Boneless Mutton: Factors Foundational to Real Price Setting

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SUMMARY: Models were developed to predict several boneless mutton components and a large amount of the variation in these components was explained by carcass weight and GR measurement (r^2 = 0.75-0.93). The 557 carcasses used ranged in weight from 9.2-43.8kg and in fat depth at the GR site from 0-41.0mm. It was shown, based on 495 carcasses that as fatscore increased so did boning time. There were significant differences between all fatscores ($P < 0.05$).

Regression analysis showed that carcass weight and fatscore both significantly affected the boning time. The relevance of this foundational information for a system which enables more sensitive price signals to be transmitted is discussed.

INTRODUCTION: The ability to determine the weight of trimmed cuts from a carcass is integral to establishing the real as opposed to the nominal value of a carcass (HOPKINS, 1989). Development of prediction equations based on parameters which are measured on the slaughter room floor is the foundation of such a system. With the establishment in Australia of the authority for uniform specifications meat and livestock (AUS-MEAT) a national meat language has been introduced. Consequently on sheep slaughter room floors two parameters are used to describe carcasses. They are carcass weight and a measure of fatness which is based on the "GR" measurement as defined by KIRTON and JOHNSON (1979).

It has been demonstrated that these two variables are good predictors of the weight of trimmed cuts of lamb (HOPKINS, 1989) and selected mutton cuts (HOPKINS et al., 1990b).

Development of computer programs to incorporate these models has been previously outlined (HOPKINS et al., 1990a) in which yield, costs and returns all influence the final monetary worth of the carcass.

This paper describes several models for predicting the weight of selected boneless mutton cuts and the effect of fatness on the time taken to bone out whole carcasses.

MATERIALS AND METHODS: Six hundred and seven mutton carcasses were selected over time from the chain of a commercial abattoir to cover a wide range in weight and fatness. Hot standard AUS-MEAT carcass weight (ANON, 1987) was recorded and the hot GR (total tissue thickness at the 12th rib 110mm from the midline) (KIRTON and JOHNSSON, 1979). Carcasses were chilled for at least 24 hours before boning.

Prior to boning by a commercial boner cold carcass weight and GR were recorded. Each carcass was butchered into a range of cuts including boneless legs, with and without the fillet head retained, and fillets. A description of the remaining cuts is given elsewhere (HOPKINS et al., 1991b). To determine the weight of long fillets (short fillets with the fillet head included) the fillet heads were removed from boned out legs and weighed for a sample of 50 carcasses. This enabled a model to be developed for determination of long fillet weights.

The method of screening data prior to analysis described by HOPKINS et al. (1990b) was used. Subsequently data for 557 carcasses were used of which 261 were wethers and 296 ewes. Of the 557 carcasses 494 had trunk meat designated 80% visual lean and for the remaining 63 it was 90%. Within this designation the total amount of meat (including all cuts) was determined.

The effect of fatscore and carcass weight on the rate of boning the entire carcass was determined. A total of 495 carcasses were studied of which 126 were fatscore 1, 109 fatscore 2, 95 fatscore 3, 76 fatscore 4 and 89 fatscore 5. The same boner was used for all carcasses.

Carcass weight, GR and their interaction were used as predictors of carcass component weights using regression analysis. The model selection was based on maximizing and minimizing the r^2 and residual standard deviation terms respectively. The effect of sex on the models was also examined by a comparison of the coefficients for sex specific models.

A box plot was used to examine the distribution and regularity of boning time according to fatscore. This showed that three observations were outliers for fatscore 5 carcasses resulting in a skewed distribution. They were subsequently removed. Analysis of variance and a range test using 95% confidence intervals were used to test whether fatscore significantly affected the time taken to bone carcasses. Multiple regression with the predictors fatscore, carcass weight and their interaction was used to examine the effect on boning time.

RESULTS: As shown in Table 1 most of the parameters measured were normally distributed although the GR measurement was skewed with a distribution weighted towards the low end of measurements.

Table 1. Means (± S.D.), medians and ranges of carcass characteristics.

