the errors. The mean percentage error measures the relative magnitude of errors by expressing the absolute error as a percentage of the true value of the observation, and then taking a mean of these values. These measures are defined as—

$$\text{Mean error} = \sum_{i=1}^{n} (y'_i - y_i)/n,$$

$$\text{Mean absolute error} = \sum_{i=1}^{n} | y'_i - y_i | /n,$$

$$\text{Mean percentage error} = \sum_{i=1}^{n} | ((y'_i - y_i)/y_i)*100 | /n,$$

where y'_i = estimated value of carcass weight or fat cover for the i'th animal, or pen of animals,

y_i = actual value of carcass weight or fat cover for the i'th animal, or pen of animals.

Carcass Weight Estimation

The results for the accuracy of weight estimation are shown in Table 1. The results are presented at three levels—individual reporter estimates for individual animals, individual reporter estimates for pens of animals, and the average performance of the four reporters over the three pens.

For individual animal estimates each reporter had a negative bias (under-estimation) with a mean error in the order of 1–6 kg. The mean absolute error for each reporter was around 11 kg, and the mean percentage error around 5.8 per cent. The consistency of the errors in estimation as measured by the mean absolute error was similar for all the reporters, but the reporters differed in the degree of bias as measured by the mean error. The errors were small in percentage terms, although not insignificant from a commercial viewpoint.

For pen estimates three of the four reporters again had a negative bias, with mean errors in the order of 0–8.3 kg. The mean absolute errors ranged from 0.6–8.3 kg, and the mean percentage errors ranged from 0.4–4.6 per cent. The performance of the reporters for pen estimates shows the anticipated improvement as compared to individual animal estimates. The apparently greater divergence in performance between the reporters can be attributed to the small number of pens observed.

The average performance of the reporters when the estimates were pooled across reporters and pens again showed a negative bias with a mean error of 3.5 kg. The mean absolute error was 5.3 kg and the mean percentage error was 2.9 per cent. This level of performance represents a considerable improvement on the individual pen estimates with the mean absolute error and the mean percentage error halved.

Table 1: The Accuracy of Estimates of Carcass Weight

Observation type	Reporter	No. of Animals or Pens	Mean Carcass Weight	Mean error of estimate	Mean Absolute error	Mean percentage error
			(Kg)	(Kg)	(Kg)	(%)
Individual Animals.	A	28	183.5	−4.3	10.8	5.8
	B	28	183.5	−1.4	10.9	5.8
	C	28	183.5	−5.9	10.9	5.7
	D	28	183.5	−1.4	11.1	6.0
Pens ..	A	3	183.5	−3.3	4.0	2.2
	B	3	183.5	−2.3	8.3	4.5
	C	3	183.5	−8.3	8.3	4.6
	D	3	183.5	0	0.6	0.4
Pens ..	Pooled ..	3	183.5	−3.5	5.3	2.9

Fat Cover Estimation

The results for the accuracy of fat estimation are shown in Table 2. The results are again presented at three levels—individual reporter estimates for individual animals, for pens of animals, and the average performance of the four reporters for three pens.

For individual animal observations reporters *C* and *D* had a greater bias than *A* and *B*, but the mean absolute errors for all reporters were of the order of 2–3 mm. Errors of this order of magnitude must be close to the limits of human visual perception, but they were relatively large in relation to average fat cover because the trial animals were young cattle with an average fat cover of only 7.5 mm. Consequently the mean percentage errors were in the order of 40–70 per cent.

For pen estimates reporters *C* and *D* again exhibited a greater bias than *A* and *B*, but the mean absolute errors were reduced to the range of 0.6–2 mm. The mean percentage errors were in the order of 8.5—28.6 per cent. The performance of the reporters for pen estimates was again considerably better than for individual animal estimates.

The average performance of the reporters when the estimates were pooled across reporters and pens showed a positive bias of 0.8 mm, a mean absolute error of 1.3 mm, and a mean percentage error of 15.9 per cent.

Table 2: The Accuracy of Estimates of Fat Cover

Observation type	Reporter	No. of Animals or Pens	Mean fat cover	Mean error of estimate	Mean Absolute error	Mean percentage error
			(mm)	(mm)	(mm)	(per cent)
Individual Animals.	A	28	7.5	−0.1	2.3	41.6
	B	28	7.5	0.8	2.4	44.8
	C	28	7.5	2.8	3.1	69.2
	D	28	7.5	2.1	2.6	55.4
Pens ..	A	3	7.5	0.3	1.0	12.2
	B	3	7.5	0	0.6	8.5
	C	3	7.5	2.0	2.0	28.6
	D	3	7.5	1.3	1.3	19.1
Pens ..	Pooled ..	3	7.5	0.8	1.3	15.9

Discussion

The results presented provide a bench mark of the current level of performance of the Victorian market reporters in carcass weight and fat cover estimation. Clearly much more information on this topic is required, especially in regard to the performance of individual reporters with pens of animals. However it should be recognized that the logistical difficulties in conducting even this modest trial are considerable.

The L.M.R.S. has attempted to upgrade the quality of market information available to producers through greater precision in livestock classification and price reporting than was formerly available. It was anticipated that an improved market reporting service would lead to an improvement in pricing efficiency in the meat market. A primary consideration is whether the current level of performance in carcass weight and fat cover estimation is commensurate with the livestock classes used by the L.M.R.S. The estimates of carcass weight and fat cover are used to classify livestock, and the carcass weight estimates are also used to compute the equivalent carcass weight prices. The current cattle classes have a weight range of at least 40 kg, while the range of fat cover for the young cattle and light steer categories relevant to this trial varies from 2–4 mm (Department of Agriculture, Victoria 1978). It has been argued earlier that the performance of individual reporters with pens of animals, and the average performance of the reporters across pens, provide the most relevant statistics to assess the quality of the Victorian L.M.R.S. reports. The reported mean absolute errors of 0–8.3 kg in carcass weight estimation for individual reporters with pens of animals, and 5.3 kg for the average performance with pens are small in relation to class intervals of 40 kg or more. These errors are also small in both absolute and percentage terms. It is concluded that the current performance of the reporters in carcass weight estimation is satisfactory and commensurate with the weight classes used by the L.M.R.S.

The reported mean absolute errors of 0.6–2 mm in fat cover estimation for individual reporters with pens of animals, and 1.3 mm for the average performance with pens are considerable in relation to a class interval of 2–4 mm. A proportion of pens will be mis-classified for fat class with errors of this order of magnitude. Classification errors for particular pens of animals will tend to cancel in their effect on the average price level for a given class, but the price range reported for a fat class will reflect classification errors. The current level of performance is considered satisfactory as a basis for L.M.R.S. reports, but the need for further improvement in this area is recognized. Two specific strategies are being pursued—further training of market reporters, and a reconsideration of the L.M.R.S. fat classes.

An interesting feature of Tables 1 and 2 is that there was little difference between reporters in their estimation abilities for individual animals as measured by the mean absolute errors. However, the reporters did differ significantly in the degree of bias in the estimates for individual animals, as measured by the mean error. For example, reporters *C* and *D* exhibited much greater bias in fat cover estimation than reporters *A* and *B*. It is noteworthy that reporters *C* and *D* had had much less experience in estimating fat cover in millimetres than reporters *A* and *B* at the time of this trial. The degree of bias has an important impact on the accuracy of the estimates for pens of animals. There is scope for a further improvement in the accuracy of estimates for pens of animals through a reduction in the bias of the estimates. It is essential that market reporters be subjected to an on-going programme of accuracy trials to at least maintain and hopefully improve upon the standards reported here. There appears to be less scope for further improvement in the mean absolute errors.

A second response to the results on fat cover estimation is to reconsider whether a smaller number of fat classes, say three, would be desirable. The L.M.R.S. classification scheme represents an attempt to specify existing trade carcass classifications in terms of objective criteria, and relate these classifications back to the live animal. The L.M.R.S. scheme appears to have gained widespread acceptance among producers and the trade and there has been little critical comment directed at the classes adopted. Although a small number of fat classes would be more commensurate with the reporters' ability to estimate fat cover, the main justification for the existing scheme is that five fat classes more adequately reflect the quality differentials recognized by the trade.

Reference

Department of Agriculture, Victoria (1978), *The Livestock Market Reporting Service*, Melbourne.