	Mean	± S.D.	Median	Range
Cold Carcass	22.0	±5.49	21.6	9.2 - 43.8
Cold GR (mm)	12.7	±9.07	12.0	0 - 41.0
Leg 1 - fillet head in (kg)	4.3	±0.82	4.3	1.9 - 6.8
Leg 2 - fillet head out (kg)	4.1	±0.81	4.1	1.8 - 6.6
Fillet - long (kg)	0.29	±0.044	0.29	0.16 - 0.42
Total meat - 90% (kg)	9.4	±2.46	9.4	5.5 - 14.0
Total meat - 80% (kg)	12.0	±1.96	11.8	6.7 - 19.5

The model developed to allow prediction of long fillet weights and subsequent adjustment of Leg 1 weights was:

$$\text{Fillet Head} = \underset{(\pm 0.017)}{0.07} + \underset{(\pm 0.0004)}{0.0018}\text{Leg 1} \quad (r^2 = 0.28,\ \text{r.s.d} = 0.017)$$

Table 2 shows the models developed to predict component weights and the total amount of meat in the carcass with either an 80 or 90% visual lean designation. The variation (r^2) of each dependent variable explained by the independent variables was high ranging from 0.75 to

0.93. As reported previously (HOPKINS et al., 1990b) carcass weight is the most important predictor.

Table 2. Prediction models for component weights (kg) using the parameters cold carcass weight (CW) and cold GR (GR).

Leg 1 =	0.21CW + 0.024GR - 0.002CWxGR ±0.001 ±0.004 ±0.0001	(r^2 = 0.93, r.s.d = 0.22)
Leg 2 =	0.21CW + 0.022GR - 0.002CWxGR ±0.001 ±0.004 ±0.0001	(r^2 = 0.93, r.s.d = 0.22)
Fillet =	0.08 + 0.01CW - 0.00007CWxGR ±0.006 ±0.0003 ±0.000006	(r^2 = 0.80, r.s.d = 0.02)
Total Meat 80% =	0.58CW - 0.004CWxGR ±0.005 ±0.0003	(r^2 = 0.75, r.s.d = 1.24)
Total Meat 90% =	0.61CW + 0.008CWxGR ±0.008 ±0.0034	(r^2 = 0.91, r.s.d = 0.59)

A very small sex effect was found for prediction of the weight of total meat designated 80% visual lean, there being a significant difference between models for ewes and wethers ($P < 0.05$). There was no sex effect on the other models.

Boning times were converted to decimal values for analysis and ranged from 3.0 to 8.6min (mean ± s.e. 5.40 ± 0.042). Comparison of the mean boning times according to fatscore revealed that all were significantly different from each other ($P < 0.05$). They were 4.48 ± 0.066, 5.20 ± 0.063, 5.66 ± 0.057, 5.83 ± 0.069 and 6.31 ± 0.085 for carcasses with fatscores of 1-5 respectively.

The most appropriate model using carcass weight and fatscore (FS) was as follows:

Time = 2.86 + 0.10CW + 0.16FS (r^2 = 0.56, r.s.d = 0.62)
±0.132 ±0.009 ±0.032

DISCUSSION: Complementary models for predicting those components not dealt with here [Bone in leg, Backstrap, Fillet (Short) and Trunk Meat] have been outlined elsewhere (HOPKINS et al., 1991b). Combining these models offers the potential to predict any combination of carcass components which may apply to either domestic or export requirements. This is the intention of work to develop a computer program for pricing of mutton carcasses (HOPKINS et al., 1991a). Such an approach will have general validity to mutton slaughtered across Australia because the models are based on a wide source of carcasses as suggested necessary by KIRTON et al. (1986). Effects such as sex would not be expected to be significant overall, based on the data presented here as a sex effect was only found for the total meat 80% model and the predicted differences for wethers and ewes were small. Outside the bounds of the data however these models would not necessarily be applicable.

One aspect that has not been discussed previously in terms of establishing the carcass value of mutton is the differential processing costs which may apply. It is evident that boning of fat carcasses not only results in a decreased yield but is also more time-consuming. A similar result has been found for lamb (HOPKINS, 1989) in which both fatness and weight were considered.

CONCLUSION: Application of the findings from this study can be incorporated into computer programs. With the recent introduction of computer-based systems for recording slaughter room floor information the various components can be linked together to enable more sensitive price signals to be transmitted.

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